Optimal Liquidity Policy

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Forum on Systemic Risk and Liquidity

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The Bailout Tracker

Program	Committed	Invested	Description
		Troubled Asset Relief Program	
Capital Purchase	288	275	Preferred shares (banks, AIG)
Public-Private Investment	100	27	Purchase toxic assets
Asset Guarantee	13	5	Backstop loan losses (Citi, BoA)
		...	
TARP Total (billions)	700	356	
		Federal Reserve Rescue Efforts	
ABCP Money Market Fund	n/a	0	Finance banks to buy ABCP
Primary Dealer Credit	n/a	0	Lending to investment banks
Term Auction Facility	500	110	Lending to commercial banks
Commercial Paper Funding	1,800	14	Buy ST corporate debt
Loan-loss backstop	317	0	Backstop loan losses (Citi, BoA)
GSE MBS purchases	1,250	776	Buy MBS to reduce rates
GSE debt purchases	200	150	Buy debt of Fannie and Freddie
Bear Stearns bailout	29	26	Loss guarantee to JPMorgan
		...	
Fed Total (billions)	6,400	1,500	

Source: http://money.cnn.com/news/storysupplement/economy/bailouttracker/index.html

Research Objectives

- What is the market failure in liquidity provision?
- What do various policy interventions achieve?
- How to assess their efficiency?

Our Approach

- Set up a simple model of liquidity demand and supply
- Interpret policy interventions using the model framework
- Assess the efficiency of various interventions under different market conditions

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- The notion of illiquidity: An example
  - 100 sellers would like to each sell a shares at $50 per share
  - Only 20 buyers are in the market to purchase at $30 per share
  - Sellers consider the asset illiquid if they believe
    - There should be 100 potential buyers who should be willing to pay $50 per share,
    - However, for whatever reason, these buyers are not present.

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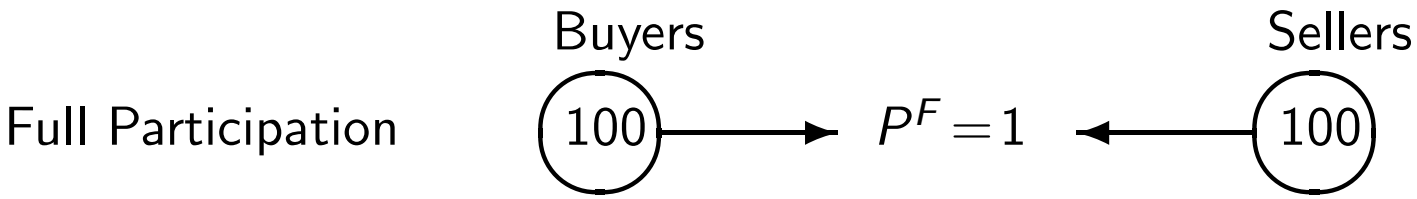
    - However, for whatever reason, these buyers are not present.
- How to capture this notion of illiquidity in the most straightforward way?
- We assume agents face participation costs that prevents them from continuously participating in the market

What Are the Costs?

- Costly market presence
  - Set up and maintain trading operations
  - Gather and process information
  - Implement trading strategies
- Slow movement of capital
  - Institutional rigidities
  - Agency issues
- Ex ante vs ex post costs
  - Market makers: pay a lower cost c_m to always participate
  - Traders: pay a higher spot c to participate only if needed

The Paper in a Nutshell



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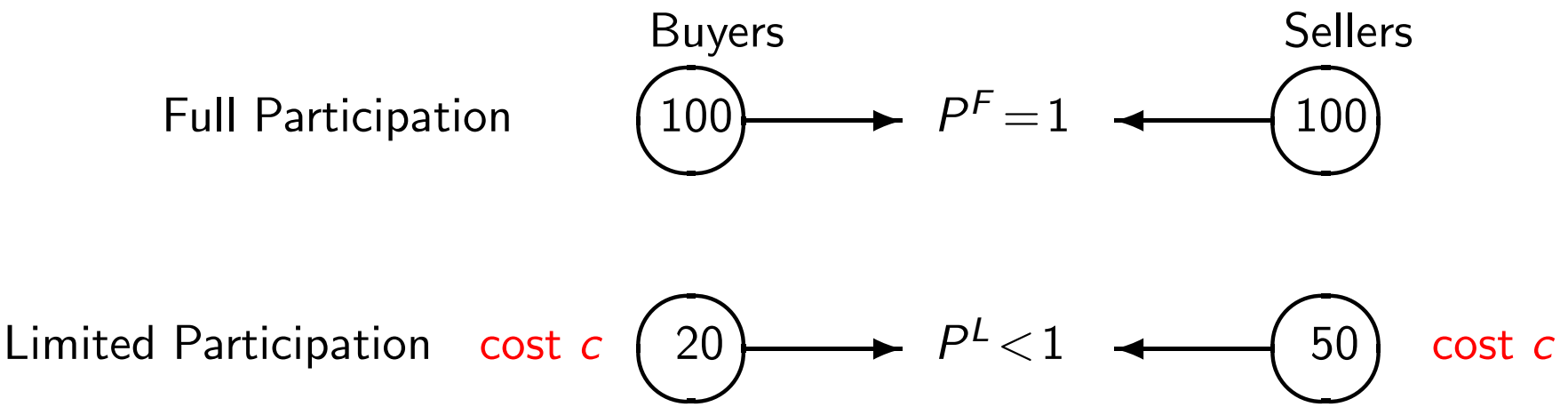

