The Macroeconomics of Trade Credit

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Reykjavík Economic Conference (May 2024)

Motivation

- Large literature studies the **aggregate effects of financial frictions**
- Benchmark models share common structure:
  1. Firms **borrow exclusively from financial intermediaries**
  2. Shocks to financial sector impact firms' capital and labor demand

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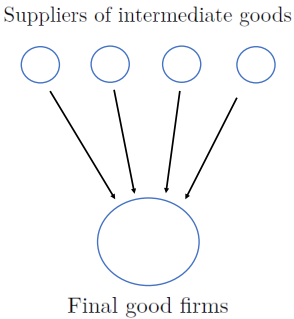
> **Trade credit** is the financing that suppliers of intermediate goods and services extend to their customers in the form of extended payment terms

- **Q: What are the macroeconomic implications of trade credit relationships?**
  - Develop **GE model with production lines** where **trade credit sustained endogenously**

A general equilibrium model of trade credit

- **Vertical supply chains** where downstream firms need **financing to purchase inputs**



A general equilibrium model of trade credit

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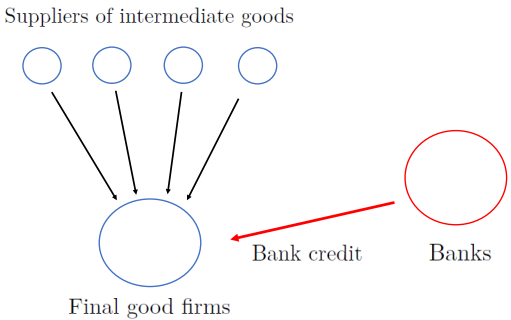

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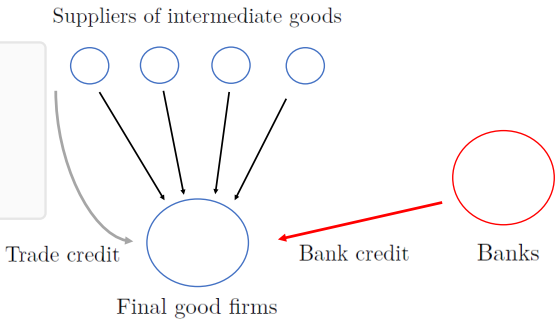
Trade credit supported by **reputation**

- Supplier stops providing goods if customer defaults
- Costly for costumer if intermediate good imperfectly substitutable



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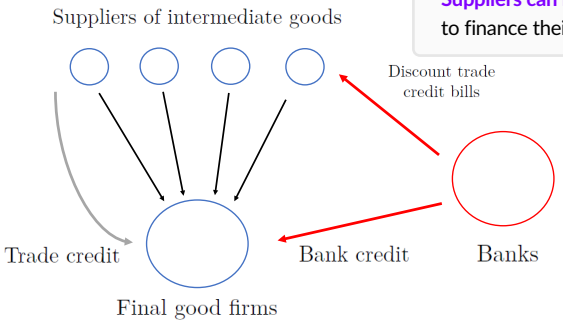


Suppliers can borrow from banks
to finance their spot expenditures

Preview of findings

- **Trade credit is a credit multiplier**
  - Breakdown of trade relationship → **unique threat of suppliers**
  - Use accounts receivable as collateral → **economy can sustain more credit overall**
- **Macro implications of trade credit**
  - On average, economy with trade credit sustains **higher output**
  - **Dampens** or **amplifies** effects of financial shocks, depending on suppliers' balance sheet
- **Quantitative results** (Italian data)
  - Economy sustains **higher output** relative to *spot* economy (16%)
  - **Amplification during the Great Recession**: trade credit accounts for 45% of output losses

Model

Environment

- Discrete time, infinite horizon
- Household preferences

$$\sum_{t=0}^{\infty} \beta^t \left[C_t - \chi \frac{L_t^{1+\frac{1}{\psi}}}{1+\frac{1}{\psi}} \right], \qquad C_t = \left[\int y_{i,t}^{\frac{\gamma-1}{\gamma}} di \right]^{\frac{\gamma}{\gamma-1}}$$

- Each industry i has a **vertical production structure**
  - Final good produced by competitive firms: $y_{i,t} = k^{1-\eta_i} \left[\left(\sum_{j=1}^{N_i} x_{ij,t}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \right]^{\eta_i}$
  - Intermediate inputs ($x_{ij,t}$) produced by N_i monopolists using labor: $x_{ij,t} = l_{ij,t}$

Timeline

- **Morning**
  - Intermediate-good producers: hire labor, pay wages, produce, and sell their goods
  - Final-good firms: **produce** δ of total production; **receive** $\delta(1-\pi_i)$ of total sales
- **Afternoon**
  - Final-good firms: receive remaining sales, **repay debt** (loans + trade credit)
- Firms can borrow from **competitive banks** in the morning and repay in the afternoon
- A **trade credit contract** specifies a triplet:
  - $x_{ij,t}$ - quantity delivered in the morning
  - $p^{s}_{ij,t}$ - spot payment to be paid in the morning
  - $p^{tc}_{ij,t}$ - trade credit to be paid in the afternoon

