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
   - Williamson (1987), Townsend (1989), Freeman and Kydland (2000), Nosal and Rocheteau (2011), Lester, Postlewaite, Wright (2012)...

2. **Limited enforcement**
   - Lenders cannot force borrowers to repay debts → self-enforcing debt contracts, endogenous credit constraint
   - Kehoe and Levine (1993), Alvarez and Jermann (2000)

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 $\rightarrow$ 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

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 $\gamma \equiv \frac{M_{t+1}}{M_t}$

Costly record-keeping technology that can record agents' transactions

- (For now) Investment in technology infinitely costly for $(1 - \Lambda)$ of sellers, costless for Λ of sellers
- (Later: heterogeneous fixed costs of investing to endogenize Λ)

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

$$(q, d, b) = \arg\max_{q,d,b} \underbrace{\{u(q) - d - b\}}_{\text{buyer's surplus}}$$

$$\text{s.t. } u(q) - d - b = \theta \underbrace{[u(q) - c(q)]}_{\text{total surplus}}$$

$$\underbrace{d \leq z}_{\text{feasibility}}$$

$$\underbrace{b \leq \overline{b}}_{\text{incentive compatibility}}$$

Limited Enforcement and Debt Limits

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

$$\underbrace{-b + W^b(z,0)}_{\text{buyer repays debt}} \geq \underbrace{\widetilde{W}^b(z)}_{\text{buyer reneges}}$$

$$b \leq \overline{b} \equiv \underbrace{W^b(0,0) - \widetilde{W}^b(0)}_{\text{cost of default}}$$

Equilibrium debt limit $\overline{b}$ solves

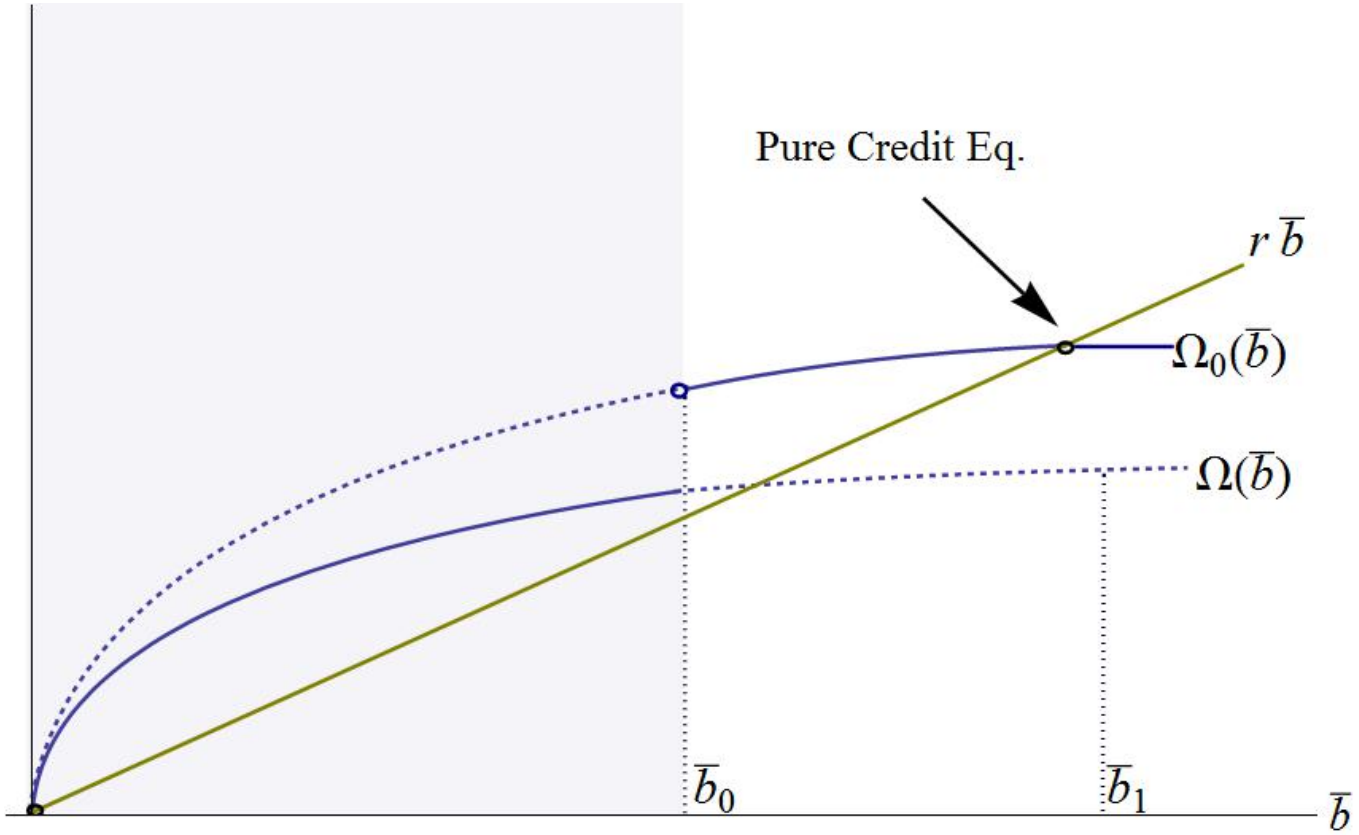
$$r\overline{b} = \Omega(\overline{b})$$

