Trade Credit and Relationships

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Disclaimers

The views expressed in this presentation are those of the authors and do not necessarily reflect the position of the Federal Reserve Board or the Federal Reserve System.

Introduction

What is trade credit?

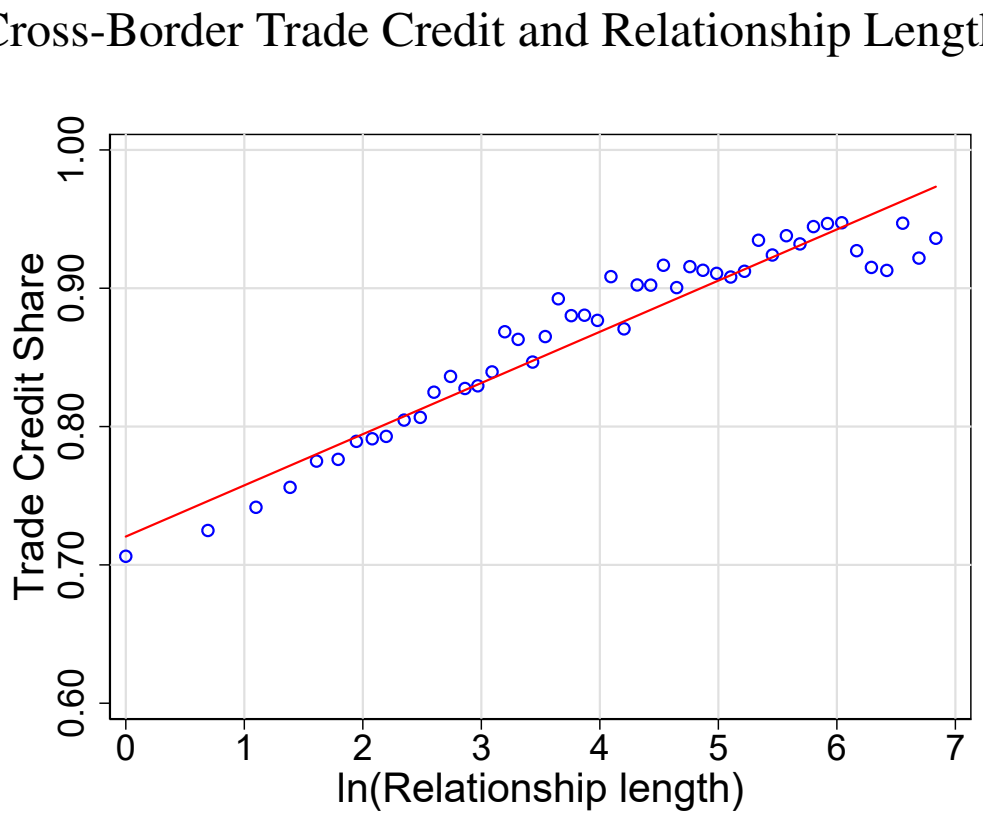
Suppose a firm sells to another firm. The buyer can pay:

- Before delivery: Cash in advance
- After delivery: Trade credit

Trade credit is used widely across developed and emerging economies:

- Most important source of short-term finance for U.S. firms: non-financial sector had $5.2 trillion USD in 2021 (24 percent of U.S. GDP)
- Trade credit dominant for domestic transactions (Ellingsen et al., 2016) and international transactions (Ahn, 2014; Demir and Javorcik, 2018; Garcia-Marin et al., 2020)

Trade Credit Increases with Relationship Age



This Paper: Model

Build a model of trade credit dynamics, combining two key channels:

Financing cost advantage (as in Garcia-Marin et al., 2020):

- Trade credit lowers gross borrowing and saves total financing costs if financial intermediation is costly and firms charge positive markups.

Commitment problem and learning (generalizes Antras and Foley, 2015):

- Trade credit is risky because a importer may be unreliable.
- Disappears with learning.

This Paper: Data and Main Findings

Data: Colombian imports (Chilean data for robustness / additional results)

- Transaction-level import data for 2007-2016.
- Importer and exporter identifier.
- Payment form for each shipment.

Main findings:

- Trade credit increases with relationship age.
- Learning effects stronger for:
  - Source countries with stronger contract enforcement.
  - Destination countries with weaker contract enforcement.
  - More complex products (i.e. with longer quality ladders).
- Commitment problem dominates in the short run.
- Financing cost channel dominates in the longer run.

▷ All findings in line with model predictions.

Firm's Payment Choice:

- International: Schmidt-Eisenlohr (2013), Ahn (2014), Antras and Foley (2015), Niepmann and Schmidt-Eisenlohr (2017), Demir and Javorcik (2018), Fischer (2020), Garcia-Marin et al. (2023)
- Domestic trade credit: Petersen and Rajan (1997), Wilner (2000), Cunat (2007), Hardy et al. (2022)

▷ Importance of relationships and learning for payment choice.

Trade Relationships (two-sided data):

- Blum et al. (2012), Eaton et. al (2014), Bernard et al. (2018), Carballo et al. (2018), Heise (2019), Benguria (2021), Monarch (2022)

▷ Link trade relationships to payment choice.

Advantages of trade relationships:

- Monarch and Schmidt-Eisenlohr (2018): Higher trade, survival, and resiliency.
- Heise (2019): Sharing of exchange-rate risk.
- Macchiavello and Morjaria (2015): Overcome enforcement frictions.

▷ Relationships allow using more trade credit, saving financing costs.

Model

Key elements in the model

1. Trade takes time.
   ▷ Exporter or importer need to finance the transaction.

2. Trade is risky.
   ▷ Reliable firms, share η, and unreliable firms, share $(1-\eta)$.
   ▷ Probability diversion opportunity arises, $1-\phi$.

3. Financial intermediation is costly.
   ▷ Banks charge higher interest rate on loans, r_b, than on deposits, r_d.

4. Firms charge positive markups.
   ▷ Revenues larger than production + financing costs, $R > (1+r_b)C$.

Basic Setup

General:

- One importer is matched with one exporter.

Exporter:

- Makes *take it or leave it offer* to importer
- Produces
- Sends goods
- Receives payment

Importer:

- Receives goods
- Sells goods
- Pays exporter

Intuition for Commitment Problem

Abstracting from financing costs.

Trade Credit: Importer may not pay.

