NBER WORKING PAPER SERIES

FIRM-TO-FIRM FINANCIAL LINKAGES AND DOLLAR RISK TRANSMISSION

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Working Paper 31078
http://www.nber.org/papers/w31078

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
March 2023, revised August 2025

This paper was previously circulated as “Trade Credit and Exchange Rate Risk Pass-Through” (NBER Working Paper No. 31078). We thank seminar participants at AEA 2023 and 2024, SED 2023, BSE ‘Firms in the Global Economy’ Workshop 2023, Banca d’Italia ‘Trade, Value Chains and Financial Linkages in the Global Economy’ Workshop 2023, 2023 BFI International Macro-Finance Conference, 2023 West Coast Workshop in International Finance, UNSW Conference on Networks, St. Louis Fed, Bank for International Settlements, UCSD, UC Berkeley, UC Santa Cruz, UC Riverside, Federal Reserve Board, NBER 2024 IFM Fall Meeting, NBER 2025 ITI Spring Meeting, NBER Monetary Policy in Emerging Markets 2025, Inter-American Development Bank, Paris School of Economics, and University of Geneva for comments and suggestions. We acknowledge valuable comments by Oleg Itskhoki, Loukas Karabarbounis, Annie Lee, and Tim Schmidt-Eisenlohr, and discussions by Matteo Cacciatore, Luisa Carpinelli, Steve Wu, Bruno Pellegrino and Gang Zhang. We are especially grateful to Valentina Bruno for an insightful discussion. The views are those of the authors and not necessarily those of the Bank for International Settlements or the National Bureau of Economic Research.

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NBER Working Paper No. 31078
March 2023, revised August 2025
JEL No. E30, F2, F3, F4, G15, G3

ABSTRACT

We study how U.S. dollar fluctuations transmit through domestic supply chains in emerging markets. Large firms borrow in foreign currency and extend trade credit to domestic partners, exposing the supply chain to exchange rate risk. We develop a model where financially constrained suppliers pass through shocks to buyers, while unconstrained firms absorb them. Using quarterly firm-level data from 19 emerging markets, we test and confirm the model's predictions. We find that even highly exposed firms reduce trade credit only modestly following a depreciation, while accepting large profit losses, suggesting that firm-to-firm credit relationships partially shield downstream firms from financial shocks.

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1 Introduction

Emerging market firms and investors rely heavily on the U.S. dollar for access to capital and liquidity. By the end of 2019, non-financial corporate debt in emerging markets denominated in USD amounted to $3.8 trillion (Avdjiev et al., 2020). Similarly, cross-border trade in goods and services is overwhelmingly invoiced in dollars (Boz et al., 2022). While the dollar's role in global trade and finance has been extensively studied, far less is known about how fluctuations in the value of the dollar transmit *within* emerging market economies across firms–especially those that do not themselves borrow in foreign currency or sell abroad. This paper studies a new mechanism of domestic transmission: dollar shocks that propagate along supply chains via inter-firm lending in the form of trade credit.

Trade credit is the dominant source of short-term finance for firms, especially small and medium-sized ones (Petersen and Rajan, 1997; Hardy et al., 2022). While credit flows in both directions along supply networks, large firms disproportionately lend to smaller buyers—and these same large firms borrow in foreign currency at favorable rates (Salomao and Varela, 2021). This creates a natural linkage: even firms without direct dollar liabilities may become exposed to the dollar through financial relationships with upstream partners.

Exposure can manifest itself in two ways. On the one hand, foreign-currency borrowing used to fund trade credit can transmit exchange rate risk downstream, amplifying the effects of a depreciation. On the other hand, because trade credit is more flexible than bank loans (Hardy et al., 2022), upstream firms can absorb the shock by adjusting their own balance sheets, thus extending the buffer to their partners. Whether dollar shocks are absorbed or passed through is ultimately a question of financial constraints.

We show that constrained firms—those with limited capacity to absorb FX shocks—adjust trade credit contracts to pass risk onto their buyers, while unconstrained firms offer insurance by maintaining credit terms. To formalize this, we build a stylized model in which trade credit arises endogenously under exchange rate risk and financial frictions. A key feature of the model is that trade credit contracts can be state-contingent: repayment terms vary with the realized exchange rate. This flexibility allows us to derive sharp testable predictions about when and how FX risk is transmitted along supply chains.

We test predictions from our model using firm-level quarterly panel data from Capital IQ, covering over 13,000 large non-financial firms in 19 emerging markets from 2000 to 2020. The data include balance sheet variables, currency composition of liabilities, and export shares. Importantly, this dataset allows us to compare the FX debt exposure and trade credit outcomes across firms in many different emerging markets, separating exporters and non-exporters. Hence, we can meaningfully capture FX exposure, while also establishing a general relationship with trade credit that holds across emerging markets.

Our analysis yields new evidence on the trade-credit channel through which FX exposure propagates through an economy. Firms that are exposed to the exchange rate due to dollar-denominated debt see a decline in their profits. This drop is larger for non-exporters than for exporters, the latter having a natural hedge via dollar-denominated revenues. In response to this shock, non-exporter firms reduce their trade credit lending. This reflects an adjustment in their invoicing: the share of sales given on credit falls, while cash holdings rise. Thus, affected firms appear to request more of their payments up front to help compensate for the fall in internal funds. This impact is asymmetric, occurring only for depreciations, indicating that the behavior of these non-exporting firms' trade credit lending is more likely due to financial constraints rather than alternative explanations, such as changes in investment opportunities that are correlated with the exchange rate.

Overall, we find that the large firms that we study absorb most of the shock rather than passing it on to their trading partners via trade credit—another key prediction of our model. Specifically, a 10% depreciation results in non-exporters with high FX exposure cutting profits by 0.4pp of assets—double their quarterly profit margin—while they reduce trade credit by only 0.14pp. Thus consistent with our model, pass-through arises only when constraints bind, and even then, the adjustment is partial.

To illustrate the aggregate implications of the trade credit channel, we focus on Peru, where FX exposure among large firms averaged 13% of assets in 2019. A 10% depreciation would reduce trade credit by 1% for Peruvian firms in our sample, but cause a much larger 14% fall in profits. This demonstrates the muted pass through illustrated in our model. Even so, this impact could be larger because the downstream recipients of trade credit—smaller firms not in our data—are often heavily reliant on this form of working capital. Hence, even modest upstream contractions could propagate meaningfully through the domestic economy.

Our findings reveal a new transmission channel for exchange rate shocks: not through pricing or foreign trade, but through domestic financial linkages. Large firms that borrow in dollars and lend locally via trade credit play a central role in either amplifying or buffering currency shocks. The degree of pass-through depends on financial conditions, making this a contingent—and potentially fragile—form of insulation in emerging markets.

Related Literature. We contribute to a growing literature on exchange rate risk, financial spillovers, and trade credit networks in emerging markets. Our key innovation is to show that large non-financial firms, acting as financial intermediaries, transmit dollar shocks domestically through endogenously chosen trade credit contracts. Crucially, trade credit passes through exchange rate shocks to downstream firms that neither borrow in foreign currency nor export, thus creating a novel path for financial contagion.

We relate closely to Bruno and Shin (2017) and Lee and Yeung Wu (2024), who show that non-financial firms in emerging markets use cheap dollar credit to accumulate short-term local-currency assets, particularly cash holdings. Our paper focuses instead on accounts receivable—i.e., trade credit—as the primary asset channel and develops a theoretical model in which such credit contracts are state-contingent on FX shocks. This margin is distinct:

rather than self-insurance via cash, firms absorb or pass through risk via sales terms and inter-firm financing structure.

Huang et al. (2024) show that Chinese firms use FX bonds to fund accounts receivable and Hardy and Saffie (2024) find that large Mexican companies borrow in dollars and extend trade credit, thus accumulating balance sheet mismatches. The latter study also finds limited FX risk transmission via trade credit for exposed firms during the 2008 crisis. Both papers offer empirical evidence based on a single crisis episode in a single country. In contrast, we develop a model where trade credit contracts are endogenous and may vary with exchange rate realizations. We validate the model's predictions using a cross-country panel of 19 emerging markets, providing generalizable evidence on the domestic transmission of FX risk.

Several papers emphasize how dollar shocks affect firm outcomes through the banking system. Bruno and Shin (2015) show that tighter dollar conditions reduce bank lending to emerging markets, while Bruno and Shin (2022) and Bruno et al. (2018) link these effects to firm-level export declines and inventory adjustments, respectively. Ma and Schmidt-Eisenlohr (2023) and Casas et al. (2023) find that exchange rate movements, especially dollar appreciations, depress import demand via balance sheet constraints. These studies emphasize financial institutions as the transmission channel. In contrast, we show how non-financial corporates act as credit providers and risk transmitters through inter-firm trade credit, governed by endogenous contract terms. The focus on non-financial corporate credit providers marks an important distinction of this work with the double-decker banking model of Bruno and Shin (2015): while there are similarities in the model setup, the incentives and constraints of trade credit are very different from bank credit, which crucially changes the dynamics and implications of the model.

Our modeling approach also diverges from existing theories of trade credit propagation. Cuñat (2007) emphasizes the insurance role of suppliers under limited enforceability, while Altinoglu (2021), Reischer (2024) and Mateos-Planas and Seccia (2021) model network-based shock propagation. These studies do not consider exchange rate risk. In contrast, we focus on the financial side of trade credit and show that FX-denominated borrowing by upstream firms leads to endogenous pass-through via contract structure. This mechanism complements recent theoretical work on contract currency choice (Drenik et al., 2022a) and domestic price dollarization (Drenik and Perez, 2021) by highlighting the role of state-contingent repayment in purely domestic transactions.

We also relate to work by Niepmann and Schmidt-Eisenlohr (2022) and Ma and Schmidt-Eisenlohr (2023), who show that FX exposure increases the cost of credit and reduces firms' ability to maintain trade. Our paper contributes by identifying an intra-firm credit channel through which those shocks propagate—not via banks or pricing contracts, but through endogenous changes in working capital terms.

Finally, we contribute to the macro literature on trade credit as a transmission device. Jacobson and von Schedvin (2015) examine how trade credit affects the propagation of corporate bankruptcy. Giannetti et al. (2021), Love et al. (2007), and Kalemli-Özcan et al. (2014) show that trade credit can act as either a buffer or amplifier depending on supplier health and liquidity. More recent work explores the stabilizing role of large firms in trade credit chains (Hardy et al., 2022; Esposito and Hassan, 2023; Bocola and Bornstein, 2023). We formalize these intuitions in a model where constrained firms shift the burden of FX shocks onto their buyers via repayment terms. Our results also relate to the literature on dollar spillovers and financial amplification (Bruno and Shin, 2019; Alfaro et al., 2021; Kim and Lee, 2024; Kim et al., 2025), and complement recent findings by Miranda-Pinto and Zhang (2022), who show that firm-level financial linkages can amplify global shocks across borders. While their focus is on international spillovers through credit and trade networks, we highlight a parallel mechanism at work within domestic economies, operating through state-contingent trade credit contracts. Importantly, we find that the stabilizing role dominates in our sample for exchange rate shocks.

2 Trade Credit and FX Debt: Data Patterns

In this section, we outline empirical patterns that motivate our key modeling assumptions. We use firm-level data across a set of emerging markets to document that: i) trade credit is an important component of firms' balance sheets, ii) large firms are net providers of trade credit, and iii) foreign currency borrowing is linked to the provision of trade credit. Some of these patterns have been shown previously to some degree. Documenting known patterns in our dataset serves two purposes. First, it shows that the known patterns hold in our data. Second, it establishes that these facts hold in a cross-country setting and so are more general than the single country studies that typically document them.

We begin by describing the new database that we use to establish the empirical patterns and to test the main theoretical predictions. Our empirical analysis is based on the Capital IQ dataset. This dataset captures primarily large firms (both publicly listed and private) across multiple countries. Capital IQ is unique in that it provides a cross-country dataset with information on the currency composition of firms' liabilities. We compute the currency composition from line-by-line data in each firm's capital structure (i.e., each individual debt).[1] Our quarterly panel contains more than 13,000 unique firms across 19 emerging market economies spanning 2006q1-2021q1.[2] In most cases, we restrict our sample by time period or to firms with data for certain control variables, making the effective sample in most of our analysis between 5,000-9,000 firms, depending on the specification.

