Financial Intermediaries, Asset Transformation, and Liquidity

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Road map of the talk

- Motivations:
  - assets' liquidity and their characteristics
  - the role for financial intermediaries
- The environment:
  - markets; assets; banks
  - private information
- Types of equilibria
  - banks' portfolios
  - asset liquidity and prices
  - welfare implications for banks

Motivations

Imperfect recognizability of an asset's authenticity or true value weakens its usefulness as a payment instrument or collateral.

- During 2007-2008, asset-backed securities became hard to serve as collateral, due to the complexity in these assets that hinders investors to verify their true value.
- Some banknotes ceased to circulate since they were threatened by counterfeits by the 1850s in the U.S.

Motivations

- Akerlof (1970):
  goods with lemons problem $\longrightarrow$ market failure
  - there is a role for middlemen to facilitate trades

- This paper:
  assets with imperfect recognizability $\longrightarrow$ market failure
  $\longrightarrow$ liquidity $\longrightarrow$ output

Can financial intermediaries improve aggregate liquidity and welfare in an economy with private information?

Objectives

- frictions: the quality of real assets is private information.
- liquidity: the role of assets in payments.

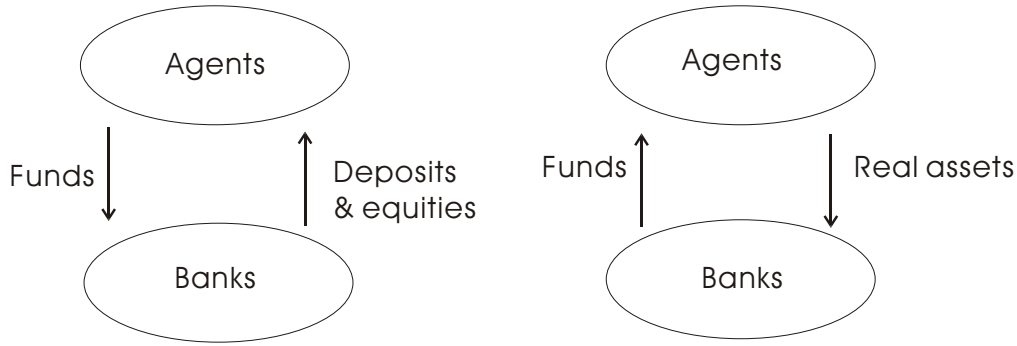
(Lagos (2010), Rocheteau (2011), Li and Rocheteau (2010))

To provide a theory of asset liquidity and explore implications for

1. the relationship between assets' characteristics, liquidity, and asset prices;
2. the effects of banks on liquidity and welfare.

