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FIRM-TO-FIRM FINANCIAL LINKAGES AND DOLLAR RISK TRANSMISSION

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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 provide empirical evidence consistent with 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: trade credit intensity 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 assess 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 Mateos-Planas and Seccia (2021), Altinoglu (2021)and Reischer (2024) 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 receivable; 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 consists 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 between FX debt and accounts receivable is notable because FX debt is typically thought of as financing long-term investments, not managing working capital. Consistent with Hardy and Saffie (2024) for Mexico, our cross-country analysis indicates that the currency composition of firms' balance sheets is associated with the degree of trade credit provision.

To further examine the link between FX debt and trade credit provision, we exploit time series variation in the cost of FX credit. In particular, we examine how FX credit, accounts receivable, and sales comove with the relative cost of FX loans. 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 begin the analysis 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, this may contribute to a positive coefficient for accounts receivable. Finally, cheaper access to credit could generally increase

[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.

firm sales (Avdjiev et al., 2019).

The outcome variables of interest include FX and local currency borrowing (e.g. loans, bonds, but excluding of trade credit), trade credit provided (accounts receivable), and sales (with all variables normalized by lagged assets). Since IRD is measured from loan interest rates, we focus on loan outcomes, but include total FX debt for comparison with Table 2, as discussed further below. 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 summarizes these results. Columns (1)-(3) show that FX currency borrowing rises with cheap foreign currency debt, but local currency borrowing does not. Columns (4) and (5) show that cheaper FX debt also moves together with sales and trade credit provision. The relationship with sales could reflect both the indirect impact via greater FX credit and the direct impact on the scale of economic activity associated with cheaper dollar funding (Avdjiev et al., 2019).

Connecting the balance-sheet and reduced-form patterns. Changes in accounts receivable (AR) can reflect changes in scale (sales) and/or changes in trade credit intensity (e.g., tighter terms or faster collection). A convenient way to separate these margins is to express receivables as the product of sales and a trade-credit-intensity proxy. Letting $\tau_{it} \equiv AR_{it}/Sales_{it}$ denote trade credit intensity, we can write

$$AR_{it} \approx \tau_{it} \cdot Sales_{it} \;\Rightarrow\; \Delta AR_{it} \approx \tau_{i,t-1}\,\Delta Sales_{it} + Sales_{i,t-1}\,\Delta\tau_{it}.$$

Table 3: Carry Trade and Trade Credit: Cross-Country Sample

	(1) FX Loans	(2) FX Debt	(3) LC Loans	(4) AR	(5) Sales
Δ IRD$_{ct}$	0.00506*	0.00446	0.00317	0.0187***	0.0384***
	(0.00302)	(0.00434)	(0.00537)	(0.00532)	(0.00887)
Observations	116544	116544	116544	132623	132836
R^2	0.00319	0.00320	0.00851	0.0123	0.0181
Firms	5182	5182	5182	5858	5788
FirmFE	Yes	Yes	Yes	Yes	Yes
SectorTimeFE	Yes	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes	Yes

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 FX debt, winsorized at 1%; in column (3), the change in local currency loans, winsorized at 1%; in column (4), the change in accounts receivable, winsorized at 1%; in column (5), 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. Interest rates are loan weighted averages of all firm loans up to the firm level, and then a simple average across firms in each country. Change in 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

IRD could be associated with changes in receivables through either margin, and the roles of sales and FX borrowing in that relationship are not obvious ex ante. Indeed, while Table 2 indicates a link between FX debt and accounts receivable, the magnitude of the coefficients in Table 3 suggests that other macro-financial factors correlated with IRD could also play a role.[5]

Table 4 examines the roles of sales and FX debt directly by including their changes alongside IRD in the receivables regression. Adding sales as a control reduces the coefficient materially; adding FX debt also reduces it. Including both reduces the IRD coefficient from 0.0187 to 0.00827 (about a 56% decline) and it becomes statistically indistinguishable from zero, while sales and FX debt remain individually significant. These associations are not causal, and there is a sizeable residual left unexplained. This residual likely reflects that IRD is a macro-financial variable that also correlates with other key developments in the economy. The wedge from this unexplained residual helps explain the difference in magnitudes between the FX–AR relationship in Table 2 and the implied relationship in Table 3.[6]

In summary, Tables 2–4 document three empirical patterns. First, within-firm balance sheet changes show that FX borrowing and receivables co-move in a manner consistent with working-capital financing (Table 2). Second, a rise in IRD is associated with increases in FX borrowing, sales, and receivables (Table 3). Third, sales and FX borrowing together absorb

[5]The correlation in Table 2 column (3) shows that accounts receivable rises by about \$0.14 for every \$1 of FX debt borrowed. By contrast, dividing the reduced-form IRD coefficients in Table 3 columns (2) and (4) implies that accounts receivable rises by about $0.0187/0.00466 \approx \$4.0$ for every \$1 of FX debt associated with IRD. This wedge suggests that IRD (or variables correlated with IRD) is also related to accounts receivable through channels other than FX borrowing, including through sales and trade credit intensity. (Since AR is a stock and Sales is a quarterly flow, $\tau_{it} = AR_{it}/Sales_{it}$ should be interpreted as a trade-credit-intensity proxy—capturing both the share of sales on trade credit and the effective maturity/collection period—rather than the exact share of a given invoice not paid up front.)

[6]One can use the estimated coefficients to alternatively gauge the relative contributions of sales and FX borrowing to the reduced-form association between receivables and IRD. Let $\theta_S \approx 0.184$ and $\theta_{FX} \approx 0.074$ denote the mappings from changes in sales and FX debt to changes in receivables (Table 4, columns 2–3), and let $\beta^S = 0.0384$ and $\beta^{FX} = 0.00466$ denote the reduced-form associations of sales and FX debt with IRD (Table 3). Then $\theta_S\beta^S \approx 0.0071$ and $\theta_{FX}\beta^{FX} \approx 0.0003$, together accounting for roughly 40% of $\beta^{AR} = 0.0187$. The remainder likely reflects other factors that co-move with IRD and are associated with receivables. This is a back-of-the-envelope accounting benchmark, not a causal decomposition.

