Trade Credit and Relationships

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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

Cross-Border Trade Credit and Relationship Length

![Cross-Border Trade Credit and Relationship Length](image_url)
Build a model of trade credit dynamics, combining two key channels:

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

- Trade credit lowers \textit{gross borrowing} and saves \textit{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 \textit{risky} because a importer may be \textit{unreliable}.
- Disappears with \textit{learning}.
This Paper: Data and Main Findings

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

- 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:


- **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):


▷ Link trade relationships to payment choice.

Advantages of trade relationships:


▷ 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 $\eta$, 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. $\tilde{\eta}_I = \eta_I + (1 - \eta_I)\phi_I$.

$$E[\Pi^{TC,E}] = \tilde{\eta}_I R - C.$$  

**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 $P^{CIA} = \tilde{\eta}_E R$.

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

▷ 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. \( \frac{\partial \eta_k}{\partial k} > 0 \) (\( k \): # previous interactions).
- Assume that learning is symmetric and independent of payment terms.
- Over time, firms learn type of trading partner.

Bayesian Learning Model
Focus on symmetric case: \( r^E_b = r^I_b = r_b \).
Intuition for Financing Cost Channel II

Net Financing Cost of Cash in Advance:
\[ r_b \times P_{CIA} - r_d \times (P_{CIA} - C) \]

Return on bank deposit:
\[ r_d \times (P_{CIA} - C) \]
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

   - Transaction-level import data
   - Importer and Exporter ID, 10-digit HS code, FOB value and volume
   - Payment form

   - 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:

\[ TC_{iept} = \beta_1 \ln(\text{Rel. Length})_{iet} \times (\text{High Div. Risk})_s + \beta_2 \ln(\text{Rel. Length})_{iet} \times (\text{Low Div. Risk})_s + \psi_{iep} + \nu_{iept}. \]

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:

\[ TC_{iept} = \alpha_1 \ln(\text{Rel. Length})_{iet} \times (\text{Long Ladder})_p + \alpha_2 \ln(\text{Rel. Length})_{iet} \times (\text{Short Ladder})_p + \psi_{iep} + \nu_{iept}. \]

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

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>P25</th>
<th>P50</th>
<th>P75</th>
<th>Obs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade Credit Dummy</td>
<td>88.1</td>
<td>32.4</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>16,082,792</td>
</tr>
<tr>
<td>Cash in Advance Dummy</td>
<td>10.2</td>
<td>30.3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>16,082,792</td>
</tr>
<tr>
<td>Letter of Credit Dummy</td>
<td>1.7</td>
<td>13.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>16,082,792</td>
</tr>
<tr>
<td>Import Value (US$)</td>
<td>20,446</td>
<td>265,362</td>
<td>220</td>
<td>1,352</td>
<td>8,105</td>
<td>16,082,792</td>
</tr>
</tbody>
</table>

*Most transactions are trade credit or cash in advance.*
### Payment Terms and Relationship Length

<table>
<thead>
<tr>
<th></th>
<th>Trade Credit</th>
<th>Cash in Advance</th>
<th>Letter of Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>First transaction</td>
<td>74.3</td>
<td>23.4</td>
<td>2.3</td>
</tr>
<tr>
<td>Fifth transaction</td>
<td>79.7</td>
<td>18.1</td>
<td>2.2</td>
</tr>
<tr>
<td>Tenth transaction</td>
<td>82.6</td>
<td>15.3</td>
<td>2.0</td>
</tr>
<tr>
<td>Eleventh transaction and beyond</td>
<td>90.5</td>
<td>8.0</td>
<td>1.6</td>
</tr>
</tbody>
</table>

▷ 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

<table>
<thead>
<tr>
<th>Payment term in ( t ):</th>
<th>Payment term in ( t + 1 ):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade Credit</td>
<td>99.1</td>
</tr>
<tr>
<td>Cash in Advance</td>
<td>7.2</td>
</tr>
<tr>
<td>Letter of Credit</td>
<td>7.8</td>
</tr>
</tbody>
</table>

Exporters often switch from cash in advance to trade credit, but rarely away from trade credit.
Econometric Evidence
Financing Terms and Relationship Age

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

- Trade credit provision increases with relationship age within relationships.
A. Colombian Imports

- Change in trade credit share vs. relationship length

B. Learning Model

- Belief about buyer vs. relationship length

▷ Dynamics consistent with Bayesian learning.
## Exporter, Importer and Relationship Learning