where

$$\Omega(\overline{b}) \equiv \underbrace{\max_z \left\{-iz + \sigma\theta\left[(1-\Lambda)S(z) + \Lambda S\left(z+\overline{b}\right)\right]\right\} - \max_{\widetilde{z}} \left\{-i\widetilde{z} + \sigma\theta S(\widetilde{z})\right\}}_{\text{flow cost of defaulting}}$$

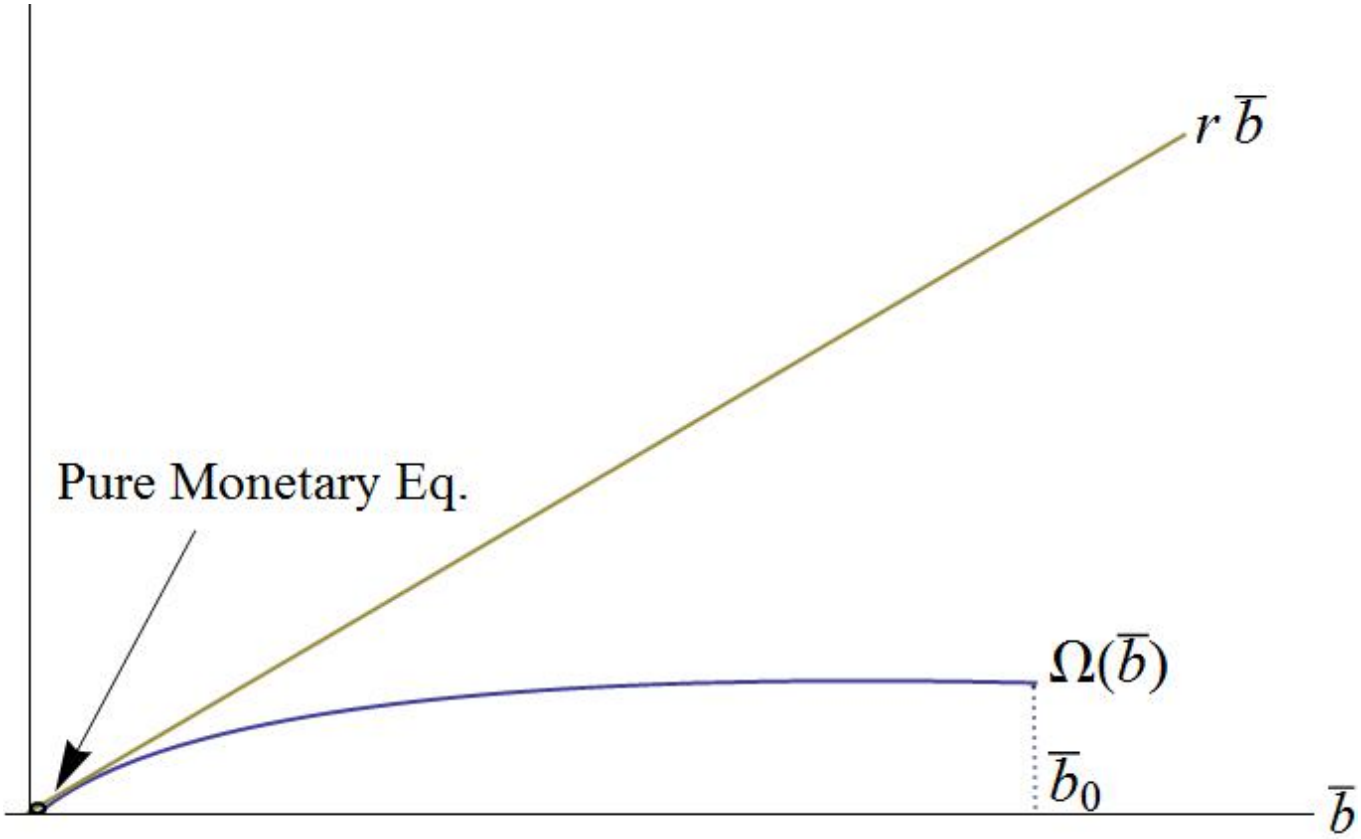