Table 4: IRD and Accounts Receivable: Role of Sales and FX Debt

	Accounts receivable			
	(1)	(2)	(3)	(4)
Δ IRD$_{ct}$	0.0187***	0.0112**	0.0157***	0.00827
	(0.00532)	(0.00464)	(0.00604)	(0.00525)
Δ Sales$_{it}$		0.184***		0.185***
		(0.00673)		(0.00734)
Δ FX Debt$_{it}$			0.0740***	0.0548***
			(0.0129)	(0.0120)
Observations	132623	129316	113845	111035
R^2	0.0123	0.113	0.0134	0.116
Firms	5858	5642	5074	4896
FirmFE	Yes	Yes	Yes	Yes
SectorTimeFE	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes

Firms reports the number of firms in each regression. Sample spans 2010-2020. Dependent variable is the change in accounts receivable, normalized by lagged assets, expressed in percent, winsorized at 1%. IRD is the average interest rate on local currency loans minus the average interest rate on FX loans in each quarter. Interest rates are loan weighted averages of all firm loans up to the firm level, and then a simple average across firms in each country. Change in 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%. Columns (2) and (4) include the change in sales (proxied by total revenue), normalized by lagged assets, winsorized at 1%. Columns (3) and (4) include the change in FX debt, normalized by lagged assets, winsorized at 1%. Errors are clustered at the firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

the better part—but not all—of the IRD–receivables association, with the residual plausibly reflecting additional co-moving factors (Table 4). Appendix B.1 reports a sales-normalized version of this exercise (Table B2); the qualitative patterns are similar but estimated with less precision, and we discuss in that appendix why the asset normalization used here is our preferred specification. In Appendix B, Table B1 further shows that FX borrowing and sales have distinct associations with receivables *relative to sales*: FX debt is positively associated with trade credit intensity ($AR/Sales$) while higher sales reduce this ratio. We return to this pattern in light of the model in Section 3.

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 the currency-invoicing choice depends on the riskiness of each currency and the comovement of pricing in each currency with consumption needs. Monetary policy credibility thus affects incentives to invoice in the local currency.

State-contingent trade credit contracts can capture partial FX denomination of trade

Table 5: 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.

credit, among other forms of flexibility (e.g. early payment discounts). An important limitation of using Capital IQ to track this in the data is that it does not detail the share of trade credit given or received in foreign currency. However, Table 5 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, denominating trade credit in foreign currency is not entirely 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.[7] Next,

[7]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

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.

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".[8] 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 accord-

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.

[8]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.

ing 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.[9]

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 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.[10] 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 $\bar{D}$.[11]

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

[9]Appendix A.3 shows explicitly that an alternative formulation with an endogenous spread $r_s(D_s) = r^* + \phi D_s$ delivers the same optimal foreign-debt choice and the same comparative statics as this quadratic-cost specification, under a simple linear mapping between ψ and ϕ. The reduced-form parameter ψ should therefore be interpreted as capturing the steepness of an underlying spread schedule, and all empirical implications we derive below are robust to either representation.

[10]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.

[11]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.

buyer pre-pays for the intermediate good before production begins.[12] 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 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 is purely a technical device to break the indeterminacy among payoff-equivalent trade credit schedules. It only matters in regions where all borrowing and repayment constraints are slack: in those cases, allowing unnecessary state contingency would generate a continuum of payoff-equivalent contracts, and κ selects the non-contingent contract in the limit as $\kappa \to 0$. When any repayment or borrowing constraint binds, the contract is uniquely pinned down by those constraints, so κ is irrelevant for allocations and for the partition between the insurance and pass-through regions. That is, κ has no impact on the allocation or comparative statics, but simply selects a unique contract.[13] Appendix A.4 presents two alternative formulations

[12]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.

[13]This could be rationalized as a small cost needed to verify the actual state of the economy in order to

in which κ is interpreted as a monetary cost (for example, legal or verification expenses) or as a general hedging cost $C(\Delta T)$ borne by the buyer. In both cases, the buyer must finance these costs out of the same borrowing capacity that funds working capital, and we show formally that the equilibrium structure—including the partition into insurance and pass-through regions and all comparative statics emphasized in the main text—is unchanged relative to the baseline $\kappa \to 0$ specification.

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.

Constraint (1) is the incentive compatibility constraint capturing the fact that the final

determine the contingent payment.

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.[14] 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. Appendix A.1 derives these statements formally and shows that, in the relevant parameter region, the only non-trivial constraints in the benchmark without trade credit are the buyer's participation constraint (1), the two period-1 budget constraints (2)–(3), and (depending on parameters) the buyer's borrowing limit (6).

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

[14]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.

supplier and buyer as well as scale of production:

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

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

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

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, in the sense that it does not violate the borrowing limit (6). Hence, this unconstrained case occurs when $\beta \in (\beta_1, \beta_2]$ and the buyer's borrowing constraint is slack. Naturally, as borrowing becomes more expensive for the supplier (higher ψ), debt and production decrease. In Appendix A.1 we show that in this region both repayment constraints (4)–(5) are strictly slack, so the unconstrained equilibrium features a unique interior solution for $(D_{s,1}, D_{b,1}, L_1)$ governed solely by the marginal borrowing cost ψ.