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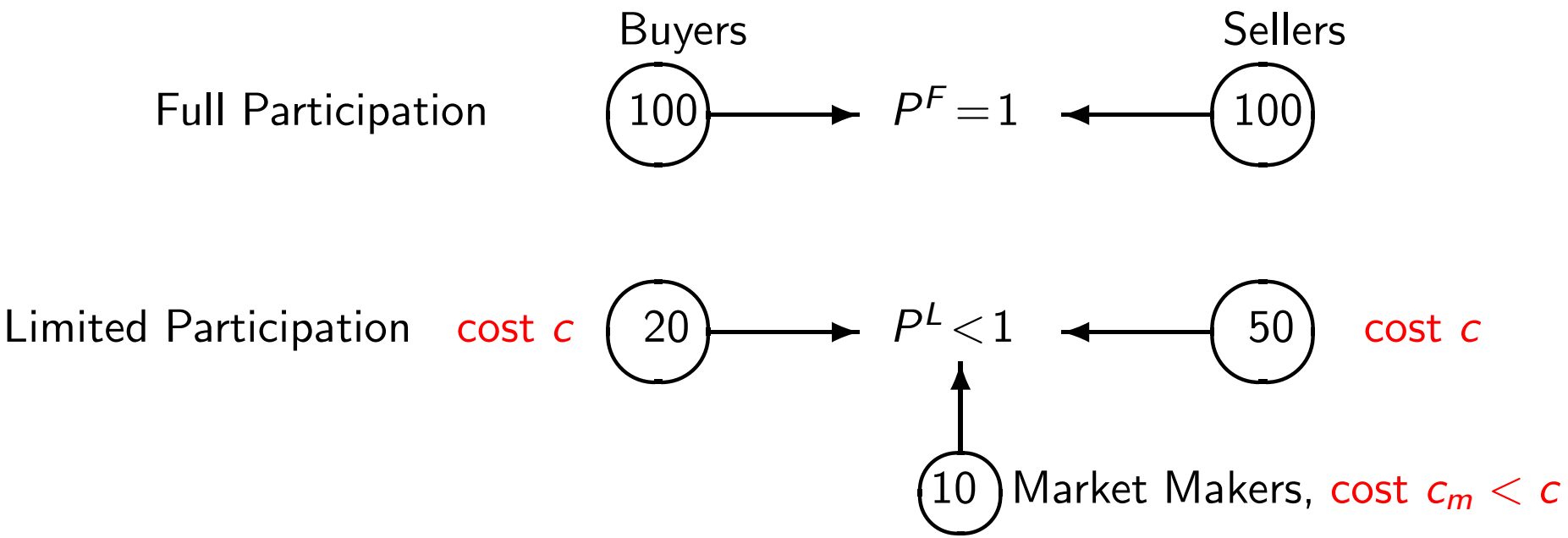

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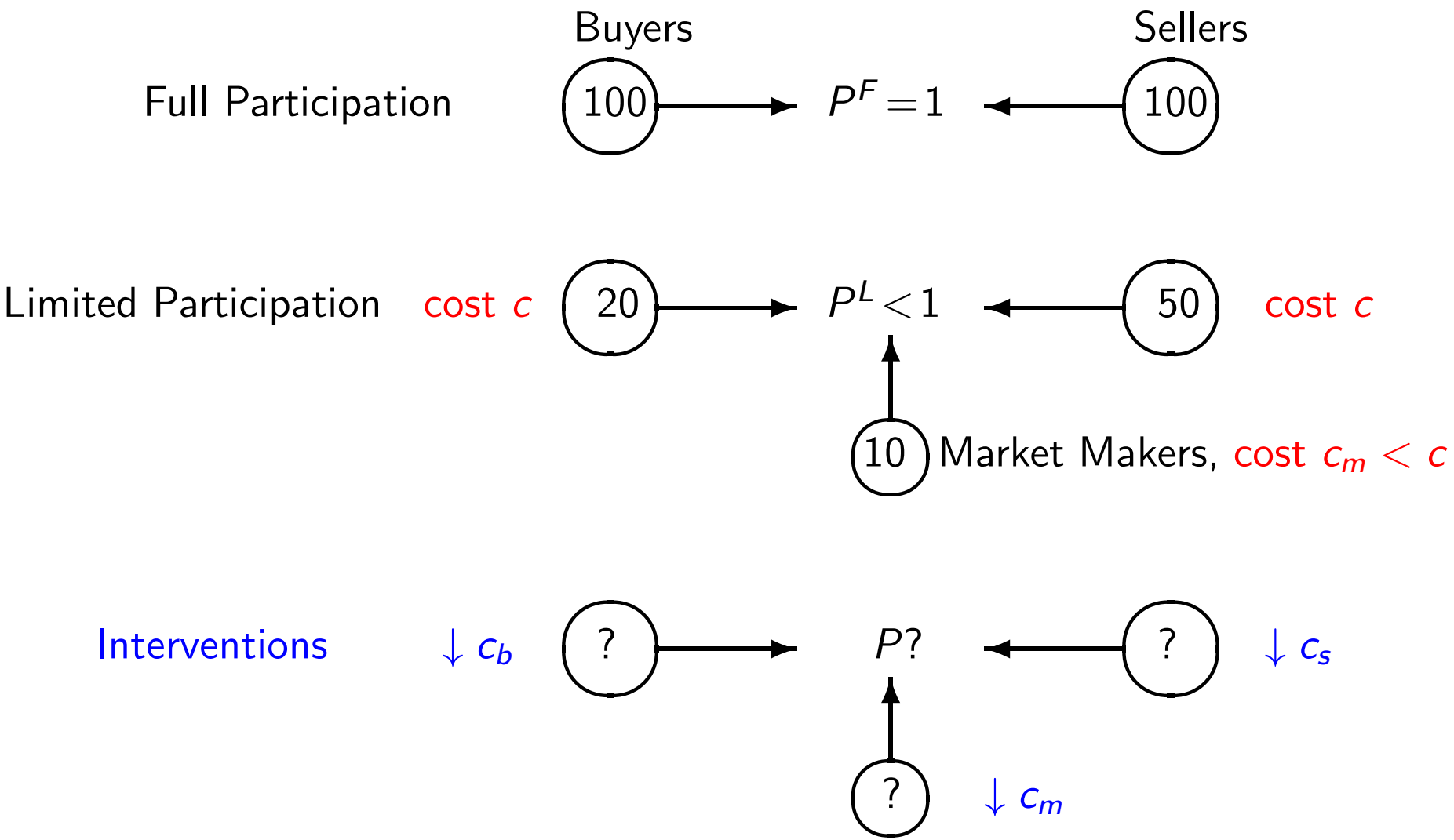