Enforcement of debt contracts

Bank credit

- Legally enforced - firm **keeps θ_t of revenues** in the event of default
  - Final-good firms: $b_{i,t} \leqslant (1-\theta_t)\,(1-\delta+\delta\pi_i)\,p_{i,t}y_{i,t}$
  - Intermediate-good firms: $b_{ij,t} \leqslant (1-\theta_t)p^{tc}_{ij,t}$
- θ_t represents **financial frictions**, follows a Markov process

Trade credit

- Not legally enforced. If costumer defaults, monopolist **excludes him from $x_{ij,t}$ forever**

$$p^{tc}_{ij,t} \leqslant \underbrace{\beta\mathbb{E}\left[\tilde{J}_{ij,t+1}\right]}_{\text{discounted customer surplus}}$$

Supplier's problem

- Supplier makes a **take-it-or-leave-it offer** to its customers
- Supplier has **commitment power** - commits to future prices and quantities

$$\max \quad \mathbb{E}_0\Big[\sum_{t=0}^{\infty} \beta^t \left(p^{s}_{ij,t} + p^{tc}_{ij,t} - W_t x_{ij,t}\right)\Big]$$

$$p^{s}_{ij,t} \leqslant \{1 - \theta_t[\delta\pi_i + (1-\delta)]\}\, p_{i,t} y_{i,t} - \sum_{j' \neq j} p^{s}_{ij',t} \qquad \text{(customer BC)}$$

$$p^{tc}_{ij,t} \leqslant \beta \mathbb{E}_t\left[\tilde{J}_{ij,t+1}\right] \qquad \text{(customer TC)}$$

$$W_t x_{ij,t} - p^{s}_{ij,t} \leqslant (1-\theta_t) p^{tc}_{ij,t} \qquad \text{(supplier BC)}$$

$$\tilde{J}_{ij,t} \geqslant 0 \qquad \text{(customer PC)}$$

$$\tilde{J}_{ij,t} = \mathbb{E}_t\left\{\sum_{\tau=0}^{\infty} \beta^{\tau}\left[p_{i,t} y_{i,t} - p^{(-j)}_{i,t} y^{(-j)}_{i,t} - p^{s}_{ij,t} - p^{tc}_{ij,t}\right]\right\} \qquad \text{(customer value)}$$

- Study **symmetric equilibrium** where all suppliers offer the same contract

Special Case

A special case

- Single industry with
  - One supplier ($N_i = 1$)
  - Fixed wages ($\psi = 0$)
  - No delayed payments from households ($\pi_i = 0$)

- ***Spot economy*** counterfactual:

$$\begin{aligned} \max \quad & p^s - Wx \\ \text{s.t.} \quad & p^s - \delta x^\eta \leqslant (1-\theta)(1-\delta)x^\eta \end{aligned}$$

- Goals of special case analysis:
  - Characterize the deterministic steady state
    - Provide intuition for ***credit multiplier***
  - Study the response to a negative financial shock
    - Provide intuition for ***smoothing*** vs. ***amplification*** (in paper)

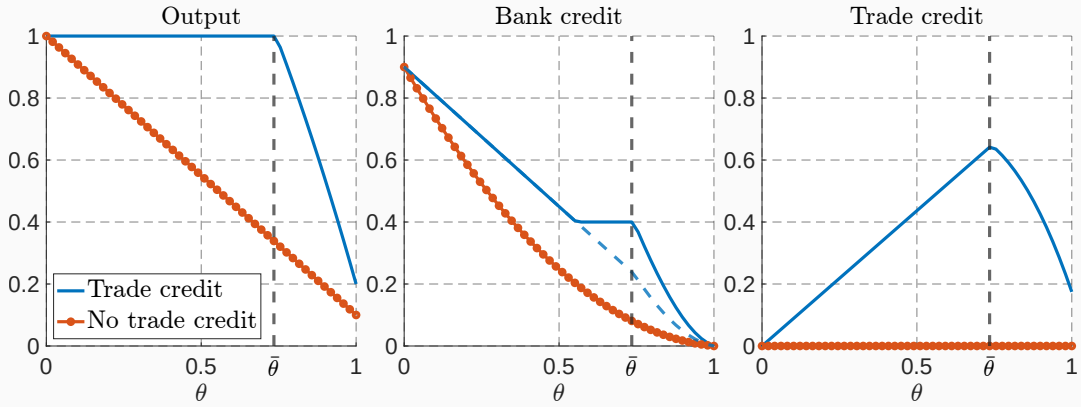
The spot economy steady state - mechanism

Monopolist problem

$$\begin{aligned} \max \quad & p^s - Wx \\ \text{s.t.} \quad & p^s - \delta x^\eta \leqslant (1-\theta)(1-\delta)x^\eta \end{aligned}$$