Pure Credit Economy

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



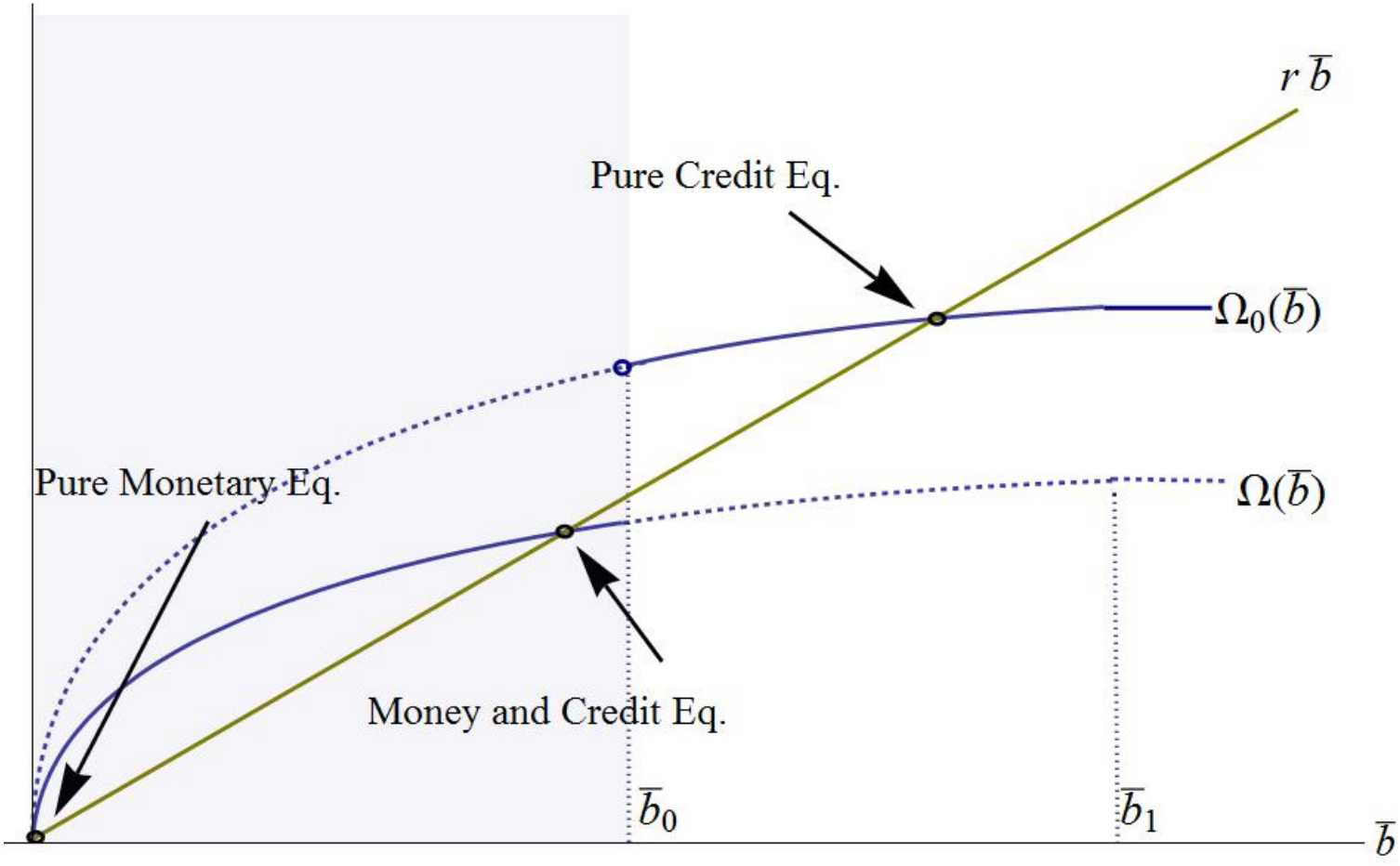
Pure Monetary Economy

- Money valued iff inflation not too high: $i < \bar{i} \equiv \sigma \frac{\theta}{1-\theta}$
- Credit not feasible if $i < \underline{i} \equiv \frac{r}{\Lambda}$