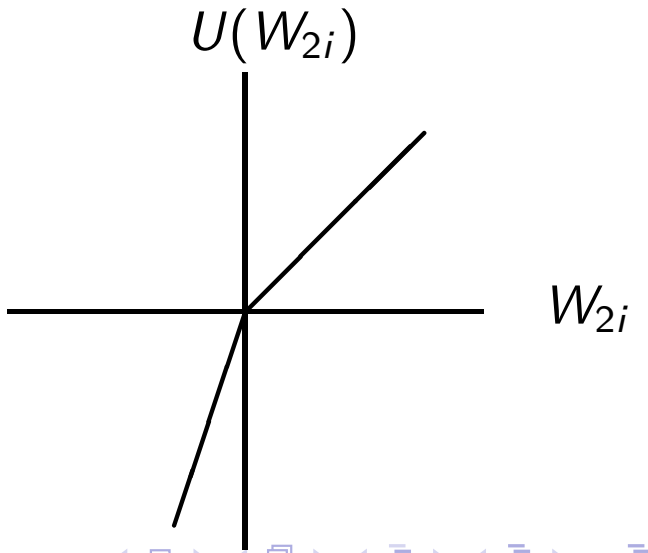
Main Results

- Competitive market fails to lead to efficient supply of liquidity.
- Ex ante liquidity provision is too low when liquidity events are rare and too high when liquidity events are more likely.
- Spot liquidity provision is always too low.
- The total liquidity provision is always too low.
- Policies need to address both ex ante and spot inefficiencies.
  - Subsidizing liquidity providers ex ante might lead to too much liquidity when liquidity events are rare.
  - Spot intervention can be ineffective and sometimes value destructive even before taking into account the cost of intervention.
  - Spot interventions that subsidize buyers can be less effective than those that subsidize sellers.

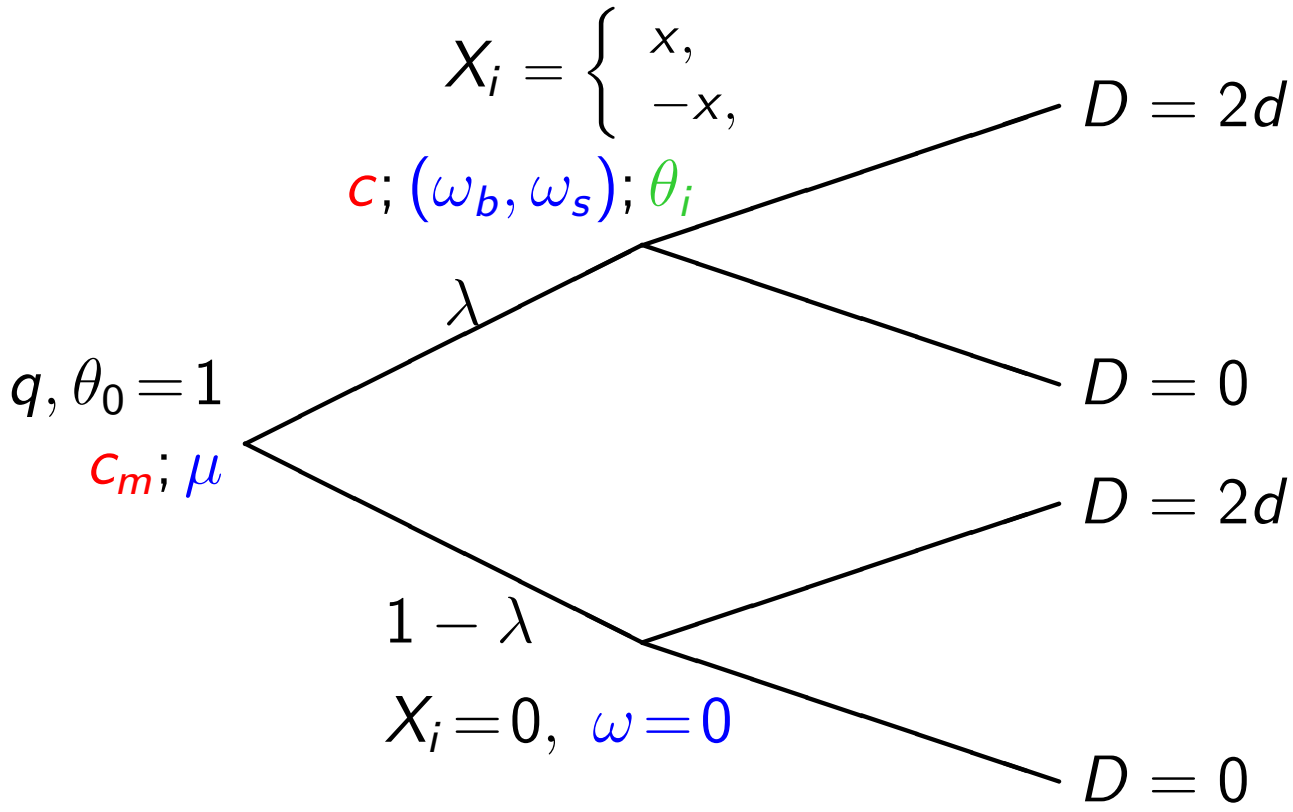
Model Setup

1. Time: $t = 0, 1, 2$.
2. Assets:
   - Stock, supply $\theta = 1$. Payoff at $t = 2$, $D = 2d$ or 0
   - Bond, numeraire, $r = 0$.
3. Agents maximize the following expected utility:

$$U(W_{2i}) = \begin{cases} W_{2i}, & W_{2i} \geq 0; \\ (1+\alpha)W_{2i}, & W_{2i} < 0. \end{cases}$$



