Trade Credit, Bank Loans and International Prices: Evidence from China

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August 26, 2024

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Motivation

- Little attention on the role of the financial relationship between exporters and foreign buyers
  - Specifically, the interactions between trade credit in international markets and domestic bank loans
- In domestic firm-to-fim transactions:
  - Product price includes an implicit interest rate if the seller issues trade credit (Amberg et al., 2021).
  - But, how is this relationship in international markets? How does this contribute to the transmission of shocks?

This paper: What is the effect of trade credit and bank loans on international prices and pass-through of shocks?

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This paper: effect of trade credit on international prices and pass-through of shocks

1. Novel facts with transaction level exports data + firms' financial statements China (2000-2011)
   - Fact 1: Higher trade credit is associated with higher bank loans
   - Fact 2: Interest costs decrease in response to home currency depreciation
   - Fact 3: Larger trade credit share indicates a more complete exchange rate pass-through
2. Monopolistic competition in export market + trade credit + domestic bank loans
   - Predictions I: Export price includes an implicit trade credit interest rate
   - Prediction II: ERPT is more complete with a higher degree of trade credit issued by the exporter.
     Mechanism: Financial term adjusts to changes in the ER, increasing shocks pass-through
     - ⋆ Home currency depreciates $\rightarrow$ Banks expect exporters to increase sales (i $\downarrow$)
     - ⋆ Change of domestic interest rate will pass on to trade credit implicit interest rate

Related Literature

1. **Firm characteristics and ERPT**
   - Productivity, credit condition, import share (Berman et al., 2012, Strasser, 2013; Chaney, 2016, Amiti et al., 2014).
2. **Firm finance and pricing behavior**
   - Liquidity-constrained firms increased prices in 2008, and unconstrained firms decreased prices (Gilchrist et al., 2017).
   - Firms issuing more trade credit increase product prices significantly more in 2008 (Amberg et al., 2021).
3. **Trade credit and liquidity propagation**
   - Multinationals use trade credits to shift capital from low-tax places to high-tax places (Desai et al., 2016).
   - Multinationals' trade credit provision is significantly affected by global liquidity shocks (Lin and Ye, 2016).

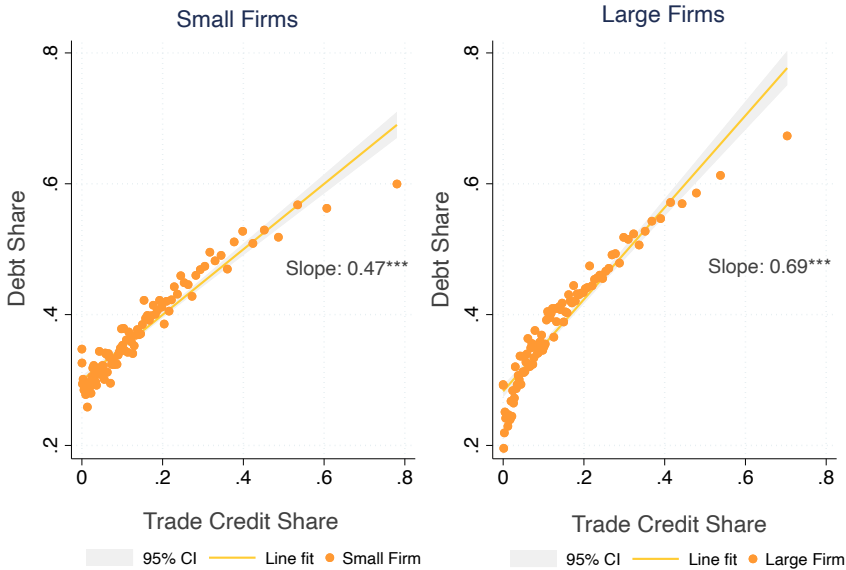
Data

Chinese Data 2000-2011

1. **Firm-level balanced sheet data (National Bureau of Statistics of China)**
   - Trade credit (receivables)
   - Bank loans
   - Total sales
   - Employment
2. **Customs data for universe of Chinese Exporters**
   - Exporter ID
   - 10-digit HS product level
   - Country of destination
   - Currency, weight, FOB value, quantities
3. **Nominal bilateral exchange rates (IMF)**

Stylized Facts

Fact 1: Higher trade credit is associated with higher bank loans



Fact 2: Interest cost change with changes in the exchange rate

$$c_{i,t} = \alpha + \beta \Delta e_{i,t} + \varphi_i + \varphi_t + \varepsilon_{i,t} \tag{1}$$

where

- $c_{i,t}$ is the log finance costs/interest costs of exporter i at time t (proxy for interest rate)
- $\Delta e_{i,t}$ is the firm-level exchange rate shocks

$$\Delta e_{i,t} = \sum_{k \in \Omega_{i,t}} \Delta e_{k,t} \times \Gamma_{i,k,t}$$