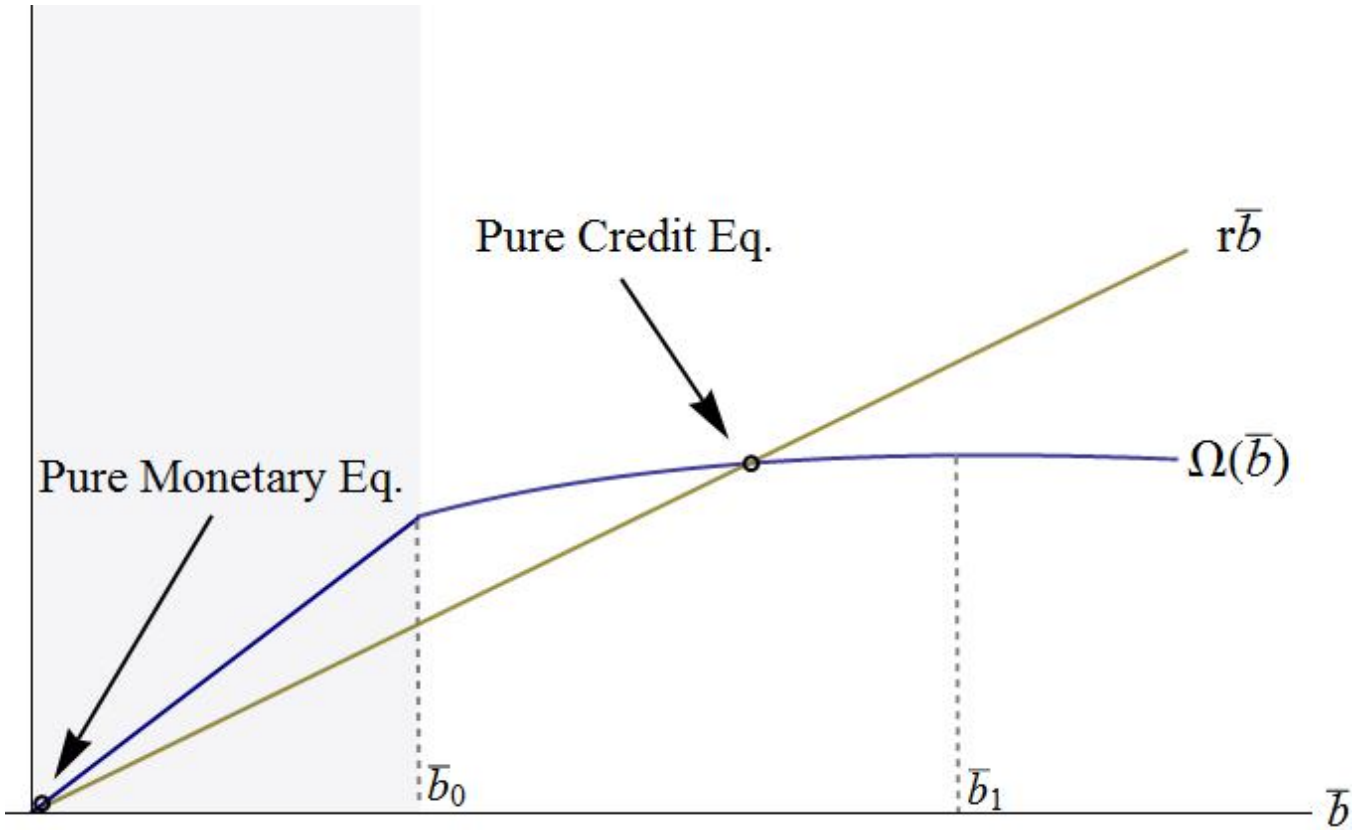


Money and Credit Economy

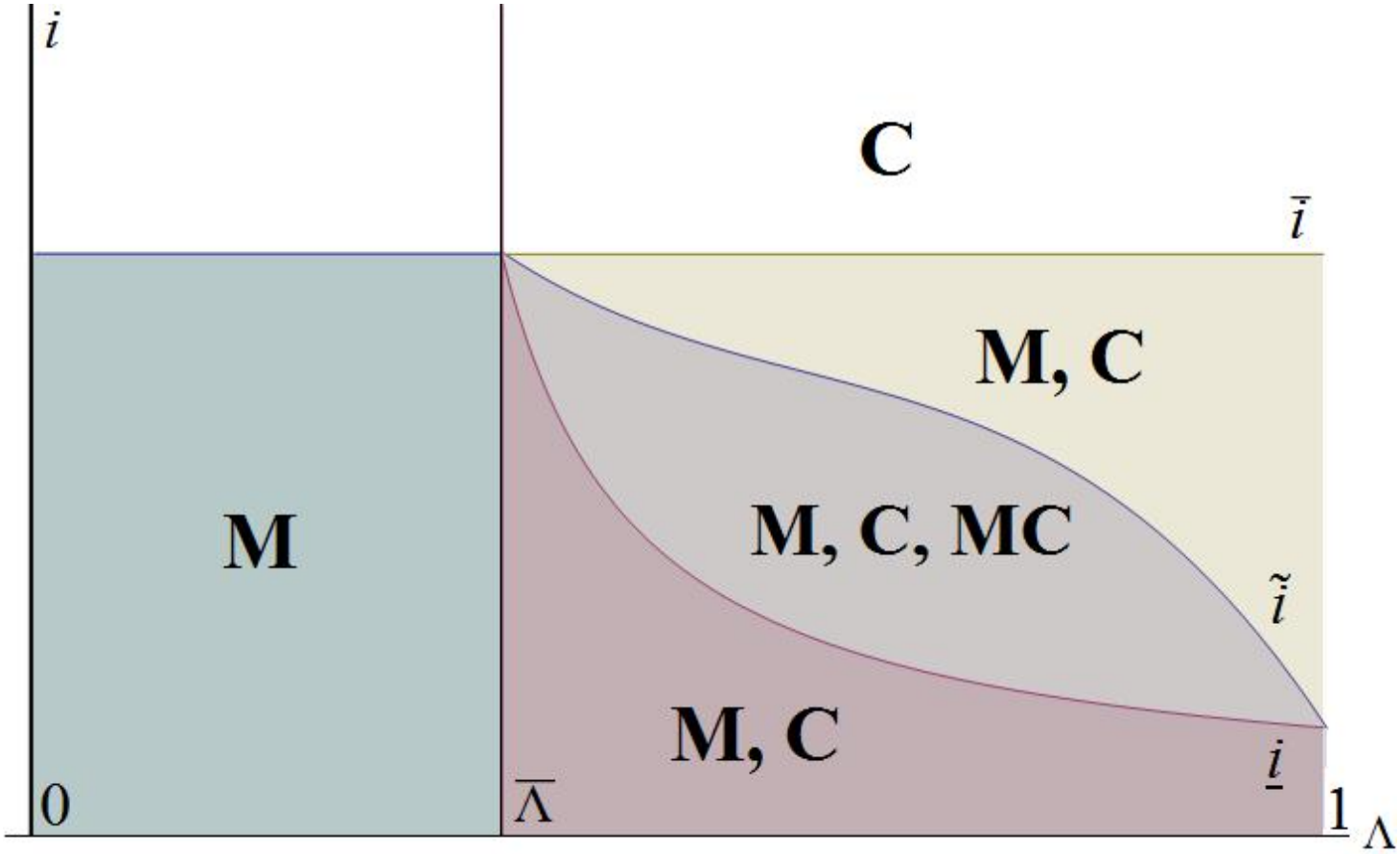
- Given $\overline{b}$, money valued iff $i < \widetilde{i}$
- Given $z > 0$, debt repayment incentive compatible if $i > \underline{i}$



Money and Credit Equilibrium Not Possible When $\Lambda = 1$



Coexistence of Money and Credit



Costly Record-Keeping

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

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

$$\max\{\underbrace{-\kappa + \sigma(1-\theta)S(z+\overline{b})}_{\text{seller invests}}, \underbrace{\sigma(1-\theta)S(z)}_{\text{seller does not invest}}\}$$