Time Line



$$W_{2i,np} = q + X_i + D, \qquad i = b, s$$
$$W_{2i,p} = q + X_i - c_i + (1 - \theta_i)P_1 + \theta_i D \qquad i = b, s, mb, ms$$

Social Planner's Objective Function

- The social planner chooses μ, ω_s and ω_b to maximize social welfare by equally weighing all agents and paying all the participation costs c and c_m.

- The objective function for the social planner is:

$$J^{FB} = \max_{\mu,\,\omega_s,\,\omega_b} \quad d + q - \left(\mu c_m + \frac{\lambda}{2}(1-\mu)(\omega_s+\omega_b)\,c\right) - \frac{\lambda\alpha}{4}(1-\mu)(1-\omega_s)(x-q)$$

$$s.t.\ Q \equiv \frac{\mu}{2}(q_{mb}-q_{ms}) + \frac{1-\mu}{2}\left(\omega_b q_b - \omega_s q_s\right) \geq 0$$

$$\text{where} \quad q_i = |q - c_i + X_i|, \quad i = b, s, mb, ms$$

Social Planner's Choice of Ex ante and Spot Participation

Proposition

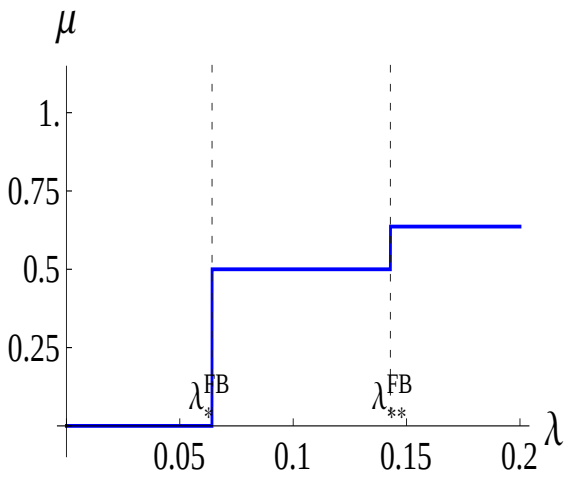
The social planner's choice of μ, ω_s and ω_b is determined as follows.

$$\{\mu^{FB}, (\omega_b^{FB}, \omega_s^{FB})\} = \begin{cases} \{0, (1, q_b/q_s)\}, & \text{if } \lambda < \lambda_*^{FB}; \\ \{\mu_b, (1,1)\} & \text{if } \lambda_{**}^{FB} > \lambda \geq \lambda_*^{FB}; \\ \{\mu_d, (0,1)\}, & \text{if } \lambda \geq \lambda_{**}^{FB}, \end{cases}$$

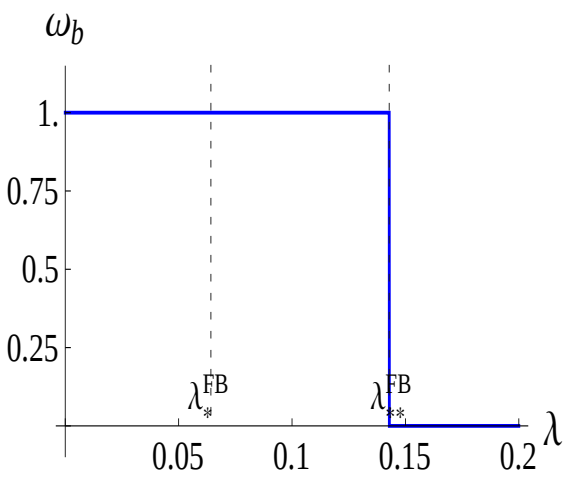
The aggregate liquidity is always sufficient, i.e., $Q \geq 0$.

The First Best

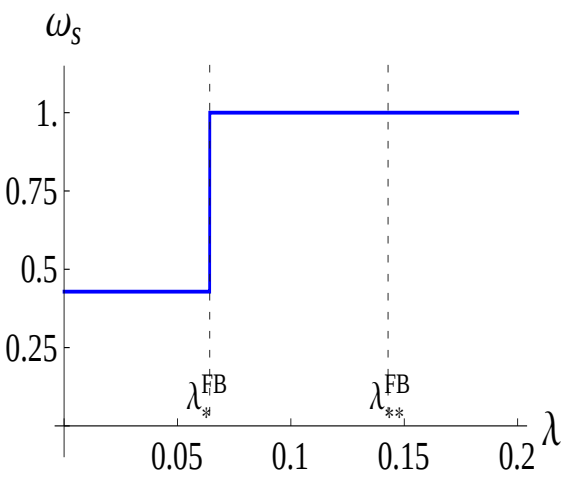
(a) Market Makers (μ)



(b) Buyers (ω_b)



(c) Sellers (ω_s)



- When $\alpha \to \infty$, sellers always participate ($\lambda_*^{FB} \to 0$).
- For finite α, trade off ex ante, expected ex post participation costs, and the expected utility costs of low wealth.
- For smaller λ, rely more on spot liquidity provision ($\mu = 0, \omega_b = 1.$)

The First Best: Summary

- Social planner provides insurance and can freely transfer wealth between agents.
- The participation cost can be interpreted as the cost to set up the insurance, to share liquidity (q) across investors.
- The valuation of the risky asset (d) does not affect the allocation since it is not needed for the insurance.
- The tradeoff depends on ex ante vs. ex post participation costs, the likelihood of the liquidity event, and the risk aversion of agents.