We further complement these financial data with information on the geographic distribution of the firm's revenues and assets that we later use to detect exporters and estimate

[1]We keep only observations where the sum of these individual debt obligations is within 5% of the total debt reported on the firm's balance sheet. We do this using annual statements, as the year-end reporting of this information is more complete and so the totals there match the balance sheet totals for most firms. To get to quarterly observations for FX debt, we do the following: we compute currency shares of debt, and linearly interpolate those between the annual observations. We then apply these shares to the quarterly debt total to get quarterly values for FX and local currency debt.

[2]These include AR, BR, CL, CO, CZ, HU, ID, IL, IN, KR, MX, MY, PE, PH, PL, RU, TH, TR, ZA. Note that the data extends back to 2000, but with poor coverage in earlier years.

the portion of assets denominated in foreign currency. Table 1 shows summary statistics for standard balance sheet data as well as our measures of foreign currency debt and assets, exports, and interest rates.

TABLE 1: SUMMARY STATISTICS, CAPITAL IQ

	N	**Mean**	**Std. dev.**	**10th**	**Median**	**90th**
AR/Assets	158,117	0.169	0.145	0.022	0.133	0.365
AR/ST Assets	155,966	0.359	0.218	0.087	0.336	0.659
AP/Liab	158,117	0.215	0.190	0.026	0.161	0.488
AP/ST Liab	158,117	0.321	0.217	0.063	0.285	0.638
(AR-AP)/Assets	158,117	0.071	0.129	-0.046	0.050	0.229
Liab/Assets	158,117	0.512	0.329	0.176	0.486	0.803
ST Debt/Assets	158,117	0.216	0.202	0.046	0.166	0.426
Profit/Assets	158,117	0.004	0.050	-0.024	0.008	0.038
Sales/Assets	158,117	0.211	0.189	0.018	0.175	0.424
Cash/Assets	158,117	0.092	0.115	0.005	0.054	0.225
Inventory/Assets	158,117	0.084	0.121	0	0.015	0.260
log(Assets)	158,117	5.080	1.971	2.818	4.878	7.756
FXDebt/Debt	133,649	0.217	0.340	0	0	0.880
FXAssets/Assets	95,624	0.070	0.184	0	0	0.255
(FXD-FXA)/Assets	81,854	-0.005	0.205	-0.168	0	0.172
Exports/Sales	124,989	0.180	0.284	0	0.001	0.672
FX Interest Rate	2,753	5.650	3.495	2.331	5	9.528
LC Interest Rate	5,776	7.585	4.811	3.310	6.409	12.755
FX IR (common sample)	2,391	5.608	3.527	2.320	5	9.473
LC IR (common sample)	2,391	8.185	5.403	3.564	6.665	14.554

Sample spans 2006q1-2021q1. Statistics are computed after winsorizing outliers at the 1% level, except for log(assets) and FXDebt/Debt. Statistics are computed on a sample where a number of key variables are non-missing (short-term debt, profits, sales, accounts receivable, accounts payable, cash, inventories, and assets). Foreign currency (FX) and local currency (LC) interest rates are reported as firm averages (one observation per firm). Sample spans quarterly data over 2000-2020. AR=accounts receivables; AP=accounts payable; ST=short term; FXD=foreign currency debt; FXA = foreign currency assets; IR=interest rate; common sample is the sample of firms with interest rate data for both FX and LC loans.

First, trade credit is a key part of firm financing and balance sheets, even for large firms. For the firms in our sample, trade credit borrowing, namely, Accounts Payable (AP), accounts for 22% of total liabilities and 32% of short term liabilities. Trade credit lending, namely, Accounts Receivable (AR), is also significant, making up 17% of total assets and 36% of short term assets. Second, firms in our sample are on average net trade credit lenders: accounts receivable minus accounts payable is roughly 7% of total assets. In contrast, trade credit is a much more important source of firm financing for smaller firms (out of the scope of our data), especially in emerging and developing economies (Hardy et al. (2022)).[3]

Third, larger firms tend to have better access to FX debt. In our sample, the correlation of log assets (which proxy firm size) with the share of FX liabilities is 0.27. On average, FX debt accounts for 22% of total firm debt, but the share is over 88% for firms in the top decile. Moreover, these firms pay lower interest rates on their FX debt than on their local currency (LC) debt—5.7% vs. 7.6% overall, or 5.6% vs 8.2% for firms that borrow in both currencies—which is consistent with findings by Salomao and Varela (2021) for Hungary and Hardy (2023) for Mexico. These simple statistics suggest that large firms can act as financial intermediaries for other firms, which is consistent with arguments in Huang et al. (2024) and Caballero et al. (2016). These firms can utilize their access to external debt (Petersen and Rajan (1997)), especially FX debt, to finance their extension of accounts receivable.

To provide direct evidence of this behavior, we document that FX debt finances the extension of trade credit. Specifically, we follow the empirical design used by Hardy and Saffie (2024) for a sample of firms in Mexico, and we apply it to our cross-country Capital IQ dataset. In particular, we use an accounting-based regression to decompose changes in short-term assets (STA) into sources of funding:

$$\Delta STA_{it} = \alpha_i + \alpha_t + \beta_1 CashFlow_{it} + \beta_2 \Delta FXDebt_{it} + \beta_3 \Delta LCDebt_{it} + \beta_4 \Delta OtherLiab_{it} + \epsilon_{it},$$

[3]For instance, as Allen et al. (2013) report in Table 5 using data from the World Bank Enterprise Surveys during the 2002-2010 period, the share of large firms with access to external credit from a financial institution decreases from 66% in high income countries down to 46% in low income countries. In Upper Middle Income countries (where many emerging markets are classified), access ranges from 65% for large firms down to 38% for small firms.

where i indexes firms and t indexes time periods (quarters). Each variable is normalized by lagged total assets. The dependent variable is short-term assets or one of its components: cash, accounts receivable, inventories, or other short-term assets. Cash flow is the internal source of funds (retained earnings). External sources of funds are divided into foreign currency (FX) debt, local currency (LC) debt, and other liabilities. α_i is a firm fixed effect, α_t is a time fixed effect, and ϵ_{it} is an error term. The dependent variable captures changes in assets while the independent variables capture practically every source of finance backing the asset change. In this sense, instead of a regression with causality pretensions, this approach consist of an accounting decomposition that captures that every asset change has to be financed either by internal funds (retained earnings) or by external sources (e.g. debt).

Table 2: FX liabilities and short-term assets

	(1) Total	(2) Cash	(3) AR	(4) Inv	(5) Oth
Cash Flow$_{it}$	0.490***	0.103***	0.169***	0.0470***	0.0328***
	(0.0171)	(0.00758)	(0.00780)	(0.00701)	(0.00528)
Δ FX Debt$_{it}$	0.568***	0.127***	0.147***	0.135***	0.0601***
	(0.0283)	(0.0142)	(0.0122)	(0.0129)	(0.00645)
Δ LC Debt$_{it}$	0.457***	0.0738***	0.138***	0.0999***	0.0433***
	(0.0199)	(0.00909)	(0.00770)	(0.00742)	(0.00432)
Δ Other Liab$_{it}$	0.385***	0.0718***	0.139***	0.0605***	0.0243***
	(0.0108)	(0.00365)	(0.00507)	(0.00496)	(0.00183)
Observations	115429	115429	115429	115429	115429
R^2	0.261	0.0262	0.119	0.0107	0.0125
Firms	5193	5193	5193	5193	5193
FirmFE	Yes	Yes	Yes	Yes	Yes
TimeFE	Yes	Yes	Yes	Yes	Yes

Sample spans 2006q1-2020q4. Firms reports the number of firms in each regression. Dependent variable in column (1) is change in total short term assets, column (2) is change in cash and financial assets, column (3) is change in accounts receivable, column (4) is change in inventories, and column (5) is change in other short term assets. Cash flow is net income over the previous quarter; FX Debt is change in FX debt liabilities over the previous quarter; LC Debt is change in local currency debt liabilities over the previous quarter; and Oth Liab is the change in other (residual) liabilities over the previous quarter. All variables are normalized by lagged assets and winsorized at 1%. Errors are clustered at the firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2 shows the results of this analysis. Column (1) shows that, for every dollar of FX debt, 57 cents are destined towards short-term assets. Column (2) shows that 13 cents of these 57 cents back up increases in cash holdings. Column (4) shows that another 14 cents are used to accumulating inventories. Interestingly, as seen in Column (3), 26% of FX currency borrowing is destined to the provision of trade credit (15 cents out of 57). The correlation of FX debt is notable because FX debt is typically thought of as financing long-term investments, not managing working capital. Regardless, this shows that exchange rate exposure appears linked with sales and trade credit.

To further strengthen the link between FX borrowing and trade credit provision, we exploit time series variation on the cost of FX credit. In particular, we show that firms take advantage of cheap FX credit, and use that credit to expand their trade credit lending. We implement this analysis with the following regression:

$$\Delta Y_{icst} = \alpha_i + \alpha_{st} + \theta \Delta IRD_{ct} + \zeta X_{icst} + \epsilon_{icst},$$

where we introduce c to index countries and s to index sectors. IRD is the average interest rate on local currency loans minus the average interest rate on FX loans for firms in each country.[4] The change in IRD, normalized by the standard deviation of the daily local currency depreciation rate over the quarter, measures whether the incentive for FX borrowing has changed (Bruno and Shin, 2017). We start the sample in 2010 when we have a wider sample of firms with interest rate data against which to compute the IRD. We expect $\theta > 0$ for foreign currency debt, as firms respond to carry trade incentives, but not for local currency debt. If firms use this FX debt to extend trade credit, then we may see a positive coefficient for accounts receivable and sales also.

The outcome variables of interest include FX and local currency borrowing (ex. loans,

[4] Within firms, the interest rate is computed as a weighted average by loan size. Then a simple average across firms within a country-quarter is taken.

bonds, exclusive of trade credit), trade credit provided (accounts receivable), and sales (with all variables normalized by lagged assets). As we move beyond our accounting decomposition, we saturate the model with more stringent sector-time fixed effects α_{st} to capture shocks to specific sectors that could influence outcomes, but we avoid country-time fixed effects which would be co-linear with our variable of interest, IRD_{ct}. We control for other relevant firm factors in X_{icst}, including lags of firm size (log assets), cash, liabilities, inventories, equity, profits (each of these preceding 5 normalized by assets), and year-on-year sales growth.

Table 3: Carry Trade and Trade Credit

	(1) FX Debt	(2) LC Debt	(3) AR	(4) Sales
Δ IRD$_{ct}$	0.00506*	0.00317	0.0187***	0.0384***
	(0.00302)	(0.00537)	(0.00532)	(0.00887)
Observations	116544	116544	132623	132836
R^2	0.00319	0.00851	0.0123	0.0181
Firms	5182	5182	5858	5788
FirmFE	Yes	Yes	Yes	Yes
SectorTimeFE	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes

Sample spans 2010q1-2020q4. Firms reports the number of firms in each regression. Sample spans 2010-2020. Dependent variables, each normalized by lagged assets and expressed in percent, are as follows: in column (1), the change in FX loans, winsorized at 1%; in column (2), the change in local currency loans, winsorized at 1%; in column (3), the change in accounts receivable, winsorized at 1%; in column (4), the change in sales (proxied by total revenue), winsorized at 1%. IRD is the average interest rate on local currency loans minus the average interest rate on FX loans in each quarter for a given country. Interest rates at the country-time level for each currency (foreign and local) are computed by taking a weighted average within each firm-time-currency unit (weighted by loans size), and then taking a simple average across firms in each country-time unit for each currency. Δ IRD is normalized by the standard deviation of the daily local currency depreciation rate over the quarter, then winsorized at 1%. Firm Controls include one quarter lags of: firm size (log assets), cash to assets ratio, total liabilities to assets ratio winsorized at 1%, inventory to assets winsorized at 1%, equity to assets winsorized at 1%, year-on-year sales growth winsorized at 1%, and profits to assets winsorized at 1%. Errors are clustered at the firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3 summarizes these results. Columns (1) and (2) show that relatively cheap foreign currency debt triggers more FX currency borrowing, but it does not influence local currency borrowing. Columns (3) and (4) show that cheaper FX lending also supports more sales and more trade credit provision.

