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Market freeze and recovery: trading dynamics under optimal intervention by a Market-Maker-of-Last-Resort

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* This presentation reflects the views of the authors and not necessarily those of the BIS or of central banks participating in the meeting.

Market Freeze and Recovery: Market-Making-of-Last-Resort

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Motivation

- Current crisis: freezes in markets with
  - subject to trading frictions (e.g. OTC)
  - where assets and/or counterparties were opaque
- Public intervention to ensure the continuous functioning of markets or trading platforms that are deemed crucial

Questions

1. How do freezes arise in markets subject to trading frictions and opaqueness?

2. How does a frozen market react to an intervention (e.g. direct asset purchase)?

3. When and how should a large player intervene when a liquidity crisis is dynamically unfolding?

What we do

1. Develop a model of market freezes building on search frictions (λ) and adverse selection (π)
   - search frictions exacerbates adverse selection problem through strategic complementarity
2. Study the market reaction to an intervention of asset purchases
   - Characterize equilibrium trading and price dynamics as a function of policy $\rightarrow$ announcement effect
3. Analyze optimal policies to resurrect the market
   - tradeoff between social cost of illiquid market and financial cost of intervention

Model

Continuous Time Framework

Fixed number of assets:

- "good" assets: fraction π yields flow $\delta_H > 0$
- "lemons": fraction $1 - \pi$ yields flow $\delta_L = 0$
- asset type is private information of the holder

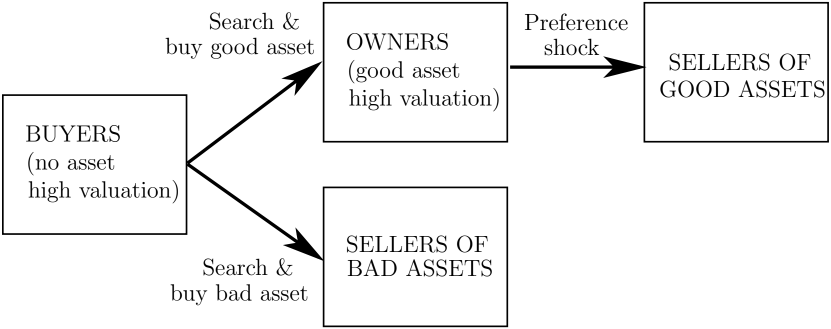
Continuum of risk-neutral investors:

- preference shock: switching from high valuation (buyers) to low valuation (sellers) at rate κ
- benefits from reallocating assets from sellers to buyers

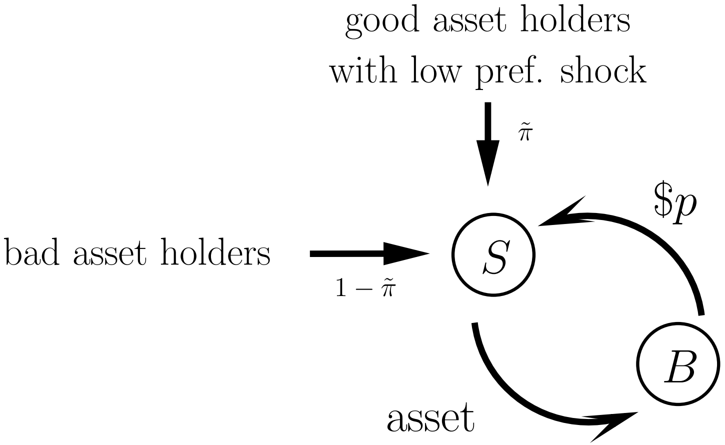
Frictional Asset Trading:

- Finding a counterparty takes time: matching rate λ
- bilateral trades: buyers offer price $p(t)$ to seller

Flows


Search &
buy good asset
OWNERS
(good asset
high valuation)
Preference
shock
SELLERS OF
GOOD ASSETS
BUYERS
(no asset
high valuation)
SELLERS OF
BAD ASSETS
Search &
buy bad asset

Lemons Problem



Pooling equilibrium: offer the same price to get an average asset
Average quality of assets: $\tilde{\pi}(t) = \frac{\mu_s(t)}{\mu_s(t)+\mu_\ell(t)}$