- Receive payment R with prob. $\tilde{\eta}^I = \eta^I + (1-\eta^I)\phi^I$.

$$\mathrm{E}\left[\Pi^{TC,E}\right] = \tilde{\eta}^I R - C.$$

Cash in advance: Exporter may not deliver.

- Goods delivered with prob. $\tilde{\eta}^E = \eta^E + (1-\eta^E)\phi^E$.
- Advance payment reduced to $P^{CIA} = \tilde{\eta}^E R$.

$$\mathrm{E}\left[\Pi^{CIA,E}\right] = \tilde{\eta}^E R - C.$$

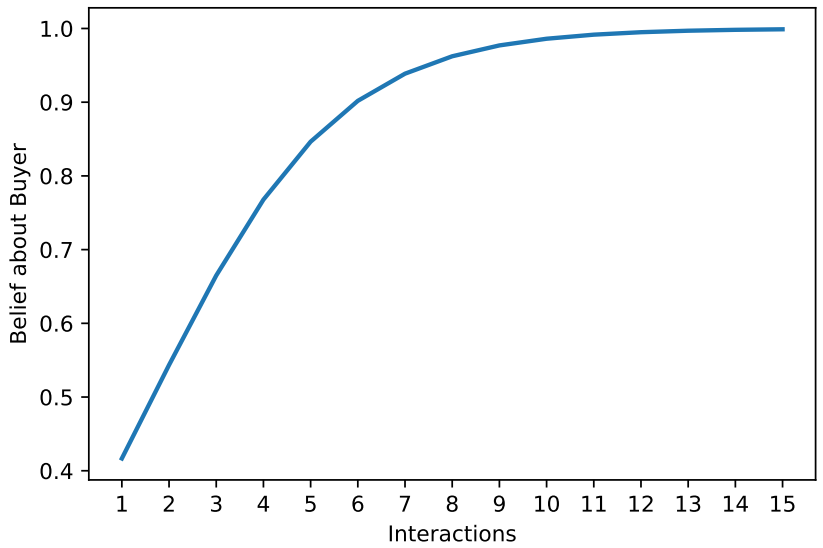
$\triangleright$ Choose trade credit if $\tilde{\eta}^I > \tilde{\eta}^E$.

Trade Credit and Learning

Importers and exporters learn over time about the reliability of their trading partner

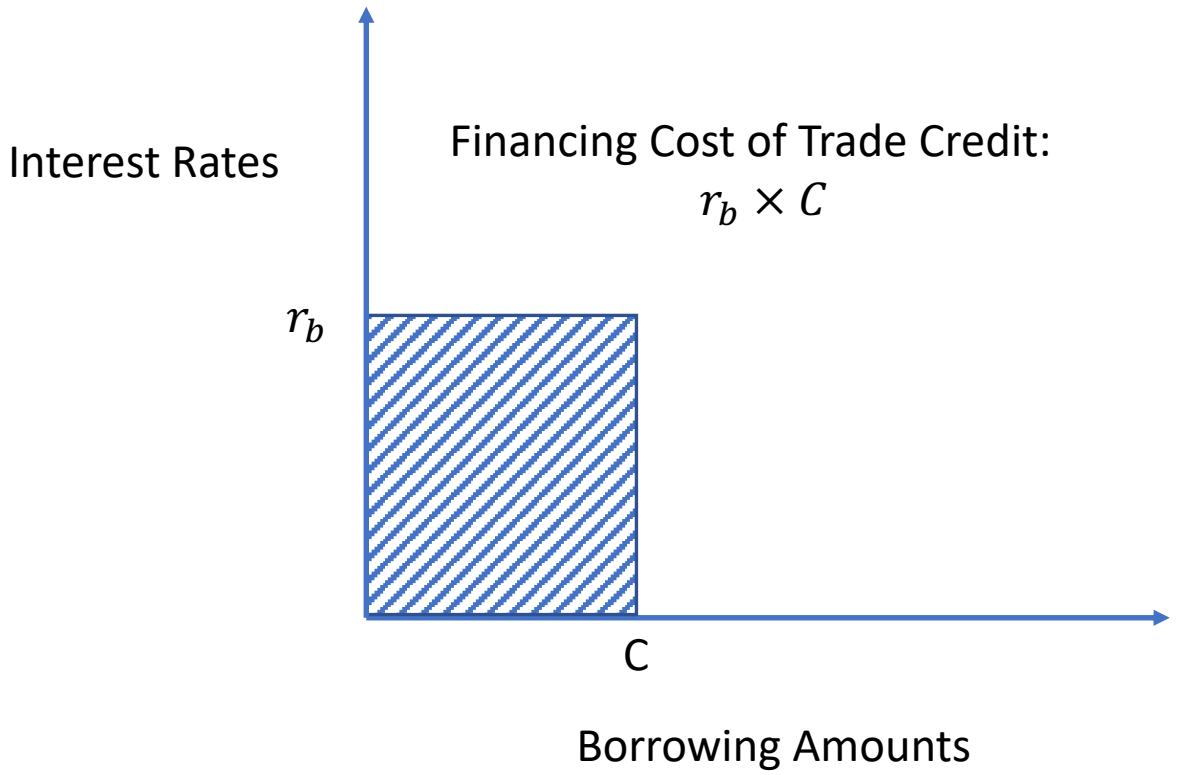
- Probability that partner is reliable increases with history of no defaults. $\partial \eta_k / \partial k > 0$ (k: # previous interactions).
- Assume that learning is symmetric and independent of payment terms.
- Over time, firms learn type of trading partner.