Features of banks

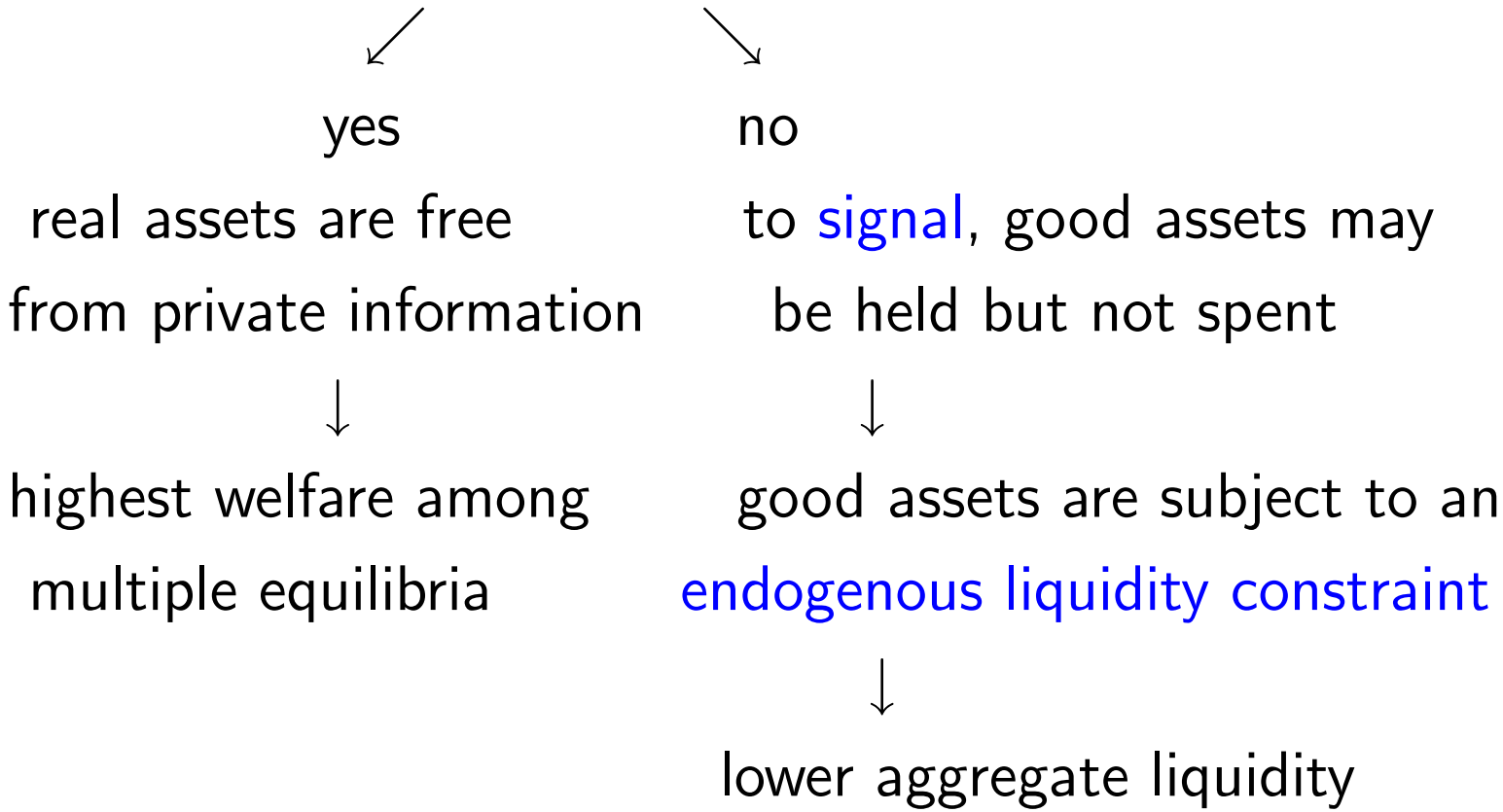
- Asset transformation



  - banks' portfolios are public information;
  - deposits and bank equity: recognizable means of payment.
- Banks have no informational advantages over individuals
  - price-quantity schedules in the asset market: screening assets' quality.

Main insights

Can banks' screening eliminate the private information problem?



Related literature

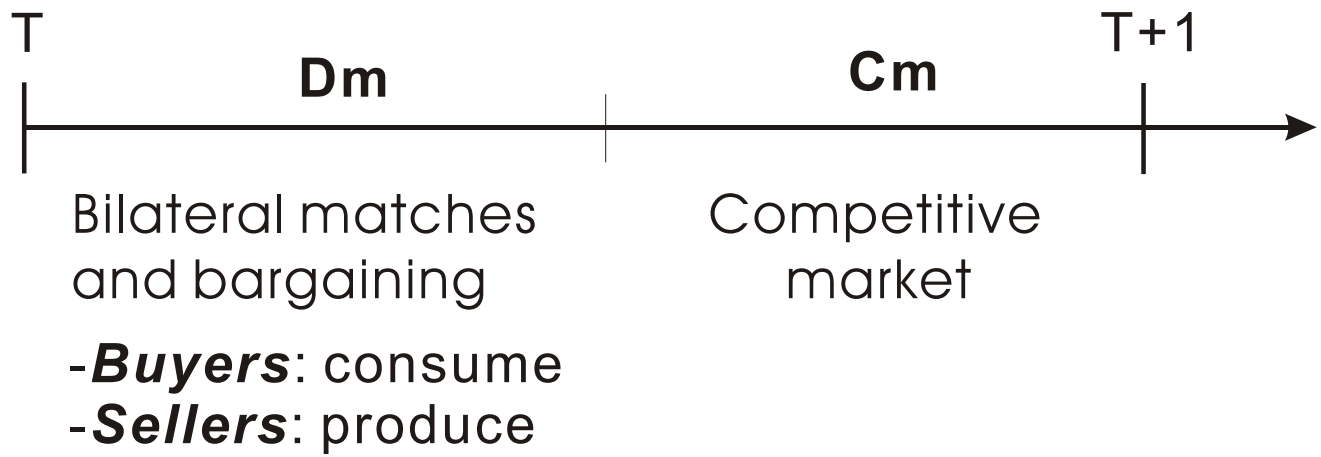
- Liquidity constraints:
  Kiyotaki and Moore (2005, 2008), Lester et al. (2008), Li and Rocheteau (2010), Tomura (2010).