- Optimality condition: $[\delta + (1-\delta)(1-\theta)]\eta x^{\eta-1} = W$
- Absent financial frictions ($\theta = 0$): output is at its **first-best level**
  - Monopolist **maximizes surplus** and **extracts it all**
  - Feasible: customers can borrow from banks entire afternoon revenues
- With financial frictions ($\theta > 0$):
  - Output **distorted downwards**: marginal benefit lower than marginal product

The economy with trade credit



Two regions

- $\theta \leqslant \bar{\theta}$: Output is first best despite financial frictions
- $\theta > \bar{\theta}$: Output distorted downwards

The economy with trade credit - mechanism

Monopolist borrowing constraint slack ($\theta \leqslant \bar{\theta}$)

- Monopolist optimality condition: $[\delta + (1-\delta)(1-\theta)]\eta x^{\eta-1} + \overbrace{\mu\theta(1-\delta)\eta x^{\eta-1}}^{\text{trade credit revenues}} = W$
- **First-best level** obtained even with $\theta > 0$
- How is the first-best allocation financed?
  - **Credit is better allocated** (more allocated towards labor)
  - **Credit is larger** (higher output than spot economy)

Monopolist borrowing constraint binds ($\theta > \bar{\theta}$)

- Monopolist borrowing constraint: $Wx \leqslant [\delta + (1-\delta)(1-\theta)]\, x^{\eta} + (1-\theta)p^{tc}$
- **Bank credit not sufficient to cover first-best allocation** wage bill

Quantitative Analysis

Trade credit across industries

- **Italian data**: annual balance sheet data from Orbis + input-output tables
- Model predicts **trade credit increases** with

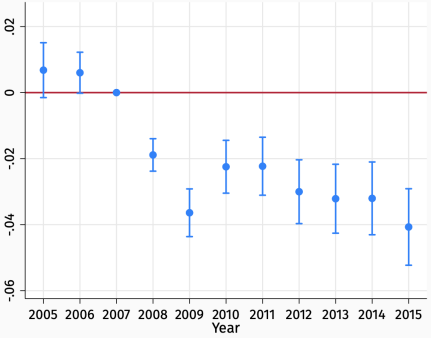
	Dep. variable: Accounts payable/sales			
	(1)	(2)	(3)	(4)
π_i → Accounts receivable/sales	0.297***			0.326***
	(0.029)			(0.027)
η_i → Intermediate inputs /sales		0.154***		0.239***
		(0.028)		(0.020)
$1/N_i$ → $\text{HHI}^{\text{supplier}}$			0.655***	0.303***
			(0.111)	(0.085)
Adj. R^2	0.329	0.092	0.116	0.477
Obs.	522	522	522	522

Note: regression includes time fixed effects.

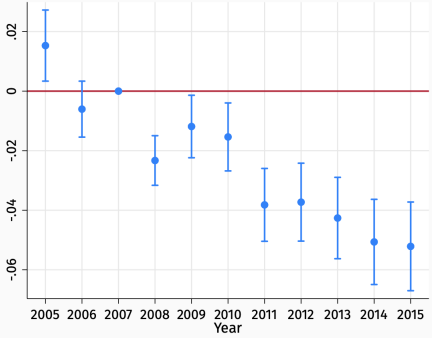
Trade credit and the Great Recession

$$y_{j,t} = \alpha_j + \delta_t + \beta_t \times \mathbb{1}\left[\bar{\theta}_i \leqslant \text{median}\left(\bar{\theta}\right)\right] + \Gamma' X_{j,t} + \epsilon_{j,t}$$

dep. variable: ln(sales)



dep. variable: ln(payables)



Notes: $X_{j,t}$ includes interaction of times fixed effect with dummies capturing firm's size, capital intensity, and sector of operation (manufacturing and service).

Macro implications of trade credit

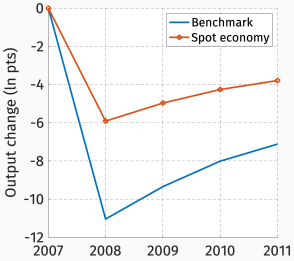
- **Compare benchmark economy** to one where all payments must be **spot payments**

Steady state: **The credit multiplier**

	Benchmark	Spot economy
Bank credit	1.00	0.33
To final good firms	0.73	0.33
To suppliers	0.27	
% allocated to wages	**0.96**	**0.03**
Output	1.00	**0.86**

Credit is **larger** and **better allocated**

Financial shock: **Amplification**



Trade credit **accounts for 45% of output decline**

Conclusion

Conclusion

- Equilibrium model with both **bank and trade credit**
  - Trade credit sustained by **threat of relationship breakdown**
  - Suppliers can borrow from banks, **raising the overall level of credit**
- Model validation
  - Fits **trade credit patterns across sectors**
  - Identifies **sectors that respond more to financial shocks**
- Use model to quantify macroeconomic effects of trade credit
  - **Higher output** on average (16%)
  - But higher volatility: **amplifies the impact of financial shocks on output**
- In paper: study **effectiveness of targeted subsidies** during a crisis

Thank you!