$\Gamma_{i,k,t}$: exporting share of firm i to destination k in period t

	(1) $c^F_{i,t}$	(2) $c^I_{i,t}$	(3) $c^F_{i,t}$	(4) $c^I_{i,t}$
$\Delta e_{i,t}$	-0.339***	-0.566***	-0.158***	-0.149**
	(0.0919)	(0.0989)	(0.0575)	(0.0640)
Period	Yes	Yes	Yes	Yes
Firm	No	No	Yes	Yes
N	183118	183118	148458	148458

→ Interest costs decrease with depreciation

Fact 3: Firms with larger trade credit share have more complete ERPT

$$\Delta p_{i,s,k,t} = \underbrace{[\alpha + \beta rec_{i,0}]}_{1-ERPT} \Delta e_{k,t} + n_{i,t} + \underbrace{\varphi_{s,k} + \varphi_t}_{Fixed\ Effects} + \varepsilon_{i,s,k,t} \quad (2)$$

s: sector , i: exporter, k: destination, t:time

where

- $\Delta p_{i,j,k,t}$ is log change in producer-currency (Chinese RMB) price
- $\Delta e_{k,t}$ is log bilateral exchange rate change (RMB per 1 unit of destination k's currency).
  - e.g. $\uparrow$ e is depreciation of Chinese RMB relative to the destination-k currency.
- $rec_{i,0}$ is trade credit (receivables) over total sales at time t=0.
- $n_{i,t}$ is log of employment

Fact 3: Firms with larger trade credit share have more complete ERPT

	(1) $\Delta p_{i,j,k,t}$	(2) $\Delta p_{i,j,k,t}$	(3) $\Delta p_{i,j,k,t}$	(4) $\Delta p_{i,j,k,t}$	(5) $\Delta p_{i,j,k,t}$
$\Delta e_{k,t}$	0.0314**	0.0492***	0.0281*	0.0497***	0.121***
	(0.0146)	(0.0176)	(0.0159)	(0.0176)	(0.0424)
$rec_{i,0}$		-0.00991**		-0.00778*	-0.00801*
		(0.00426)		(0.00412)	(0.00410)
$\Delta e_{k,t} \times rec_{i,0}$		-0.124***		-0.125***	-0.134***
		(0.0473)		(0.0476)	(0.0468)
$rec_{i,t-1}$			-0.000123*		
			(0.0000681)		
$\Delta e_{k,t} \times rec_{i,t-1}$			-0.00819***		
			(0.00264)		
$n_{i,t}$				0.00219***	0.00183***
				(0.000542)	(0.000574)
$\Delta e_{k,t} \times n_{i,t}$					-0.0111*
					(0.00588)
Product-destination FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Obs	1443809	1443809	1110858	1443809	1443809

Complete exchange rate pass-through: no change in RMB price ($\beta = 0$).
→ With trade credit, an increase in the ER increases the price in RMB more (USD more).

10% ↑ trade credit share, 1.24% ↑ ERPT. $\begin{cases} \text{No trade credit , ERPT: 95.08 \% (= 1 - 0.0492)} \\ \text{20\% trade credit share, ERPT 97.56\% (= 1 - 0.0492 + 0.124· 0.2)} \end{cases}$

The Model: Setting and Timeline

Open economy model with exporters, importers and domestic banks

Manova (2013) + exporters endogenously choosing to default to banks as in Arellano et al. (2012).

Three Agents

- Importers in foreign countries
- Exporters in the home country
- Bank in the home country

Two key sections:

1. Export Market:
   - Supply (home): monopolistic competition
   - Demand (foreign): importers demand goods and borrow from exporters
2. Financial Market: exporter borrows from domestic banks
   - Endougenous Firm Level Interest Rates

A story of bank loans and international trade credit

- No trade credit: importer pays full amount in advance to finance for exporters' production activities.
- Trade credit: exporter has no cash in hand, needs to finance with the local banks

1. **Bank Financed Costs - Liquidity constraint:**

$$\underbrace{b_{ik}}_{Bank\ \ Loan} = \underbrace{d_{ik}\tau_{mk}c_{ms}q_{ik}}_{BankFinanced\ Costs} \tag{3}$$

   - ★ d_{ik}: the fraction of the input-bundle cost that is financed by domestic bank
   - ★ c_{ms}: input bundle cost to produce one unit of output
   - ★ τ_{mk}: iceberg costs of shipment from China to country k

2. **Firm Financed Costs - Prepayment amount:**

$$\phi_i \underbrace{p^*_{ik}e_{mk}q_{ik}}_{Sales} = (1-d_{ik}) \quad \underbrace{\tau_{mk}c_{ms}q_{ik}}_{Firms'\ Financed\ Costs} \tag{4}$$

   where ϕ_i is the prepayment share (1-trade credit share)

Timeline

Period t: exchange rate level is realized

Stage 1	**Bank** decides interest rate for each loan.
Stage 2	**Exporter** choose price, production and loan (max profit given ER shock & expected demand shock).
Stage 3	**Demand shock** is realized. **Importers** choose demand.
Stage 4	**Exporter** decides whether to default on bank loan or not.