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 acts as a borrowing constraint for the supplier: if ψ is too large (so that $\psi \geq \psi_2$), even driving the buyer to her borrowing limit is not sufficient to support a positive level of $D_{s,2}$, and the only feasible allocation features zero borrowing and production. 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. Appendix A.1 also shows that $D_{s,2} < D_{s,1}$ and $L_2 < L_1$ whenever both equilibria exist, so moving from the unconstrained to the constrained regime unambiguously tightens financial conditions and reduces output.

3.2 Model With Trade Credit

In the model without trade credit, agents are constrained in that the only source of credit is bank 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. Appendix A.2 works through the Kuhn–Tucker system and proves that the only relevant regimes are (i) an unconstrained regime in which neither (13) nor (15) binds and trade credit is effectively non-contingent, and (ii) a constrained regime in which both (13) and (15) bind in the depreciation state and the contract is strictly state-contingent.

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.

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. Equivalently, for $\psi \leq \underline{\psi}$ the unconstrained-supplier solution is feasible and delivers flat (non-contingent) trade credit, whereas for $\psi > \underline{\psi}$ the unconstrained solution would violate (13) in the depreciation state and the equilibrium switches to the constrained regime characterized by (22)–(24).

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 5, 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.

The model also generates a joint prediction about scale and trade credit intensity. A decrease in the supplier's borrowing cost ψ raises both production scale $Y = pL$ and the ratio of trade credit to sales $\tilde{T}/Y$ (as shown in Appendix A.2). That is, cheaper foreign funding increases not only how much the firm sells, but also trade credit intensity. These two margins—scale and trade credit intensity—are distinct equilibrium responses to the same underlying change in financial conditions. This is consistent with the empirical patterns in Table B1, where FX debt is positively associated with $AR/Sales$ while higher sales reduce this ratio, indicating that the two margins are empirically distinguishable and move in the directions predicted by the model.

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. We first relate firms' trade credit provision to their profitability, scale, and borrowing conditions (Testable Prediction 1). We then analyze how firms with different degrees of FX exposure adjust trade credit and external borrowing in response to exchange rate shocks (Testable Prediction 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.[15] In terms of the model, Low $\text{IR}_t = 1$ is a reduced-form indicator of a low effective cost parameter ψ—that is, of firms facing a flatter endogenous spread schedule and therefore operating further inside their borrowing frontier.[16]

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 6 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

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

[16] Appendix A.3 shows that the quadratic borrowing cost ψD_s^2 is isomorphic to a formulation with an endogenous spread $r_s(D_s) = r^* + \phi D_s$, so our empirical measures of borrowing conditions can be interpreted in either representation, capturing equilibrium outcomes.

(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 are consistent with the basic predictions of the model that more profitable and less financially constrained firms intermediate more trade credit thorough their supply chains. The magnitude of the coefficients is also economically meaningful: moving from the 25th to the 75th percentile of short-term debt or profitability is associated with increases in trade credit of several tenths of a percentage point of assets, in line with the model's prediction that financially unconstrained firms use their balance sheet to scale up inter-firm lending.

Table 6: 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 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. R^2 is within R^2. Errors are clustered at the industry-year level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: 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 7 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).[17]

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 trade credit intensity. Both mechanisms imply that pass-through is increasing in financial vulnerability.

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

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

where FXL denotes liabilities denominated in foreign currency and FXA proxies for foreign-

[17]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.

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.[18] 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), trade credit intensity ($AR/Sales$), 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 practices remain limited in many emerging markets, and to the extent that firms do hedge, our estimates will be biased

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

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.[19]

Table 8 presents the main results.[20] 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

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

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

percentile - see Table 1).[21] 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.[22]

As they are hit by a negative shock to profits, non-exporters tend to cut back on their trade credit lending (column 4). They reduce trade credit intensity (column 2) as predicted by our model, but they also see an increase in cash holdings (column 3).[23] 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.

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

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

[23] In Appendix A.2, we show that the model predicts that less constrained firms—those with lower ψ—have higher trade credit intensity ($AR/Sales$). Hence, the model implies that more exposed firms would lower their trade credit intensity during a home currency depreciation (column 2 of Table 8). This is also consistent with the pattern in Table B1, where a decrease in the cost of foreign borrowing is associated with a rise in trade credit intensity.

Table 8: 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$_{it-1}$ $\times$ 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 receivable 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 receivable 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 B3 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 trade credit intensity, 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 9 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.[24] 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-

[24]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 9: 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 receivable 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 receivable 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 10 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 10: 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 receivable 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 B4 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%.[25]

Considering a 10% depreciation of the Peruvian Sol, we apply our estimated coefficients from Table 8—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 demonstrates 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

[25] 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.

providers may become constrained. This could amplify the shock substantially, particularly 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 find support for 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. Finally, constraint (10) allows us to write trade credit as a function of firm sales in any equilibrium. Letting $Y = pL$ denote firm sales, the ratio of trade credit to sales becomes

$$\frac{\tilde{T}}{Y} = 1 - \frac{D_b(1+r) + \frac{\Gamma}{\beta}}{Y}$$

Clearly, $sign(\frac{\partial \frac{\tilde{T}}{Y}}{\partial \psi}) = sign(\frac{\partial L}{\partial \psi})$. Thus, a decrease in the borrowing cost raises a firm's trade credit to sales ratio.

A.3 Alternative borrowing-cost specification and endogenous spread

In the main text, we model the supplier's access to foreign funding with a quadratic borrowing cost term ψD_s^2 that enters directly in the period-1 problem. This captures, in reduced form, the idea that the marginal cost of foreign borrowing is increasing in the level of dollar debt D_s. In this section, we show that an explicit specification with a debt-level-dependent spread on foreign borrowing delivers exactly the same optimal foreign debt and the same comparative statics, once parameters are mapped appropriately.

A.3.1 Baseline quadratic-cost specification (no trade credit)

To make the comparison transparent, start from the no-trade-credit benchmark in which the supplier chooses foreign borrowing D_s, domestic borrowing for the buyer D_b, and scale L.

