Inside Money, Liquidity Dry-up and Market Power

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Motivation

- Money is supplied by the central banks instead of markets.
- Repeated failures in issuing money with decentralization
  1. Wild-cat banking in the U.S. Free-Banking Era (Gorton(2013))
     - Private bank-notes circulates with a discount.
  2. A liquidity dry-up in the financial market during the recent Great Recession (Gorton-Metrick(2012))
     - Asset-backed securities are used for collateral transactions with a haircut.
- The role of government
  - Self-regulated system: Klein(1974), Hayek(1974), King(1983), and Calomiris-Kahn(1996)
  - Centralization: Friedman and Schwartz (1986) - the risk of fraud and the externality

Questions

- Money is supported by a franchise value or asset-holdings.
  - Franchise value: Monnet and Sanches(2015), Sanches(2016)
- Is the decentralized liquidity provision efficient? If the assets are scarce? If the assets are opaque?
  - The opacity of the backed assets: Kaplan(2006), Andolfatto et al.(2014), Dang et al.(2017)
- If not, can a monopoly be an alternative? What types of regulations are effective?
  - Pecuniary externality: Gerbach(1998), Hart-Zingales(2011), Benigno-Robatto(2019), Luck-Schempp(2019)

What I do

- Construct a monetary exchange model where
  1. Money is required for one type of transactions, while assets are used for the other type of transactions.
  2. Bankers can issue money by holding assets and/or with their franchise values.
  3. Bankers create fake assets at a proportional cost under opacity.

- Compare the competitive and the monopoly equilibrium with the efficient allocations to understand the trade-offs.

Preview of Results

- An inefficient liquidity dry-up arises when the assets are scarce and the faking cost is small.
  - Market failure: the decentralized bankers cannot internalize the effect of money issuance on prices.
- The single supplier is a price maker.
  - He/she can correct the pecuniary externality.
  - The maximized profit can be beneficial to support money transactions.
- An entry barrier can recover the efficiency.

The environment

- Time $t = 0, 1, 2, \ldots, \infty$ with two sub-periods *CM, DM*.
- Agents
  1. Buyers: $\sum_{t=0}^{\infty} \beta^t [-H_t + u(x_{1t}) + u(x_{2t})]$, $-\frac{xu''(x)}{u'(x)} = \sigma$,
  2. Sellers: $\sum_{t=0}^{\infty} \beta^t [X_t - h_t]$
  3. Bankers: $\sum_{t=0}^{\infty} \beta^t [X_t^i - H_t^i]$
- Technology
  - Both CM and DM goods can be produced at a linear cost.
- Market structure
  - CM: Walrasian, DM: Bilateral matching w/ bargaining
- Information
  - No memory and limited commitment
  - Trade is *quid pro quo* with money.

The environment, II

- Assets
  - One unit of real asset provides a dividend y in each period.
- Bankers
  - Cannot access to DM, but can issue money.
  - Can create fake assets at a cost of γ per unit of assets.

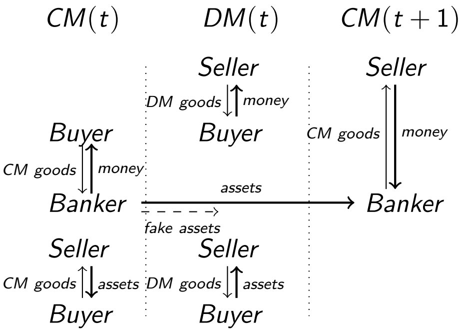


Figure: Transaction Process

Maximization problems

- Given prices (q_t, ψ_t), an individual banker maximizes:

$$\underset{a_t^i, \bar{m}_t \geq 0}{Max} \ J_t = -\psi_t a_t^i + \beta(\psi_{t+1} + y)a_t^i + q_t \bar{m}_t - \beta \bar{m}_t + \beta J_{t+1}$$

$$s.t. \quad \beta(\psi_{t+1} + y)a_t^i \theta_t + \beta J_{t+1} \geq \beta \bar{m}_t, \quad (LC)$$

$$-\psi_t a_t^i + \beta(\psi_{t+1} + y)a_t^i + q_t \bar{m}_t - \beta \bar{m}_t + \beta J_{t+1} \geq -\gamma a_t^i + q_t \bar{m}_t. \quad (IC)$$

