Exchange Rate Volatility and Insurance via Trade Credit

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January 7, 2023

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Firm Borrowing and Lending

Trade Credit: firm-to-firm borrowing/lending in non-financial sector

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- State-contingency
  - 88% firms in Western Europe in 2018 had late frequent payments
  - 50% firms in US in 2003 incur no late penalties with main supplier
  - common to pay suppliers in installments for sold inventories only

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Large firms act as financial intermediaries

- TC is 1/3 of short-term liabilities for $7K+$ large firms in 19 EMs during 2004-2020 (Capital IQ)

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- TC is 1/3 of short-term liabilities for $7K+$ large firms in 19 EMs during 2004-2020 (Capital IQ)
- Net lenders: $(AR - AP)/Assets = 7\%$
- Large firms have higher share of debt in FX (Capital IQ)
  - 23% of total debt in FX for average firm, 94% for 90th %tile
  - Corr(FX debt share, log assets)=0.27

Trade Credit As Insurance

Today's Talk:

Large firms take on currency risk and insure small trade partners.

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1. Model trade credit along supply chains in presence of FX shocks
    - Key feature: trade credit supply depends on firm ability to borrow
    - Key result: large firms keep TC supply unchanged when they face adverse FX borrowing shock $\rightarrow$ trade credit is insurance

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Large firms take on currency risk and insure small trade partners.

→ Trade credit is means of risk sharing.

1. Model trade credit along supply chains in presence of FX shocks
   - Key feature: trade credit supply depends on firm ability to borrow
   - Key result: large firms keep TC supply unchanged when they face adverse FX borrowing shock → trade credit is insurance
2. Validate model's predictions using firm-level data for 7K+ large firms in 19 EMs during 2004-2020 (Capital IQ)

Contribution to Literature

Recent theory of trade credit in macro:

- Giannetti et al. (2021, JPE), Hardy et al. (2022, WP), Shao (2020, WP), Reischer (2020, WP)

Currency choice of debt:

- Salomao and Varela (2021 ReStud), Kim et al. (2015 JIE),...

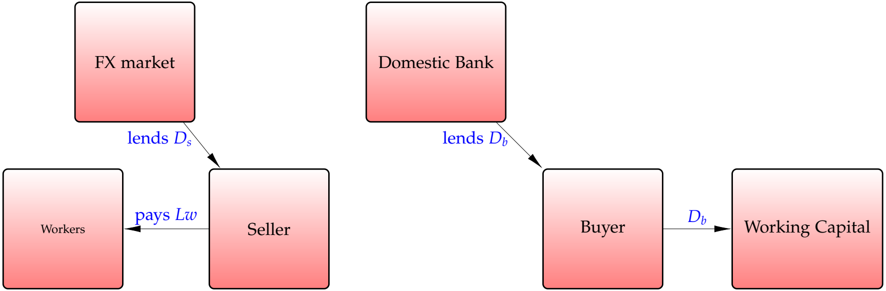
Empirical evidence of trade credit as stabilizer

- Amberg et al. (2021 JPE), Garcia-Appendini and Montoriol-Garriga (2013 JFE), Adelino et al. (2022 RFS), Ersahin et al. (2022 WP), Hardy and Saffie (2022 WP)...

Model: Environment

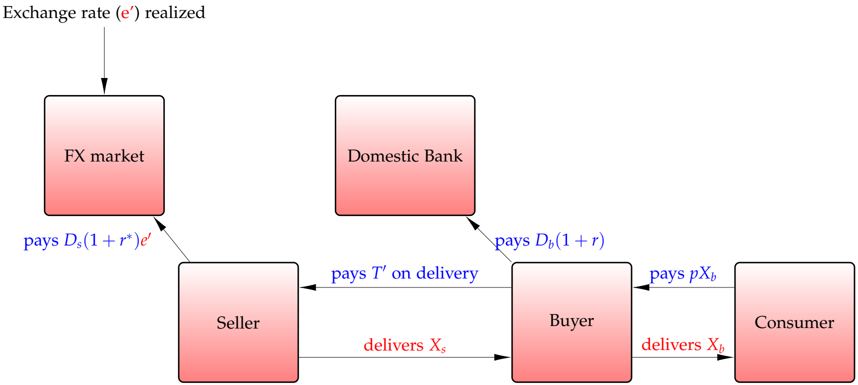
- Small open economy
- Two periods
- Agents
  - Large intermediate good supplier (seller) borrows in FX at rate r^* subject to quadratic borrowing cost scaled by ψ
  - Small final good producer (buyer) borrows in home currency at rate $r > r^*$ up to amount $\bar{D}$
- e (e') is price of one unit of foreign currency today (tomorrow)
- Two states of nature for e': $e_h > e_l$