The supplier borrows D_s in foreign currency at rate r^* and faces a quadratic borrowing cost ψD_s^2 in period 1. The buyer borrows D_b in local currency at rate r. There is no trade credit, so the only transfer from buyer to supplier at date 2 is T'. Let Γ denote the buyer's outside option and normalize the expected exchange rate to one, $\tilde{e}' = 1$, as in the main text.

In the unconstrained interior region (where the buyer's borrowing cap and repayment constraints are slack and the buyer's participation and period-1 budget constraints bind), we have

$$D_b = T', \qquad \beta\big[pL - T'(1+r)\big] = \Gamma, \qquad D_s - \psi D_s^2 - wL = 0,$$

so that

$$T' = \frac{pL - \Gamma/\beta}{1+r}, \qquad L = \frac{D_s - \psi D_s^2}{w}. \tag{25}$$

Substituting (25) into the supplier's objective yields a one-dimensional problem in D_s,

$$\Pi_Q(D_s) = \frac{\beta}{1+r}\left[\frac{p}{w}(D_s - \psi D_s^2) - \frac{\Gamma}{\beta}\right] - \beta(1+r^*)D_s. \tag{26}$$

The first-order condition for an interior optimum is

$$\frac{\partial \Pi_Q}{\partial D_s} = \frac{\beta p}{(1+r)w}(1 - 2\psi D_s) - \beta(1+r^*) = 0, \tag{27}$$

or, after dividing by β,

$$\frac{p}{(1+r)w}(1 - 2\psi D_s) = (1+r^*). \tag{28}$$

Solving for D_s gives

$$D_s^Q = \frac{1 - \dfrac{(1+r^*)(1+r)w}{p}}{2\psi} = \frac{\dfrac{p}{(1+r)w} - (1+r^*)}{2\psi\,\dfrac{p}{(1+r)w}}. \tag{29}$$

Given D_s^Q, the associated scale is

$$L^Q = \frac{D_s^Q - \psi(D_s^Q)^2}{w}. \tag{30}$$

A.3.2 Endogenous-spread specification (no trade credit)

Consider now an alternative borrowing technology in which the supplier faces a debt-dependent spread on foreign borrowing:

$$r_s(D_s) \equiv r^* + \phi D_s,$$

so that the gross foreign-currency repayment is $(1+r_s(D_s))D_s = (1+r^*)D_s + \phi D_s^2$. We drop the quadratic term from the period-1 budget and instead include this spread in the period-2 repayment.

In the same unconstrained region as above, the buyer-side constraints are unchanged and we again have

$$D_b = T', \qquad \beta\big[pL - T'(1+r)\big] = \Gamma, \qquad D_s - wL = 0,$$

so that

$$T' = \frac{pL - \Gamma/\beta}{1+r}, \qquad L = \frac{D_s}{w}. \tag{31}$$

Substituting (31) into the supplier's objective, which now reads

$$\Pi_S(D_s) = D_s - wL + \beta\big[T' - (1 + r_s(D_s))D_s\big],$$

we obtain

$$\Pi_S(D_s) = \frac{\beta}{1+r}\left[\frac{p}{w}D_s - \frac{\Gamma}{\beta}\right] - \beta(1 + r_s(D_s))D_s. \tag{32}$$

With $r_s(D_s) = r^* + \phi D_s$, the first-order condition is

$$\frac{\partial \Pi_S}{\partial D_s} = \frac{\beta p}{(1+r)w} - \beta(1 + r^* + \phi D_s) - \beta D_s \phi = 0 \tag{33}$$

$$\Leftrightarrow \ \frac{p}{(1+r)w} - (1+r^*) - 2\phi D_s = 0, \tag{34}$$

so that

$$D_s^S = \frac{\dfrac{p}{(1+r)w} - (1+r^*)}{2\phi}. \tag{35}$$

The implied scale is

$$L^S = \frac{D_s^S}{w}. \tag{36}$$

A.3.3 Mapping and implications

Comparing (29) and (35), we see that whenever

$$\phi = \psi \frac{p}{(1+r)w}, \tag{37}$$

we obtain

$$D_s^S = D_s^Q$$

in the unconstrained region. In words, there is a simple linear mapping between the quadratic-cost parameter ψ and the slope ϕ of the spread schedule such that the supplier's optimal foreign-debt choice is identical under the two specifications.

Under the mapping (37), the implied scales satisfy

$$L^S = \frac{D_s^Q}{w} \quad \text{and} \quad L^Q = \frac{D_s^Q - \psi(D_s^Q)^2}{w},$$

so that

$$L^S - L^Q = \frac{\psi (D_s^Q)^2}{w} > 0.$$

This difference reflects only the timing of the borrowing cost: in the quadratic-cost specification the cost ψD_s^2 is paid in period 1 and tightens the working-capital constraint directly; in the spread specification it shows up as part of the period-2 repayment.

For our purposes, the key point is that in both formulations the marginal cost of foreign borrowing is strictly increasing in D_s, and the derivative of this marginal cost with respect to ψ (or ϕ) is of the same sign. All comparative statics in the main text with respect to the borrowing-cost parameter therefore go through unchanged: a higher ψ in the quadratic-cost specification corresponds, via (37), to a steeper spread schedule ϕ, and in both cases this tightens effective borrowing conditions, lowers optimal D_s, and increases the likelihood that the supplier's repayment constraint binds in the depreciation state.

The same logic extends to the trade-credit equilibrium: trade credit is strictly increasing in D_s in the unconstrained region, so looser borrowing conditions (lower ψ or lower ϕ) lead to more foreign borrowing and more trade credit in either representation. This is the sense in which the endogenous-spread version of the model is fully consistent with, and provides a microfoundation for, the empirical specification where observed interest rates are used as a proxy for borrowing conditions.