- Given prices (q_t, ψ_t), a representative buyer solves:

$$\underset{m_t, a_t, x_{1t}, x_{2t} \geq 0}{Max} - q_t m_t - \psi_t a_t + \rho u(x_{1t}) + (1-\rho)u(x_{2t})$$

$$s.t. \quad \beta m_t \geq \rho x_{1t}, \quad (CC)$$

$$\beta(\psi_{t+1} + y)a_t \geq (1-\rho)x_{2t} \quad (CC)$$

- The asset and money markets clear:

$$a_t + a_t^i = 1, \quad (MC)$$

$$m_t = \bar{m}_t. \quad (MC)$$

Equilibrium conditions

$$
\begin{aligned}
q_t &= \beta u^{'}(x_{1t}), && (Buyer's\ FOC) \\
\psi_t &= \beta(\psi_{t+1} + y)u^{'}(x_{2t}), && (Buyer's\ FOC) \\
\theta_t &= 1 - \frac{\psi_t - \gamma}{\beta(\psi_{t+1} + y)}, && (IC) \\
\underbrace{\psi_t - \beta(\psi_{t+1} + y)}_{MC\ of\ holding\ assets} &= \underbrace{(q_t - \beta)(\psi_{t+1} + y)\theta_t}_{MB\ of\ issuing\ money}, && (Issuer's\ FOC) \\
\beta \bar{m}_t &\leq \beta(\psi_{t+1} + y)a_t^i \theta_t \\
&\quad + \frac{\beta}{1-\beta}\left[\{-\psi_t + \beta(\psi_{t+1} + y)\}a_t^i + (q_t - \beta)\bar{m}_t\right] && (LC)
\end{aligned}
$$

Efficient allocations

- Social welfare function:
  $W_t = \rho\{u(x_{1t}) - x_{1t}\} + (1-\rho)\{u(x_{2t}) - x_{2t}\} + y$
- The first best is $x_{1t} = x_{2t} = x^*$ where $u'(x^*) = 1$.

Definition 2

Given (γ, y), a stationary optimal allocation consists of $(a, a^i, x_1, x_2, m, \bar{m}, q, \psi, \theta)$ which maximize the social welfare W subject to the buyer's FOCs, LC, IC, CCs and MCs.

- Cases
  1. $x_1 = x_2 = x^*$ and $\theta = 1$, if $\gamma \geq \psi_f \geq x^*$ where $\psi_f := \frac{\beta y}{1-\beta}$.
  2. $x_1 = x_2 = x^*$ and $\theta = \frac{\gamma}{\psi_f} < 1$, if $\psi_f \geq x^*$ and $\frac{\rho x^*}{\gamma} + \frac{(1-\rho)x^*}{\psi_f} \leq 1$
  3. $x_1 = x_2 < x^*$ and $\theta = 1$, if $\psi < x^*$ and $\gamma \geq \psi = \frac{\beta y u'(x_2)}{1-\beta u'(x_2)}$ where $x_2(1-\beta u'(x_2)) = \beta y$.
  4. $x_1 < x_2 < x^*$ and $\theta < 1$, if $\gamma < \psi < x^*$.

Competitive equilibrium

- Zero profit: $u'(x_2) - 1 = \theta(u'(x_1) - 1)$
- LC: $\rho x_1 = \frac{\beta\rho x_1(u'(x_1)-1)}{1-\beta} +$
$$\begin{cases} \frac{\beta y-(1-\rho)x_2(1-\beta u'(x_2))}{1-\beta}, & \text{if } \theta = 1 \\ \frac{\beta y-(1-\rho)x_2(1-\beta u'(x_2))}{1-\beta u'(x_2)}\{\theta - \frac{\beta(u'(x_2)-1)}{1-\beta}\}, & \text{if } \theta \in (0,1) \end{cases}$$
where $\theta = \frac{\gamma(1-\beta u'(x_2))}{\beta y} - u'(x_2) + 1.$ B/S link

Definition 1

Given (γ, y), a stationary competitive equilibrium consists of $(a, a^i, x_1, x_2, m, \bar{m}, q, \psi, \theta)$ which satisfy the FOCs, LC, IC, CCs and MCs.

- Outcomes are the same as planner's except for $\gamma < \psi < x^*$.