- The recognizability of assets:
  Lester et al. (2008), Green and Weber (1996), Nosal and Wallace (2007), Rocheteau (2011).

- Bank liabilities serve as payments:
  Gorton and Pennacchi (1990), Williamson (1999).

The environment

- Each period contains a DM and a CM
  - DM: decentralized market
  - CM: competitive market
- Two types of agents: *Buyers* and *Sellers*



Trades

DM: buyers and sellers meet bilaterally and randomly

- the buyer makes a take-it-or-leave-it offer
  - output: x_1
  - assets transferred from buyer: (y_a, y_d, y_e)
- buyers: utility $u_1(x_1)$; sellers: disutility $c_1(x_1)$

Trades

CM: all agents consume and produce

- each buyer is endowed with A^E units of real assets
  - one-period-lived assets
  - the private signal about the quality of A^E
- production technology: $x_2 = h$
- banks open
  - portfolio choices: deposits and bank equity
- an asset market opens in late CM

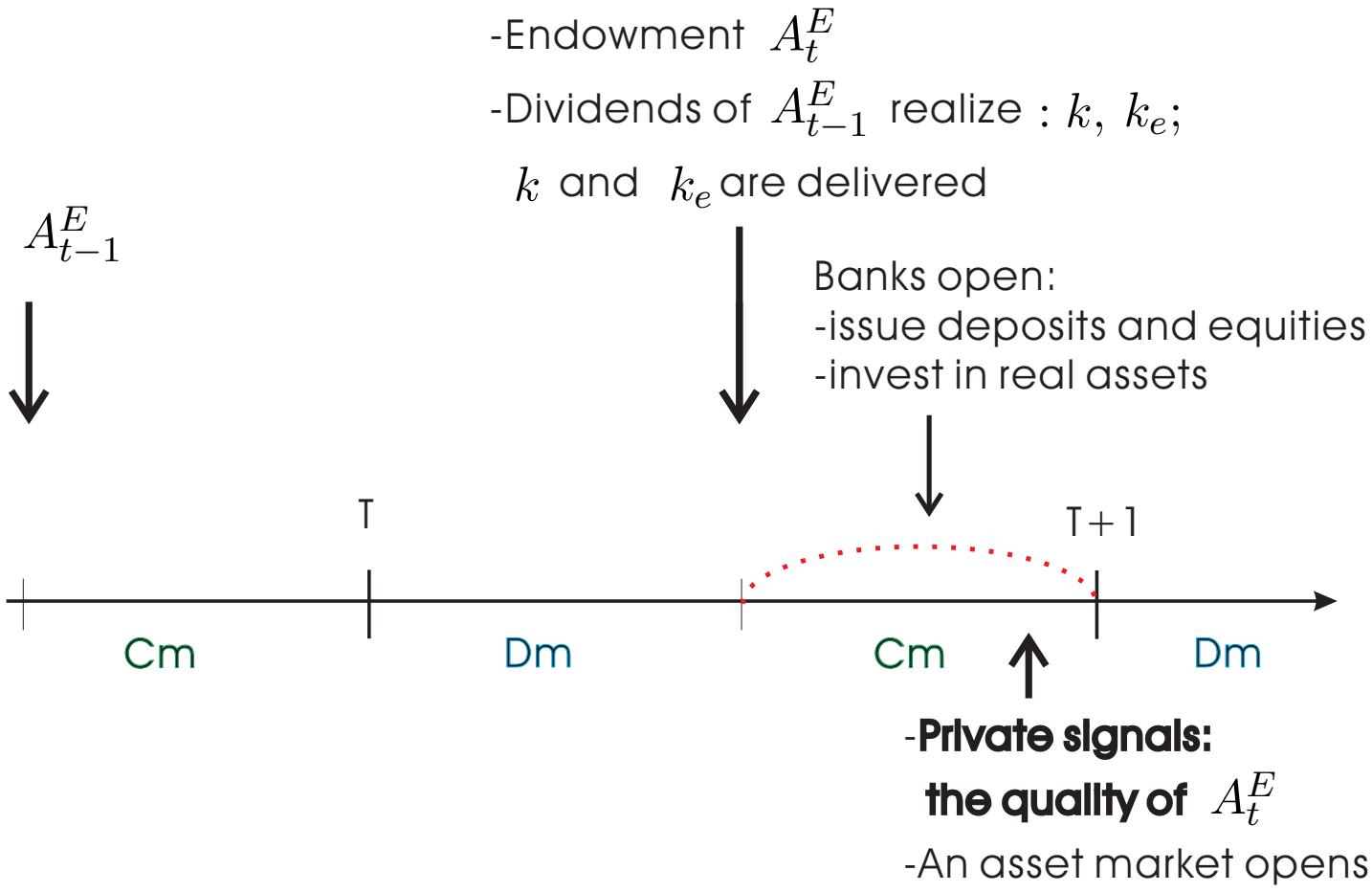
In DM, buyers use assets to make payments