A.4 Alternative formulations of the contingency cost κ

In the main text, we introduce a small fixed cost $\kappa > 0$ whenever the supplier chooses a state-contingent trade credit schedule, $T'_h \neq T'_l$. This term is a selection device: it breaks the indeterminacy among payoff-equivalent state-contingent contracts when the buyer can be fully insured without using state-contingent trade credit. The baseline model uses $\kappa \to 0$ as a pure selection device to eliminate this indeterminacy without affecting allocations.

In this subsection, we show this approach is without loss of generality by providing two economically grounded reformulations in which the cost of state contingency is pecuniary and explicitly financed by the buyer. In both formulations, we demonstrate that: (i) within the interior of each baseline region (unconstrained or constrained), the equilibrium binding constraints and comparative statics are preserved for small cost parameters; (ii) the wedge between state-contingent transfers remains invariant to the cost parameter when the supplier's repayment constraint binds; and (iii) letting the cost parameter tend to zero recovers exactly the baseline representation. The partition between regions may shift slightly with positive costs (as firms near indifference may choose flat contracts to avoid small costs), but the characterization within each region is unchanged.

A.4.1 Buyer-financed verification cost

We keep the environment and notation from the main text. The supplier chooses foreign borrowing D_s, domestic borrowing for the buyer D_b, scale L, and trade credit (T, T'_h, T'_l). Let $e' \in \{e_h, e_l\}$ denote the exchange rate in period 2 with $\Pr(e' = e_h) = p_h$ and $\Pr(e' = e_l) = 1 - p_h$.

In the baseline formulation, state-contingent trade credit enters the supplier's objective via $-\kappa \mathbf{1}\{T'_h \neq T'_l\}$. Here we instead interpret $\kappa_b > 0$ as a monetary cost paid by the buyer in period 1 whenever the contract is state contingent. The buyer must finance this cost out of her borrowing capacity. This cost can be interpreted as verification, legal, or administrative expenses required to implement state-contingent contracts.

Formally, let

$$I \equiv \mathbf{1}\{T'_h \neq T'_l\}.$$

We modify the buyer's period-1 budget constraint to

$$D_b - T - \kappa_b I \;\geq\; 0, \tag{38}$$

and her lifetime participation constraint to

$$D_b - T - \kappa_b I + \beta\big[pL - D_b(1+r) - \tilde{T}'\big] \;\geq\; \Gamma, \tag{39}$$

where $\tilde{T}' \equiv p_h T_h' + (1-p_h)T_l'$ as in the main text. All other constraints (the supplier's working-capital constraint, the buyer's repayment constraint, and the supplier's repayment constraints in each state) are exactly as in the baseline model.

Case 1: Flat contracts ($I = 0$). If $T_h' = T_l'$, then $I = 0$ and κ_b drops out of both (38) and (39). The buyer- and supplier-side problems are then identical to those in the baseline model. In particular, whenever the supplier is unconstrained and can fully insure the buyer using non-contingent trade credit and standard borrowing, the optimal contract remains flat and the cost of state contingency is irrelevant.

Case 2: State-contingent contracts with binding constraints ($I = 1$). In the constrained region of the main text in which the supplier's repayment constraint binds in the depreciation state and the contract is strictly state-contingent, the buyer hits her borrowing cap and the supplier's repayment constraint is tight. Under the monetary κ_b formulation, this region is characterized by:

$$D_b = \bar{D}, \tag{40}$$

$$D_b - T - \kappa_b = 0 \quad \Rightarrow \quad T = \bar{D} - \kappa_b, \tag{41}$$

$$pL - \bar{D}(1+r) \geq T_h', \tag{42}$$

$$T_h' \geq e_h(1+r^*)D_s, \tag{43}$$

$$T_l' \geq e_l(1+r^*)D_s, \tag{44}$$

$$D_s + T - \psi D_s^2 - wL \geq 0. \tag{45}$$

Substituting (41) into the buyer's participation constraint (39):

$$\bar{D} - (\bar{D} - \kappa_b) - \kappa_b + \beta[pL - \bar{D}(1+r) - \tilde{T}'] \geq \Gamma$$

$$\beta[pL - \bar{D}(1+r) - \tilde{T}'] \geq \Gamma \tag{46}$$

When the period-1 financing constraint (41) binds, the κ_b terms enter both (38) and (39) symmetrically and cancel from the participation constraint, as shown in (46). This implies that the buyer's lifetime utility depends on T'_h and T'_l only through their expected value $\tilde{T}'$ for the purpose of satisfying the participation constraint.

To derive the wedge $T'_h - T'_l$, we require that constraints (42) and (43) both bind in the high state, giving:

$$T'_h = e_h(1+r^*)D_s = pL - \bar{D}(1+r) \tag{47}$$

Substituting this into (46):

$$\begin{aligned}
\beta[pL - \bar{D}(1+r) - \tilde{T}'] &= \Gamma \\
\beta[pL - \bar{D}(1+r) - p_h T'_h - (1-p_h)T'_l] &= \Gamma \\
\beta[pL - \bar{D}(1+r) - p_h[pL - \bar{D}(1+r)] - (1-p_h)T'_l] &= \Gamma \\
\beta[(1-p_h)[pL - \bar{D}(1+r)] - (1-p_h)T'_l] &= \Gamma \\
\beta(1-p_h)[pL - \bar{D}(1+r) - T'_l] &= \Gamma \\
T'_l = pL - \bar{D}(1+r) - \frac{\Gamma}{\beta(1-p_h)}
\end{aligned}$$

Therefore, the wedge is:

$$T'_h - T'_l = \frac{\Gamma}{\beta(1-p_h)}, \tag{48}$$

exactly as in the baseline solution. This wedge is invariant to κ_b because the cost cancels from the participation constraint when period-1 financing binds.