As it is clear from Table 2, the predominance of accounts receivable is not exclusive to FX borrowing, as every source of funds is strongly related to the provision of trade credit. What is unique about FX-backed accounts receivable is the potential currency mismatch that the trade credit provider accumulates. In fact, if trade credit extended is not contingent on the realization of the exchange rate (for example, if it is denominated in local currency), then the provider of trade credit absorbs the currency risk, thus isolating firms along the supply chain from the adverse effects of a potential currency depreciation.

Thus, the share of trade credit denominated in FX is one indicator of the pass-through of FX currency debt along supply chains via trade credit, capturing a mechanical link. While some trade credit will be denominated in FX because it is for exports or imports, FX invoicing can occur within domestic sales as well. For example, Licandro and Mello (2019) find that Uruguayan firms invoice 24% of their *domestic* sales in USD, in part driven by matching their own dollar invoiced inputs and dollar debts (and shifting the currency risk to their trading partner). Drenik et al. (2022b) show theoretically that this choice will depend on the risk in each currency and how the pricing in each currency comoves with consumption needs. Monetary policy credibility thus affects incentives to invoice in the local currency.

An important limitation of Capital IQ is that it does not detail the share of trade credit given or received in foreign currency. However, Table 4 compiles statistics from other studies in order to provide some benchmarks. Hardy and Saffie (2024), who use data on listed firms in Mexico, show that roughly one third of trade credit owed is in foreign currency. Among exporters, the figure is closer to 50%, as may be expected since they are also typically more intensive importers (Blaum, 2024), while for non-exporters it is 22%. Hence, this is not

Table 4: Share of Trade Credit in Foreign Currency

	(1) Hardy and Saffie (2024) AP Mexico	(2) Lee and Yeung Wu (2024) AR Korea
Foreign Currency	2.41	6.3
Local Currency	4.99	19.3
Share Foreign	0.33	0.25

Average of trade credit by currency as a percent of total assets.

just driven by the natural hedge of exporters. For the perspective of the lending firm, Lee and Yeung Wu (2024) show that the average Korean firm has one quarter of its accounts receivable in foreign currency. We take one quarter to one third to be a reasonable benchmark for how much trade credit is denominated in foreign currencies for emerging market firms.

Given these estimates, a 10% depreciation of the local currency against the dollar would increase the local currency value of trade credit by 2.5-3.3% for the average firm. State contingent contracts that are linked to the exchange rate could manifest in other ways besides foreign currency invoicing, but this example provides a concrete reference.[5] Next, we present a model that links FX borrowing, sales, and trade credit provision. In the model, a large firm with access to FX-denominated debt engages in bilateral trade credit with a smaller partner that has no access to FX debt. Trade credit can be freely contingent on the realization of the exchange rate, providing an endogenous exchange rate pass-through that is rooted on the financial role, rather than on the commercial (i.e. trade) role, of the dollar.

[5]Trade credit contracts typically include a discount for paying early and a penalty for paying late. Trade credit can be more flexible than bank credit, as firms face fewer regulations on their balance sheet management and recognition of delinquent debts. The ability to selectively enforce late payment penalties can make trade credit repayment state contingent. Wilner (2000) shows theoretically that, in the context of repeated interactions, trade creditor firms grant more concessions to a customer in financial distress in order to maintain an enduring product market relationship. Yang and Birge (2018) model firms as sharing inventory risk with suppliers by basing repayment on portion of goods actually sold to customers, making trade credit effectively state contingent. Suppliers accept this arrangement and do not impose late penalties because it enables larger volumes to be purchased. Late payments of trade credit are quite common (Wu et al., 2020), as is failure to enforce late penalties. See Hardy et al. (2022) for further evidence. Selective enforcement of late penalties could thus provide flexibility for firms to adapt to exchange rate shocks.

3 A Theory of Trade Credit with Currency Risk

The economy consists of three types of agents: a large intermediate-good producer who can borrow in foreign currency, a small firm that uses the intermediate good to produce and deliver a final product to the consumers and can only borrow in domestic currency at a higher rate, and a perfectly-competitive financial system that provides firms with credit. We label the intermediate-good producer (who sells goods to the final good producer) as "seller" and we label the final-good producer as "buyer".[6] The time horizon consists of two periods, where each period is a quarter of a year. In period 1, there is uncertainty regarding the realization of the exchange rate, which affects the debt-repayment value of the large seller. Let $e = 1$ denote the period 1 exchange rate expressed as domestic currency per unit of foreign currency. $e^{'}$ is the exchange rate in period 2 and can take on two values: e_h and e_l, where $E(e^{'}) = 1$, $e_h > 1 > e_l$. Let $p_h \in (0, 1)$ denote the probability that $e^{'} = e_h$.

We first describe an economy without trade credit arrangements. In period 1, the intermediate-good supplier uses labor in order to produce the intermediate good according to a production function $X = L$, where L denotes the amount of labor units employed at wage rate w. She begins the period with zero net worth, so in order to hire labor, she needs to raise funds. We use the subscript s to refer to the seller or intermediate-good supplier. She can borrow an amount D_s from the financial system in foreign currency, which needs to be repaid in period 2 at interest rate r^*. Any amount saved between period 1 and 2 earns the same rate of interest, r^*. The supplier also incurs a borrowing cost ψD_s^2, where a higher value of $\psi > 0$ captures a supplier with more costly access to foreign debt.

The final good producer obtains the intermediate good from the supplier in period 1 and transforms it into a final good using a linear technology, where a unit of input yields a unit

[6] This setup does not reflect a "Walmart-style" supply chain structure, where a large buyer has many sellers. Rather, one could think of it as firms having one supplier for a given product. The assumption that the seller firm can borrow in foreign currency reflects that large firms in the data tend to be net lenders of trade credit and also have greater access to FX debt.

of final good. Like the supplier, the final good producer begins period 1 with zero net worth and needs to raise funds in order to purchase the intermediate good. The buyer deposits a payment $T^{'}$ in a bank account in period 1, but the supplier does not receive the payment until period 2.[7] Unlike the supplier, the final good producer is small and does not have access to foreign currency debt. We use the subscript b to denote the final good producer or buyer. She can raise debt D_b in domestic currency to be repaid in period 2 at interest rate $r > r^*$ up to the borrowing limit $\bar{D}$.[8]

We introduce bilateral trade credit into this benchmark environment. A supplier may obtain credit from a final-good producer to whom she sells the intermediate product if the buyer pre-pays for the intermediate good before production begins.[9] Alternatively, a final good producer can be a recipient of trade credit if she makes the payment to the supplier in period 2 after selling the final good to the consumer. Because the supplier is exposed to exchange rate risk when repaying her loan in the second period, we allow the second period payment of the final good producer to the supplier to be state-contingent: namely, the final good producer can pay an amount $T_h^{'}$ when $e^{'} = e_h$ and $T_l^{'}$ when $e^{'} = e_l$, with $T_h^{'} > T_l^{'}$. In this case, the large supplier passes through a portion of the exchange rate shock onto the final good producer via trade credit. This ex ante pass-through creates a link from the exchange rate to trade credit repayment. This is a flexible contract that can capture partial FX denomination of trade credit, among other forms of flexibility (e.g., early payment discounts). Alternatively, the supplier might choose to retain all the currency risk. In this

[7]This is akin to a letter of credit where a bank keeps the amount paid by one party until the effective delivery of the goods takes place. Thus, these funds are not available for the supplier to pay her workers and the final good producer needs to borrow in order to post this payment as the consumer is not paying in advance for the goods.

[8]The asymmetry in the nature of financial constraints for the two agents is not critical, but it allows for a characterization of the problem in closed form. In particular, the final good producer's problem is linear, which greatly simplifies the solution method. Hardy et al. (2022) explore trade credit in a general equilibrium model with convex borrowing costs for both types of agents as well as endogenous market power due to search-and-matching frictions.

[9]This payment is referred to as customer deposit and it enters in the Other Current Liabilities category on a firm's balance sheet. Since customer deposit is just one of many entries in this category, whose composition varies by industry, we do not examine the properties of this category theoretically or empirically.

case, $T_h^{'} = T_l^{'}$, and the large supplier shields the buyer from the exchange rate shock. This case could be equivalent to the supplier extending all trade credit to their partner in domestic currency. We assume that making trade credit provision state contingent (e.g., denominating it in foreign currency) incurs a small non-pecuniary fixed cost, $\kappa > 0$. This small cost brakes potential marginal indifference between contingent and non-contingent trade credit provision under certain parameterizations.[10]

3.1 Model Without Trade Credit

We assume that the large supplier makes a take-it-or-leave-it offer to the small final good producer. The supplier's problem is given by:

$$\max_{D_b, D_s, T^{'}, L} D_s - \psi D_s^2 - wL + \beta \left[T^{'} - \tilde{e}^{'} D_s(1+r^*) \right] \text{ s.t.}$$

$$D_b - T^{'} + \beta[pL - D_b(1+r)] - \Gamma \geq 0 \tag{1}$$

$$D_b - T^{'} \geq 0 \tag{2}$$

$$D_s - \psi D_s^2 - wL \geq 0 \tag{3}$$

$$pL \geq D_b(1+r) \tag{4}$$

$$T^{'} \geq e_h D_s(1+r^*) \tag{5}$$

$$\bar{D} \geq D_b, \tag{6}$$

where $\tilde{e}^{'} \equiv p_h e_h + (1-p_h)e_l = 1$ is the expected exchange rate in period 2, $p > 0$ is the (exogenous) price of the final good and $\Gamma > 0$ is the buyer's (exogenous) outside option. We assume that agents with access to foreign markets can borrow and save at rate r^* that satisfies $\beta(1+r^*) = 1$, while agents with access to the home financial market can borrow at rate $r > r^*$ and save at rate $\underline{r} < r^*$. Thus, no agent in this economy has incentives to save.

[10] This could be rationalized as a small cost needed to verify the actual state of the economy in order to determine the contingent payment.

Constraint (1) is the incentive compatibility constraint capturing the fact that the final good producer's surplus must be at least equal to her outside option, $\Gamma > 0$. Constraints (2) and (3) capture the borrowing needs of the final and intermediate good producer in the first period, respectively. The final good producer borrows to post collateral that supports the promised transaction (letter of credit), while the supplier borrows to pay the workers. Constraints (4) and (5) reflect the feasibility of the debt obligations by ensuring repayment.[11] Constraint (6) captures the degree of financial constraint of the buyer in the domestic market.

Notice that the constraint (1) must always bind because the supplier extracts all surplus from her partner, constraints (2) and (3) also bind as there is no incentive for any agent to save. Imposing these restrictions, it is straightforward to see that constraint (4) will never bind as long as $\Gamma > 0$. Finally, in Appendix A.1, we show that constraint (5) never binds because the supplier makes a take-it-or-leave-it-offer and extracts all surplus from the buyer, so she drives the buyer to her borrowing limit before reaching her repayment constraint.

The solution then consists of two cases, one in which constraint (6) is slack and the other when it is binding. We describe these two cases below.

Unconstrained Borrowing and Scale. Assuming that constraints (5) and (6) are not binding, and taking FOCs allows us to characterize the unconstrained optimal debt for the supplier and buyer as well as scale of production:

$$D_{s,1} = \frac{\beta p - (1+r)w}{2\psi\beta p} > 0 \quad \text{if } 1 > \beta > \beta_1 \equiv \frac{(1+r)w}{p} \tag{7}$$

$$L_1 = \frac{D_{s,1} - \psi D_{s,1}^2}{w} \tag{8}$$

$$D_{b,1} = \frac{pL_1 - \frac{\Gamma}{\beta}}{1+r} \quad \text{if } \beta_2 \equiv \beta_1(1+2\beta_1) \geq \beta > 0. \tag{9}$$

[11]For the supplier, the only relevant repayment constraint is in the case when she faces an unfavorable exchange rate next period, e_h, which makes the domestic-currency equivalent of her debt payment higher.