▷ deposits and bank equity

▷ real assets may be subject to private information problem

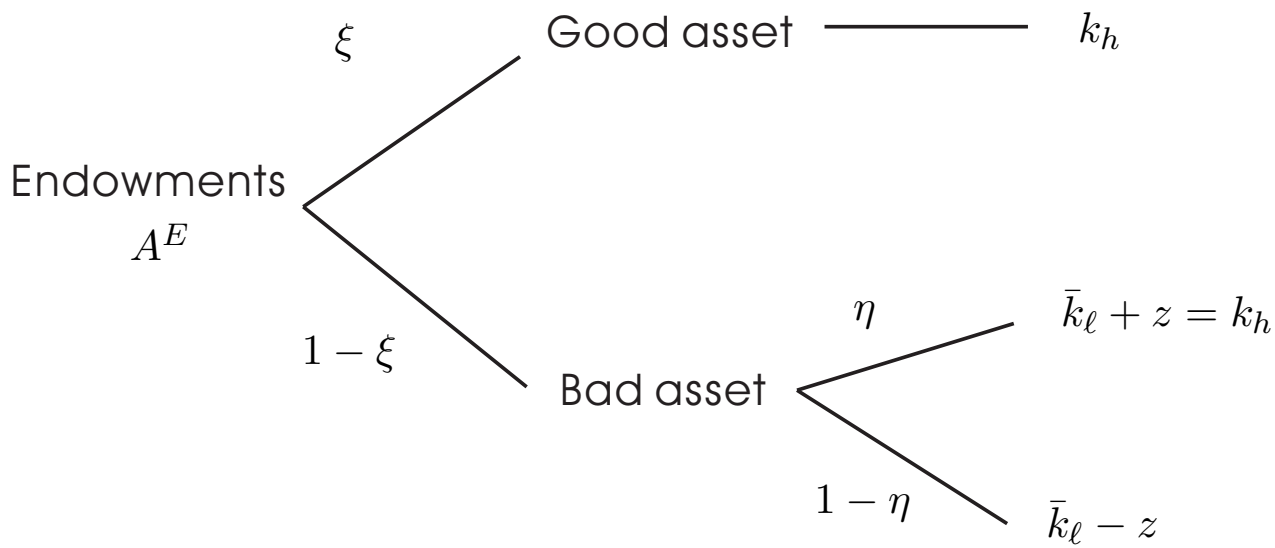
$\Rightarrow$ private information regarding means of payment

Time sequence



Private information

The quality of real assets:



- The expected value of bad assets is lower than that of good assets.

Agents' problem in the CM

The value function of a buyer is

$$W^b(a,d,e;k_j) = \max_{x_2,h,a',d',e'} \{x_2 - h + \beta V^b_{j,+1}(a',d',e')\}$$

$$s.t.\ \ x_2 + d' + q_e e' = h + k_j a + (1+i)d + k_e e + q_a^{j,+1}(A^E - a')$$

- k_j: dividends of asset j, $j \in \{h,\ell\}$;
  k_e: dividends of bank equity; q_e: the price of bank equity;
- i: deposit interest rate; $q_a^{j,+1}$: price of asset $j,+1$.
- $V^b_{j,+1}(a',d',e')$: buyer's value function in the DM of period $t+1$.