The Competitive Equilibrium

- The competitive equilibrium: market determines both the participation decision (μ, ω_b, and ω_s) and the price of the risky asset (P_1).

- Solution method
  - Step 1: Solve individual portfolio choice and participation decisions given P_1.
  - Step 2: Solve equilibrium P_1, given ω_b, ω_s, and μ.
  - Step 3: Solve equilibrium ω_b and ω_s, given μ, such that agents are indifferent between participating or not.
  - Step 4: Solve for equilibrium μ such that agents are indifferent between becoming traders or market makers.

The Competitive Equilibrium

Proposition

When $c > \overline{c}$, the competitive equilibrium is as follows:

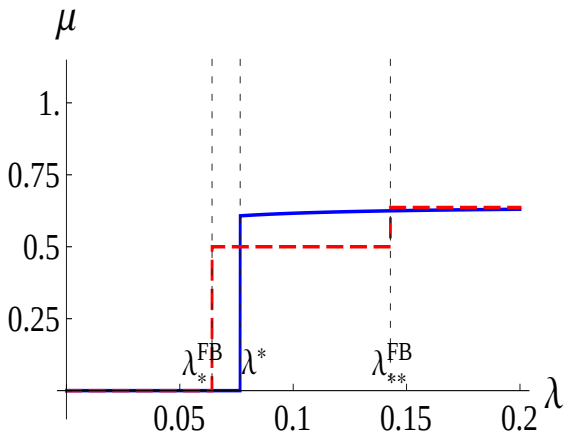
$$\{\mu, (\omega_b, \omega_s), P_1\} = \begin{cases} \{0, (0,0), d_s\}, & \text{if } \lambda < \lambda^*; \\ \{\mu_g, (0,1), d_{\mu g}\} & \text{if } \lambda^* \leq \lambda < \lambda^{**}; \\ \{\mu_d, (0,1), d_{\mu d}\}, & \text{if } \lambda \geq \lambda^{**}; \end{cases}$$

The aggregate liquidity can be insufficient:

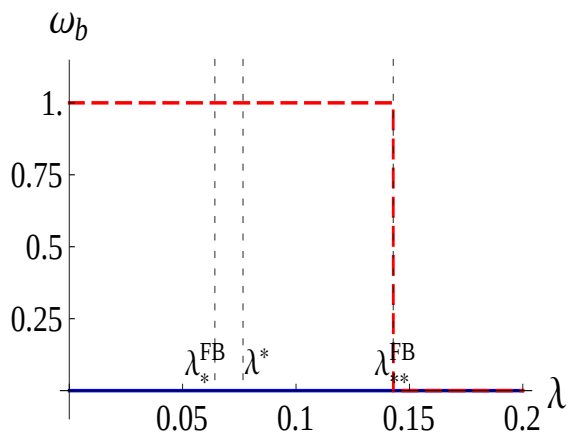
$$Q = \begin{cases} 0, & \text{if } \lambda < \lambda^*; \\ < 0, & \text{if } \lambda^* \leq \lambda < \lambda^{**}; \\ = 0, & \text{if } \lambda \geq \lambda^{**}; \end{cases} .$$

Contrasting the First Best and the Competitive Equilibrium

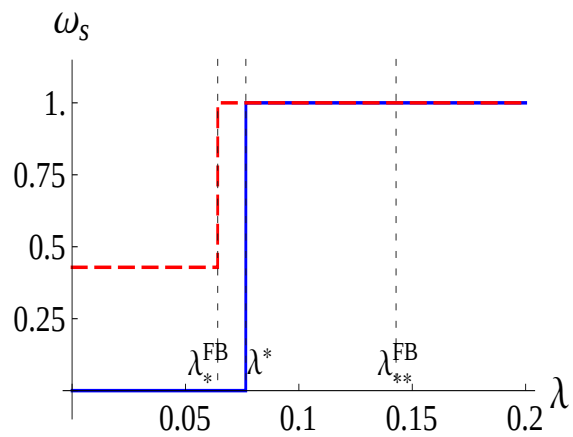
(a) Market Makers (μ)



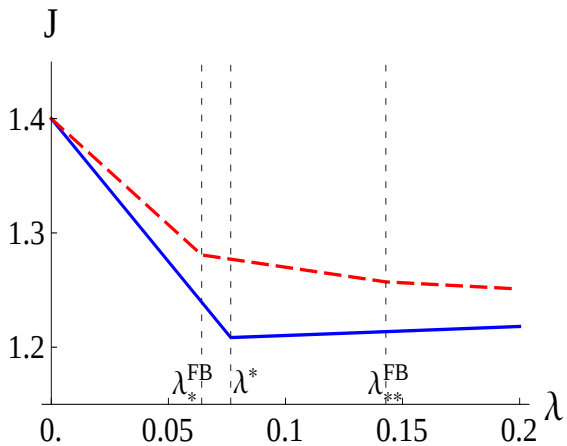
(b) Buyers (ω_b)



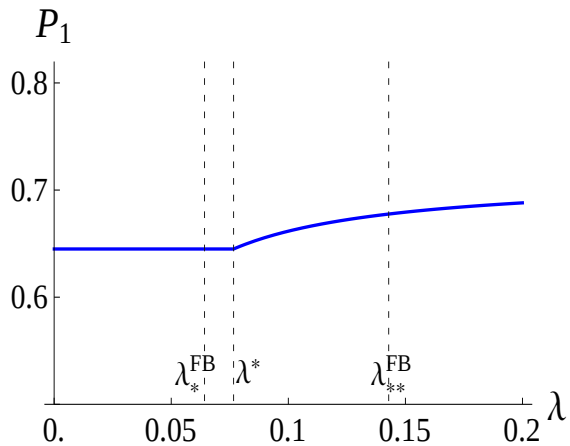
(c) Sellers (ω_s)