Bayesian Learning Model

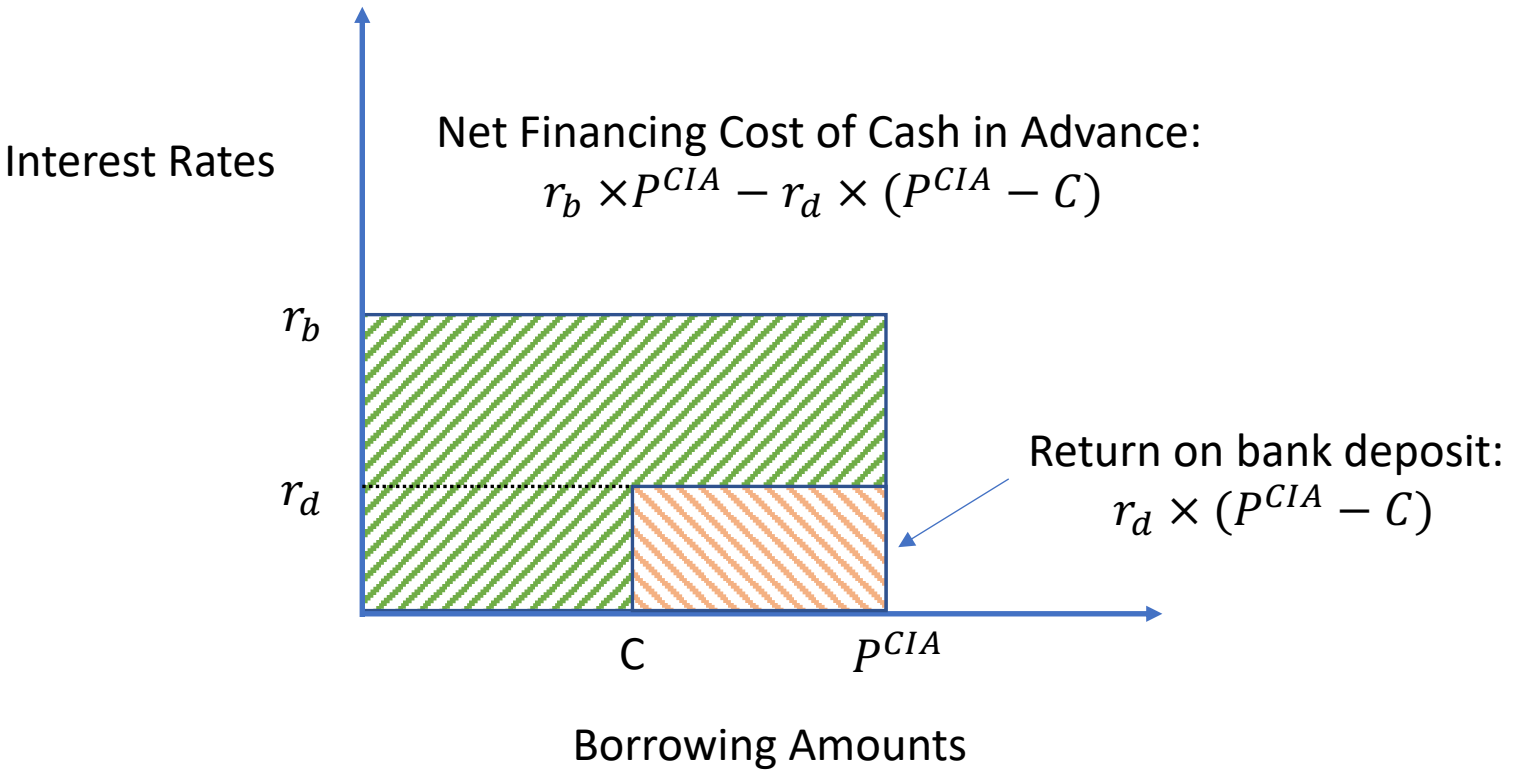


Intuition for Financing Cost Channel

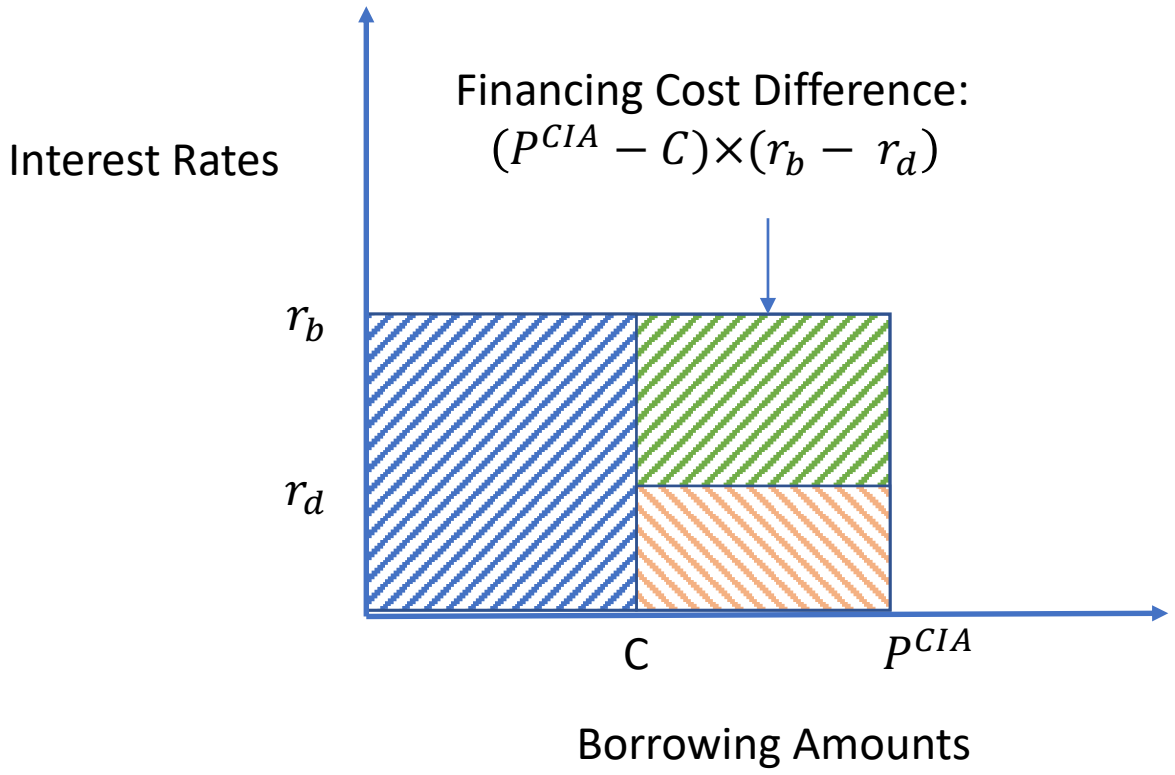
Focus on symmetric case: $r_b^E = r_b^I = r_b$.