The lower bound on the parameter β ensures that the supplier's optimal choice of debt is positive. The upper bound, in turn, ensures that the buyer's optimal choice of debt is feasible (i.e. it doesn't not violate constraint (6)). Hence, this case occurs when $\beta \in (\beta_1, \beta_2]$. Naturally, as borrowing becomes more expensive for the supplier (higher ψ), debt and production decrease.

Constrained Borrowing and Scale. When constraint (6) binds, $D_{b,2}$ and L_2 are determined from the buyer's borrowing and participation constraints, which yield:

$$D_{b,2} = \bar{D} \quad \text{if } 1 > \beta > \beta_2$$
$$L_2 = \frac{\bar{D}(1+r) + \frac{\Gamma}{\beta}}{p}$$

Using these expressions into the supplier's first-period constraint yields a quadratic equation that characterizes the supplier's debt. The unique root that yields a positive debt level is:

$$D_{s,2} = \frac{1}{2\psi} - \frac{\sqrt{1 - 4\psi\left(\frac{w\Gamma}{\beta p} + \frac{w\bar{D}(1+r)}{p}\right)}}{2\psi} \quad \text{if } \psi < \psi_2 \equiv \frac{1}{4\left(\frac{w\Gamma}{\beta p}\right) + \bar{D}\beta_1}$$

Note that the maximum debt level is given by $\frac{1}{2\psi}$. More importantly, note that, the supplier needs to have high enough debt capacity in order for this equilibrium to exist; namely, the parameter that governs her borrowing cost, ψ, needs to be low enough. This parameter restriction effectively imposes a borrowing constraint on the supplier, and drives borrowing by both agents to zero. Debt raised and production scale are lower compared to the unconstrained scenario above, which is intuitive, so we relegate the proof to Appendix A.1.

3.2 Model With Trade Credit

In the model without trade credit, agents are constrained in that the only source of credit is debt. Thus, we extend the model to allow each agent to issue credit to her trade partner when in need of funds. In this case, the supplier makes a take-it-or-leave-it offer to the buyer, which solves the following program:

$$\max_{D_s,D_b,L,T,T_h',T_l'} D_s + T - \psi D_s^2 - wL + \beta[\tilde{T}' - \tilde{e}' D_s(1+r^*)] - \mathbf{I}_{T_h' \neq T_l'} \kappa \text{ s.t.}$$

$$D_b - T + \beta[pL - D_b(1+r) - \tilde{T}'] - \Gamma \geq 0 \tag{10}$$

$$D_b - T \geq 0 \tag{11}$$

$$D_s + T - \psi D_s^2 - wL \geq 0 \tag{12}$$

$$T_h' - D_s(1+r^*)e_h \geq 0 \tag{13}$$

$$T_l' - D_s(1+r^*)e_l \geq 0 \tag{14}$$

$$pL - D_b(1+r) \geq {T_h}' \tag{15}$$

$$\bar{D} \geq D_b \tag{16}$$

$${T_h}' \geq {T_l}', \tag{17}$$

where, T denotes the payment that the final good producer makes to the supplier in the first period; i.e. the buyer pre-pays for the intermediate-good purchase, which constitutes customer deposit for the supplier. As described above, ${T_l}'$ (T_h') denotes the payment that the final good producer makes to the supplier in the second period if the exchange rate realization is e_l (e_h), and $\tilde{T}' \equiv p_h {T_h}' + (1-p_h){T_l}'$. Hence, trade credit is state-contingent. Because the buyer pays for the input only after she had made the final-good sale to the consumer, ${T_l}'$ and ${T_h}'$ represent trade credit that the supplier extends to the final good producer. Finally, $\mathbf{I}_{{T_h}' \neq {T_l}'}$ denotes an indicator function that takes on the value of 1 when trade credit is contingent on the realization of the exchange rate.

As in the more restricted problem described above, the first constraint reflects the fact that the buyer's surplus must exceed her outside option, $\Gamma > 0$, while the next two constraints capture the borrowing needs of the buyer and the supplier in the first period. The subsequent two are the repayment constraints for the supplier in the two states of the world governed by the realization of the exchange rate. Expression (15) is the only relevant repayment constraint for the buyer in the second period and may bind when the exchange rate realization is unfavorable and given by e_h. The remaining two constraints are the buyer's borrowing constraint and the constraint that defines the magnitudes of the state-contingent payments, where the payment in the poor state of the world is higher due to the higher domestic-currency equivalent of the debt due.

Once again, the first three constraints will always bind as no agent wants to borrow more than necessary to cover the first-period costs, and the supplier will extract all surplus from the buyer. Next, observe that, in the poor state of the world, the repayment constraints for the intermediate and the final good producer, constraints (13) and (15) must bind jointly as, otherwise, either agent can relieve her trade partner if she has slack when repaying debt. Finally, in Appendix A.2, we show that expression (14) which corresponds to the repayment constraint for the supplier in the good state of the world never binds.

In short, because the supplier faces a convex cost of borrowing, while the buyer's problem is linear, the buyer either borrows exactly to the limit, $\bar{D}$, or not at all, depending on whether she can borrow at a lower rate on the margin than her larger trade partner. The solution then consists of two possibilities: one in which the large supplier is unconstrained and one in which she is constrained in the poor state of the world. We describe each in turn below.

Unconstrained Supplier and Zero XR Risk Pass-Through. When repayment constraints are not binding, the FOCs deliver the following optimal choice for the supplier's debt level and production scale:

$$D_s^{TC} = \frac{\beta p - w}{2\psi\beta p} \quad \text{if } 1 > \beta > \beta_3 \equiv \frac{w}{p} \tag{18}$$

$$L^{TC} = \frac{D_s^{TC} - \psi\left(D_s^{TC}\right)^2 + D_b^{TC}}{w} \tag{19}$$

Furthermore, the unconstrained supplier chooses a mean transfer next period equal to $\tilde{T}^{TC'}$ to extract the entire surplus from the buyer. From expression (10) it follows that any linear combination of transfer payments that satisfies $\tilde{T}^{TC'} \equiv p_h T_h^{'} + (1 - p_h)T_l^{'}$ and constraint (17) is optimal. However, because the supplier incurs a non-pecuniary cost $\kappa > 0$ to provide state-contingent payments, it follows that $\tilde{T}^{TC'} = T_h^{'} = T_l^{'}$, and is given by:

$$\tilde{T}^{TC'} = pL^{TC} - D_b^{TC}(1 + r) - \Gamma/\beta \tag{20}$$

Substituting the optimal solution in the supplier's objective function and comparing the maximized value at the two debt levels for the buyer, $\bar{D}$ and 0, yields the following solution:

$$D_b^{TC} = \begin{cases} \bar{D} & \text{if } 1 \geq \beta_1 \\ 0 & \text{if } 1 < \beta_1 \end{cases} \tag{21}$$

Three observations are in order. First, there exists an equilibrium in which the buyer does not raise any debt, but production still occurs and is entirely financed by the supplier, since the parameter restrictions that support this solution, $1 < \beta_1 \equiv \frac{w(1+r)}{p}$ and $1 > \beta > \beta_3 \equiv \frac{w}{p}$, can occur jointly. This can only occur because the supplier has high debt capacity and can cover all costs of production.

Second, the model with trade credit always yields higher bank debt for the supplier–compare expressions (18) and (7)–and higher production scale (see Appendix A.2). Moreover, expression (20) is increasing in labor, which confirms that trade credit extended by the supplier rises as production and debt increase. Therefore, trade credit provision loosens financial constraints and improves scale. Third, since the supplier's profit constitutes her objective function, it must be that profits increase with debt raised by the supplier (up to the optimal amount of debt). We summarize these results below.

Testable Prediction 1. Financially unconstrained firms raise more debt, have higher scale and higher profits, and extend more trade credit.

Next, we explore how firms respond to changes in the exchange rate. First, observe that the supplier's profits are state-contingent:

$$\Pi(e^{'}) = \tilde{T}^{TC'} - e^{'} D_s^{TC}(1 + r^*).$$

Because the second-period transfer, $\tilde{T}^{TC'}$, is not state-contingent in equilibrium, the exchange rate pass-through from the supplier to the final good producer is zero in this case. Thus, all the exchange rate risk is absorbed by the supplier as her profit decreases in the exchange rate. Hence, the large and unconstrained supplier insulates the small buyer from exchange rate risk via trade credit. Next, we characterize the possibility of incomplete, but positive, exchange rate risk pass-through.

Constrained Supplier and Positive FX Risk Pass-Through. To characterize the supplier's debt, combine constraints (13), (15), and (12) to obtain a quadratic equation in D_s, for a given D_b. In this case, the buyer's debt satisfies:

$$D_b^C = \bar{D} \quad \text{if} \;\; 1 \geq \beta_1,$$

and the supplier's debt is given by:

$$D_s^C = \frac{1}{2\psi}\left[\frac{w(1+r^*)e_h}{p} - 1 + \sqrt{\left(1-\frac{w(1+r^*)e_h}{p}\right)^2 + 4\psi\left(1-\frac{w(1+r)}{p}\right)\bar{D}}\right] \tag{22}$$

where the C superscript denotes a constrained solution. In contrast to the case in which the supplier is unconstrained, an equilibrium in which the buyer does not raise any debt is no longer supported. As it is clear from expression (22), when the buyer's debt is zero, the supplier's debt also collapses to zero. This result follows from the fact that, in this equilibrium, the supplier does not have a large enough capacity to finance all production. To see this, substitute the unconstrained supplier's debt from expression (18) and trade credit from expression (20) into the supplier's repayment constraint (13) to obtain the following parameter restriction, which ensures that D_s^{TC} violates the supplier's repayment constraint:

$$\frac{\frac{1}{4}\left(\frac{p}{w}-\frac{w}{p\beta^2}\right)-(1+r^*)\frac{e_h}{2}\left(1-\frac{w}{p\beta}\right)}{\frac{\Gamma}{\beta}-\left(\frac{p}{w}-(1+r)\right)\bar{D}} \equiv \underline{\psi} < \psi.$$

When the parameter that regulates the supplier's borrowing cost, ψ, is high enough, the supplier's repayment constraint is binding, and the equilibrium is the constrained one—an intuitive result. In Appendix A.2, we show that debt raised, trade credit extended, and production scale are all lower in this constrained equilibrium compared to the scenario in which the supplier is not financially constrained.

More interestingly, when the supplier is constrained, the second-period transfers are state-contingent and pinned down, together with the production scale, from constraints (10), (13), and (15), and they satisfy:

$$T_h^{C'} = D_s^C(1+r^*)e_h \tag{23}$$

$$T_l^{C'} = T_h^{C'} - \frac{\Gamma}{\beta(1-p_h)} \tag{24}$$

$$L^C = \frac{T_h^{C'} + \bar{D}(1+r)}{p}.$$

In this case, the supplier's accounts receivable are a function of the exchange rate, so the supplier passes through part of the exchange rate shock onto her partner. What is the magnitude of this pass-through? We can evaluate the deviation in trade credit from its mean, $\tilde{T}^{C'} \equiv p_h T_h^{C'} + (1-p_h)T_l^{C'}$, due to a deviation in the exchange rate from its respective mean, $\tilde{e}'$. Focusing first on the poor state of the world, the pass-through is given by:

$$\frac{T_h^{C'} - \tilde{T}^{C'}}{e_h - 1} = \frac{\Gamma}{\beta(e_h - 1)} > 0$$

Instead, when we focus on the good state of the world, we obtain:

$$\frac{\tilde{T}^{C'} - T_l^{C'}}{1 - e_l} = \frac{\Gamma}{\beta\left(\frac{1}{p_h} - 1\right)(1 - e_l)} > 0$$

These expressions show that pass-through emerges endogenously when the supplier's repayment constraint binds. This occurs when her cost of borrowing in foreign currency, captured by the parameter ψ, is sufficiently high. Specifically, when ψ exceeds a threshold $\underline{\psi}$—which depends on the exchange rate, the buyer's participation requirement Γ, and the scale of production $\bar{D}$—the unconstrained solution with flat repayment terms violates the repayment constraint. In this case, the supplier must vary the repayment terms across exchange rate realizations, making the contract state-contingent. The degree of pass-through is decreasing in the size of the depreciation (i.e., higher e_h), since a larger shock spreads the repayment adjustment over a wider FX movement. When ψ is low or Γ is high, the constraint is slack and the supplier offers full insurance. When ψ is high and the constraint binds, the supplier cannot absorb the shock and must adjust the repayment burden across states, implicitly passing part of the FX shock to the buyer.