Period t + 1: new exchange rate level is realized

Stage 4: Exporter makes default decision

- $\lambda_{ik} \in [0,1]$: probability firm fails to produce and cannot repay the loan
  - Loans are committed before demand shock is realized, λ_{ik} is also the default probability.
- Profit of a default exporter $\pi_{ik}(Default) = 0$.
  - Costs or penalties the borrower has to bear upon default and exclude strategic default.
- **Firm defaults if, for a given level of demand shock γ_{ik}, profits after repayment are lower than 0.**

$$\lambda_{ik} = Pr[\pi_{ik}(NoDefault) < \pi_{ik}(Default)]$$

$$\lambda_{ik} = Pr[\underbrace{p^*_{ik} e_{mk} q_{ik}}_{sales} - \underbrace{\tau_{mk} c_{ms} q_{ik}}_{variable\ costs} - \underbrace{c_{ms} f_{mk}}_{fixed\ costs} - \underbrace{r_{ik} b_{ik}}_{interest\ costs} < 0]$$

$\rightarrow$ Condition of default based on a cut-off of demand shock $\hat{\gamma}_{ik}(r_{ik}, b_{ik}, e_{mk})$

- When $\gamma_{ik} > \hat{\gamma}_{ik}(r_{ik}, d_{ik}, e_{mk})$, firm's profit is enough to cover repayment.

Stage 4: Default Probability Dynamics

- Assume $\gamma_{ik}^{1/\varepsilon} \sim U[0, \gamma^H]$. We can solve for default probability.

$$\lambda_{ik} = \frac{1}{\gamma^H}\left[\bar{\gamma}^{1/\varepsilon}\frac{\varepsilon-1}{\varepsilon} + \bar{\gamma}^{\frac{1-\varepsilon}{\varepsilon}}\left(\frac{\theta_{sk}Y_k}{P_{sk}^{1-\varepsilon}}\right)^{-1} e_{mk}^{-\varepsilon}\left(\frac{\varepsilon}{\varepsilon-1}\tau_{mk}c_{ms}\right)^{\varepsilon-1}(1+r_{ik}d_{ik})^{\varepsilon-1}c_{ms}f_{mk}\right] \tag{5}$$

- Default probability is dependent on:
  - Interest rate level r_{ik}: Higher interest rate, exporter more likely to default: $r_{ik} \uparrow \Rightarrow \lambda_{ik} \uparrow$
  - Trade credit level d_{ik}: More trade credit to buyers, more likely default: $d_{ik} \uparrow \Rightarrow \lambda_{ik} \uparrow$
  - Exchange rate e_{mk}: Higher exchange rate level (depreciation), lower default probability: $e_{mk} \uparrow \Rightarrow \lambda_{ik}$

Stage 3: Importers choose quantity demanded

Importers k's demand in sector s for a exporter/variety i from China (m) is

$$q_{ik} = (\gamma_{ik} p_{ik}^{*-\varepsilon} \theta_{ks} Y_k)/(P_{ks}^{1-\varepsilon}) \tag{6}$$

- θ_{ks} is the share of total expenditure in sector s.
- γ_{ik} **is the demand shock for exporter/variety** i**.**
- p_{ik}^* is in the currency unit of importing country k:

$$p_{ik}* = \frac{p_{ik}}{e_{mk}}$$

p_{ik}: price in Chinese RMB
e_{mk}: bilateral exchange rate

$\rightarrow$ When e_{mk} increases, RMB depreciates compared with currency of k.

Stage 2: Exporter's Problem

- Profit Maximization:

$$\max_{p^*} \quad \pi_{ik} = \underbrace{(1-\lambda_{ik})}_{P(\text{No Default})} \Big(\underbrace{p^*_{ik} e_{mk} q_{ik}}_{\text{sales}} - \underbrace{\tau_{mk} c_{ms} q_{ik}}_{\text{variable costs}} - \underbrace{c_{ms} f_{mk}}_{\text{fixed costs}} - \underbrace{r_{ik} b_{ik}}_{\text{interest costs}} \Big) + \underbrace{\lambda_{ik}}_{P(\text{Default})} \cdot \underbrace{0}_{\pi(\text{Default})}$$

subject to importer demand

$$q_{ik} = \frac{\bar{\gamma}_{ik} p^{*-\varepsilon}_{ik} \theta_{sk} Y_k}{P^{1-\varepsilon}_{sk}} \tag{6}$$

and liquidity constraint

$$b_{ik} = d_{ik} \tau_{mk} c_{ms} q_{ik} \tag{3}$$

FOC:

$$\boxed{p^*_{ik} = e^{-1}_{mk} \frac{\varepsilon}{\varepsilon - 1} \tau_{mk} c_{ms} (1 + r_{ik} d_{ik})} \tag{7}$$