Model without Trade Credit Period 1



- Buyer borrows at the end of the period to set aside working capital

Model without Trade Credit Period 2



- Buyer borrows at the end of the period to set aside working capital to pay next morning after delivery and before her production takes place.

Model without Trade Credit

(Large) Seller makes TIOLI offer to (small) buyer

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

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

$$D_b - T' \geq 0$$

$$D_s - \psi D_s^2 - wL \geq 0$$

$$pL \geq D_b(1+r)$$

$$T' \geq e_h D_s(1+r^*)$$

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

- $\tilde{e}' \equiv p_h e_h + (1-p_h)e_l = 1$, $p_h \in (0,1)$
- $p > 0$ and $\Gamma > 0$ are exogenous price and buyer's outside option, respectively.
- $X_b = X_s$, $X_s = L$ are production functions
- Saving rate r^* satisfies $\beta(1+r^*) = 1 \rightarrow$ No savings

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$$D_b - T' + \beta[pL - D_b(1 + r)] - \Gamma \geq 0 \qquad (=)$$

$$D_b - T' \geq 0 \qquad (=)$$

$$D_s - \psi D_s^2 - wL \geq 0 \qquad (=)$$

$$pL \geq D_b(1 + r) \qquad (>) \text{ if } \Gamma > 0$$

$$T' \geq e_h D_s(1 + r^*)$$

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

Model without Trade Credit: Solution

4 cases for large firm debt/production depending on params

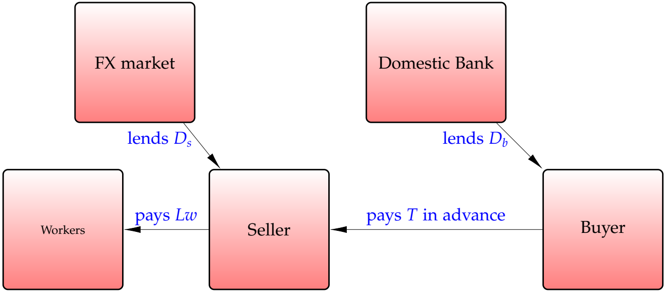
1. Unconstrained agents

$$D_s = \frac{\beta p - (1+r)w}{2\psi\beta p} \qquad L = \frac{D_s - \psi D_s^2}{w}$$

2. Constrained seller, unconstrained buyer
3. Constrained buyer, unconstrained seller
4. Constrained buyer, constrained seller

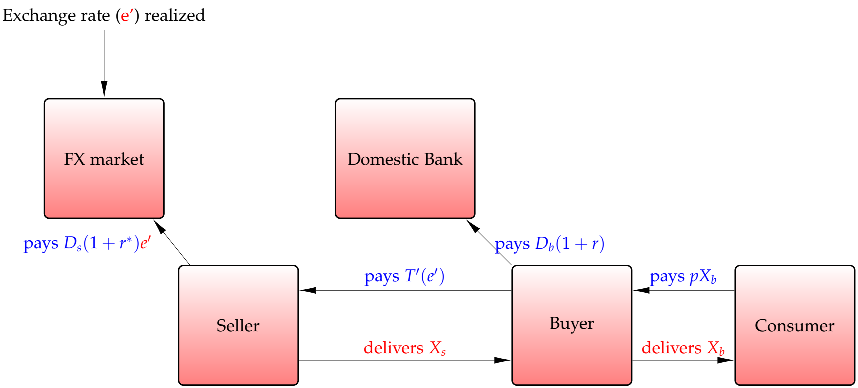
Constrained cases yield lower debt/production

Model with Trade Credit 1



- T are accounts payable for the seller (payment prior to the delivery of the goods). The buyer is giving trade credit.

