THE COEXISTENCE OF MONEY AND CREDIT AS MEANS OF PAYMENT

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Adoption vs. Use of Cash & Credit Cards

We focus on the choice of cash vs. credit by consumers and merchants

- Emergence of credit cards as a major form of unsecured debt
  - Delayed settlement, requires record-keeping
- But cash still very entrenched: Gerdes (2008), Foster et. al. (2011)
  - On the spot, anonymous

Payments system is a two-sided market: usage and adoption decisions jointly determined by both consumers and merchants

- What are the channels through which consumer demand affects merchant acceptance, and vice versa?
This Paper

A theory that captures two-sided market interaction between consumers and retailers: explain usage and adoption of cash and credit cards.

1. Under what conditions can money and credit coexist as means of payment?

2. How does policy and inflation affect the money-credit margin?

3. What are the welfare effects of different payment arrangements?
This Paper

Model needs *frictions* for both *money and credit* to be used as means of payment: build on Lagos and Wright (2005) to include....

1. **Costly record-keeping**
   - Retailers can invest in costly record-keeping technology to verify, record transactions → *endogenous acceptability of credit*

2. **Limited enforcement**
   - Lenders cannot force borrowers to repay debts → self-enforcing debt contracts, *endogenous credit constraint*
Main Insights

1. **Coexistence of money and credit** at individual consumer level
   - Requires moderate inflation: lowers rate of return on money but relaxes debt limits
   - Requires heterogeneous record-keeping: Kocherlakota (1998)

2. **Strategic complementarities** in retailers’ decision to invest and buyer’s debt limit → multiple steady-state equilibria
   - Network externalities in credit adoption: hysteresis, hold-up problems

3. **Welfare in money and credit economy** can dominate welfare in pure money and pure credit economy
The Coexistence of Money and Credit as Means of Payment

The Model

Environment

Continuum $[0, 2]$ of agents: evenly divided among buyers and sellers

Each period divided in 2 sub-periods

1. Decentralized retail market (DM): bilateral meetings
   - Buyers want to consume output, $q$, that only sellers can produce

2. Competitive market (CM): centralized settlement system
   - Numéraire, $x$, produced with linear technology in labor

Buyer’s preferences: $\mathbb{E} \sum_{t=0}^{\infty} \beta^t \left[ \underbrace{u(q_t)}_{\text{DM}} + \underbrace{U(x_t) - h_t}_{\text{CM}} \right]

Seller’s preferences: $\mathbb{E} \sum_{t=0}^{\infty} \beta^t \left[ -\underbrace{c(q_t)}_{\text{DM}} + \underbrace{U(x_t) - h_t}_{\text{CM}} \right]$
Money and Credit

**Frictions**: limited commitment and enforcement, limited record-keeping

Money grows / shrinks at constant rate $\gamma = \frac{M_{t+1}}{M_t}$

Costly record-keeping technology that can record agents’ transactions
  - (For now) Investment in technology infinitely costly for $(1 - \Lambda)$ of sellers, costless for $\Lambda$ of sellers
  - (Later: heterogeneous fixed costs of investing to endogenize $\Lambda$)

Centralized credit system: contracts written in DM can be repaid in CM
  - $b \in \mathbb{R}_+$ units of (one-period) IOUs, worth one unit of numéraire
  - Any default is publicly recorded
  - Punishment for default is permanent exclusion from use of credit (defaulter can only use money for all future trades)
Terms of Trade

Kalai (1977)’s proportional bargaining rule

- Buyer gets $\theta \in (0, 1)$ of total surplus

Contract $(q, d, b)$ solves

$$(q, d, b) = \arg \max_{q,d,b} \{ u(q) - d - b \}$$

subject to

$$u(q) - d - b = \theta [u(q) - c(q)]$$

$\begin{align*}
d & \leq z \\
& \text{feasibility} \\

b & \leq \bar{b} \\
& \text{incentive compatibility}
\end{align*}$$
Limited Enforcement and Debt Limits