Stage 2: Equilibrium Price

$$p_{ik}^{*} = \underbrace{\frac{\varepsilon}{\varepsilon - 1}}_{\text{Mark up}} \underbrace{\frac{\tau_{mk} c_{ms}}{e_{mk}}}_{\text{Marginal Costs}} \underbrace{(1 + r_{ik} d_{ik})}_{\text{Finantial Term}}$$

- Exporters charge a price premium when allowing for trade credit
  - A higher level of trade credit is associated with higher prices, all else equal.
- Exporters' cost for trade credit is the interest rate domestic banks charge them.
  - A higher interest rate is associated with higher prices, all else equal.

Stage 1: Bank determines interest rate

- In a perfectly competitive bank market, the bank chooses interest rate to equate the expected return of lending to the exporter to an alternative risk-free return (a is the risk-free rate which we normalized to be 0).

$$\underbrace{b_{ik}(1+a)}_{\text{Risk free return}} = \underbrace{(1-\lambda_{ik})(1+r_{ik})b_{ik}+\lambda_{ik}0}_{\text{Expected return}} \tag{8}$$

- Interest Rate:

$$r_{ik} = \frac{\lambda_{ik}}{1+\lambda_{ik}} \tag{9}$$

$\rightarrow$ If bank perceives the exporter has a lower default probability, then sets a lower interest rate.

We can then solve for equilibrium r_{ik} by using first-order approximation.

The Model: Equilibrium Outcomes

Equilibrium interest rate

- The equilibrium r_{ik} is:

$$r_{ik} = \frac{\mathbf{A} + \mathbf{B} e_{ik}^{-\varepsilon}}{\mathbf{C} - \mathbf{D} d_{ik} e_{ik}^{-\varepsilon}} \tag{10}$$

where A, B, C and D are positive exogenous parameters.

Proposition 1

Interest rate decreases with home currency depreciation.
In perfectly competitive bank market, bank sets interest rate considering the default probability of exporter. The equilibrium interest rate decreases with home currency depreciation and increases with the trade credit level that exporter grants to the buyers. $\Rightarrow \frac{\partial r}{\partial e} < 0$ *and* $\frac{\partial r}{\partial d} > 0$

$\rightarrow$ Maps with Fact II: Interest cost change with changes in the exchange rate

Discussion about ERPT

- Recall that the optimal price is

$$p_{ik}^{*} = e_{mk}^{-1} \frac{\varepsilon}{\varepsilon - 1} \tau_{mk} c_{ms} (1 + r_{ik} d_{ik}) \tag{11}$$

- Derive ERPT

$$\begin{aligned} \frac{\partial \log p^{*}}{\partial \log e} &= -1 + \frac{\partial \log(1 + rd)}{\partial \log e} \\ &= -1 + \frac{d}{1 + rd} e \underbrace{\frac{\partial r}{\partial e}}_{<0} < -1 \end{aligned}$$

  - Complete ERPT: $\frac{\partial \log p^{*}}{\partial \log e} = -1$
  - More complete ERPT with trade credit: $\frac{\partial \log p^{*T}}{\partial \log e} < -1$

Proposition 2

Other things equal, the optimal price including implicit trade credit premium has a more complete ERPT.

Trade Credit Impact on the Level of ERPT

$$\frac{\partial}{\partial d}\underbrace{\frac{\partial \log p^*}{\partial \log e}}_{ERPT} = \frac{\partial}{\partial d}\left(\frac{d}{1+rd}\right)e\frac{\partial r}{\partial e} + \frac{d}{1+rd}e\frac{\partial}{\partial d}\left(\frac{\partial r}{\partial e}\right)$$

Proposition 3

Exporters who grant higher trade credit to foreign buyers respond more intensively on pricing given exchange shocks.

$$\frac{\partial}{\partial d}\frac{\partial \log p^*}{\partial \log e} < 0$$

$\rightarrow$ Maps with Fact III: Firms with larger trade credit share have more complete ERPT

Conclusions

- Firms that grant trade credit to their buyers set higher prices
  - Exporters charge a price premium to importers for delayed pay
- Transmission of exchange rate shocks is stronger, the higher the level of trade credit
  - Note: In a world with incomplete ERPT, this still does not bring more than complete pass-through
- Trade credit and bank loans are complementary

Next Step: Calibrate the model and run a counterfactual to lower financial costs.

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(Comments or suggestions to leticiaj@umich.edu)