Value function in the DM

(x_1, y_a, y_d, y_e): the quantity of outputs and transfers of assets.

- The buyer's value function is,

$$V_j^b(a', d', e') = S_j(a', d', e') + k_j a + (1+i)d + k_e e + W^b(0,0,0)$$

  - $S_j(a', d', e')$: buyer's surplus from trade in the DM
  - $S_j(a', d', e') \equiv u_1[x_1(y_a, y_d, y_e)] - k_j y_a(a', d', e')$
    $-(1+i)y_d(a', d', e') - k_e y_e(a', d', e')$

Portfolio choices

- All buyers choose the same d and e;

$$\frac{1-(1+i)\beta}{\beta} \geq \xi S_{h,2}(a,d,e)+(1-\xi)\{\eta[S_{h,2}(a,d,e)+(1-\eta)S_{\ell,2}(a,d,e)]\},$$

$$\text{“}=\text{”} \ \ \textit{if} \ \ d>0.$$

$$\frac{q_e-k_e\beta}{\beta} \geq \xi S_{h,3}(a,d,e)+(1-\xi)\{\eta[S_{h,3}(a,d,e)+(1-\eta)S_{\ell,3}(a,d,e)]\},$$

$$\text{“}=\text{”} \ \ \textit{if} \ \ e>0.$$

- q_a^j: determined by banks' problem in the asset trade.

$$\frac{q_a^h-k_h\beta}{\beta} \geq S_{h,1}(a,d,e) \quad \text{“}=\text{”} \quad \textit{if} \quad a_h>0.$$

$$\frac{q_a^\ell-k_\ell\beta}{\beta} \geq S_{\ell,1}(a,d,e) \quad \text{“}=\text{”} \quad \textit{if} \quad a_\ell>0.$$

Banks' flow of funds

- Source of funds: deposits, equity, and dividends from bank assets
- Use of funds: investments, dividend and interest payments
- Flow of funds in period t is

$$k_e E + (1+i)D + q_a^h \Omega_h^{'} + q_a^\ell \Omega_\ell^{'} = D^{'} + q_e E^{'} + (k_h \Omega_h + k_\ell \Omega_\ell).$$

  - Ω_j: the quantity of asset j banks hold in period t.

Banks' problem in the asset market

Banks want to buy ω_j units of asset j, at the price q_a^j, $j = h, \ell$

$$\max_{q_a^h, q_a^\ell, \omega_h, \omega_\ell} \xi[-q_a^h \omega_h + \beta k_h \omega_h] + (1-\xi)[-q_a^\ell \omega_\ell + \beta k_\ell \omega_\ell]$$

$$\text{s.t.} \quad q_a^h \omega_h + \beta V_h^b(a_h, d, e; k_h) \geq \beta V_h^b(A^E, d, e; k_h), \tag{1}$$

$$q_a^\ell \omega_\ell + \beta V_\ell^b(a_\ell, d, e; k_\ell) \geq \beta V_\ell^b(A^E, d, e; k_\ell); \tag{2}$$

$$q_a^h \omega_h + \beta V_h^b(a_h, d, e; k_h) \geq q_a^\ell \omega_\ell + \beta V_h^b(a_\ell, d, e; k_h), \tag{3}$$

$$q_a^\ell \omega_\ell + \beta V_\ell^b(a_\ell, d, e; k_\ell) \geq q_a^h \omega_h + \beta V_\ell^b(a_h, d, e; k_\ell); \tag{4}$$

$$q_a^h, q_a^\ell \geq 0, \omega_h \leq A^E, \omega_\ell \leq A^E. \tag{5}$$

- Condition (1)-(2): participation constraints.
- Condition (3)-(4): incentive compatibility constraints.

