Strategic Debt in a Monetary Economy

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1 Introduction

2 Model

3 Equilibrium

4 Welfare and Policy

5 Simulations

6 Conclusion

7 Appendix

8 References

Research Questions

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Strategic Debt

What is the theory of strategic debt?

Standard Cake Bargaining

Agents A (•) and B (•) bargain over 1 cake with 8 slices, exerting equal bargaining power.

Agent C (•) owns 2 additional slices of cake.

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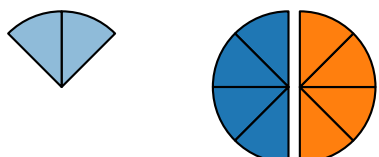

Figure: Cake consumption of agents A (•), B (•), and C (•) without strategic debt.

Cake Bargaining with Strategic Debt

Agents A (•) and C (•) write a contingent limited-liability **debt contract**:

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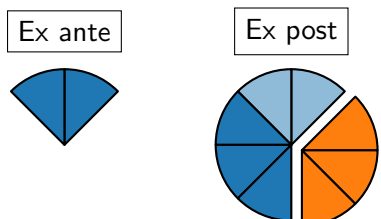

Figure: Cake consumption of agents A (●), B (●), and C (●) with strategic debt.

Empirical Literature

Empirical evidence for the role of debt in bargaining:

- Bronars and Deere (1991): firms protect their shareholders' surplus from extraction by **workers' unions** through debt.
- Kale and Shahrur (2007): a firm's leverage is positively related to the **concentration levels** in its supplier and customer industries.
- Towner (2020): **U.S. hospitals** with higher debt-to-equity ratios negotiate higher reimbursement rates from health insurers.
- etc.

Theoretical Linking Points

New Monetarist models:

- money search: (Lagos and Rocheteau, 2005; Lagos and Wright, 2005; Rocheteau and Wright, 2005);
- the accelerating effect of inflation on decentralized trade:
  1. endogenous matching probabilities of buyers (Lagos and Rocheteau, 2005);
  2. worse ability of buyers to reshuffle money balances as compared to sellers (Ennis, 2009);
  3. match-specific preference shocks (Dong and Jiang, 2014; Liu, Wang and Wright, 2011; Nosal, 2011)

1 Introduction

2 Model

3 Equilibrium

4 Welfare and Policy

5 Simulations

6 Conclusion

7 Appendix

8 References

Agents & Goods

Three types of agents:

1. There is a unit mass of infinitely-lived *consumers*. At the beginning of period t, each consumer incurs preference shock $\epsilon_t \sim G$, $\epsilon_t \in [0, \bar{\epsilon}]$.
2. In period t, a unit mass of **one-period-lived** identical *producers* is born who dies at the end of period $t + 1$.
3. There is a unit mass of infinitely-lived identical *financiers*.

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Two types of **non-storable** consumption goods:

1. *General goods* can be produced and consumed by all agents.
2. *Search goods* are exclusively produced (by producers) and consumed (by consumers) in bilateral matches.

Consumers' preferences Producers' preferences

Goods Markets

	Decentralized market (DM)	Competitive market (CM)
Traders	consumer $\leftrightarrow$ producer	consumers, producers, financiers
Goods	search goods	general goods
Trading protocol	Kalai bargaining	Walrasian

Market Alternation

DM_t and CM_t alternate:

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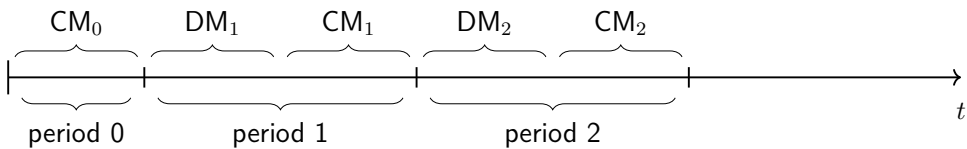

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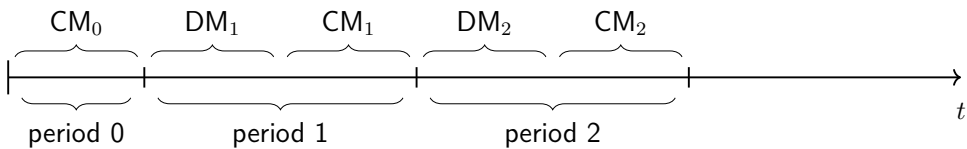

Figure: Alternation of DM_t and CM_t.