Intuition for Financing Cost Channel II



Intuition for Financing Cost Channel III



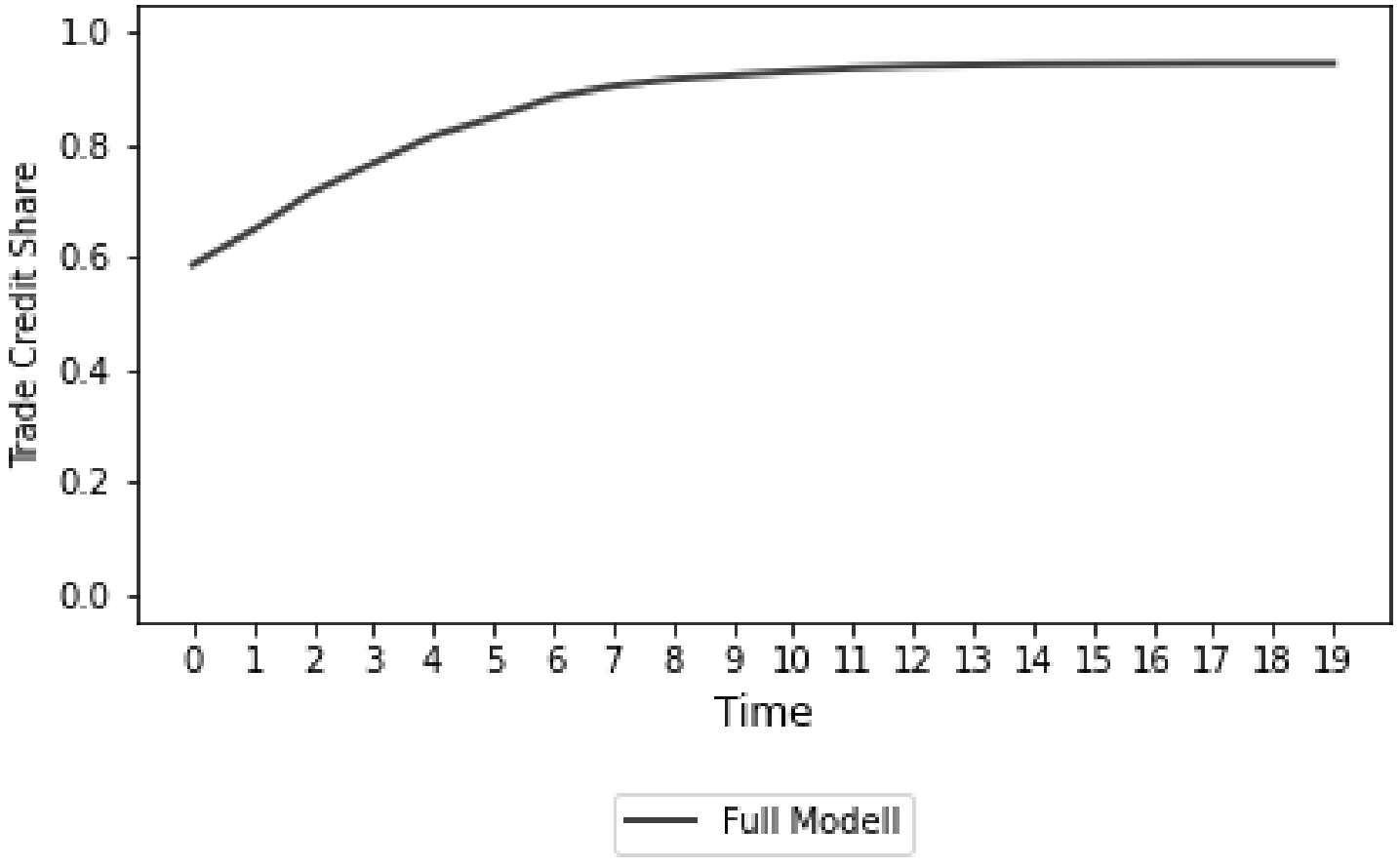
Thus: Trade credit has lower financing costs than cash in advance if payment exceeds production costs and borrowing is above the deposit rate.

Key Model Predictions

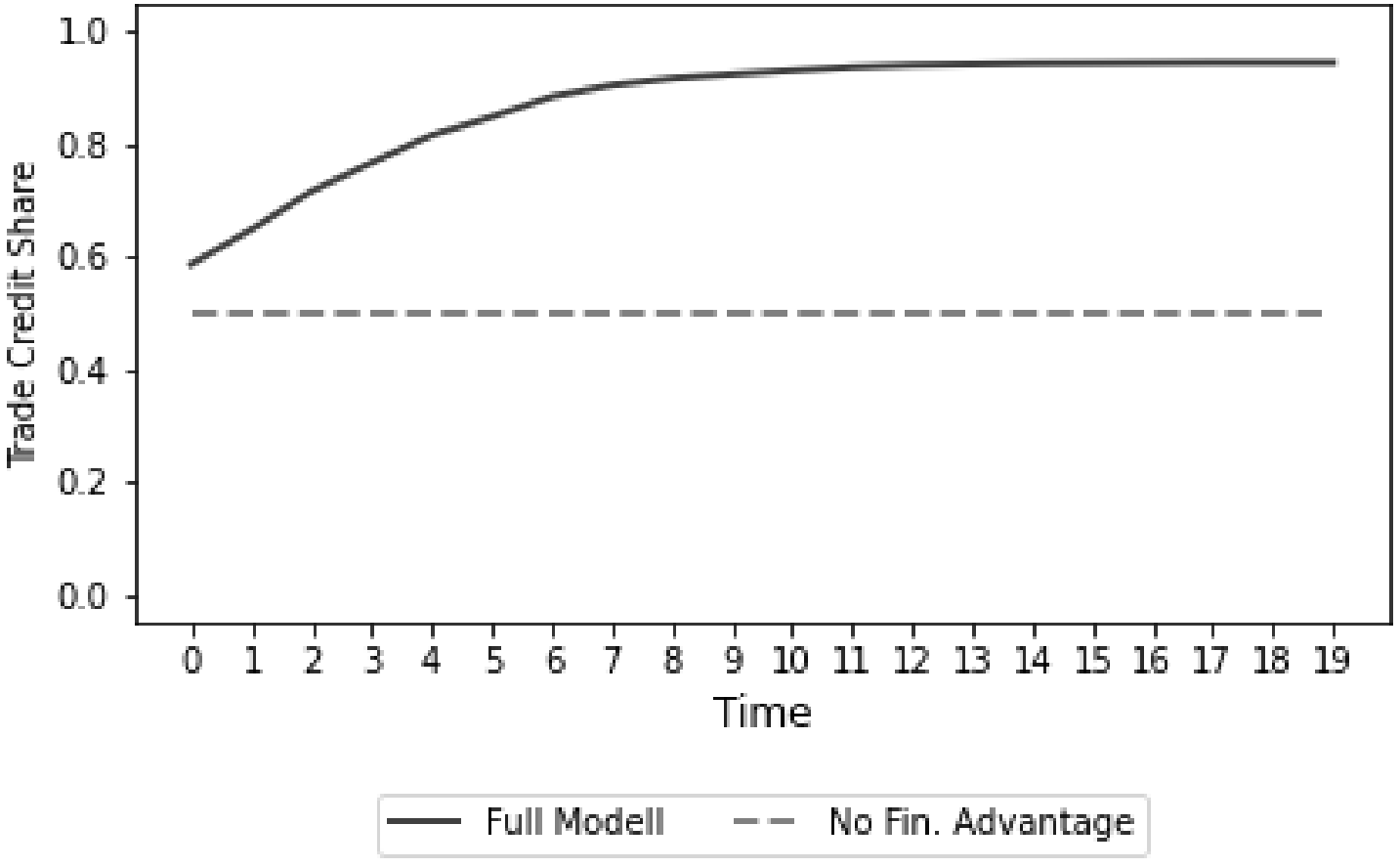
- Trade credit increases with relationship age.
- Learning effects stronger for:
  - More complex products.
  - Countries with weaker rule of law.
- Commitment problem dominates in the short run.
- Financing cost channel dominates in the longer run.