Algorithm to find an equilibrium

Strategy to pin down equilibrium:

1. conjecture a possible portfolio
2. check if the portfolio optimizes agents' and banks' problems in the CM
3. agents' and banks' portfolio choices; market clearing conditions $\longrightarrow a_h, a_\ell, d, e, q_a^h, q_a^\ell, q_e, i, k_e$
4. bargaining in the DM $\longrightarrow$ terms of trade: (x_1, y_a, y_d, y_e)

Types of equilibria

- Banks solve the private information problem:
  1. banks buy all of good assets and zero or some bad assets
  2. banks buy all of bad assets and zero or some good assets

- Banks do not solve the private information problem:
  3. banks buy more good assets than bad ones
  4. banks buy more bad assets than good ones
  5. banks buy the same quantity of good and bad assets

$\Rightarrow$ real assets which serve as payments in the DM are threatened by private information problem

Buyers' offer without private information

Any offer made by a buyer who does not sell all of real assets to banks is,

$$\max_{x_1^j, y_a^j, y_d^j, y_e^j} [u_1(x_1) - k_j y_a - (1+i) y_d - k_e y_e]$$

$$s.t. - c_1(x_1) + k_j y_a + (1+i) y_d + k_e y_e \geq 0,$$

$$y_a \leq a_j, \quad y_d \leq d, \quad y_e \leq e,$$

Any offer made by a buyer who sells all of his real assets to banks is,

$$\max_{x_1^{-j}, y_d^{-j}, y_e^{-j}} [u_1(x_1) - (1+i) y_d - k_e y_e]$$

$$s.t. - c_1(x_1) + (1+i) y_d + k_e y_e \geq 0,$$

$$y_d \leq d, \quad y_e \leq e.$$

Proposition 1 (Asset prices)

When banks buy all one type of assets, deposits, bank equity and real assets have the same liquidity, and $\frac{k_e}{q_e} = 1 + i$.

1. If banks buy all good assets, then $q_a^h > q_a^\ell$.
2. If banks buy all bad assets and $\frac{\sigma_\ell k_\ell}{\sigma_h k_h} > 1$, then

$$q_a^\ell > q_a^h - \beta(k_h - k_\ell),$$

where $\sigma_j \equiv \frac{u_1'(x_1^j)}{c_1'(x_1^j)} - 1$. Moreover, when k_h is large enough such that $\frac{\sigma_\ell k_\ell}{\sigma_h k_h} < 1$, then banks buy good assets at a higher price, i.e., $q_a^h > q_a^\ell$.

Buyers' offer under private information

Any offer made by a buyer with good assets is such that

$$\max_{x_1^h, y_a^h, y_d^h, y_e^h} [u_1(x_1) - k_h y_a - (1+i) y_d - k_e y_e] \tag{6}$$

$$s.t. - c_1(x_1) + k_h y_a + (1+i) y_d + k_e y_e \geq 0, \tag{7}$$

$$u_1(x_1) - k_\ell y_a - (1+i) y_d - k_e y_e \leq u_1(x_1^\ell) - c_1(x_1^\ell), \tag{8}$$

$$y_a \leq a_h, y_d \leq d, y_e \leq e. \tag{9}$$

- In eqm, condition (7) holds with equality because buyers make take-it-or-leave-it offers;
- condition (8) holds with equality to prevent imitating.

Proposition 2 (The pecking-order payment arrangement)

The buyer h's offer, $(x_1^h, y_a^h, y_d^h, y_e^h)$, has the following properties:

- If $(1+i)d + k_e e < c_1(x_1^*)$, then

$$y_d^h = d,$$
$$y_e^h = e.$$

And (x_1^h, y_a^h) satisfies

$$\begin{aligned} k_h y_a^h &= c_1(x_1^h) - (1+i)d - k_e e, \\ u_1(x_1^\ell) - c_1(x_1^\ell) &= u_1(x_1^h) - c_1(x_1^h) \\ &\quad + (1 - \frac{k_\ell}{k_h})[c_1(x_1^h) - (1+i)d - k_e e], \end{aligned}$$

where $x_1^\ell = min\{x_1^*, c_1^{-1}[k_\ell a_\ell + (1+i)d_\ell + k_e e_\ell]\}$.
Moreover, if $a_h > 0$, then $x_1^h < x_1^\ell$ and $y_a^h \leq a_h$.