The anonymity in bilateral matches in the DM necessitates **money**.

Debt Contracts

Financiers write one-period limited-liability **debt contracts** with borrowers.

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A **debt contract**, written in CM_t, specifies:

- Loan repayment b_{t+1} due in CM_{t+1}, subject to limited liability.
- Transfer $b_{t+1}/R_t(b_{t+1})$ to borrower in CM_t, given competitive pricing kernel

$$R_t : \mathbb{R}_+ \to \mathbb{R}_+ \cup \{\infty\}, \qquad b \mapsto R_t(b).$$

1 Introduction

2 Model

3 Equilibrium

4 Welfare and Policy

5 Simulations

6 Conclusion

7 Appendix

8 References

Bargaining

Consider a match of a consumer with real money holdings $m \geq 0$ and preference shock $\epsilon \in [0, \bar{\epsilon}]$, and a producer with limited-liability debt b.

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Search-good quantity q and payment p are determined through proportional Kalai (1977) bargaining:

$$(q, p) = \arg\max_{q,p \geq 0} \{\epsilon u(q) - p\},$$

$$\text{s.t.} \quad p \leq m \qquad \text{and} \qquad \theta \underbrace{[\epsilon u(q) - p]}_{\substack{\text{consumer's} \\ \text{surplus}}} = (1-\theta) \underbrace{[-c(q) + \overbrace{\max\{p - b, 0\}}^{\text{limited liability}}]}_{\text{producer's surplus}},$$

where we use the following notation:

- $\theta \in [0, 1]$: producer's bargaining power
- $u(q)$ and $c(q)$: consumer's utility function and producer's cost function

Successful Matches

We write $q(m, b, \epsilon)$ and $p(m, b, \epsilon)$ for the bargaining outcome.

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A match is called *successful* if $q(m, b, \epsilon) > 0$.

$\rightarrow$ A successful match has full debt repayment.

Extensive Margin I

Definition

We define

$$\hat{\epsilon}(b, m) \equiv \inf\{\epsilon \in [0, \bar{\epsilon}] \ : \ q(m, b, \epsilon) > 0\}$$

as the smallest preference shock ϵ for which a match is successful, given b and m.

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Why should a match be unsuccessful?
$\rightarrow$ Preference shock ϵ is too small to make the consumer willing to pay for the producer's debt repayment.

Extensive Margin II

Lemma

It holds that

$$\frac{\partial \hat{\epsilon}(m,b)}{\partial b} > 0.$$

$\Rightarrow$ The probability $1 - G(\hat{\epsilon})$ of a successful match **decreases** in b!

Consumers' Optimal Money Holdings

The consumer's **money demand** is determined through

$$\iota_{t+1} = \int_{\hat{\epsilon}(m_{t+1},b_{t+1})}^{\bar{\epsilon}} \mathcal{L}(\epsilon', m_{t+1}, b_{t+1}) G(\mathrm{d}\epsilon'),$$

where ι_{t+1} denotes the **Fisher rate**, and where $\mathcal{L}(\epsilon, m, b)$ denotes the **liquidity premium** in match (ϵ, m, b).

Consumers' value functions

Producers' Optimal Debt

The producer's optimal debt b_{t+1} is determined through

$$0 \geq \underbrace{(1-\theta)[1-G(\hat{\epsilon}_{t+1})]}_{\text{surplus extraction}} \underbrace{- \theta \int_{\hat{\epsilon}_{t+1}}^{\bar{\epsilon}} \mathcal{L}(\epsilon, m_{t+1}, b_{t+1}) G(\mathrm{d}\epsilon)}_{\text{reduction of bargaining set}} \underbrace{- b_{t+1} g(\hat{\epsilon}_{t+1}) \frac{\partial \hat{\epsilon}}{\partial b}}_{\substack{\text{extensive} \\ \text{margin effect}}}$$

with "=" if $b_{t+1} > 0$.

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with "=" if $b_{t+1} > 0$.

Producers **complement** their bargaining power with their ability to commit in financial contracts:

- Producers make take-it-or-leave-it (TIOLI) offers ($\theta = 1$): no debt issuance.
- Consumers make TIOLI offers ($\theta = 0$): much debt issuance.