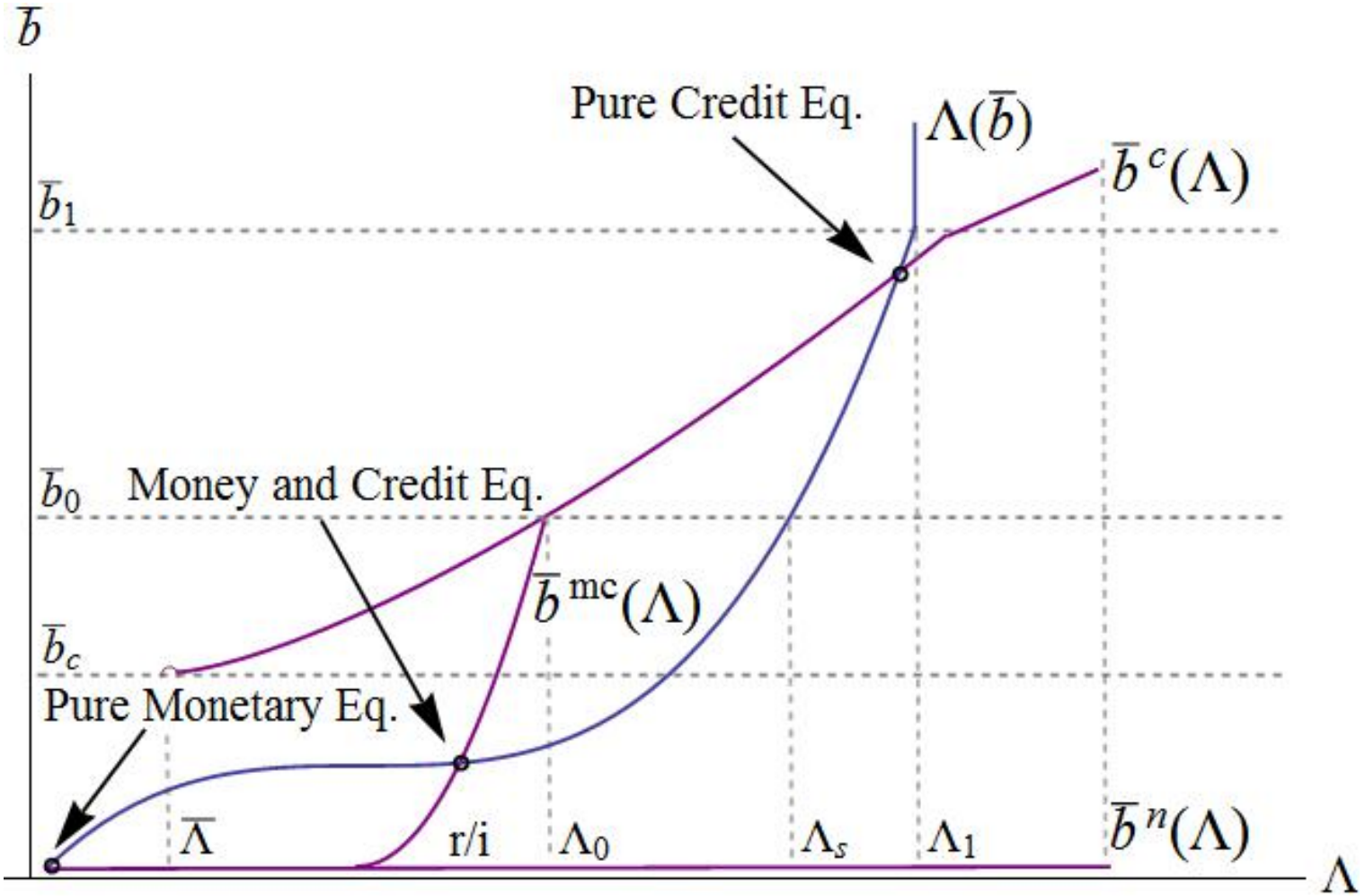
Threshold for record-keeping cost: $\overline{\kappa} \equiv \sigma(1-\theta)[S(z+\overline{b}) - S(z)]$