Determine debt limit, $\bar{b}$, s.t. debt repayment is incentive compatible:

$$-b + W^b(z, 0) \geq \tilde{W}^b(z)$$

buyer repays debt \hspace{1cm} buyer reneges

$$b \leq \bar{b} \equiv W^b(0, 0) - \tilde{W}^b(0)$$

cost of default

Equilibrium debt limit $\bar{b}$ solves

$$r\bar{b} = \Omega(\bar{b})$$

where

$$\Omega(\bar{b}) \equiv \max \{ -iz + \sigma \theta [(1 - \Lambda) S(z) + \Lambda S(z + \bar{b})] \} - \max \{ -i\tilde{z} + \sigma \theta S(\tilde{z}) \}$$

flow cost of defaulting
Pure Credit Economy

- Agents have to be patient enough to sustain credit: $r < \sigma \Lambda \frac{\theta}{1-\theta}$
- Need threshold fraction of sellers to accept credit: $\Lambda > \bar{\Lambda} \equiv \frac{r(1-\theta)}{\sigma \theta}$
Pure Monetary Economy

- Money valued iff inflation not too high: \( i < \bar{i} \equiv \sigma \frac{\theta}{1-\theta} \)
- Credit not feasible if \( i < \bar{i} \equiv \frac{r}{\lambda} \)
Money and Credit Economy

- Given $\bar{b}$, money valued iff $i < \bar{i}$
- Given $z > 0$, debt repayment incentive compatible if $i > i$
Money and Credit Equilibrium Not Possible When $\Lambda = 1$
Coexistence of Money and Credit

The Coexistence of Money and Credit as Means of Payment

Equilibrium with Limited Enforcement
Costly Record-Keeping

Sellers can invest ex-ante in costly record-keeping technology

- Per-period cost of investing: $\kappa$, drawn from CDF $F(\kappa) : \mathbb{R}_+ \rightarrow [0, 1]$.

\[
\max \left\{ -\kappa + \sigma(1-\theta)S(z + \bar{b}), \sigma(1-\theta)S(z) \right\}
\]

seller invests

seller does not invest

Threshold for record-keeping cost: $\bar{\kappa} \equiv \sigma(1-\theta)[S(z + \bar{b}) - S(z)]$

Individual seller’s decision to invest: $\lambda(\kappa) \in [0, 1]$ satisfies

\[
\lambda(\kappa) = \begin{cases} 
1 & \text{if } \kappa < \bar{\kappa} \\
[0, 1] & \text{if } \kappa = \bar{\kappa} \\
0 & \text{if } \kappa > \bar{\kappa}.
\end{cases}
\]

Aggregate measure of sellers who invest: $\Lambda \equiv \int_0^\infty \lambda(\kappa)dF(\kappa) = F(\bar{\kappa})$
Equilibrium $\bar{b}$ and $\Lambda$ if $i < \bar{i}$ (Money Valued)
Equilibrium $\bar{b}$ and $\Lambda$ if $i \geq \bar{i}$ (Money Not Valued)
Internal Multiplier Effects

Consider a **decrease in record-keeping costs**, $\kappa$

- Benefit of investing $\uparrow \rightarrow \Lambda \uparrow \rightarrow$ benefit of borrowing $\uparrow \rightarrow$ debt limit relaxes $\rightarrow \overline{b} \uparrow \rightarrow$ benefit of investing $\uparrow \rightarrow \Lambda \uparrow \ldots$.

Similar feedback effect for an **increase in inflation rate**, $\gamma$

- Rate of return on money $\downarrow \rightarrow$ cost of default $\uparrow \rightarrow$ debt limit relaxes $\rightarrow \overline{b} \uparrow \rightarrow$ benefit of investing $\uparrow \rightarrow \Lambda \uparrow \ldots$.
Conclusions

A simple theory of money and credit as means of payment

- Two-sided aspect in payment markets: strategic complementarities → network externalities, coordination failures in payment adoption

Lessons for payment systems

- Entrenchment of cash: hold-up problems in technological adoption
- Internal multiplier effects even for small changes in policy
- Economies with similar technologies can still end up with different payment systems

In progress: quantitative analysis

- Calibrate model to U.S. economy using data from SCF, Boston Fed SCPC