Testable Prediction 2. Suppliers who are more vulnerable to an exchange rate depreciation raise less debt, extend less trade credit, and pass through more exchange rate shocks via accounts receivable.

Discussion and interpretation of results. The connection between accounts receivable and exchange rate shocks operates through two complementary forces. First, as shown in Table 4, accounts receivable can be implicitly contingent on the realization of the exchange rate. A depreciation increases the domestic-currency cost of the supplier's foreign-currency repayment obligation. If the supplier is financially constrained, she cannot offer flat repayment terms and instead requires higher repayment in the depreciation state, generating endogenous pass-through. Second, when the constraint binds, the supplier also cuts back on new trade credit issuance and demands more cash in advance. In both cases, constrained suppliers adjust their contracts in ways that transmit the FX shock downstream.

Which types of firms are more likely to exhibit this behavior? In the model, suppliers with high borrowing costs ψ—those perceived as riskier by international lenders—are more likely to face binding constraints and reduced ability to absorb shocks. Similarly, firms that carry foreign-currency liabilities but lack offsetting dollar revenues—such as importers without export income—are more vulnerable to FX-induced stress. By contrast, exporters in emerging markets typically earn revenues in dollars and are better hedged (Boz et al., 2022). In the next section, we test these model predictions using firm-level data on FX liabilities and export status.

4 Empirical Analysis

In this section, we test the two key predictions using the firm-level data from Capital IQ that we describe in Section 2.

Testable Prediction 1. Higher profits, more short-term debt, higher sales, and better borrowing terms are associated with more trade credit provision.

To test this prediction, we run the following regression:

$$AR_{icst} = \alpha_i + \alpha_{cst} + \beta_d Debt_{icst} + \beta_s Sales_{icst} + \beta_p Profits_{icst} + \beta_r LowIR_{icst} + \zeta X_{icst} + \epsilon_{icst}$$

The dependent variable is a firm's accounts receivable (trade credit extended), normalized by assets. Thus we examine how much of a firm's resources are allocated to extending trade credit. In the model, the amount of debt that a firm raises, and the firm's sales and profitability are directly related to the amount of trade credit that it extends. In this sense, more profitable firms with high sales volumes borrow more in order to provide trade credit. Because trade credit is a short-term contract, we focus on short-term debt excluding accounts payable (captures access to short-term funds like commercial paper, which are typically matched with accounts receivable).

In the model, debt, profits and sales all reflect the degree to which a firm is financially constrained, which is a function of the cost parameter, ψ. We recognize that these variables may reflect other factors in reality. Therefore, in order to directly capture the degree to which a firm is financially constrained, we perform an empirical exercise with a more limited sample of firms in our dataset for which we have information on interest rates at the level of an individual loan. In particular, the variable Low IR_t is a dummy variable that equals unity if the firm's average interest rate on their bank debt is lower than the country-sector average, indicating that the firm's borrowing is less constrained.[12]

[12]While not available for every debt instrument or in every period, many firms have at least some data on

The vector X includes other firm-level controls such as accounts payable, inventories, cash holdings, and log assets. All variables in the regression are normalized by the firm's assets, except the interest rate dummy and log assets. Each observation is at the level of a firm, country, sector, and quarter of a given year, so we can saturate the model with country (c) - sector (s) - time (t) fixed effects. This allows us to create better comparison groups among firms, comparing firms in the same sector, country and quarter. Thus, if we assume that trade partners are similar for firms in these buckets, trade credit variation would mostly correspond to differences in the independent variables. Moreover, country-sector-time fixed effects also absorb any common shocks for firms in each industry-country group. We present specifications with different levels of fixed effects, including one with firm fixed effects, to examine changes within a firm over time.

For reference, recall that, the theory predicts that β_d, β_s, β_p and β_r should be positive. Table 5 presents the results of our first empirical exercise. Columns 1-4 show that our variables of interest all have the expected sign, and are robust to including no fixed effects (column 1) up through country-sector-time fixed effects (column 4). Column 5 adds the dummy variable that amounts to unity when the firm's interest rate on a loan is lower than the average, which also shows a positive sign. Lastly, column 6 includes firm fixed effects, showing that when the firm increases its short-term debt, its sales, or its profits, it also increases the share of resources going to trade credit lending. Thus, the data confirms the basic predictions of the model that more profitable and less financially constrained firms intermediate more trade credit thorough their supply chains.

the interest rate that they pay on their debt. Thus, we consider firm averages compared to country-sector averages in order to maintain a wide sample. FX debt typically carries a lower interest rate than local currency debt, so we consider these separately and classify a firm as low interest rate if either their FX or local currency debt interest rate is below the respective country-sector average.

Table 5: Trade Credit Lending and Bank Debt

	(1)	(2)	(3)	(4)	(5)	(6)
Short-Term Debt$_{it}$	0.0926***	0.0760***	0.0727***	0.0735***	0.0669***	0.0346***
	(0.00453)	(0.00368)	(0.00350)	(0.00359)	(0.00312)	(0.00246)
Profit$_{it}$	0.315***	0.310***	0.303***	0.305***	0.267***	0.0875***
	(0.0165)	(0.0139)	(0.0138)	(0.0141)	(0.0166)	(0.00879)
Sales$_{it}$	0.114***	0.147***	0.157***	0.159***	0.155***	0.142***
	(0.00575)	(0.00481)	(0.00458)	(0.00465)	(0.00520)	(0.00513)
Low IR$_{i}$					0.00571***	
					(0.000675)	
Accounts Payable$_{it}$	0.522***	0.480***	0.447***	0.447***	0.454***	0.264***
	(0.0128)	(0.0109)	(0.0102)	(0.0102)	(0.0105)	(0.00674)
Cash$_{it}$	-0.0720***	-0.0933***	-0.104***	-0.104***	-0.0901***	-0.125***
	(0.00319)	(0.00256)	(0.00252)	(0.00254)	(0.00324)	(0.00304)
Inventory$_{it}$	-0.0723***	-0.0577***	-0.0497***	-0.0504***	-0.0472***	-0.0430***
	(0.00682)	(0.00622)	(0.00484)	(0.00496)	(0.00496)	(0.00360)
Size$_{it}$	-0.0156***	-0.0122***	-0.0125***	-0.0126***	-0.0131***	-0.0113***
	(0.000255)	(0.000250)	(0.000238)	(0.000244)	(0.000261)	(0.000698)
Observations	158117	158117	158094	157155	133061	156307
R^2	0.300	0.271	0.263	0.265	0.265	0.155
CountryFE	No	Yes	-	-	-	-
IndustryFE	No	Yes	-	-	-	-
TimeFE	No	Yes	-	-	-	-
CountryTimeFE	No	No	Yes	-	-	-
IndustryTimeFE	No	No	Yes	-	-	-
CountryIndustryFE	No	No	Yes	-	-	-
CountryIndustryTimeFE	No	No	No	Yes	Yes	Yes
FirmFE	No	No	No	No	No	Yes

Sample splans 2006q1-2021q1. Dependent variable is accounts receivable relative to assets, winsorized at 1%. Controls include short-term debt (excluding accounts payable), profits, sales, accounts payable, cash, and inventories, all normalized by assets and winsorized at 1%; and log(assets), and in column 5 a dummy=1 if the firm's average interest rate on external debt is below the country-industry average for either local currency debt or foreign currency debt. R^2 is within R^2. Errors are clustered at the industry-year level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Trade Credit Lending and Bank Debt: By Firm Type

	(1) Exporters	(2) Non-Exporters	(3) Net TC Lenders	(4) Net TC Borrowers
Short-Term Debt$_{it}$	0.0530***	0.0801***	0.0924***	0.00972***
	(0.00426)	(0.00398)	(0.00415)	(0.00354)
Profit$_{it}$	0.220***	0.331***	0.236***	0.0927***
	(0.0218)	(0.0155)	(0.0134)	(0.0117)
Sales$_{it}$	0.189***	0.154***	0.173***	0.0637***
	(0.00759)	(0.00499)	(0.00456)	(0.00451)
Accounts Payable$_{it}$	0.431***	0.446***	0.711***	0.336***
	(0.0109)	(0.0118)	(0.00811)	(0.00997)
Cash$_{it}$	-0.0728***	-0.112***	-0.0836***	-0.0565***
	(0.00619)	(0.00306)	(0.00260)	(0.00364)
Inventory$_{it}$	-0.0379***	-0.0518***	-0.0388***	-0.0161***
	(0.00523)	(0.00630)	(0.00425)	(0.00439)
Size$_{it}$	-0.0112***	-0.0129***	-0.0124***	-0.00296***
	(0.000458)	(0.000290)	(0.000236)	(0.000271)
Observations	40639	114643	127063	28247
R^2	0.284	0.256	0.376	0.349
CountryIndustryTimeFE	Yes	Yes	Yes	Yes

Sample spans 2006q1-2021q1. Dependent variable is accounts receivable relative to assets, winsorized at 1%. Controls include short-term debt (excluding accounts payable), profits, sales, accounts payable, cash, and inventories, all normalized by assets and winsorized at 1%; and log(assets), and in column 5 a dummy=1 if the firm's average interest rate on external debt is below the country-industry average for either local currency debt or foreign currency debt. Firm is classified as exporter if foreign revenue/total revenue > 20% on average, and non-exporter otherwise. Firm is classified as net trade credit seller if on average accounts receivable > accounts payable, and net trade credit buyer otherwise. R^2 is within R^2. Errors are clustered at the industry-year level. * p < 0.10, ** p < 0.05, *** p < 0.01

One concern with our empirical exercise is that the firms in our data may not correspond to the suppliers, or net trade credit providers, in our model. Moreover, in the next section, we will be examining how firms in our dataset react to increases in the cost of borrowing in foreign currency. Since we will study exchange rate shocks, it will be important to differentiate between firms that sell domestically and firms that export, since the latter group enjoy a natural hedge when domestic currency depreciates. As our dataset contains large firms, exporting is a natural concern. To address these concerns, in Table 6 we repeat the exercise from above, but we split the sample of firms into subgroups: exporters vs. non-exporters and net trade credit lenders (suppliers) vs. net trade credit borrowers (buyers).[13]

The results in columns (1)-(4) demonstrate that the key correlations hold in all subsamples. Interestingly, the strength of the correlation of trade credit lending with external debt and profits is stronger for non-exporters, who will constitute the key sample of firms that we will examine in our next exercise. Similarly, net trade credit lenders, which correspond to suppliers in our model, demonstrate considerably stronger relationship between trade credit lending and debt, sales and profitability, than do net trade credit borrowers.

Testable Prediction 2. Firms that are more vulnerable to an exchange rate depreciation—due to higher borrowing costs or limited hedging capacity—raise less debt, extend less trade credit, and are more likely to pass through exchange rate shocks to their buyers.

In the model, FX pass-through arises through two mechanisms. First, ex-ante: firms that face tighter repayment constraints design trade credit contracts that embed more state contingency—offering less insurance to buyers in the event of depreciation. Second, ex-post: when the exchange rate depreciates, exposed firms face a binding constraint and are unable to finance new credit provision, so they demand more cash in advance and reduce the share of sales extended on credit. Both mechanisms imply that pass-through is increasing in financial vulnerability.

We capture firm-level exposure to FX shocks using the following measure:

$$FXExposure_{it} = \frac{FXL_{it} - FXA_{it}}{Assets_{it}},$$

[13]Our theory is structured as a large supplier and a small buyer. In reality, most firms (especially the large firms in our data) are both buyers and suppliers, both extending and receiving trade credit as part of their operations. Firms that tend to extend more trade credit (accounts receivable = AR) than they receive (accounts payable = AP) on average (and so are closer to our suppliers) might behave differently from other firms regarding how they pass through shocks to trade credit (ex. their business model may be better equipped to sustain trade credit). Formally, we define a firm as a supplier if $AR - AP > 0$ on average. Firms are classified as exporters if foreign revenue/total revenue $> 20\%$ on average (i.e. enough export revenue to be a meaningful hedge to FX debt), and non-exporters otherwise.

where FXL denotes liabilities denominated in foreign currency and FXA proxies for foreign-currency-denominated assets. While Capital IQ provides granular data on FX debt, it does not directly report FX assets. We therefore proxy FXA using the value of foreign assets reported in the geographic segment data.[14] To account for natural revenue hedges, we define a firm as an exporter if more than 20% of its revenues are foreign-sourced, and we separately analyze outcomes for exporters and non-exporters.