Comparison to Other Models

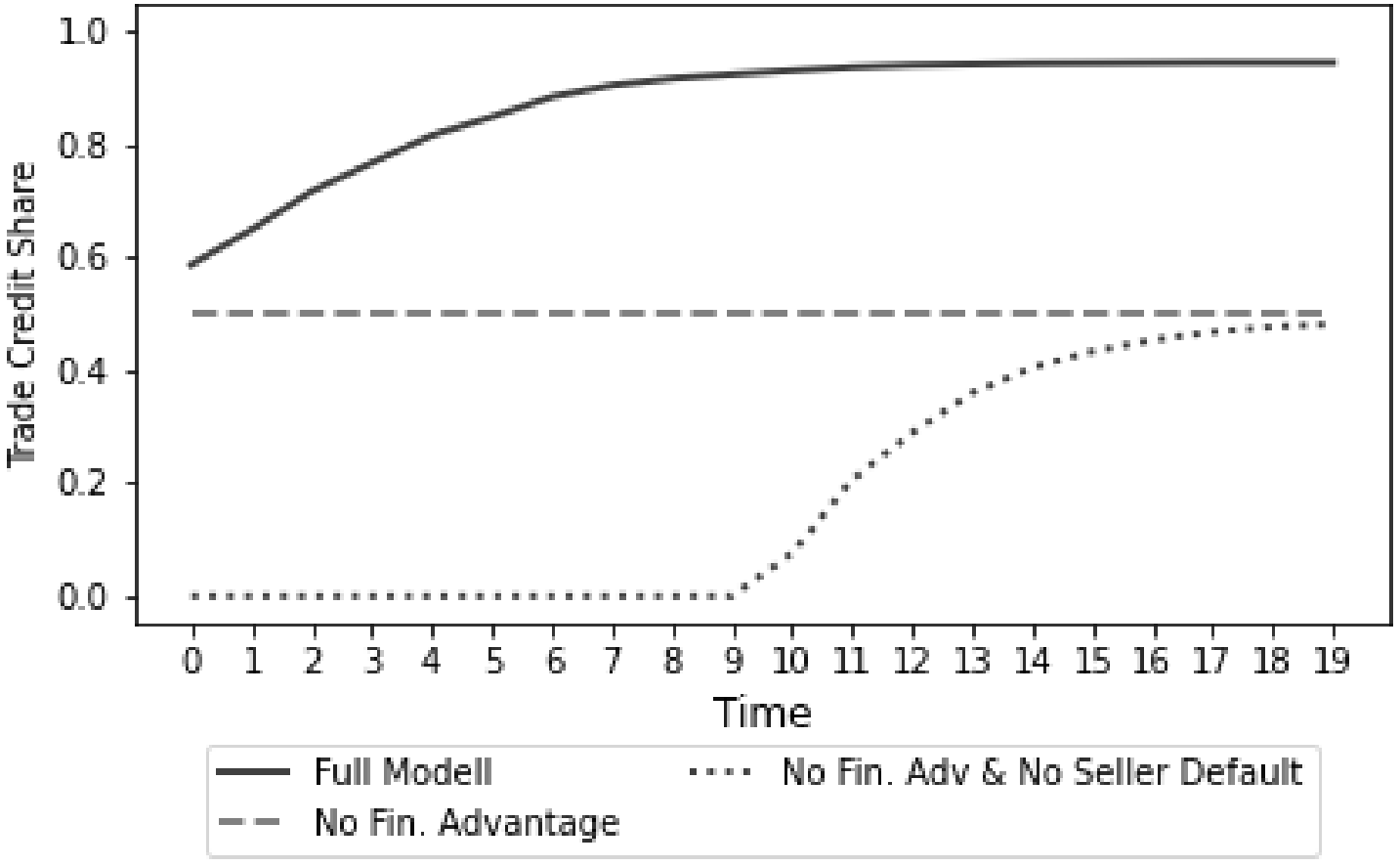
- Let borrowing costs vary randomly, symmetrically around baseline.
- Calculate share of firms that pick trade credit.