Model with Trade Credit 2



- T are accounts payable for the seller (payment prior to the delivery of the goods). The buyer is giving trade credit.
- $T'(e')$ are accounts receivable for the seller (payment after the delivery of the goods). The seller is giving trade credit.

Model with Trade Credit

(Large) Seller makes TIOLI offer to (small) buyer

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

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

$$D_b - T \geq 0$$

$$D_s + T - \psi D_s^2 - wL \geq 0$$

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

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

$$pL - D_b(1 + r) \geq T_h'$$

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

$$T_h' \geq T_l'$$

- $T_l' \equiv T'(e_l), T_h' \equiv T'(e_h)$ and $\tilde{T}' \equiv p_h T_h' + (1 - p_h) T_l'$, $p_h \in (0, 1)$

Model with Trade Credit: Solution

(Large) Seller makes TIOLI offer to (small) buyer

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

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

$$D_b - T \geq 0 \qquad (=)$$

$$D_s + T - \psi D_s^2 - wL \geq 0 \qquad (=)$$

$$T_h{}' - D_s(1 + r^*)e_h \geq 0 \qquad (=) \text{ joint}$$

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

$$pL - D_b(1 + r) \geq T_h{}' \qquad (=) \text{ joint}$$

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

$$T_h{}' \geq T_l{}'$$

Result 1: Trade Credit is Insurance

1. When seller is unconstrained, buyer debt solves $D_b = 0$ or $D_b = \bar{D}$ depending on who can borrow cheaper on the margin

2. Unconstrained seller's optimal choice

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

3. Unconstrained seller picks $\tilde{T}'$ to extract surplus from buyer
   - With $\epsilon > 0$ cost of insurance, $\tilde{T}' = T_h{}' = T_l{}'$ comes from PC:

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

4. Unconstrained seller has state-contingent profits

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

Key observation: Trade credit does not change with e' $\rightarrow$ insurance

Result 2: Trade Credit Loosens Constraints

When large seller is unconstrained:

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

$$D_s = \frac{\beta p - (1+r)w}{2\psi\beta p} \qquad L = \frac{D_s - \psi D_s^2}{w}$$

and $D_b = 0$ or $D_b = \bar{D} > 0$

Key observation: TC lending requires more debt by large seller but yields higher scale.

$\rightarrow$ Larger and more profitable firms with more debt extend more TC.

Result 3: Constrained Firms Pass Through FX Shock

1. When seller is constrained, buyer debt solves $D_b = 0$ or $D_b = \bar{D}$ depending on who can borrow cheaper on the margin
2. Constrained seller's debt and production are lower
3. Trade credit and profits are state contingent

Key observation: Trade credit changes (imperfectly) with $e^{'}$

$\rightarrow$ Insurance is limited

Data Description

Data is derived from Capital IQ

- Primary dataset: Financial information for mostly large firms (both listed and private)
- Separate capital structure dataset: details liability sources, including a currency breakdown
- Compute FX share of debt, match to financial information, keep firms where the totals match within 5% (over 95% of sample)

Sample

- 19 EM economies
- 7000+ firms over 2004q1-2020q4

Trade Credit Supply and Firm Characteristics

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

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- Model: Firms with more profits and debt lend more through their supply chains.

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- Model: Firms with more profits and debt lend more through their supply chains.