To estimate how FX exposure interacts with exchange rate movements, we follow the standard approach in the balance sheet shock literature (e.g., Caballero, 2021; Bleakley and Cowan, 2008) and estimate the following empirical specification:

$$\begin{aligned} Y_{icst} =& \alpha_i + \alpha_{cst} + \gamma_1 FXExposure_{it-1} + \gamma_2 FXExposure_{it-1} \times XRDepr_{ct} \\ &+ \gamma_3 Controls_{it-1} + \gamma_4 Controls_{it-1} \times XRDepr_{ct} + \epsilon_{icst}, \end{aligned}$$

where $XRDepr_{ct}$ is the quarter-over-quarter depreciation rate of the local currency against the U.S. dollar, and α_i and α_{cst} denote firm and country-sector-time fixed effects, respectively.

We examine four outcome variables: profits over assets (to identify balance sheet stress), accounts receivable over sales (share of credit extended), cash holdings over assets (to capture liquidity buffers), and accounts receivable over assets (level of trade credit). The key coefficients are γ_1 and γ_2, which capture the ex-ante and total effects of FX exposure on each outcome. Based on the theory, we expect $\gamma_1 < 0$ for accounts receivable among non-exporters, reflecting precautionary reductions in trade credit by risk-exposed firms. We expect $\gamma_2 < 0$ for profits (due to FX losses), and also potentially for trade credit variables, though the magnitude of that adjustment—the degree of pass-through—is an empirical question. For exporters, we expect smaller or insignificant γ_2 coefficients due to their natural hedges. While large firms may also engage in financial hedging (Alfaro et al., 2023), such

[14] This segment-level data, available for roughly 85% of firms in the sample, identifies foreign vs. domestic revenue and asset shares.

practices remain limited in many emerging markets, and to the extent that firms do hedge, our estimates will be biased downward.

We include a set of lagged firm-level controls and their interactions with $XRDepr_{ct}$ to account for other channels through which exchange rate shocks could affect firm outcomes. These controls include lagged profitability, accounts payable, short-term liabilities, bank debt, bonds, equity issuance, total liabilities, log assets, and sales—all normalized by assets except for log assets. Because exchange rates are not exogenous, we use lagged FX exposure to mitigate endogeneity concerns and include firm fixed effects to absorb time-invariant exposure levels. Country-sector-time fixed effects control flexibly for macroeconomic and sectoral trends—such as business cycle effects or global demand shocks—that may co-move with the exchange rate. Our identification strategy thus relies on the within-sector, within-country variation in lagged FX exposure interacting with contemporaneous currency movements.

Credit supply shocks correlated with the exchange rate could affect trade credit lending by these firms. While we cannot control for credit supply shocks at the firm level, our use of country-industry-time fixed effects accounts for any shocks that broadly affect credit conditions within a country or sector. For firm-level credit supply shocks to bias our estimates, they would need to be correlated within industries such that firms with greater FX debt systematically borrow from banks that are themselves more vulnerable to the exchange rate. There is little evidence of such assortative matching at scale, and we view this channel as unlikely to materially affect our results.[15]

Table 7 presents the main results.[16] We focus on the effect of an exchange rate depreciation in the first row. Column 1 shows that non-exporters on average see a significant decline in profits when hit by an exchange rate shock. Consider a scenario of a 10% depreciation of the local currency and a non-exporting firm with a $FXExposure$ that is 17% of assets (90th

[15]See Hardy (2023) for an approach that directly addresses credit supply shocks using matched bank-firm loan data and FX exposure.

[16]To be concise, we present only the coefficients of interest. Appendix Tables B1 and B2 report the full regression results.

percentile - see Table 1).[17] This firm would see quarterly profits decline by about 0.4pp of assets compared to an unexposed firm ($0.17 \times 0.1 \times -0.228 = 0.388\%$). This is a sizeable shock. It is about double the average quarterly profits of firms with average $FXExposure$ in the 90th percentile (0.18% of assets). So, even a 5% depreciation would wipe out their average profits in a quarter.[18]

As they are hit by a negative shock to profits, non-exporters tend to cut back on their trade credit lending (column 4). They decrease the share of sales given on credit (column 2), but also see an increase in cash holdings (column 3). For the same scenario as above (10% depreciation with 17% $FXExposure$), the firm sees a decline in accounts receivable of 0.14pp of assets (1% decline of the average accounts receivable of these firms) and a rise in cash holdings of 0.17pp of assets (a 2.5% increase for their average cash holdings). This is consistent with these firms requesting more cash in advance when selling, given their decreased internal cash flow to service their existing debt. Furthermore, the decline in accounts receivable and the increase in cash is close to each other in magnitude, suggesting a direct trade-off between the two types of short-term assets.

The magnitudes of these effects suggest that these firms are absorbing most of the shock, consistent with the insurance mechanism laid out in the model. In terms of volume (readily seen by comparing the coefficients in columns (1) and (4)), the shock to profits is more than twice as large as the adjustment to trade credit. The shock to profits is also much larger in proportion to quarterly profits than is the trade credit adjustment compared to typical trade credit volumes discussed in the previous paragraph.

[17] Note this figure is similar for both exporters and non-exporters.

[18] The median quarterly profits across all firms in the sample is 0.8% of assets while the average is 0.4%.

Table 7: Exchange rate shock and trade Credit Adjustment

	Non-Exporters				Exporters			
	(1) Profits/ Assets	(2) AR/ Sales	(3) Cash/ Assets	(4) AR/ Assets	(5) Profits/ Assets	(6) AR/ Sales	(7) Cash/ Assets	(8) AR/ Assets
FX Exposure$_{it-1}$ × XR Depr$_t$	-0.228***	-0.469**	0.101*	-0.0838*	-0.0705**	0.1599	0.0378	-0.0358
	(0.0401)	(0.233)	(0.0526)	(0.0440)	(0.0341)	(0.2094)	(0.0482)	(0.0358)
FX Exposure$_{it-1}$	0.00527	-0.003	0.0203***	-0.00574	0.00271	-0.0258	0.0157***	-0.00976**
	(0.00331)	(0.0281)	(0.00538)	(0.00440)	(0.00306)	(0.0203)	(0.00548)	(0.00414)
Observations	72407	69837	61114	71772	19299	18973	17577	19355
R^2	0.0372	0.0134	0.0320	0.0710	0.0579	0.00834	0.0596	0.0868
CountryIndustryTimeFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Sample spans 2006q1-2021q1. Dependent variable in columns (1) and (5) is the ratio of profits to assets, winsorized at 1%; in columns (2) and (6) is the ratio of accounts receivables to sales, with large values capped at 2; in columns (3) and (7) is the ratio of cash to assets, winsorized at 1%; and in columns (4) and (8) is the ratio of accounts receivables to assets, winsorized at 1%. The primary independent variables is a one quarter lag of (FX Debt - Foreign Assets)/Assets, winsorized at 1%, and its interaction with the quarter on quarter depreciation rate of the period average exchange rate. Other controls include one quarter lags of the following variables, each normalized by assets, winsorized at 1%, and also include its interaction with the depreciation rate: profits, accounts payable, short-term liabilities, bank debt, bond debt, equity, total liabilities, and sales. Log assets and its interaction with the depreciation rate are also included. See Table B1 in the appendix for reporting of these coefficients. Exporters are defined as having foreign revenue/total revenue > 20%, otherwise firms are non-exporters. R^2 is within R^2. Errors are clustered at the industry-date level. * p < 0.10, ** p < 0.05, *** p < 0.01

Consistent with their natural hedge, exposed exporters see a much smaller drop in their profits relative to non-exporters (comparing the coefficient estimates in columns (1) and (5)). If anything, exporters might increase the share of sales made on credit, although the coefficient is not precisely estimated. Even with a short-term hit to profits, their outlook is improved and revenues are rising, so these firms might take advantage of the opportunity to attract more customers with better terms on their sales. But overall, there is no measured response of cash and trade credit for these firms.

If firms reduce trade credit because a depreciation tightens their financial constraints, we should observe asymmetric behavior across depreciations and appreciations. Specifically, a depreciation increases the local-currency value of foreign-currency debt, potentially pushing firms into a binding repayment constraint and forcing them to cut trade credit. An appreciation, by contrast, lowers debt burdens and boosts profitability, but should not lead firms to reduce credit provision unless other frictions are at play. This stands in contrast to an alternative explanation, where firms with more FX debt simply have a greater change in optimal scale across exchange rate states (e.g. better investment opportunities when the dollar is cheaper). If that were the case, we would expect symmetric changes in trade credit around depreciations and appreciations.

Table 8 shows results for non-exporters, splitting exchange rate movements into appreciations and depreciations (positive values are depreciations, negative values are appreciations). We find that both appreciations and depreciations significantly affect firm profits—an expected outcome due to currency mismatch.[19] However, consistent with our model of constraint-driven pass-through, only depreciations lead firms to reduce trade credit and raise cash buffers, despite profits being affected by both appreciations and depreciations. This asymmetric adjustment pattern suggests that firms pass through shocks when finan-

[19]Since appreciations are the negative values of the exchange rate change variable, a negative coefficient means that profits rise when a firm has FX debt greater than FX assets. The similarity of the coefficients suggests this effect is symmetric.

cially constrained, but absorb them when constraints are slack.

TABLE 8: EXCHANGE RATE SHOCK AND TRADE CREDIT ADJUSTMENT: ASYMMETRIC SHOCKS

	Non-Exporters			
	(1) Profits/Assets	(2) AR/Sales	(3) Cash/Assets	(4) AR/Assets
FX Exposure$_{it-1}$ × XR Only Depr$_t$	-0.229***	-0.601*	0.162**	-0.150**
	(0.0517)	(0.308)	(0.0648)	(0.0633)
FX Exposure$_{it-1}$ × XR Only Appr$_t$	-0.224*	0.0161	-0.127	0.163
	(0.122)	(0.632)	(0.136)	(0.106)
FX Exposure$_{it-1}$	0.00535	0.00581	0.0164***	-0.00123
	(0.00371)	(0.0313)	(0.00598)	(0.00499)
Observations	72407	69837	61114	71772
R^2	0.0372	0.0305	0.0320	0.0711
CountryIndustryTimeFE	Yes	Yes	Yes	Yes
FirmFE	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes

Sample spans 2006q1-2021q1. Dependent variable in column 1 is the ratio of profits to assets, winsorized at 1%; in column 2 is the ratio of accounts receivables to sales, with large values capped at 2; in column 3 is the ratio of cash to assets, winsorized at 1%; and in column 4 is the ratio of accounts receivables to assets, winsorized at 1%. The primary independent variables is a one quarter lag of (FX Debt - Foreign Assets)/Assets, winsorized at 1%, and its interaction with the quarter on quarter depreciation rate of the period average exchange rate, separately positive values (depreciations) and negative values (appreciations). Other controls include one quarter lags of the following variables, each normalized by assets, winsorized at 1%, and also include its interaction with the depreciation rate: Profits, accounts payable, short-term liabilities, bank debt, bond debt, equity, total liabilities, and sales. Log assets and its interaction with the depreciation rate are also included. Exporters are defined as having foreign revenue/total revenue > 20%, otherwise firms are non-exporters. R^2 is within R^2. Errors are clustered at the industry-date level. * p < 0.10, ** p < 0.05, *** p < 0.01

Our second testable prediction indicates that constrained firms would be less able to access external finance. Table 9 places debt (bank+bond) as the dependent variable for non-exporting firms, where we expect $\gamma_2 < 0$. Column (1) reveals a negative coefficient as expected, though not significant. But as we narrow the sample firms to our net trade credit lenders (matching the firms of interest in our model), the coefficient becomes larger and statistically significant. Columns (4) and (5) show the split for accounts receivable into net trade credit lenders and borrowers. Here, both groups have a negative coefficient, but that of the trade credit lender group is statistically significant.