Producers' value functions

1 Introduction

2 Model

3 Equilibrium

4 Welfare and Policy

5 Simulations

6 Conclusion

7 Appendix

8 References

Welfare

Welfare is defined as

$$\mathcal{W} \equiv \sum_{t=1}^{\infty} \beta^t \int_{\hat{\epsilon}_t}^{\bar{\epsilon}} \underbrace{[\epsilon_t u(q) - c(q)]_{q=q(\epsilon_t, m_t, b_t)}}_{\text{gross surplus in DM}_t} G(\mathrm{d}\epsilon_t),$$

where β denotes the agents' time-discount factor.

Distortions

Lemma

Debt is distortionary at the intensive and extensive margin of decentralized trade.

The economics behind the distortionary nature of debt is a **pecuniary externality**: debt is too cheap.

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The economics behind the distortionary nature of debt is a **pecuniary externality**: debt is too cheap.

Optimal fiscal policy: a **Pigouvian tax** that makes debt prohibitively expensive.

Monetary Policy I

What can **monetary policy** do in the absence of Pigouvian taxation?

Proposition

A deviation from the Friedman rule ($\iota = 0$) increases the mass of successful matches and welfare:

$$\left.\frac{\mathrm{d}\hat{\epsilon}}{\mathrm{d}\iota}\right|_{\iota=0} < 0 \qquad \textit{and} \qquad \left.\frac{\mathrm{d}\mathcal{W}}{\mathrm{d}\iota}\right|_{\iota=0} > 0.$$

Monetary Policy II

Corollary

At the Friedman rule, it holds that

$$\left.\frac{\mathrm{d}W^{p,0}}{\mathrm{d}\iota}\right|_{\iota=0} = 0 \qquad \textit{and} \qquad \left.\frac{\mathrm{d}W^{c}}{\mathrm{d}\iota}\right|_{\iota=0} = \left.\frac{\mathrm{d}\mathcal{W}}{\mathrm{d}\iota}\right|_{\iota=0} > 0.$$

1 Introduction

2 Model

3 Equilibrium

4 Welfare and Policy

5 Simulations

6 Conclusion

7 Appendix

8 References

Money, Debt, and Mass of Successful Matches

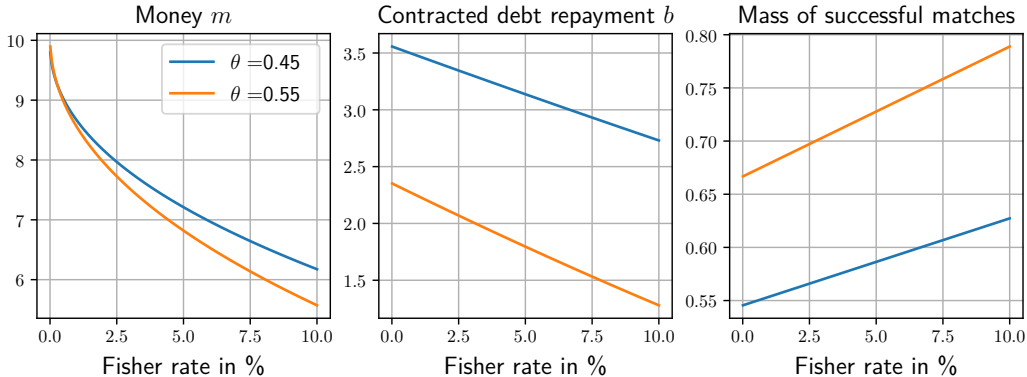

Figure: Money, debt, and extensive margin for $\theta = 0.45, 0.55$.

Gross Surpluses

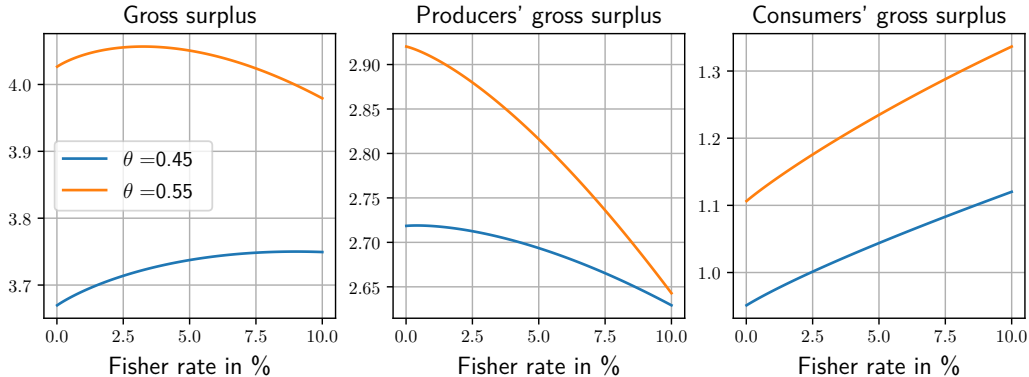

Figure: Surpluses for $\theta = 0.45, 0.55$.