However, κ_b does affect the *levels* of D_s, L, T_h', and T_l' through its impact on working capital. From (47):

$$L = \frac{\bar{D}(1+r) + e_h(1+r^*)D_s}{p} \tag{49}$$

From the supplier's working-capital constraint (45) binding with $T = \bar{D} - \kappa_b$ from (41):

$$D_s + \bar{D} - \kappa_b = \psi D_s^2 + wL$$

Substituting (49):

$$D_s + \bar{D} - \kappa_b = \psi D_s^2 + w \cdot \frac{\bar{D}(1+r) + e_h(1+r^*)D_s}{p}$$

Rearranging:

$$\psi D_s^2 + \left[\frac{we_h(1+r^*)}{p} - 1\right] D_s + \frac{w\bar{D}(1+r)}{p} - \bar{D} + \kappa_b = 0$$

Using the quadratic formula and selecting the positive root:

$$D_s^C(\kappa_b) = \frac{1 - \frac{we_h(1+r^*)}{p} + \sqrt{\left(1 - \frac{we_h(1+r^*)}{p}\right)^2 - 4\psi\left[\frac{w\bar{D}(1+r)}{p} - \bar{D} + \kappa_b\right]}}{2\psi} \tag{50}$$

For the baseline case with $\kappa_b = 0$, this reduces to equation (22) in the main text:

$$D_s^{baseline} = \frac{1 - \frac{we_h(1+r^*)}{p} + \sqrt{\left(1 - \frac{we_h(1+r^*)}{p}\right)^2 - 4\psi\left[\frac{w\bar{D}(1+r)}{p} - \bar{D}\right]}}{2\psi} \tag{51}$$

Since the term under the square root in (50) is smaller than in (51) when $\kappa_b > 0$, we have:

$$D_s^C(\kappa_b) < D_s^{baseline} \quad \text{for all } \kappa_b > 0 \tag{52}$$

The state-contingent transfers are then:

$$T'_h = e_h(1+r^*)D_s^C(\kappa_b), \tag{53}$$

$$T'_l = T'_h - \frac{\Gamma}{\beta(1-p_h)} = e_h(1+r^*)D_s^C(\kappa_b) - \frac{\Gamma}{\beta(1-p_h)}, \tag{54}$$

and production scale is:

$$L^C = \frac{\bar{D}(1+r) + T'_h}{p} = \frac{\bar{D}(1+r) + e_h(1+r^*)D_s^C(\kappa_b)}{p}. \tag{55}$$

Thus, the structure of the insurance region and the extent of FX passthrough are qualitatively unchanged. The participation wedge $T'_h - T'_l$ from (48) remains the same as in the baseline. However, κ_b tightens the working-capital constraint through (41), which reduces $D_s^C(\kappa_b)$ via (50). Given that $T'_h = e_h(1+r^*)D_s^C(\kappa_b)$ from (53) and $T'_l = T'_h - \Gamma/[\beta(1-p_h)]$ from (54), the levels of both period-2 transfers fall with κ_b even though their wedge remains fixed.

Small-cost perturbation result. For sufficiently small κ_b, the equilibrium structure is preserved in the following sense: consider parameter values in the interior of either baseline region (unconstrained or constrained). By continuity, a sufficiently small κ_b does not change which constraints bind within that region. The boundary between regions may shift (firms near indifference may switch to flat contracts to avoid κ_b), but within each region the characterization is unchanged. In the unconstrained region, flat contracts remain optimal and (38) and (39) reduce to the baseline constraints. In the constrained region, the same set of constraints binds as in the baseline, and the characterization in equations (40)–(55) applies. The wedge (48) is identical to the baseline, and the levels of (D_s, L, T'_h, T'_l) converge to their baseline values (equation (22) and associated expressions) as $\kappa_b \to 0$. Therefore, all comparative statics in the main text are preserved for small κ_b, and letting $\kappa_b \to 0$ recovers exactly the baseline representation in which κ is an infinitesimal selection device.

A.4.2 General pecuniary hedging cost $C(\Delta T)$

We now consider a more general pecuniary formulation in which the extent of state contingency is captured by the gap

$$\Delta T \equiv T'_h - T'_l,$$

and the buyer pays a convex hedging cost $C(\Delta T)$ in period 1. This cost is financed out of the same borrowing capacity that funds working capital. We assume

$$C(0) = 0, \qquad C'(\Delta T) \geq 0, \qquad C''(\Delta T) > 0.$$

The fixed-cost specification in Section A.4.1 corresponds to the limiting case where $C(\Delta T) = \kappa_b \cdot \mathbf{1}\{\Delta T > 0\}$, a step function that imposes a constant cost for any positive degree of state contingency. The smooth convex cost $C(\Delta T)$ generalizes this by allowing the marginal cost of state contingency to increase continuously with the gap ΔT.

Let the exchange-rate state in period 2 be $s \in \{h, \ell\}$ with probabilities $\Pr(s = h) = p_h$ and $\Pr(s = \ell) = 1 - p_h$. The buyer's period-1 financing constraint becomes

$$D_b \;\geq\; T + C(\Delta T), \tag{56}$$

and her lifetime payoff, abstracting from terms that do not depend on (T'_h, T'_l), can be written as

$$\mathbb{E}[V^B] = p_h\, U_h(T'_h) + (1 - p_h)\, U_\ell(T'_l) - C(\Delta T), \tag{57}$$

where $U_s(T'_s)$ represents the buyer's continuation value in state s. Specifically, from the buyer's period-2 budget constraint $pL \geq D_b(1 + r) + T'_s$, the buyer's payoff in state s (net of the transfer) is $pL - D_b(1+r) - T'_s$, so we can write:

$$U_s(T'_s) = pL - D_b(1+r) - T'_s \tag{58}$$

Thus $U'_s(T'_s) = -1 < 0$: a higher transfer in state s reduces the buyer's continuation value.