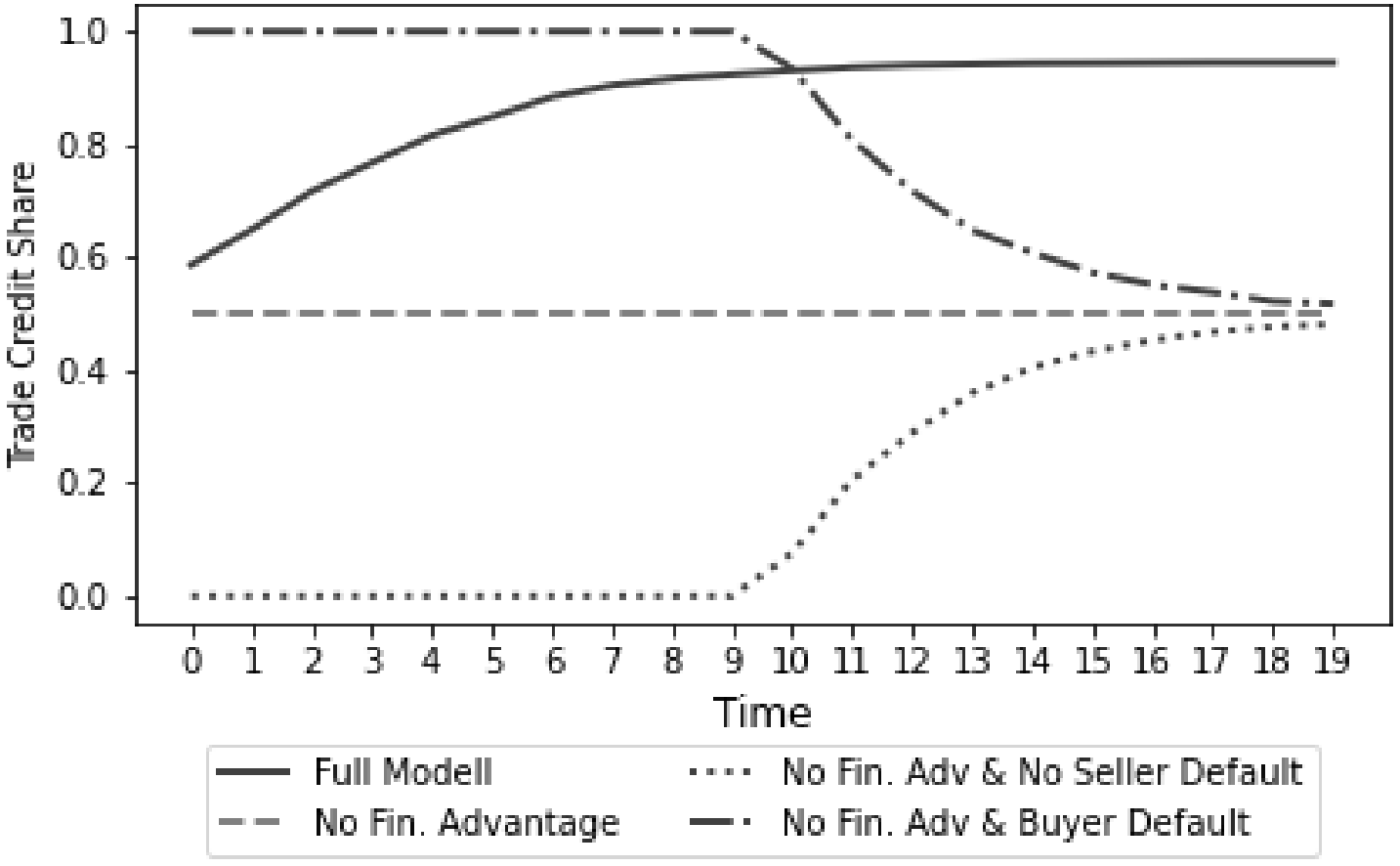
1) Full model with financing cost advantage.



2) Model without financing cost advantage ($r_d = r_b$).



3) Model without financing cost advantage ($r_d = r_b$). And No Seller Default (as in Antras and Foley (2015)).



3) Model without financing cost advantage ($r_d = r_b$). And No Seller Default (as in Antras and Foley (2015)).

4) Model without financing cost advantage ($r_d = r_b$). And No Buyer Default (opposite of Antras and Foley (2015)).

Data and Specifications

Data

1. Colombian Customs data (2007-2016)
   - Transaction-level import data
   - Importer and Exporter ID, 10-digit HS code, FOB value and volume
   - Payment form
2. Chilean National Customs Service (2003-2007):
   - Transaction-level export-data
   - Exporter ID, importing country, 8-digit HS code, FOB value and volume
   - Payment form
3. Annual National Industrial Survey (ENIA):
   - Detailed plant-product level information for markup and productivity estimation
4. Additional data sources:
   - WB Worldwide Governance Indicators: rule of law
   - IMF IFS: deposit and lending rates (home + foreign)

Empirical Specifications I

Baseline:

$$TC_{iept} = \alpha_1 \ln(\text{Rel. Length})_{iet} + \psi_{iep} + \nu_{iept},$$

with TC_{iept} a dummy for importer i, exporter e, product p, and day t.

Diversion Risk:

$$\begin{aligned} TC_{iept} = {} & \beta_1 \ln(\text{Rel. Length})_{iet} \times (\text{High Div. Risk})_s \\ & + \beta_2 \ln(\text{Rel. Length})_{iet} \times (\text{Low Div. Risk})_s + \psi_{iep} + \nu_{iept}. \end{aligned}$$

Predicted signs:

- $\alpha_1 > 0$: TC increases with relationship length.
- $\beta_1 < \beta_2$: Effect on TC decreases with source-country diversion risk.

Empirical Specifications II

Quality ladder length:

$$\begin{aligned} TC_{iept} &= \alpha_1 \ln(\text{Rel. Length})_{iet} \times (\text{Long Ladder})_p \\ &\quad + \alpha_2 \ln(\text{Rel. Length})_{iet} \times (\text{Short Ladder})_p + \psi_{iep} + \nu_{iept}. \end{aligned}$$

Joint specification (Chile):

$$TC_{edpt} = \alpha_1 \ln(\text{Rel. Length})_{edpt} + \alpha_2 \ln(\text{Markups})_{ipt} + \psi_{edp} + \nu_{edpt}.$$

Predicted signs:

- $\alpha_1 > \alpha_2$: Effect on TC stronger for more complex products.
- $\alpha_1 > 0$, $\alpha_2 > 0$: TC increases with relationship length and markups.

Descriptive Evidence

Summary Statistics

Summary Statistics

	Mean	Std. Dev.	P25	P50	P75	Obs.
	(1)	(2)	(3)	(4)	(5)	(6)
Trade Credit Dummy	88.1	32.4	100	100	100	16,082,792
Cash in Advance Dummy	10.2	30.3	0	0	0	16,082,792
Letter of Credit Dummy	1.7	13.0	0	0	0	16,082,792
Import Value (US$)	20,446	265,362	220	1,352	8,105	16,082,792

▷ Most transactions are trade credit or cash in advance.