Proposition 2 (con't)

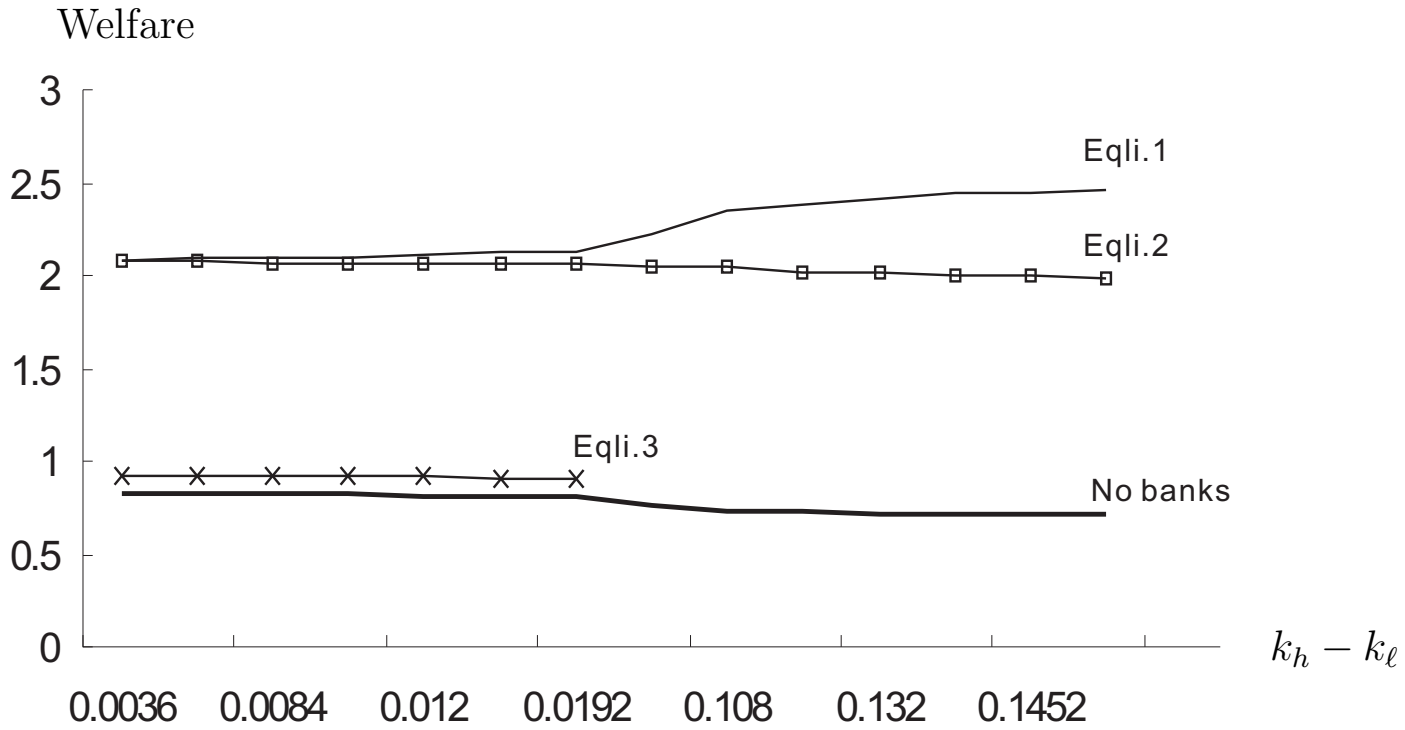
- If $(1+i)d + k_e e > c_1(x_1^*)$, then

$$\begin{aligned} x_1^h &= x_1^* \\ k_h y_a^h + (1+i) y_d^h + k_e y_e^h &= c_1(x_1^*) \\ y_a^h &= 0. \end{aligned}$$

Proposition 3 (The liquidity-price relationship)

When banks do not remove private information problems, good assets are subject to liquidity constraints, and the asset prices are such that $q_a^h < q_a^\ell + \beta(k_h - k_\ell)$.

Welfare



$$\mathbb{W} = \sum_{t \geq 0} \beta^t \int_{j \in h,\ell} [u_1(x_1^j) - c_1(x_1^j)]dj + \sum_{t \geq 0} \beta^t \int_{j \in h,\ell} [u_2(x_2^j) - h^j]dj.$$

eqli.1: banks buy all of good assets, and no bad ones;

eqli.2: banks buy all of bad assets, and no good ones;

eqli.3: banks buy some of good and bad assets.

Conclusion

- Prices of risky real assets are affected by assets' contributions to trades.
- Good assets face an endogenous liquidity constraint under private information.
  - ▷ bank liabilities are preferred means of payment
  - ▷ to signal, good real assets may be held but not spent.
- Banks can improve aggregate liquidity and welfare by providing recognizable assets, even if they are not able to verify assets' quality.
- When bank liabilities are backed with high quality real assets, the economy achieves the highest welfare.