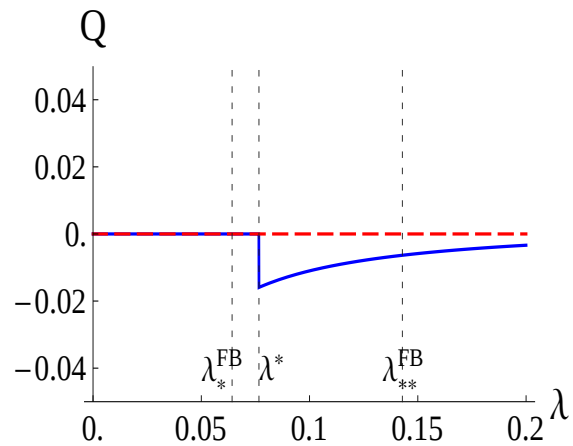
(d) Value Function (J)



(e) Price (P_1)



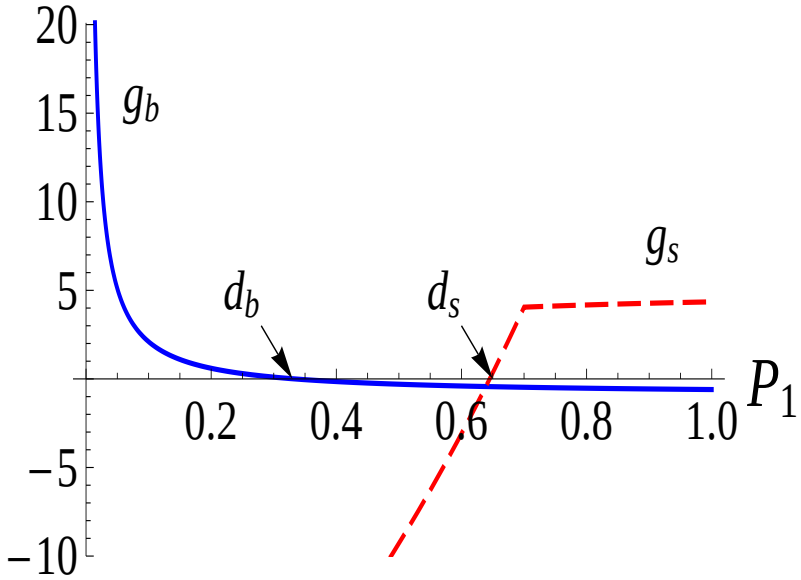
(f) Liquidity (Q)



The Inefficiency of the Competitive Equilibrium

- Ex ante liquidity provision can be either too high or too low
  - Ex ante liquidity is too low when liquidity events are rare ($\mu^* < \mu^{FB}$)
  - Ex ante liquidity is too high when liquidity events are more likely ($\mu^* > \mu^{FB}$)
- Spot liquidity provision is always too low ($\omega_b^* < \omega_b^{FB}$).
- The total liquidity provision is always too low (either $\omega_s^* < \omega_s^{FB}$ or $Q^* < Q^{FB}$).

Understanding the Inefficient Spot Liquidity Provision



- Buyers participate $\Leftrightarrow P_1 \leq d_b$; Sellers participate $\Leftrightarrow P_1 \geq d_s$
- Whenever $g_b + g_s > 0$, the social planner chooses $\omega_b > 0$.
- Yet the competitive equilibrium ω_b is always lower.
- In the example, $\omega_b = 0$. If not, then
  $P_1 \leq d_b < d_s \Rightarrow g_s < 0 \Rightarrow \omega_s = 0 \Rightarrow Q > 0 \Rightarrow P_1 = d > d_b$

The Source of Inefficient Spot Liquidity Provision

- The participation of buyers has a positive externality, namely, it increases P_1 and hence improves seller utility.
- Yet, buyers need to bear the full cost of participation.
- Therefore, they choose insufficient liquidity provision.
- This market failure is more prevalent for higher c (more private costs for buyers) or lower d (less public benefit for sellers).

The Source of Inefficient Ex Ante Liquidity Provision

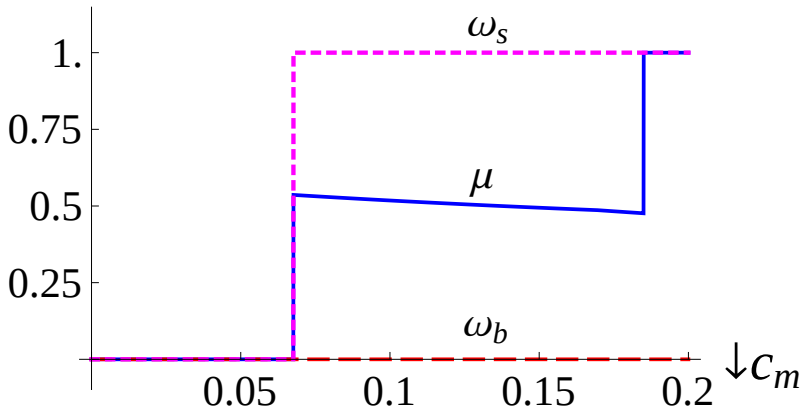
- Ex ante liquidity provision can be either too high or too low.
  - μ^* is too low when liquidity event is rare (low λ)
  - μ^* is too high when liquidity event is likely (high λ)
- Ex ante liquidity provision is inefficient for two reasons:
  - First, hoarding of liquidity in anticipation of lower spot liquidity provision, leading to $\mu^* > \mu^{FB}$.
  - Second, like spot liquidity, ex ante liquidity is also a public good that benefits potential sellers in the future. Yet market makers bear the full cost of participation, leading to $\mu^* < \mu^{FB}$.
- The first effect dominates when λ is relatively high, and the second effect dominates when λ is low.
  - When λ is very large, both the first best and the competitive equilibrium choose to only provide liquidity ex ante. Then the first effect disappears and μ^* is again too low.