Inefficient liquidity dry-up

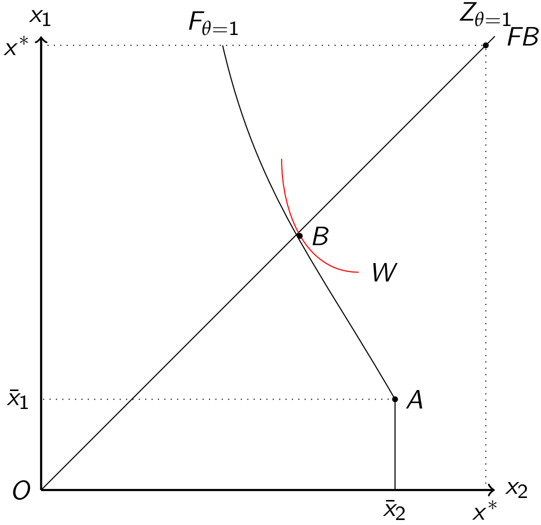


Figure: Competitive Equilibrium

Inefficient liquidity dry-up

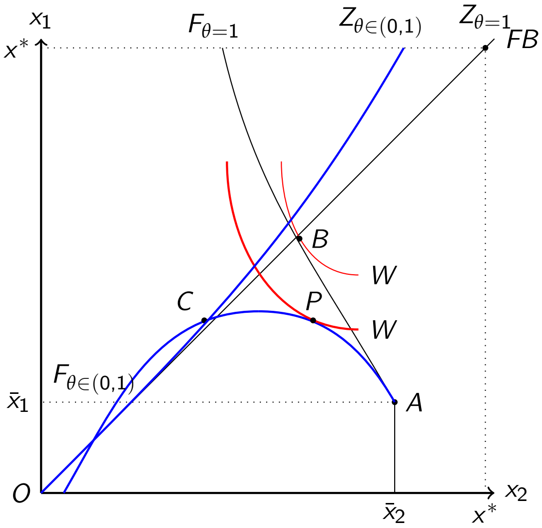


Figure: Competitive Equilibrium

Monopoly equilibrium

- A monopoly banker maximizes the profit by considering the price effect:

$$\underset{a_t^i,\bar{m}_t,\psi_t,q_t,\theta_t\geq 0}{Max} \quad \Pi_t = -\psi_t a_t^i + \beta(\psi_{t+1} + y)a_t^i + q_t\bar{m}_t - \beta\bar{m}_t \quad (1)$$

where $J_t = \frac{\Pi_t}{1-\beta}$.

Definition 3

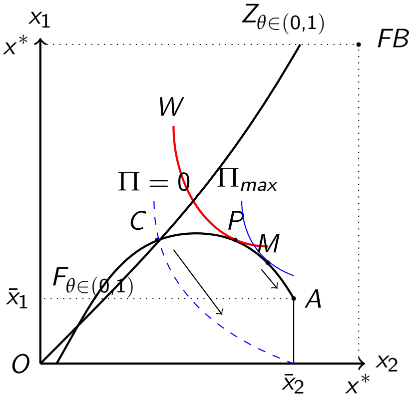
Given (γ, y), a stationary monopoly equilibrium consists of $(a, a^i, x_1, x_2, m, \bar{m}, q, \psi, \theta)$ which maximizes Eq. (1) subject to the buyer's FOCs, IC, CC, PC and MCs.

Monopoly rent

- Cases
  1. $x_1 = \hat{x}_1 < x^*$, $x_2 = x^*$ where $(1-\sigma)u'(\hat{x}_1) = 1$ and $\theta = 1$, if $1-\sigma < \beta$ and $\gamma \geq \psi_f \geq (1-\rho)x^*$.
  2. $x_1 = \hat{x}_1 < x^*$, $x_2 = x^*$ and $\theta = 1$, if $1-\sigma \geq \beta$ and $\gamma \geq \psi_f \geq \rho(\hat{x}_1 - \bar{x}_1) + (1-\rho)x^*$
  3. $x_1 = \hat{x}_1 < x^*$, $x_2 < x^*$ and $\theta = 1$, if $\psi < (1-\rho)x^*$ $\gamma \geq \psi = \frac{\beta y u'(x_2)}{1-\beta u'(x_2)}$ where $x_2(1-\beta u'(x_2)) = \beta y$.
  4. $x_1 < x_2 < x^*$ and $\theta = 1$, if $\psi < x^*$ and $\gamma \geq \psi = \frac{\beta y u'(x_2)}{1-\beta u'(x_2)}$ where $x_1(1-\beta u'(x_1)) + x_2(1-\beta u'(x_2)) = \beta y$.
  5. $x_1 < x_2 < x^*$ and $\theta < 1$, if $\gamma < \psi < x^*$.
- The allocations are suboptimal when the assets are plentiful: the maximum money issuance is $\hat{x}_1 < x^*$ for the monopoly rent.