The buyer is also subject to enforcement constraints

$$T'_s \ \leq\ \bar{T}_s(L), \qquad s \in \{h, \ell\}, \tag{59}$$

which represent the maximum the buyer can credibly pay in each state. In the constrained equilibrium of the main text, $\bar{T}_h = pL - \bar{D}(1+r)$ from the buyer's period-2 budget constraint in the high state.

Case 1: Unconstrained region (enforcement constraints slack). When all enforcement constraints are slack and the buyer's continuation value is linear in transfers (with $U'_s(T'_s) = -1$ from (58)), the buyer is indifferent to any decomposition of $\tilde{T}' = p_h T'_h + (1-p_h) T'_l$ that delivers the required expected value, provided the hedging cost $C(\Delta T)$ is covered. Since $C(\cdot)$ is minimized at $\Delta T = 0$ where $C(0) = 0$ and $C(\Delta T) > 0$ for all $\Delta T > 0$, the optimal contract is flat: $T'_h = T'_l = \tilde{T}'$.

More generally, if there were additional state-dependent frictions creating $U'_h \neq U'_\ell$ (not present in our baseline specification), an interior solution would trade off insurance against the marginal cost of state contingency. Under our linear specification with $U'_s = -1$ in both states, such interior solutions do not arise, and the cost-minimizing choice is the flat contract.

Case 2: Constrained region (high-state enforcement constraint binds). This corresponds to the constrained equilibrium in the main text where the supplier's repayment constraint forces T_h' to the buyer's enforcement limit. We have:

$$D_b = \bar{D}, \tag{60}$$

$$D_b - T - C(\Delta T) = 0, \tag{61}$$

$$T_h' = \bar{T}_h = pL - \bar{D}(1+r), \tag{62}$$

$$T_h' = e_h(1+r^*)D_s. \tag{63}$$

Substituting (61) into the buyer's participation constraint yields:

$$D_b - T - C(\Delta T) + \beta[pL - D_b(1+r) - \tilde{T}'] \geq \Gamma$$
$$\bar{D} - [\bar{D} - C(\Delta T)] - C(\Delta T) + \beta[pL - \bar{D}(1+r) - \tilde{T}'] \geq \Gamma$$

$$\beta[pL - \bar{D}(1+r) - \tilde{T}'] \geq \Gamma \tag{64}$$

Just as in Section A.4.1, when the period-1 financing constraint binds, the cost term $C(\Delta T)$ cancels from the participation constraint. The participation constraint (64) determines the expected transfer $\tilde{T}'$, but to pin down the wedge $\Delta T = T_h' - T_l'$, we use the binding constraints (62):

$$\begin{aligned}\tilde{T}' &= p_h T_h' + (1-p_h)T_l' \\ &= p_h[pL - \bar{D}(1+r)] + (1-p_h)T_l'\end{aligned}$$

From (64):

$$\tilde{T}' = pL - \bar{D}(1+r) - \frac{\Gamma}{\beta}$$

Equating these:

$$\begin{aligned}
p_h[pL - \bar{D}(1+r)] + (1-p_h)T_l' &= pL - \bar{D}(1+r) - \frac{\Gamma}{\beta} \\
(1-p_h)T_l' &= [pL - \bar{D}(1+r)](1-p_h) - \frac{\Gamma}{\beta} \\
T_l' &= pL - \bar{D}(1+r) - \frac{\Gamma}{\beta(1-p_h)}
\end{aligned}$$

Therefore, the wedge is:

$$\Delta T = T_h' - T_l' = [pL - \bar{D}(1+r)] - \left[pL - \bar{D}(1+r) - \frac{\Gamma}{\beta(1-p_h)}\right] = \frac{\Gamma}{\beta(1-p_h)} \tag{65}$$

This is **exactly the same wedge as in the baseline model and in equation** (48) **from Section A.4.1.** The cost function $C(\Delta T)$ must be paid (evaluated at this ΔT), tightening working capital and reducing the levels of D_s, L, T_h', and T_l' through the same working-capital channel as in Section A.4.1. However, $C(\Delta T)$ does not determine the size of the wedge when the supplier's repayment constraint binds—that is pinned down by the participation constraint and enforcement limits, exactly as in the baseline.

Small-cost perturbation result. From the supplier's perspective, expected revenue from trade credit is

$$\mathbb{E}[V^S] = p_h T_h' + (1-p_h)T_l' = \tilde{T}', \tag{66}$$

subject to the buyer's participation and enforcement constraints. The presence of $C(\Delta T)$ affects only how the buyer trades off insurance against the period-1 hedging cost; it does not alter the shape of the feasible set or the way in which foreign borrowing, working capital, and trade credit jointly relax the repayment constraint. For sufficiently small $C''(\Delta T)$ (nearly linear cost around the relevant ΔT), the impact of $C(\cdot)$ on equilibrium allocations is minimal. In the unconstrained region, flat contracts remain optimal since $C(0) = 0$ and $C(\Delta T) > 0$

for $\Delta T > 0$. In the constrained region where the supplier's repayment constraint binds, the wedge ΔT is determined by (65) exactly as in the baseline, and $C(\Delta T)$ enters only as a level effect on available resources (tightening working capital and reducing D_s, L, and both transfer levels while preserving their wedge). As $C''(\Delta T) \to 0$ uniformly, the equilibrium converges to the baseline. As a result, within the interior of each baseline region:

- The partition of the parameter space into regions with (i) full insurance (flat contracts) and (ii) partial insurance (state-contingent contracts with the wedge from (65)) remains qualitatively the same as in the baseline model for small $C''(\cdot)$. The boundaries between regions may shift as firms near indifference choose flat contracts to avoid hedging costs.