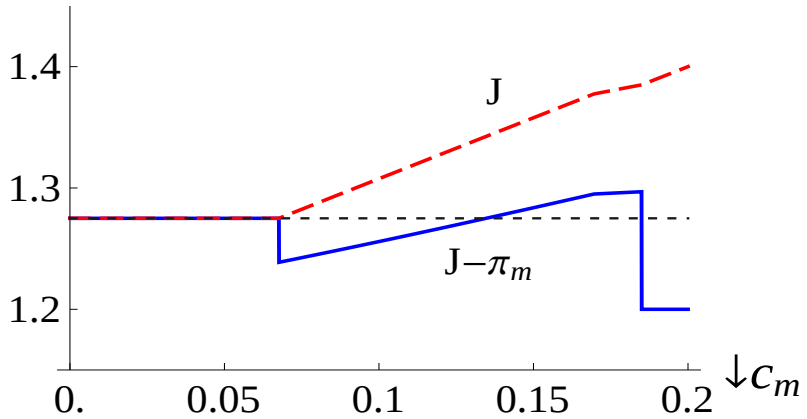
Policy Interventions

- Policies need to address both ex ante and spot inefficiencies.
- Compare the efficiency of various interventions under different market conditions (high or low λ).
  - Subsidize market makers ($\downarrow c_m$)
  - Subsidize buyers ($\downarrow c$ for buyers, denoted by $\downarrow c_b$)
  - Subsidize sellers ($\downarrow c$ for sellers, denoted by $\downarrow c_s$)
- Compare the feasibility of each interventions.

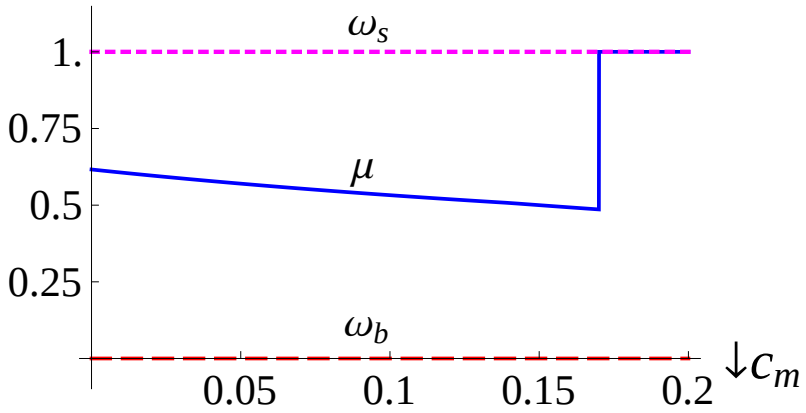
Subsidizing Market Makers

(a) Low probability of liquidity events ($\lambda = 0.05$)

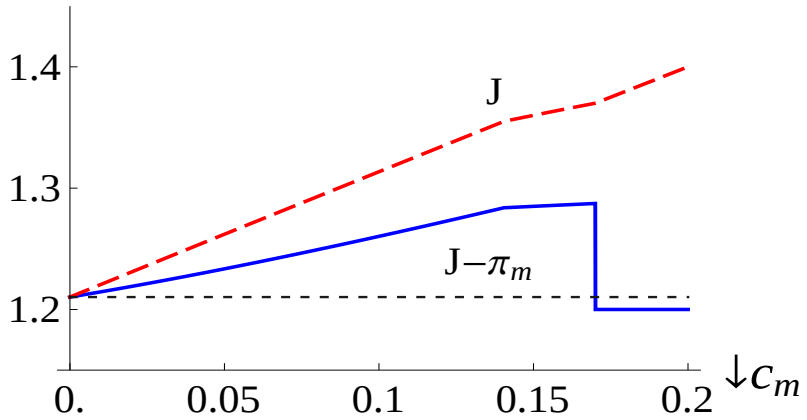




(b) High probability of liquidity events ($\lambda = 0.1$)



Participation $(\mu, \omega_b, \omega_s)$



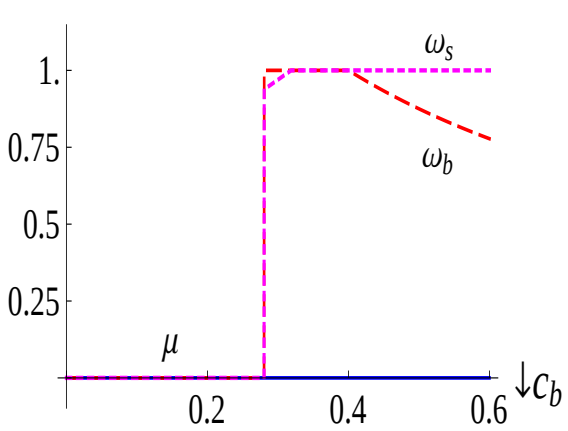
Value Function (J)