	Net TC>0	Net TC>0
Bank Debt_{it}	0.00208	0.0281^{***}
	(0.00327)	(0.00347)
Sales_{it}	0.122^{***}	0.0888^{***}
	(0.00396)	(0.00416)
Profits_{it}	0.175^{***}	0.0921^{***}
	(0.0145)	(0.0125)
Observations	120046	119321
R^2	0.0779	0.0449
FirmFE	No	Yes
CountryIndustryTimeFE	Yes	Yes

Dependent variable is net trade credit extended for net lenders (accounts receivable-accounts payable) relative to total assets. Controls include bank debt, sales, profits, cash holdings, total liabilities, and inventory, all normalized by assets, along with size (measured as log assets). All variables are winsorized at 1%, except for size. Sample spans 2004-2020. R^2 is within R^2. Errors are clustered at the industry-year level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Insurance Along Supply Chains: Non-Manufacturing

$$Y_{icst} = \alpha_i + \alpha_{cst} + \gamma FXDShare_{it-1} + \beta FXDShare_{it-1} \times XRShock_{ct} + \zeta X_{icst} + \epsilon_{icst}$$

	(1) Bank Debt	(2) CAPEX	(3) Profits	(4) AP	(5) AR
FX Debt Share$_{it-1}$	0.0410***	-0.00141***	-0.00257**	-0.00295**	-0.0104***
	(0.00322)	(0.000459)	(0.00113)	(0.00149)	(0.00162)
FX Debt Share$_{it-1}$	-0.0473**	-0.00835***	-0.0225**	-0.0144	-0.0121
× XR Shock$_{ct}$	(0.0224)	(0.00315)	(0.00929)	(0.0165)	(0.0202)
Observations	113954	104436	115636	95119	112345
R^2	0.172	0.00532	0.0273	0.0820	0.0261
FirmFE	Yes	Yes	Yes	Yes	Yes
CountryIndustryTimeFE	Yes	Yes	Yes	Yes	Yes

Dependent variable is shown in the columns, each normalized by assets and winsorized at 1%. XR Shock is a dummy equal to 1 if there was a depreciation of 30% or greater vis-a-vis th US dollar. FXDebtShare is foreign currency debt divided by total debt. Controls include cash holdings, total liabilities, and inventory, all normalized by assets, along with size (measured as log assets). All variables are winsorized at 1%, except for size. And, all controls are interacted with XR Shock. Sample spans 2004-2020. R^2 is within R^2. Errors are clustered at the industry-year level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

- Firms with more FX exposure do not contract trade credit more during a depreciation but they do suffer more real effects.

Insurance Along Supply Chains: Manufacturing

	(1) Bank Debt	(2) CAPEX	(3) Profits	(4) AP	(5) AR
FX Debt Share$_{it-1}$	0.0358***	-0.00122***	-0.000288	-0.00295***	-0.00905***
	(0.00222)	(0.000335)	(0.000826)	(0.000969)	(0.000935)
FX Debt Share$_{it-1}$	0.0289***	-0.00179	-0.0249***	0.00523	0.00413
$\times$ XR Shock$_{ct}$	(0.0100)	(0.00389)	(0.00638)	(0.0142)	(0.0125)
Observations	108783	102723	110171	92812	109181
R^2	0.189	0.00733	0.0146	0.0544	0.0229
FirmFE	Yes	Yes	Yes	Yes	Yes
CountryIndustryTimeFE	Yes	Yes	Yes	Yes	Yes

Dependent variable is shown in the columns, each normalized by assets and winsorized at 1%. XR Shock is a dummy equal to 1 if there was a depreciation of 30% or greater vis-a-vis th US dollar. FXDebtShare is foreign currency debt divided by total debt. Controls include cash holdings, total liabilities, and inventory, all normalized by assets, along with size (measured as log assets). All variables are winsorized at 1%, except for size. And, all controls are interacted with XR Shock. Sample spans 2004-2020. R^2 is within R^2. Errors are clustered at the industry-year level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

- Results are also present for manufacturing firms (more likely to export, potential natural hedge).

Conclusion

Showed theoretically and empirically that

- firms trade off debt and trade credit
- larger, more profitable (unconstrained) firms that borrow more extend more trade credit
- large unconstrained firms that borrow in FX reduce profits during depreciations but maintain TC lines

Trade credit provides insurance during depreciation episodes.