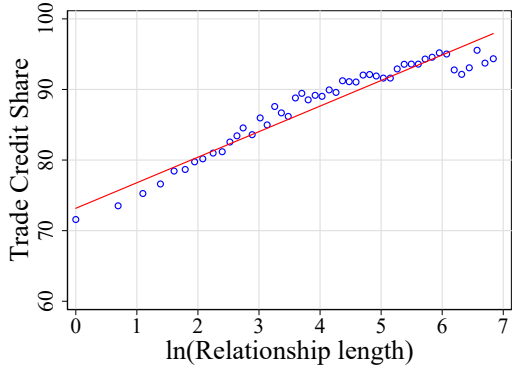
Payment Terms and Relationship Length

	Trade Credit	Cash in Advance	Letter of Credit
First transaction	74.3	23.4	2.3
Fifth transaction	79.7	18.1	2.2
Tenth transaction	82.6	15.3	2.0
Eleventh transaction and beyond	90.5	8.0	1.6

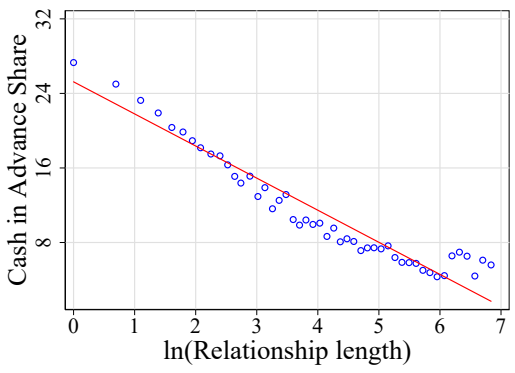
▷ Trade credit provision increases with relationship age.

Financing Terms and Relationship Age

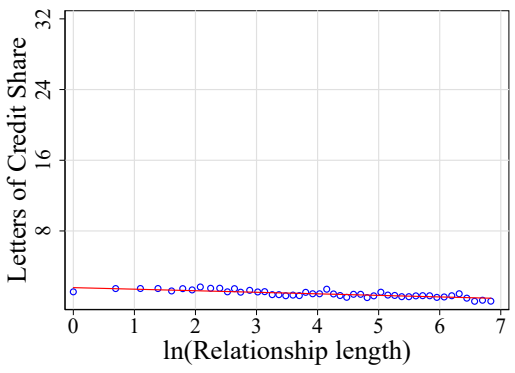
A. Trade Credit



B. Cash in Advance



C. Letter of Credit



▷ Trade credit mostly increases at the expense of cash in advance.

Financing Terms: Transition Matrix

Transition Probability Between Payments Forms (%)

	Payment term in $t+1$:		
	Trade Credit	Cash in Advance	Letter of Credit
Payment term in t:			
Trade Credit	99.1	0.7	0.1
Cash in Advance	7.2	92.6	0.2
Letter of Credit	7.8	1.2	91.0

▷ Exporters often switch from cash in advance to trade credit, but rarely away from trade credit.

Econometric Evidence

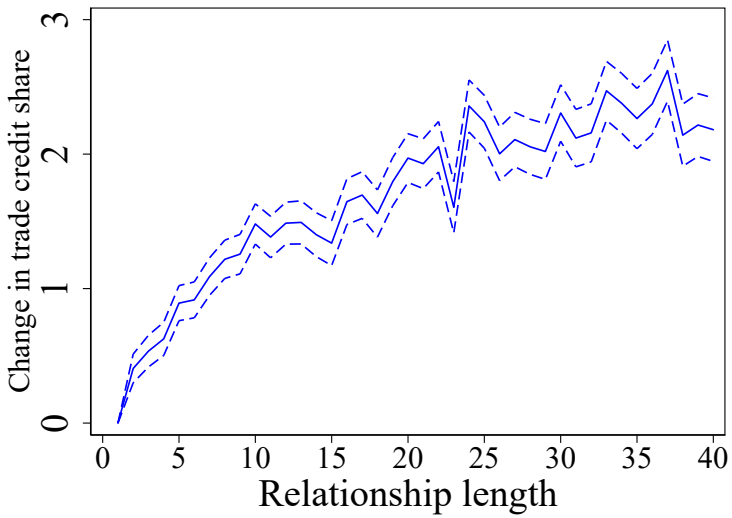
Financing Terms and Relationship Age

	(1)	(2)	(3)	(4)
ln(Relationship Length)	0.211***	0.637***	0.472***	0.401***
	(0.026)	(0.021)	(0.016)	(0.048)
Sample	All	All	All	Balanced
Importer-Exporter-HS10 FE	Yes	Yes	Yes	Yes
Source Country-Year FE	—	Yes	Yes	Yes
Importer-HS10-Year FE	—	—	Yes	Yes
Observations	13,645,337	13,645,081	12,947,042	994,519

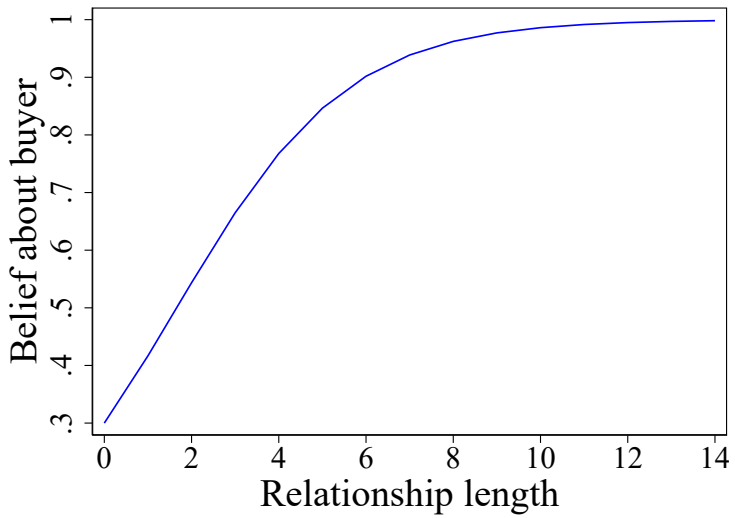
▷ Trade credit provision increases with relationship age **within relationships**.

Financing Terms and Relationship Age II

A. Colombian Imports



B. Learning Model



▷ Dynamics consistent with Bayesian learning.

Exporter, Importer and Relationship Learning

	(1)	(2)
ln(Relationship Length)	1.003***	0.672***
	(0.044)	(0.107)
ln(Importer Experience)	-0.275***	0.090
	(0.033)	(0.097)
ln(Country–Specific Importer Experience)	-0.022**	-0.029
	(0.009)	(0.056)
ln(Exporter Experience)	-0.494***	-0.367***
	(0.043)	(0.115)
Sample	All	Balanced
Importer-Exporter-HS10 FE	Yes	Yes
Source Country-Year FE	Yes	Yes
Importer-HS10-Year FE	Yes	Yes
Observations	12,947,042	994,519

▷ Key margin is at the exporter-importer level.