- The sign of FX passthrough and its dependence on financial tightness are unchanged: when the supplier is unconstrained, the optimal contract provides full insurance ($\Delta T = 0$); when the supplier's repayment constraint binds in the depreciation state, the optimal contract features the wedge from (65) and passthrough rises.

- All comparative statics in the main text are preserved for small hedging costs.

Finally, this formulation provides a natural way to relate the cost of state contingency to exchange-rate volatility or other economic frictions: higher volatility can be represented by a higher marginal cost $C'(\Delta T)$ at any given gap, or by a steeper curvature $C''(\Delta T)$, both of which would reduce the incentive to use state-contingent contracts when constraints are slack. We keep the reduced-form fixed-cost representation in the main text for simplicity and use the pecuniary-cost formulation here to show that the main insurance and passthrough predictions are robust to richer microfoundations of the contingency cost.

B Additional Empirical Results

B.1 Sales Normalized IRD Analysis

Table 4 in the main text shows that, once both sales and FX debt are included as controls, the coefficient on ΔIRD in the accounts receivable regression becomes small and statistically insignificant. Table B1 below complements that analysis by examining accounts receivable *relative to sales* as the dependent variable. This ratio serves as an indicator of trade credit intensity ($AR/Sales$), a proxy for the share of sales extended on credit and the effective maturity/collection period. The results show that FX debt and sales have distinct associations with this ratio: more FX debt is associated with a higher trade credit intensity, whereas higher sales are associated with a lower trade credit intensity. These patterns are consistent with the model's prediction that cheaper foreign funding raises both scale and trade credit intensity (Section 3), and that these are empirically distinguishable margins.

As a robustness check for Table 4, we examine whether normalizing both accounts receivable and FX debt by sales—rather than by lagged assets—yields coefficient ratios that align with the balance-sheet decomposition in Table 2. Specifically, we regress $\Delta(AR/Sales)$ and $\Delta(FXDebt/Sales)$ on ΔIRD. If measured FX borrowing were the sole link from IRD to receivables, the ratio of the $AR/Sales$ coefficient to the $FXDebt/Sales$ coefficient should approximate the 0.147 mapping from Table 2 column (3).

Table B2 reports the results. The coefficient on ΔIRD is imprecisely estimated for the FX debt outcome (column 1), rendering the ratio comparison uninformative, but the qualitative patterns still hold. This imprecision reflects a fundamental difficulty with sales normalization for this exercise: FX debt is a balance-sheet stock, while sales is an income-statement flow. Because IRD is itself positively associated with sales (Table 3), dividing FX debt by sales creates a mechanical "denominator problem"—even when FX debt rises, the ratio $FXDebt/Sales$ may fall or remain flat because sales is moving in the same direction.

Table B1: Carry Trade and Trade Credit: Trade Credit Intensity ($AR/Sales$)

	Trade credit intensity ($AR/Sales$)			
	(1)	(2)	(3)	(4)
Δ IRD$_{ct}$	0.00177***	0.00188***	0.00179**	0.00189***
	(0.000632)	(0.000632)	(0.000696)	(0.000696)
Δ Sales$_{it}$		-0.00271***		-0.00275***
		(0.000346)		(0.000376)
Δ FX Debt$_{it}$			0.00291**	0.00317**
			(0.00146)	(0.00146)
Observations	129724	129724	111336	111336
R^2	0.00974	0.0151	0.0109	0.0167
Firms	5662	5662	4910	4910
FirmFE	Yes	Yes	Yes	Yes
SectorTimeFE	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes

Firms reports the number of firms in each regression. Sample spans 2010-2020. Dependent variable is trade credit intensity ($AR/Sales$), expressed in percent, extreme values capped at 0 and 200%. IRD is the average interest rate on local currency loans minus the average interest rate on FX loans in each quarter. Interest rates are loan weighted averages of all firm loans up to the firm level, and then a simple average across firms in each country. Change in 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%. Columns (2) and (4) include the change in sales (proxied by total revenue), normalized by lagged assets, winsorized at 1%. Columns (3) and (4) include the change in FX debt, normalized by lagged assets, winsorized at 1%. Errors are clustered at the firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

This contrasts with $AR/Sales$, where accounts receivable and sales are more naturally linked ($AR \approx \tau \times Sales$), so the ratio has a clear economic interpretation as trade credit intensity.

The asset normalization used throughout our main analysis avoids this issue because lagged assets are predetermined and do not respond to contemporaneous IRD movements. Thus, the analysis in Table 4 relies on the asset-normalized specification, which is also consistent with the balance-sheet decomposition in Table 2.

Table B2: Carry Trade and Trade Credit: Sales-Normalized Outcomes

	(1) Δ FX Debt/Sales	(2) Δ AR/Sales
Δ IRD_{ct}	0.0218	0.228*
	(0.0415)	(0.137)
Observations	113489	129246
R^2	0.00141	0.00109
Firms	4987	5638
FirmFE	Yes	Yes
SectorTimeFE	Yes	Yes
FirmControls	Yes	Yes

Firms reports the number of firms in each regression. Sample spans 2010-2020. Dependent variables, each normalized by sales and expressed in percent, are as follows: in column (1), the change in FX debt, winsorized at 1%; in column (2), the change in accounts receivable, winsorized at 1%. IRD is the average interest rate on local currency loans minus the average interest rate on FX loans in each quarter. Interest rates are loan weighted averages of all firm loans up to the firm level, and then a simple average across firms in each country. Change in 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. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

B.2 Full Tables from Section 4

Tables B3-B4 include estimated coefficients for all variables included in the main specifications that test Prediction 2 of the model (Tables 8 and 10).

Table B3: 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 receivable 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 receivable 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 B4: 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 receivable 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, ***