Trade-offs

- The monopoly banker can rewind the liquidity dry-up when assets are scarce under opacity.
- He/she holds less assets to lower the price of asset to raise the pledgeability.
- Consequently, the aggregate liquidity supply is well-managed: the both transactions increase with the higher franchise value.



Comparison

Proposition 1

If y and γ are sufficiently small and β is sufficiently large, then $W_M > W_C$.

Lemma 1

If $\bar{\gamma} < \gamma < \bar{\psi}_c$, then $\theta_m > \theta_c$, where $\bar{\gamma} = \frac{\beta y(u'(\bar{x}_2)-1)}{1-\beta u'(\bar{x}_2)}$.

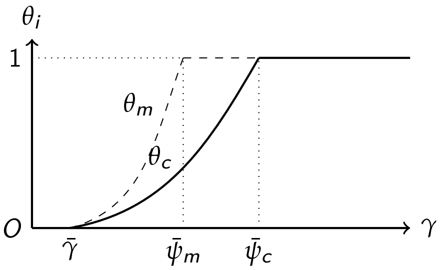


Figure: Pledgeability Comparison

Entry barrier

- The efficiency can be recovered by collecting an entry cost, κ.
- The hump-shaped curve remains as long as the assets are opaque.

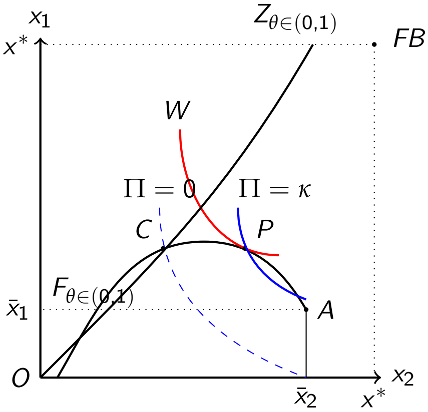


Figure: Entry Barrier

Conclusion

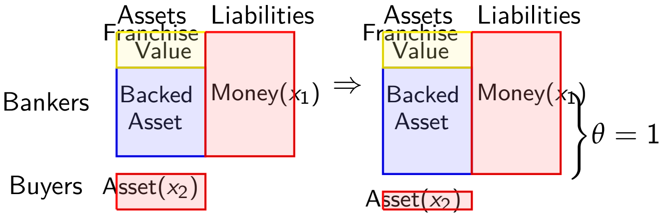
- This paper explores the circumstance where the competitive bankers issue money under the opacity.
  1. Concentrated banking system could be better if it is costly to monitor or supervise decentralized many banks, especially in recessions.
  2. If an asset is demanded for other purposes, it becomes more costly to use it as collateral: Plentiful and illiquid assets are preferred for backing.
- Other unexplored issues:
  - Role of central bank assets
  - Fiscal limits and central bank transparency
  - Optimal monetary policy with opaque assets

Thank you!

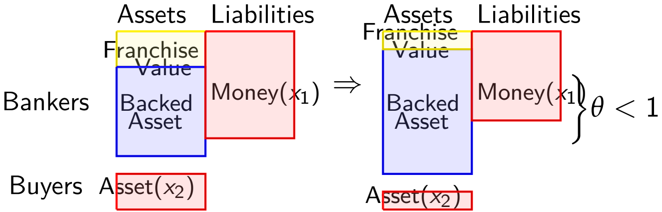
Liquidity Dry-up

back

i) IC does not bind($\theta = 1$): $x_2 \downarrow$, $\psi \uparrow$, $x_1 \uparrow$