Relationships and Contract Enforcement

	(1)	(2)	(3)	(4)
ln(Relationship Length) × (High Div. Risk)	0.179***	0.599***	0.428***	0.357***
	(0.027)	(0.022)	(0.018)	(0.068)
ln(Relationship Length) × (Low Div. Risk)	0.253***	0.679***	0.521***	0.454***
	(0.025)	(0.024)	(0.018)	(0.065)
Sample	All	All	All	Balanced
Importer-Exporter-HS10 FE	Yes	Yes	Yes	Yes
Source Country-Year FE	—	Yes	Yes	Yes
Importer-HS10-Year FE	—	—	Yes	Yes

▷ Learning effects are stronger for sources with less diversion risk.

Relationships, Trade Credit and Product Complexity

	(1)	(2)	(3)	(4)
ln(Relationship Length) × Long Quality Ladder	0.265***	0.689***	0.502***	0.462***
	(0.045)	(0.039)	(0.028)	(0.029)
ln(Relationship Length) × Short Quality Ladder	0.127***	0.606***	0.457***	0.433***
	(0.040)	(0.033)	(0.026)	(0.027)
Sample	All	All	All	Balanced
Importer-Exporter-HS10 FE	Yes	Yes	Yes	Yes
Source Country-Year FE	—	Yes	Yes	Yes
Importer-HS10-Year FE	—	—	Yes	Yes
Observations	9,744,531	9,744,297	9,227,462	8,366,908

▷ Learning effects are stronger for more complex products.

Trade Credit, Markups and Learning

Trade Credit, Markup and Relationship Length in Chilean Exports: 2SLS Results

	(1)	(2)	(3)	(4)
ln(Relationship Length)	1.237***	0.623***	1.277***	0.0702
	(0.136)	(0.151)	(0.156)	(0.355)
ln(Markup)	6.280**	6.738**	1.858	11.44**
	(3.093)	(3.233)	(5.261)	(5.124)
First-Stage F-Statistic	71.0	75.3	118.3	22.5
Relationships	All	All	$<$10 trades	$\geq$10 trades
Exporter-Destination Country-HS8 FE	Yes	Yes	Yes	Yes
Destination Country-Year FE	—	Yes	Yes	Yes
Observations	202,507	202,507	109,950	92,557

▷ Commitment problem dominates in the short run; financing costs channel dominates in the longer run

Conclusions

Conclusions

Relationships are central for trade credit:

- Consistent with models learning and enforcement.
- Learning interacts with financing cost advantage.
- In the short run, enforcement and learning are key.
- In the longer run, financing cost advantage of trade credit dominates.

New benefit of long-term relationships:

- Lowers financing costs by easing the use of trade credit.

Thank You!

Appendix

Trade Credit

The exporter maximizes:

$$\begin{aligned} \mathrm{E}[\Pi^{TC,E}] &= \tilde{\eta}^I P^{TC} - (1 + r_b^E)C, \\ \text{s.t. } \mathrm{E}[\Pi^{TC,I}] &= R - P^{TC} \geq 0, \end{aligned}$$

with probability of payment of $\tilde{\eta}^I = \eta^I + (1 - \eta^I)\phi^I$.

Optimal payment: $P^{TC} = R$ implies:

$$\mathrm{E}[\Pi^{TC,E}] = \tilde{\eta}^I R - (1 + r_b^E)C.$$

$\triangleright$ TC profits decrease with:

- Risk of non-payment by **importer** $(1 - \tilde{\eta}^I)$.
- **Exporter** borrowing costs (r_b^E).

Cash-in-Advance

The exporter maximizes:

$$\begin{aligned} \mathrm{E}[\Pi^{CIA,E}] &= (1+r_d)(P^{CIA}-C), \\ \text{s.t. } \mathrm{E}[\Pi^{CIA,I}] &= \tilde{\eta}^E R-(1+r_b^I)P^{CIA} \geq 0, \end{aligned}$$

with probability of delivery $\tilde{\eta}^E = \eta^E + (1-\eta^E)\phi^E$.

Optimal payment $P^{CIA} = \frac{\tilde{\eta}^E}{1+r_b^I} R$ implies:

$$\mathrm{E}[\Pi^{CIA,E}] = (1+r_d)\left(\frac{\tilde{\eta}^E}{1+r_b^I}R - C\right).$$

$\triangleright$ CIA profits decrease with:

- Risk of non-delivery by **exporter** $(1-\tilde{\eta}^E)$.
- **Importer** borrowing costs (r_b^I).

Optimal Payment Choice

- Profits are higher with trade credit if:

$$\frac{\Pi^{TC,E} - \Pi^{CIA,E}}{C} = \frac{\Delta\Pi^{E}}{C} = \tilde{\eta}^{I}\ \mu - (1 + r_b^E) - (1 + r_d)\left(\frac{\tilde{\eta}^{E}}{1 + r_b^I}\ \mu - 1\right).$$

- Which simplifies in the symmetric case to:

$$\frac{\Delta\Pi^{E}}{C} = \left(\frac{\tilde{\eta}}{1 + r_b}\ \mu - 1\right)(r_b - r_d).$$

Estimating Firm-Product Level Markups

De Loecker, Goldberg, Khandelwal and Pavcnik (2016)

- Producers' cost minimization problem ($\mathbf{V_{it}}$: variable inputs):

$$\text{F.O.C.: } \triangleright \text{Markup: } \quad \mu_{ipt} \quad = \quad \underbrace{\frac{d \ln Q_{ipt}(\cdot)}{d \ln V_{ipt}}}_{\text{Output Elast.}} \times \underbrace{\left[\frac{P_{ipt}^{v} V_{ipt}^{v}}{P_{ipt} Q_{ipt}} \right]^{-1}}_{\text{Expendit. Share}}$$

- Independent of demand side, requires estimation of production function
- Strategy: Use sample of single-product plants to identify production function coefficients
- Use reported variable cost share (TVC) to compute products' material share in MP plants
  - Example: Value of material inputs used by plant i for product j in year t:

$$M_{ijt} = s_{ijt}^{TVC} \cdot M_{it} \quad \text{where} \quad s_{ijt}^{TVC} = \frac{TVC_{ijt}}{\sum_j TVC_{ijt}}$$