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

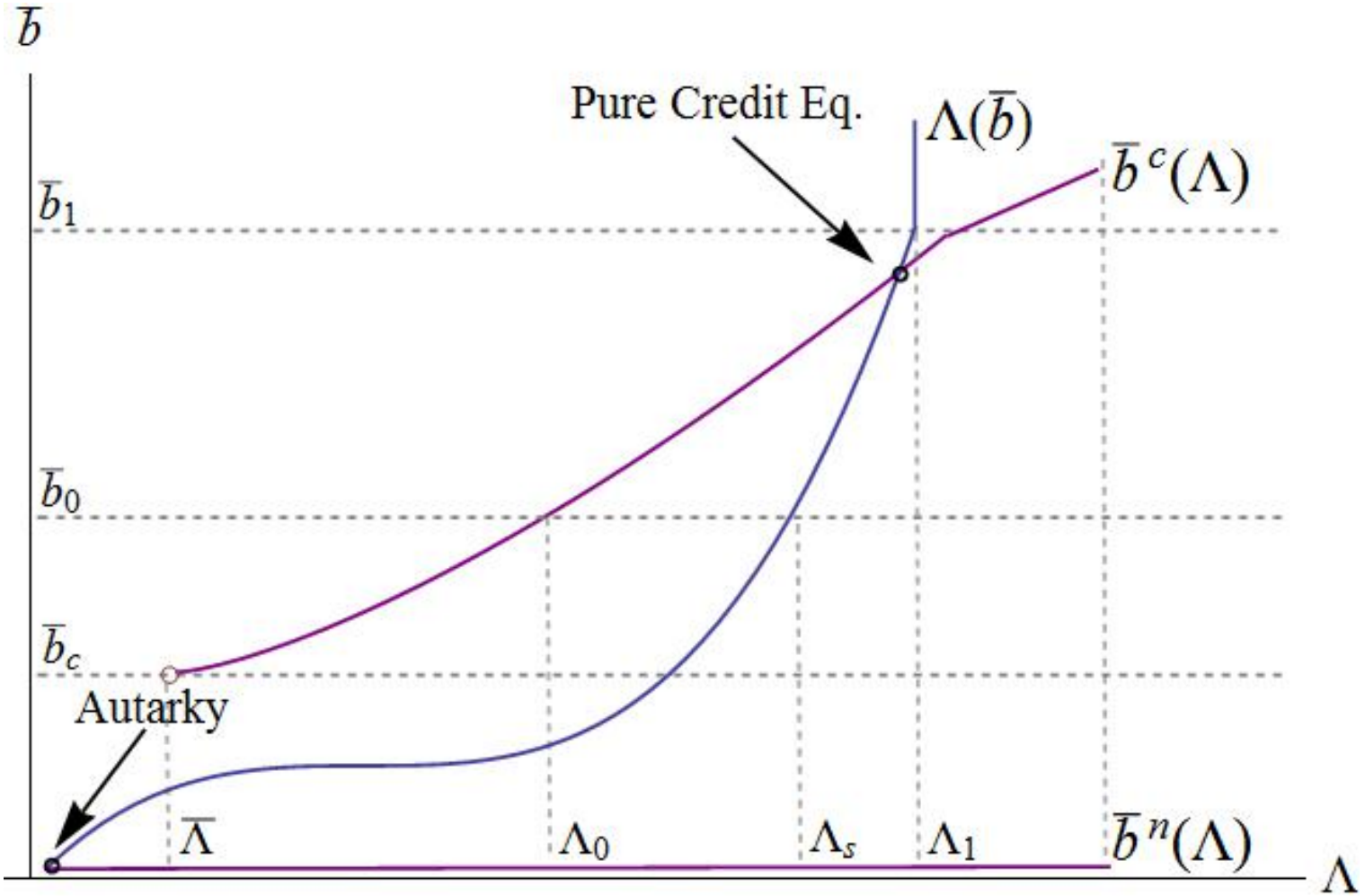
$$\lambda(\kappa) = \begin{cases} 1 \\ [0,1] \\ 0 \end{cases} \text{ if } \kappa \begin{cases} < \\ = \\ > \end{cases} \overline{\kappa}.$$

Aggregate measure of sellers who invest: $\Lambda \equiv \int_0^\infty \lambda(\kappa) dF(\kappa) = F(\overline{\kappa})$

Equilibrium $\bar{b}$ and Λ if $i < \bar{i}$ (Money Valued)



Equilibrium $\bar{b}$ and Λ if $i \geq \bar{i}$ (Money Not Valued)



Internal Multiplier Effects

Consider a **decrease in record-keeping costs**, κ

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

Similar feedback effect for an **increase in inflation rate**, γ

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

Conclusions

A **simple theory of money and credit** as means of payment

- Two-sided aspect in payment markets: strategic complementarities
  $\rightarrow$ 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