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(Relationship Length)</td>
<td>1.003***</td>
<td>0.672***</td>
</tr>
<tr>
<td></td>
<td>(0.044)</td>
<td>(0.107)</td>
</tr>
<tr>
<td>ln(Importer Experience)</td>
<td>-0.275***</td>
<td>0.090</td>
</tr>
<tr>
<td></td>
<td>(0.033)</td>
<td>(0.097)</td>
</tr>
<tr>
<td>ln(Country–Specific Importer Experience)</td>
<td>-0.022**</td>
<td>-0.029</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.056)</td>
</tr>
<tr>
<td>ln(Exporter Experience)</td>
<td>-0.494***</td>
<td>-0.367***</td>
</tr>
<tr>
<td></td>
<td>(0.043)</td>
<td>(0.115)</td>
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</tbody>
</table>

### Sample

<table>
<thead>
<tr>
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<tbody>
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<td>Yes</td>
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<tr>
<td>Observations</td>
<td>12,947,042</td>
<td>994,519</td>
</tr>
</tbody>
</table>

▷ Key margin is at the exporter-importer level.
Learning effects are stronger for sources with less diversion risk.
### Econometric Evidence

<table>
<thead>
<tr>
<th>Model</th>
<th>(1)</th>
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<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(Relationship Length) $\times$ Long Quality Ladder</td>
<td>0.265***</td>
<td>0.689***</td>
<td>0.502***</td>
<td>0.462***</td>
</tr>
<tr>
<td></td>
<td>(0.045)</td>
<td>(0.039)</td>
<td>(0.028)</td>
<td>(0.029)</td>
</tr>
<tr>
<td>ln(Relationship Length) $\times$ Short Quality Ladder</td>
<td>0.127***</td>
<td>0.606***</td>
<td>0.457***</td>
<td>0.433***</td>
</tr>
<tr>
<td></td>
<td>(0.040)</td>
<td>(0.033)</td>
<td>(0.026)</td>
<td>(0.027)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample</th>
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<th>All</th>
<th>All</th>
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<tr>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Source Country-Year FE</td>
<td>—</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Importer-HS10-Year FE</td>
<td>—</td>
<td>—</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Observations</td>
<td>9,744,531</td>
<td>9,744,297</td>
<td>9,227,462</td>
<td>8,366,908</td>
</tr>
</tbody>
</table>

Learning effects are stronger for more complex products.
Trade Credit, Markup and Relationship Length in Chilean Exports: 2SLS Results

<table>
<thead>
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<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(Relationship Length)</td>
<td>1.237***</td>
<td>0.623***</td>
<td>1.277***</td>
<td>0.0702</td>
</tr>
<tr>
<td></td>
<td>(0.136)</td>
<td>(0.151)</td>
<td>(0.156)</td>
<td>(0.355)</td>
</tr>
<tr>
<td>ln(Markup)</td>
<td>6.280**</td>
<td>6.738**</td>
<td>1.858</td>
<td>11.44**</td>
</tr>
<tr>
<td></td>
<td>(3.093)</td>
<td>(3.233)</td>
<td>(5.261)</td>
<td>(5.124)</td>
</tr>
<tr>
<td>First-Stage F-Statistic</td>
<td>71.0</td>
<td>75.3</td>
<td>118.3</td>
<td>22.5</td>
</tr>
<tr>
<td>Relationships</td>
<td>All</td>
<td>All</td>
<td>&lt;10 trades</td>
<td>≥10 trades</td>
</tr>
<tr>
<td>Exporter-Destination Country-HS8 FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Destination Country-Year FE</td>
<td>—</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Observations</td>
<td>202,507</td>
<td>202,507</td>
<td>109,950</td>
<td>92,557</td>
</tr>
</tbody>
</table>

▷ 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:

\[
E[\Pi_{TC,E}] = \tilde{\eta}^I P^{TC} - (1 + r_E^E) C,
\]

subject to
\[
E[\Pi_{TC,I}] = R - P^{TC} \geq 0,
\]

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

Optimal payment: \( P^{TC} = R \) implies:

\[
E[\Pi_{TC,E}] = \tilde{\eta}^I R - (1 + r_E^E) C.
\]

TC profits decrease with:
- Risk of non-payment by importer \( (1 - \tilde{\eta}^I) \).
- Exporter borrowing costs \( (r_E^E) \).
Cash-in-Advance

The exporter maximizes:

\[
E[\Pi^{CIA,E}] = (1 + r_d)(P^{CIA} - C),
\]

s.t. \[
E[\Pi^{CIA,I}] = \tilde{\eta}^E R - (1 + r_b^I)P^{CIA} \geq 0,
\]

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:

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

▷ CIA profits decrease with:

- Risk of non-delivery by exporter \((1 - \tilde{\eta}^E)\).
- Importer borrowing costs \((r_b^I)\).
• 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 ($V_{it}$: variable inputs):

  \[
  \text{F.O.C.: Markup: } \mu_{ipt} = \frac{d \ln Q_{ipt}(\cdot)}{d \ln V_{ipt}} \times \left[ \frac{P_{ipt} V_{ipt}}{P_{ipt} Q_{ipt}} \right]^{-1} \]

  - Output Elast.
  - 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 $t$:

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