Table 9: Non-exporters' Debt and Trade Credit Adjustments

	Debt/Assets			AR/Assets	
	(1) All	(2) Net TC Lenders	(3) Net TC Borrowers	(4) Net TC Lenders	(5) Net TC Borrowers
FX Exposure$_{it-1}$ × XR Depr$_t$	-0.0303	-0.158**	0.386	-0.104**	-0.121
	(0.0774)	(0.0725)	(0.275)	(0.0488)	(0.0875)
FX Exposure$_{it-1}$	0.00593	0.00879	-0.0270	-0.00447	-0.00646
	(0.00873)	(0.0100)	(0.0239)	(0.00545)	(0.00694)
Observations	70511	54678	13730	55887	13808
R^2	0.737	0.748	0.693	0.0862	0.0517
CountryIndustryTimeFE	Yes	Yes	Yes	Yes	Yes
FirmFE	Yes	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes	Yes

Sample spans 2006q1-2021q1. Sample is only non-exporters. Exporters are defined as having foreign revenue/total revenue > 20%, otherwise firms are non-exporters. Firm is classified as net trade credit lender if on average accounts receivable > accounts payable, and net trade credit borrower otherwise. Dependent variable in columns 1-3 is the ratio of debt (bond + bank) to assets, winsorized at 1%; in columns 4-5 is the ratio of accounts receivables to assets, winsorized at 1%. The primary independent variables is a one quarter lag of (FX Debt - Foreign Assets)/Assets, winsorized at 1%, and its interaction with the quarter on quarter depreciation rate of the period average exchange rate. Other controls include one quarter lags of the following variables, each normalized by assets, winsorized at 1%, and also include its interaction with the depreciation rate: Profits, accounts payable, short-term liabilities, bank debt, bond debt, equity, total liabilities, and sales. Log assets and its interaction with the depreciation rate are also included. See Table B2 for reporting of these coefficients. R^2 is within R^2. Errors are clustered at the industry-date level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Overall, the empirical results in this section suggest that firms that are more exposed to exchange rate shocks to their balance sheet pass through a larger degree of the shocks to their trade partners via a decrease in trade credit or a worsening in the terms of trade credit extended. However, they do not pass through the shock proportionally, largely protecting their trading partners. Hence, these firms bear the majority of FX risk.

What are the potential aggregate implications of an exchange rate shock? A back-of-the-envelope calculation can be useful to provide a benchmark. We take Peru as an example of an economy with significant FX exposure: at the end of 2019, the average $FXExposure$

among large firms in our sample was 13%.[20]

Considering a 10% depreciation of the Peruvian Sol, we apply our estimated coefficients from Table 7—columns (4) and (8) for trade credit, and columns (1) and (5) for profits—to the FX exposure of firms in our Peru sample (that is, both exporters and non-exporters). This yields an estimated decline in aggregate accounts receivable of about 1% for these firms. However, the same shock implies a decline in their profits of about 14%. This again confirms the muted pass through illustrated in our model, helping to limit the aggregate effects.

Our findings have several implications. First, our analysis overlooks the distributional impact on the firms that receive trade credit—many of which are small, financially constrained, and outside our data sample. A modest aggregate decline in trade credit may mask severe disruptions if the adjustment is concentrated among certain sectors or suppliers. For example, Almeida et al. (2024) find that trade-credit-dependent small firms experience stronger transmission of oil shocks, more so when the shock coincides with high-profitability quarters.

Second, if FX exposure rises broadly in an economy, a given exchange rate shock will impose larger balance sheet losses on upstream firms. Upstream firms may be more sensitive to lost credit, especially as supply chains become longer (Kim and Shin, 2023; Kalemli-Özcan et al., 2014). Smaller firms (not in our sample) may also be more sensitive to these shocks (Kim et al., 2015; Hardy, 2023), so if they borrow significantly in FX, their trade credit lending could be more affected by a shock. Thus, an increase in FX debt that is broad-based could potentially lead to sharper declines in trade credit when an exchange rate shock arises.

Third, our finding of limited pass-through likely depends on the continued access to bank credit for large firms. If a sharp depreciation coincides with a tightening in financial conditions—such as during a twin crisis (Kaminsky and Reinhart, 1999)—even large trade credit providers may become constrained. This could amplify the shock substantially, particularly

[20] In 2014, the Central Bank of Peru announced an increase in reserve requirements for FX loans, making such loans more costly. This policy led to a decrease in FX lending to small firms (Amado, 2022). Despite this, large firms in Peru continued to borrow substantially in FX, making them the main conduit for exposure and potential shock transmission to other firms in the economy.

for firms with no alternative sources of working capital. Given the evidence that fluctuations in dollar strength affects global bank credit (Bruno and Shin, 2015), shocks to bank credit supply and their interaction with this channel are highly relevant.

These results suggest that financial authorities should monitor not only the FX exposure of banks, but also that of large non-financial corporations. These firms play a central role in absorbing shocks along supply chains, and their financial health determines how much risk is transmitted or absorbed within the domestic economy.

5 Conclusion

This paper identifies a new transmission channel for exchange rate shocks in emerging markets: firm-to-firm trade credit. We show that large non-financial corporations with access to foreign currency borrowing provide working capital to smaller domestic firms through trade credit, and in doing so, become potential transmitters—or absorbers—of exchange rate risk.

We develop a stylized model of trade credit provision between a large supplier and her small trading partner who produces final goods. Motivated by the international finance literature, we assume that both firms face borrowing constraints, but the large supplier can borrow at low interest rates in foreign currency, while the small producer can only access domestic-currency debt at a high rate. A key feature in the model is that trade credit is state contingent—namely, the amount of trade credit extended is directly linked to the realization of the exchange rate, which affects the large firm's liabilities. According to the model, trade credit provision loosens partners' financial constraints and raises both parties' debt levels as well as production scale. As a corollary, the model predicts that unconstrained firms with larger scale and more debt extend more trade credit. When firms experience a rise in their cost of borrowing, characterized by a depreciation of the domestic currency, more constrained firms pass through the exchange rate shock more to their trade partners. We verify these predictions using firm-level data for large firms in emerging markets.

The theory that we provide above features complete as well as incomplete exchange rate pass-through via trade credit—a channel that has not been explored by the existing literature. More importantly, the empirical analysis suggests that more constrained firms tend to pass on the shock to their trade credit lending, while less constrained firms do not. The degree of exchange rate risk pass-through thus depends on firm-level exposure to currency mismatch and their financial health. Our findings make clear that the firms absorbing most of the shock are large non-exporters with significant FX liabilities—these are the primary bearers of exchange rate risk in the economy.

Future work should study the aggregate consequences of this behavior. In particular, can these large firms, which carry this exchange rate risk on their balance sheets, insulate the overall economy from negative shocks? How do these risks play out during a banking crisis? Authorities would benefit from greater monitoring of the FX mismatches of non-financial corporates and their health, in addition to that of banks.

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A Proofs and Derivations

A.1 Model Without Trade Credit

Constrained versus unconstrained borrowing and scale. To see that constrained borrowing and scale and lower than their unconstrained counterparts, note that, if constraint (6) binds, it must be that $D_{b,1}$ is not feasible, otherwise it would have been chosen; hence $\bar{D} < D_{b,1}$. Constraint (1) then implies that production must decline if the supplier wants to continue to extract all the surplus from the buyer; thus $L_2 < L_1$. It follows from constraint

(3) that the same ordering is true for debt levels, $D_{s,2} < D_{s,1}$, since D_s is a decreasing function of L as long as debt is below the maximum admissible level, $\frac{1}{2\psi}$.

Ruling out equilibria where constraint (5) binds. Why does constraint (5) never bind in equilibrium? The intuitive answer is because the supplier, who makes a take-it-or-leave-it-offer, extracts all surplus from the buyer and drives the buyer to her borrowing limit first. To see this, suppose constraint (5) binds and (6) does not. In that case, the buyer can borrow a little bit more, which would relax constraint (5) and raise production. But, these marginal increases must respect the buyer's participation constraint, (1). Substituting the binding constraints (2), (3) and (5) into constraint (1) allows us to rewrite constraint (1) as follows:

$$\left(\frac{p}{w} - (1+r)(1+r^*)e_h\right) D_s - \frac{p}{w}\psi D_s^2 - \frac{\Gamma}{\beta} \geq 0$$

The quadratic formula yields two solutions for D_s:

$$D_s = \frac{\frac{p}{w} - (1+r)(1+r^*)e_h \pm \sqrt{\left(\frac{p}{w} - (1+r)(1+r^*)e_h\right)^2 - 4\psi\frac{p\Gamma}{w\beta}}}{2\psi\frac{p}{w}}$$

Let $x \equiv \frac{p}{w} - (1+r)(1+r^*)e_h$ and $y = 4\psi\frac{p\Gamma}{w\beta}$. If $x > 0$, then both roots are positive, and constraint (1) is slack. The seller will continue to raise debt and production until the buyer reaches the borrowing limit given by constraint (6). Hence, the equilibrium corresponds to the constrained scenario described in the main text. If $x < 0$, a real root does exist. Hence constraint (5) can never bind.

A.2 Model With Trade Credit

Borrowing and scale with and without trade credit. As described in the main text, comparing the unconstrained solution with trade credit in expression (18) to the unconstrained solution without trade credit in expression (7), it is clear that the supplier raises more debt when she extends trade credit. Production scale is increasing in the amount of debt raised by the supplier, since the derivative with respect to supplier debt of expression (19) (or similarly, expression (8)) is positive for any debt level below the maximum level of $1/(2\psi)$. It then follows that the production scale is higher when there is trade credit, since the value in expression (19) exceeds the value in expression (8) for any level of debt raised by the buyer. Finally, when the buyer's constraint is binding in the model without trade credit, debt and production are constrained below the unconstrained optimum, so it follows immediately that the model with trade credit yields higher levels of debt and production in this case.

Ruling out equilibria where constraint (14) binds. Why does constraint (14) never bind in equilibrium? To see this, assume that constraints (10), (11), and (12) are binding, and suppose that (14) is binding. Then, the supplier can increase both D_s and T_l' to raise her profits. To ensure that constraint (10) is not violated, T_h' should be decreased. This process can be repeated until constraint (13) binds. Substituting constraints (14) and (13) in the objective function yields profits of $-\kappa$. This cannot be a solution because the supplier is better off not producing. If profits had been maximized before constraint (13) binds, then this solution corresponds to the unconstrained case described in the main text. Thus, constraint (14) cannot bind.

Constrained versus unconstrained borrowing and scale in the presence of trade credit. As described in the main text, the constrained solution arises when the repayment constraints in the poor state of the world are binding. If constraints (13) and (15) bind, it must be that D_S^{TC} is not feasible, otherwise it would have been chosen; hence $D_S^{TC} > D_S^C$. Both, $\tilde{T}^{TC'}$ and $\tilde{T}^{C'}$ are recovered from constraint (10), and L^{TC} and L^C follow from constraint (12). From constraint (10), $\tilde{T}'$ is increasing in L, and because $D_s < \frac{1}{2\psi}$ in all cases, constraint (12) implies that L is increasing in D_s. Namely, if the supplier's debt level is higher, then so is the scale of production and trade credit extended. Indeed, the supplier raises more debt when unconstrained, as this is the optimum amount.

B Additional Empirical Results

The two tables below include estimated coefficients for all variables included in the specifications that test Prediction 2 of the model.