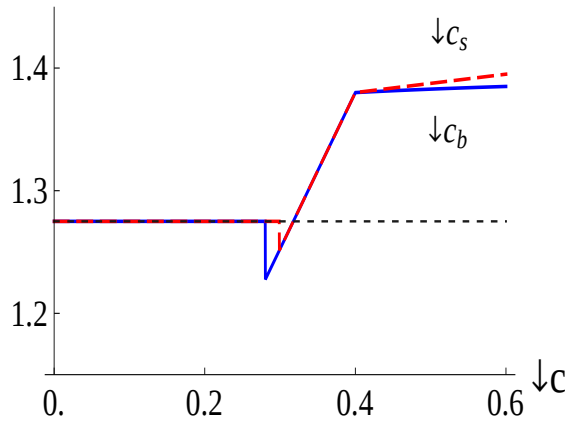
Subsidizing Market Makers

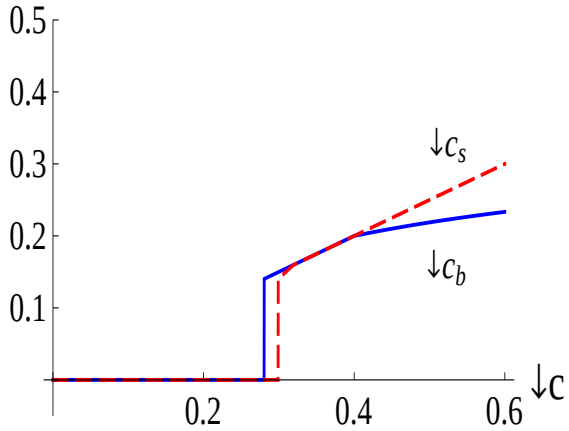
- Subsidizing market makers is generally welfare improving when the probability of liquidity event is high, but it might lead to too much ex ante liquidity provision and reduce welfare when the probability of liquidity event is low.
- The total subsidy is $\pi_m = (\Delta c_m)\left(\mu^*|_{c'_m}\right)$, for $c'_m = c_m - \Delta c_m$
- This strategy can be implemented by taxing all agents (π_m per capita) at time 0 and then distributing the tax proceeds to market makers.

Subsidizing Buyers or Sellers

(a) Low probability of liquidity events ($\lambda = 0.05$)







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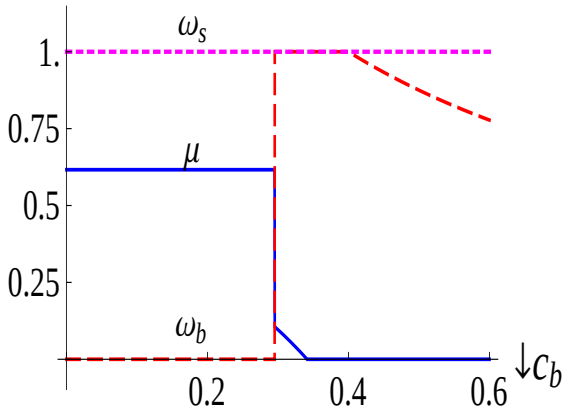

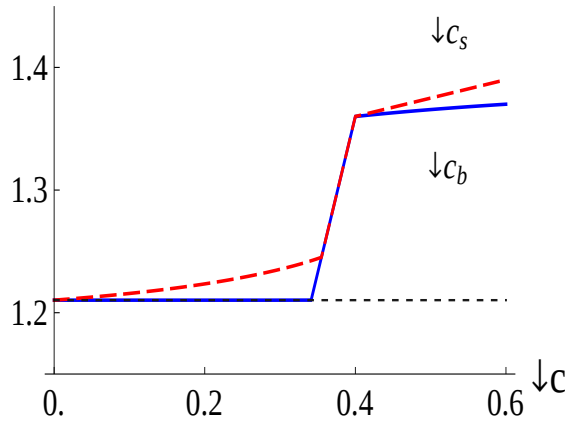

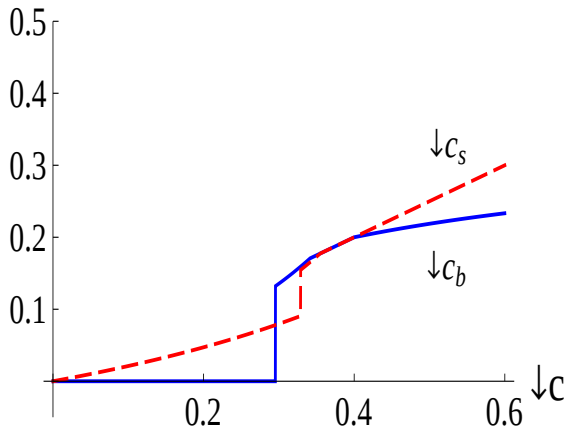

Participation $(\mu, \omega_b, \omega_s)$ Value Function (J) Subsidy (π_i)

Subsidizing Buyers or Sellers

- Spot intervention can be ineffective and sometimes value destructive even before taking into account the cost of intervention.
- The total subsidy at time 1 when subsidizing buyers is $\pi_b = \frac{1}{2}\left(1 - \left(\mu^*|_{c_b'}\right)\right)(-\Delta c_b)\left(\omega_b^*|_{c_b'}\right)$, $c_b' = c - \Delta c_b$. Similarly for π_s.
- Subsidizing sellers is more efficient than subsidizing potential buyers in the spot market.
- This strategy can be implemented by issuing bonds to subsidize buyers or sellers at time 1, and then balancing the budget by taxing at time 2.
- Taxing at time 0 is less feasible.

Relating the Model to Observed Policy Interventions

- Subsidize market makers
  - Margin and capital requirements for dealers and hedge funds
  - Primary Dealer Credit Facility
- Subsidize buyers
  - Public-Private Investment Program
- Subsidize sellers
  - Asset guarantee or loan-loss backstop to troubled banks (Citi, BoA), Term Auction Facility, Capital Purchase Program, Loan modification program
- Other interventions
  - Direct purchase of toxic assets (e.g., Public-Private Investment Program, GSE MBS purchases)
  - Coordinate market participants (e.g., bank consortium organized for LTCM)

Concluding Remarks

- Present a simple model of liquidity demand and supply.
- Competitive market fails to lead to efficient supply of liquidity.
- Policies need to address both ex ante and spot inefficiencies.
- Extensions
  - Endogenize x in a dynamic setting: the impact of past trading strategy and current asset value D
  - Endogenize q and D in a production economic: the impact of market liquidity on the real sector