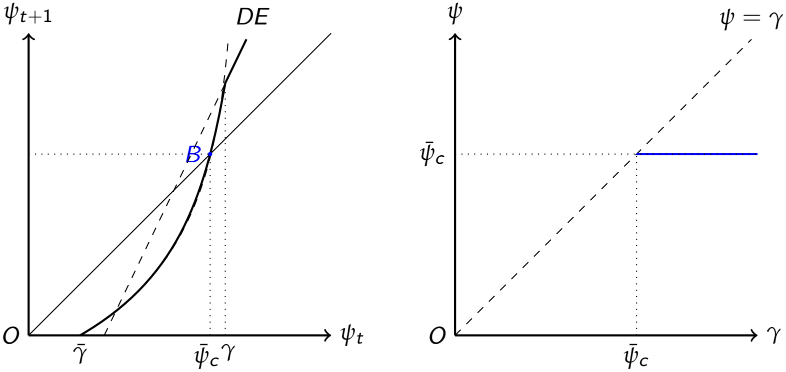


ii) IC binds($\theta < 1$): $x_2 \downarrow$, $\psi \uparrow$, $\theta \downarrow$, $\Pi \downarrow$, $x_1 \Downarrow$



Equilibrium case (i)

- When the faking cost is high, $\gamma \geq \bar{\psi}_c$, IC does not bind with $\theta = 1$.
- No effect on the price of money, $q = 1$.
- The monetary equilibrium is unique and stable.

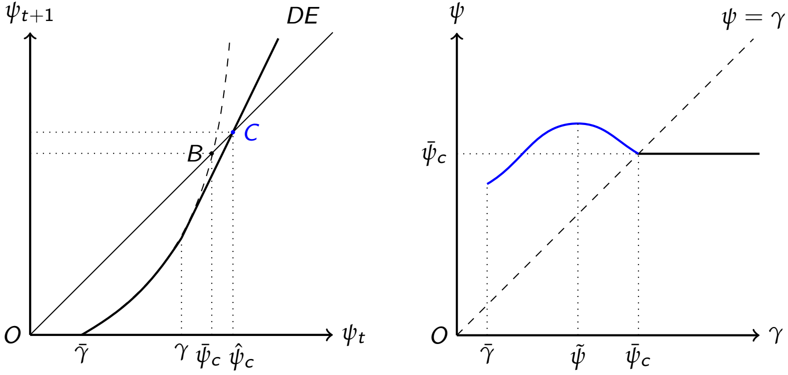


(a) Dynamic Equation

(b) Steady-State Asset Price

Equilibrium case (ii)

- When the faking cost is intermediate, $\bar{\gamma} < \gamma < \bar{\psi}_c$, IC binds with $\theta \in (0, 1)$.
- The price of money, $q > 1$, goes up.
- The monetary equilibrium is unique and stable.

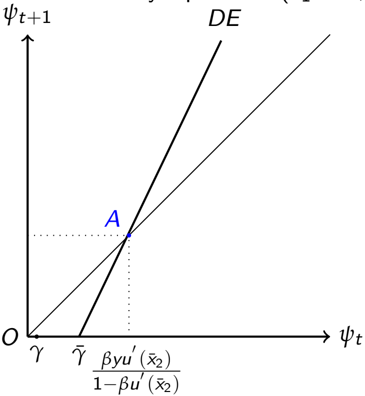


(a) Dynamic Equation **(b)** Steady-State Asset Price

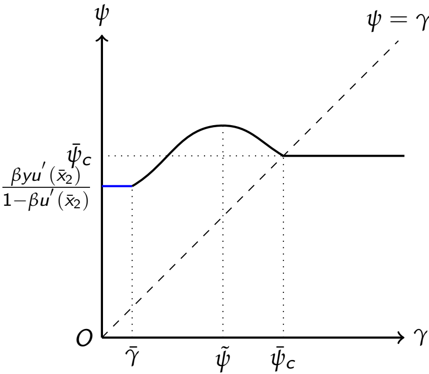
Equilibrium case (iii)

back

- When faking cost is low, $\gamma \leq \bar{\gamma}$, IC binds with $\theta = 0$.
- Non-monetary equilibrium($x_1 = 0$, $a = 1$) is unique and stable.



(a) Dynamic Equation



(b) Steady-State Asset Price