Table B1: Exchange Rate Shock and Trade Credit Adjustment

	Non-Exporters				Exporters			
	(1) Profits/Assets	(2) AR/Sales	(3) Cash/Assets	(4) AR/Assets	(5) Profits/Assets	(6) AR/Sales	(7) Cash/Assets	(8) AR/Assets
FX Exposure$_{it-1}$ × XR Depr$_t$	-0.228***	-0.469**	0.101*	-0.0838*	-0.0705**	0.160	0.0378	-0.0358
	(0.0401)	(0.233)	(0.0526)	(0.0440)	(0.0341)	(0.209)	(0.0482)	(0.0358)
FX Exposure$_{it-1}$	0.00527	-0.00314	0.0203***	-0.00574	0.00271	-0.0258	0.0157***	-0.00976**
	(0.00331)	(0.0281)	(0.00538)	(0.00440)	(0.00306)	(0.0203)	(0.00548)	(0.00414)
Profit$_{it-1}$	0.121***	-0.0397	0.0911***	0.0531***	0.123***	0.0447	0.140***	0.109***
	(0.0118)	(0.0507)	(0.0132)	(0.0126)	(0.0212)	(0.0888)	(0.0278)	(0.0267)
AP$_{it-1}$	-0.000840	0.125***	0.000741	0.162***	-0.0114	0.165**	-0.136***	0.245***
	(0.00522)	(0.0446)	(0.00966)	(0.0113)	(0.00917)	(0.0785)	(0.0163)	(0.0260)
ST Liab$_{it-1}$	-0.00364	0.112***	-0.000160	0.0384***	0.00275	0.188***	0.0750***	0.0706***
	(0.00398)	(0.0184)	(0.00449)	(0.00437)	(0.00633)	(0.0429)	(0.00810)	(0.00704)
Bank Debt$_{it-1}$	-0.00966***	0.0313	-0.0189***	-0.0252***	-0.00861	0.204***	-0.0859***	0.0188**
	(0.00301)	(0.0198)	(0.00564)	(0.00481)	(0.00658)	(0.0431)	(0.0115)	(0.00877)
Bond Debt$_{it-1}$	-0.00240	0.00780	0.0276***	-0.0215***	-0.00809	0.0756	-0.0499***	0.0169
	(0.00417)	(0.0296)	(0.00797)	(0.00713)	(0.00928)	(0.0691)	(0.0147)	(0.0120)
Equity$_{it-1}$	0.0162	0.0962*	-0.0735***	-0.0118	0.0300	0.417***	-0.135***	0.0454*
	(0.0121)	(0.0525)	(0.0130)	(0.0135)	(0.0186)	(0.0884)	(0.0238)	(0.0266)
Liabilities$_{it-1}$	0.00770	0.0130	-0.118***	-0.0206	0.0204	0.168*	-0.222***	-0.0269
	(0.0127)	(0.0583)	(0.0145)	(0.0137)	(0.0164)	(0.0955)	(0.0243)	(0.0215)
Size$_{it-1}$	0.00144*	-0.00348	-0.0205***	-0.0165***	-0.00102	0.0194*	-0.00910***	-0.00515*
	(0.000744)	(0.00646)	(0.00128)	(0.00130)	(0.00184)	(0.00991)	(0.00256)	(0.00280)
Sales$_{it-1}$	0.0197***	-0.641***	0.0154***	0.0856***	0.0338***	-0.557***	0.0154*	0.112***
	(0.00256)	(0.0278)	(0.00513)	(0.00474)	(0.00527)	(0.0450)	(0.00827)	(0.00991)
Profit$_{it-1}$ × XR Depr$_t$	0.0157	0.848	0.0834	0.0615	0.708	0.489	-0.163	-0.362
	(0.158)	(0.655)	(0.180)	(0.172)	(0.498)	(1.625)	(0.442)	(0.455)
AP$_{it-1}$ × XR Depr$_t$	-0.00574	-0.540*	0.0536	-0.0560	0.0946	-2.205***	-0.0474	-0.199
	(0.0425)	(0.279)	(0.0839)	(0.0720)	(0.100)	(0.754)	(0.182)	(0.229)
ST Liab$_{it-1}$ × XR Depr$_t$	0.0687	0.00865	0.0486	0.0135	-0.351***	0.0948	-0.128*	0.0537
	(0.0458)	(0.183)	(0.0566)	(0.0370)	(0.105)	(0.377)	(0.0654)	(0.0851)
Bank Debt$_{it-1}$ × XR Depr$_t$	-0.0216	-0.0786	0.0248	0.000892	0.0961	-0.0229	-0.0387	-0.0575
	(0.0296)	(0.177)	(0.0437)	(0.0352)	(0.0977)	(0.490)	(0.169)	(0.105)
Bond Debt$_{it-1}$ × XR Depr$_t$	0.0345	-0.137	-0.114**	-0.00250	-0.122	-0.255	-0.0713	0.102
	(0.0346)	(0.248)	(0.0556)	(0.0525)	(0.135)	(0.819)	(0.219)	(0.160)
Equity$_{it-1}$ × XR Depr$_t$	-0.0883	-0.420	-0.197*	0.0124	0.192	-0.385	-0.413	0.316
	(0.0890)	(0.569)	(0.101)	(0.0913)	(0.212)	(1.279)	(0.317)	(0.333)
Liabilities$_{it-1}$ × XR Depr$_t$	-0.173*	-0.362	-0.239**	0.0566	0.168	-0.454	-0.231	0.271
	(0.101)	(0.601)	(0.118)	(0.101)	(0.192)	(1.327)	(0.300)	(0.298)
Size$_{it-1}$ × XR Depr$_t$	-0.00438**	-0.00380	0.00105	-0.000884	-0.00795	0.0193	-0.0134	0.00382
	(0.00212)	(0.0140)	(0.00532)	(0.00341)	(0.00508)	(0.0370)	(0.00851)	(0.00699)
Sales$_{it-1}$ × XR Depr$_t$	0.00296	0.440***	-0.0820*	0.0563	0.0860**	1.098**	0.114	0.0173
	(0.0260)	(0.144)	(0.0432)	(0.0377)	(0.0423)	(0.449)	(0.0888)	(0.0840)
Observations	72407	69837	61114	71772	19299	18973	17577	19355
R^2	0.0372	0.0304	0.0320	0.0710	0.0579	0.0345	0.0596	0.0868
CountryIndustryTimeFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Sample spans 2006q1-2021q1. Dependent variable in columns (1) and (5) is the ratio of profits to assets, winsorized at 1%; in columns (2) and (6) is the ratio of accounts receivables to sales, with large values capped at 2; in columns (3) and (7) is the ratio of cash to assets, winsorized at 1%; and in columns (4) and (8) is the ratio of accounts receivables to assets, winsorized at 1%. The primary independent variables is a one quarter lag of (FX Debt - Foreign Assets)/Assets, winsorized at 1%, and its interaction with the quarter on quarter depreciation rate of the period average exchange rate. Other controls include one quarter lags of the following variables, each normalized by assets, winsorized at 1%, and also include its interaction with the depreciation rate: profits, accounts payable (AP), short-term (ST) liabilities, bank debt, bond debt, equity, total liabilities, and sales. Log assets and its interaction with the depreciation rate are also included. Exporters are defined as having foreign revenue/total revenue > 20%, otherwise firms are non-exporters. R^2 is within R^2. Errors are clustered at the industry-date level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B2: Non-exporters' Debt and Trade Credit Adjustments

	Debt/Assets			AR/Assets	
	(1) All	(2) Net TC Lenders	(3) Net TC Borrowers	(4) Net TC Lenders	(5) Net TC Borrowers
FX Exposure$_{it-1}$ × XR Depr$_t$	-0.0303	-0.158**	0.386	-0.104**	-0.121
	(0.0774)	(0.0725)	(0.275)	(0.0488)	(0.0875)
FX Exposure$_{it-1}$	0.00593	0.00879	-0.0270	-0.00447	-0.00646
	(0.00873)	(0.0100)	(0.0239)	(0.00545)	(0.00694)
Profit$_{it-1}$	-0.0592***	-0.0582***	-0.0752*	0.0584***	0.0109
	(0.0186)	(0.0214)	(0.0390)	(0.0158)	(0.0168)
AP$_{it-1}$	-0.0156	-0.0175	0.0114	0.229***	0.0701***
	(0.0120)	(0.0151)	(0.0217)	(0.0148)	(0.0133)
ST Liab$_{it-1}$	0.0101	0.0189**	-0.00571	0.0475***	0.00746
	(0.00701)	(0.00867)	(0.0130)	(0.00563)	(0.00518)
Bank Debt$_{it-1}$	0.886***	0.888***	0.886***	-0.0261***	-0.0111
	(0.0119)	(0.0141)	(0.0227)	(0.00574)	(0.00724)
Bond Debt$_{it-1}$	0.904***	0.891***	0.939***	-0.0267***	-0.0181**
	(0.0150)	(0.0166)	(0.0361)	(0.00881)	(0.00796)
Equity$_{it-1}$	-0.0903***	-0.110***	-0.0610	-0.0180	-0.00236
	(0.0229)	(0.0282)	(0.0417)	(0.0178)	(0.0119)
Liabilities$_{it-1}$	-0.0392	-0.0627**	-0.00851	-0.0282	-0.0155
	(0.0248)	(0.0300)	(0.0471)	(0.0182)	(0.0140)
Size$_{it-1}$	0.00279	0.00313	0.00730	-0.0192***	-0.00162
	(0.00232)	(0.00240)	(0.00828)	(0.00145)	(0.00176)
Sales$_{it-1}$	-0.00745	-0.00958	0.000503	0.0969***	0.0663***
	(0.00760)	(0.00969)	(0.0132)	(0.00597)	(0.00659)
Profit$_{it-1}$ × XR Depr$_t$	0.0471	0.0164	-0.240	0.0998	0.251
	(0.225)	(0.268)	(0.337)	(0.223)	(0.246)
AP$_{it-1}$ × XR Depr$_t$	0.0406	0.167	-0.269**	0.0323	-0.0538
	(0.0953)	(0.127)	(0.136)	(0.104)	(0.111)
ST Liab$_{it-1}$× XR Depr$_t$	-0.0989	-0.229**	0.169**	0.0335	-0.0104
	(0.0812)	(0.112)	(0.0677)	(0.0586)	(0.0439)
Bank Debt$_{it-1}$ × XR Depr$_t$	0.317***	0.367***	0.0869	-0.0236	0.0685
	(0.103)	(0.131)	(0.178)	(0.0442)	(0.0683)
Bond Debt$_{it-1}$× XR Depr$_t$	0.318***	0.356***	0.174	-0.0428	-0.0541
	(0.0973)	(0.127)	(0.195)	(0.0659)	(0.0806)
Equity$_{it-1}$ × XR Depr$_t$	0.279	0.151	0.653**	-0.0217	-0.108
	(0.174)	(0.209)	(0.265)	(0.111)	(0.149)
Liabilities$_{it-1}$ × XR Depr$_t$	0.342*	0.233	0.630*	0.0410	-0.122
	(0.197)	(0.231)	(0.338)	(0.125)	(0.177)
Size$_{it-1}$ × XR Depr$_t$	0.0115**	0.00795*	0.0190	0.00116	-0.00294
	(0.00506)	(0.00477)	(0.0148)	(0.00402)	(0.00502)
Sales$_{it-1}$ × XR Depr$_t$	0.00749	0.0509	-0.0714	0.0267	0.0257
	(0.0373)	(0.0527)	(0.0811)	(0.0492)	(0.0606)
Observations	70511	54678	13730	55887	13808
R^2	0.737	0.748	0.693	0.0862	0.0517
CountryIndustryTimeFE	Yes	Yes	Yes	Yes	Yes
FirmFE	Yes	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes	Yes

Sample spans 2006q1-2021q1. Sample is only non-exporters. Exporters are defined as having foreign revenue/total revenue > 20%, otherwise firms are non-exporters. Firms are classified as a net trade credit lender if on average accounts receivable > accounts payable, and net trade credit borrower otherwise. Dependent variable in columns 1-3 is the ratio of debt to assets, winsorized at 1%; in columns 4-5 is the ratio of accounts receivables to assets, winsorized at 1%. The primary independent variables is a one quarter lag of (FX Debt - Foreign Assets)/Assets, winsorized at 1%, and its interaction with the quarter on quarter depreciation rate of the period average exchange rate. Other controls include one quarter lags of the following variables, each normalized by assets, winsorized at 1%, and also include its interaction with the depreciation rate: Profits, accounts payable (AP), short-term (ST) liabilities, bank debt, bond debt, equity, total liabilities, and sales. Log assets and its interaction with the depreciation rate are also included. R^2 is within R^2. Errors are clustered at the industry-date level. * p < 0.10, ** p < 0.05, ***