1 Introduction
2 Model
3 Equilibrium
4 Welfare and Policy
5 Simulations
6 Conclusion
7 Appendix
8 References

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Financiers exert a **pecuniary externality**.

Optimal policies:

- Fiscal: a **Pigouvian tax** that drives debt out of existence.
- Monetary: a **deviation from the Friedman rule** that stimulates decentralized trade at the extensive margin and improves welfare.

1 Introduction
2 Model
3 Equilibrium
4 Welfare and Policy
5 Simulations
6 Conclusion
7 Appendix
8 References

Consumers' Preferences

A consumer has periodic utility

$$U_t^c = \epsilon_t u(q_t) + x_t,$$

where

- q_t: DM-good consumption;
- x_t: CM-good net consumption ($x_t < 0$ if CM-good is produced);
- $\epsilon_t \overset{\text{i.i.d.}}{\sim} G$: idiosyncratic preference shock;
- G has support $[0, \bar{\epsilon}] \subset [0, \infty)$;
- u: $u' > 0$ and $u'' < 0$.

Lifetime utility: $\sum_{t=0}^{\infty} \beta^t U_t^c$ with time-discount factor $\beta \in (0, 1)$.

agents & goods

Producers' Preferences

A producer born in CM_t has utility

$$U_t^p = x_t + \beta[-c(q_{t+1}) + x_{t+1}],$$

where

- q_{t+1}: DM-good production in DM_{t+1};
- x_t: CM-good net consumption in CM_t;
- x_{t+1}: CM-good net consumption in CM_{t+1};
- c: $c' > 0$ and $c'' \geq 0$.

agents & goods

Consumers' CM Value Function

A consumer's value of entering CM_t with real balances m and LBSs a reads

$$W_t^c(m,a) = \max_{m',a' \geq 0} \{x + \beta \mathbb{E}_G[V_{t+1}^c(m',a'|\epsilon')]\},$$

$$\text{s.t.} \qquad x = m + a - \left[\frac{\phi_t m'}{\phi_{t+1}} + \frac{a'}{R_t^f}\right],$$

where $V_{t+1}^c(m',a'|\epsilon')$ is the value of entering DM_{t+1} with real balances m' and LBSs a', having preference shock ϵ'.

Consumer's optimal money holdings

Producers' CM Value Functions

A producer's value of being born in CM_t reads

$$W_t^{p,0} = \max_{b' \geq 0} \left\{ \frac{b'}{R_t(b')} + \beta \mathbb{E}_G[V_{t+1}^p(b'|\epsilon')] \right\},$$

where $V_{t+1}^p(b'|\epsilon')$ is the value of entering DM_{t+1} with debt b' and being matched with a consumer with preference shock ϵ'.

The producer's value of entering CM_{t+1} with real balances m and limited-liability debt b reads

$$W_{t+1}^{p,1}(m, b) = \max\{m - b, 0\}.$$

Producer's optimal debt

Bargaining with Value Functions

The terms of trade in a match of a consumer with preference shock ϵ are determined through proportional Kalai (1977) bargaining:

$$
\begin{aligned}
(q,p) &= \arg\max_{q,p\geq 0}\{\epsilon u(q) + W_t^c(m-p,a) - W_t^c(m,a)\},\\
\text{s.t.}\quad & p \leq m,\\
& \theta\left[\epsilon u(q) + W_t^c(m-p,a) - W_t^c(m,a)\right]\\
& \qquad = (1-\theta)\left[-c(q) + W_t^{p,1}(p,b) - W_t^{p,1}(0,b)\right],
\end{aligned}
$$

where $\theta \in [0,1]$ denotes the producer's bargaining power.

Bargaining

1 Introduction

2 Model

3 Equilibrium

4 Welfare and Policy

5 Simulations

6 Conclusion

7 Appendix

8 References

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Toy Calibration

	$u(q)$	$c(q)$	$(1-\theta)$	β	$[0,\bar{\epsilon}]$	G
Values	$1.4\sqrt{q}$	$q^2/2$	0.5	0.96	$[0,1]$	$U(0,\bar{\epsilon})$