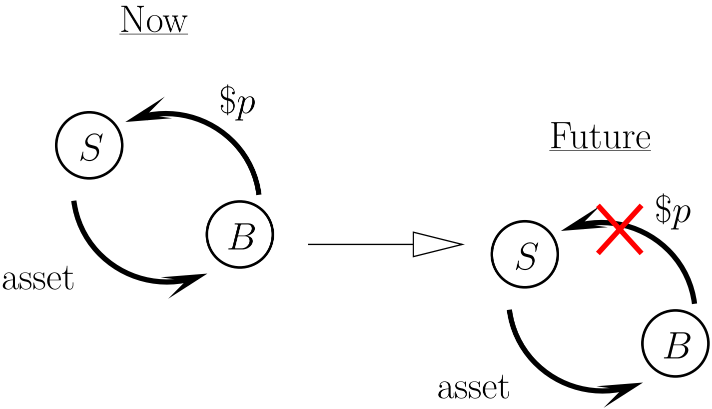
Decision to Buy an Asset

- $\Gamma(t)$ = Expected trade surplus for a buyer:

$$\frac{\tilde{\pi}(t)}{1-\tilde{\pi}(t)}\left(\frac{v_o}{v_s}-1\right)+\underbrace{\left(\frac{v_\ell(t)}{v_s}-1\right)}_{\text{Strat. Compl.}}$$

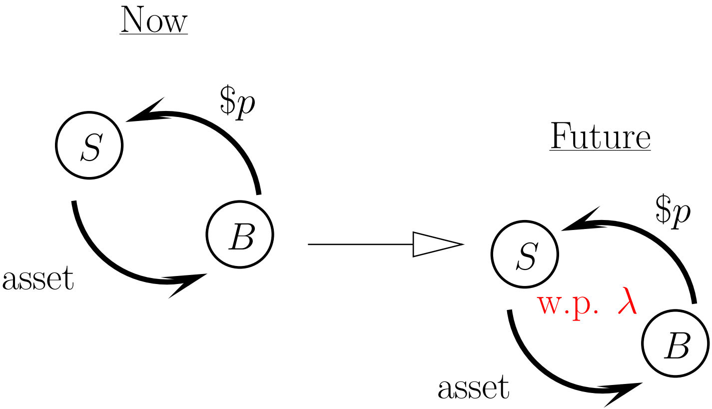
- Buyer is willing to trade iff expected trade surplus $\Gamma(t) \geq 0$

Dynamic Strategic Complementarity



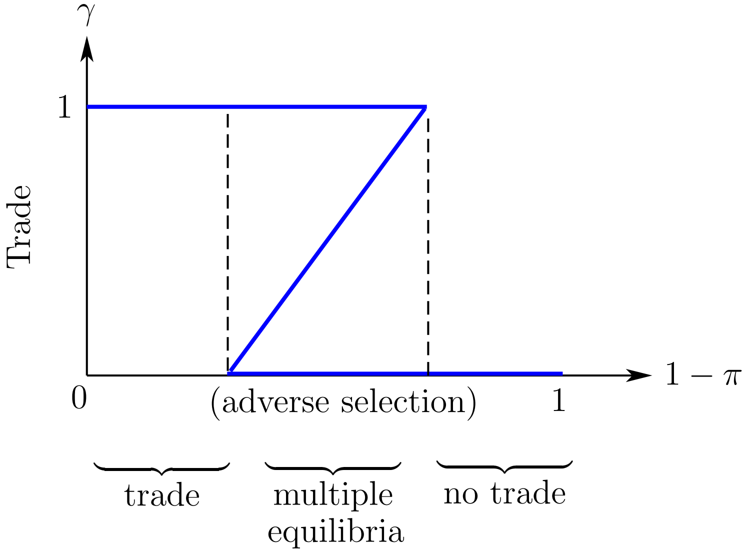
No trade in future ⇒ unable to resell assets in future ⇒ low incentive to buy now

Dynamic Strategic Complementarity

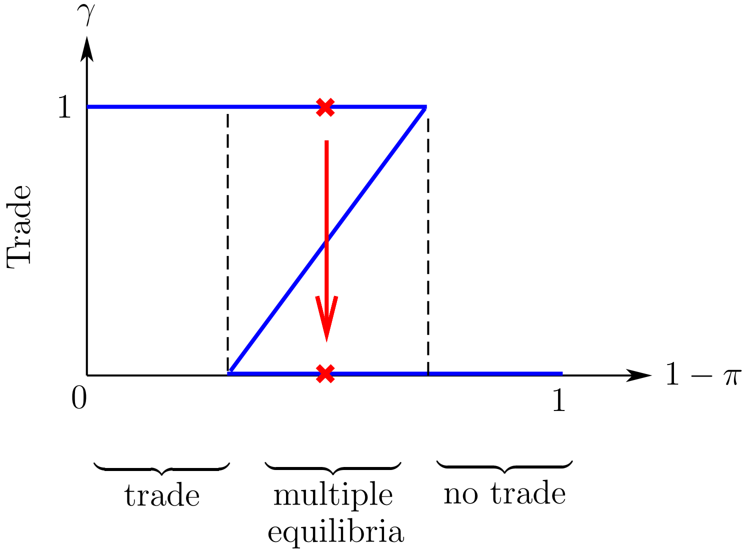


No trade in future ⇒ unable to resell assets in future ⇒ low incentive to buy now (Note: lower $\lambda \rightarrow$ weaker strat. compl.)

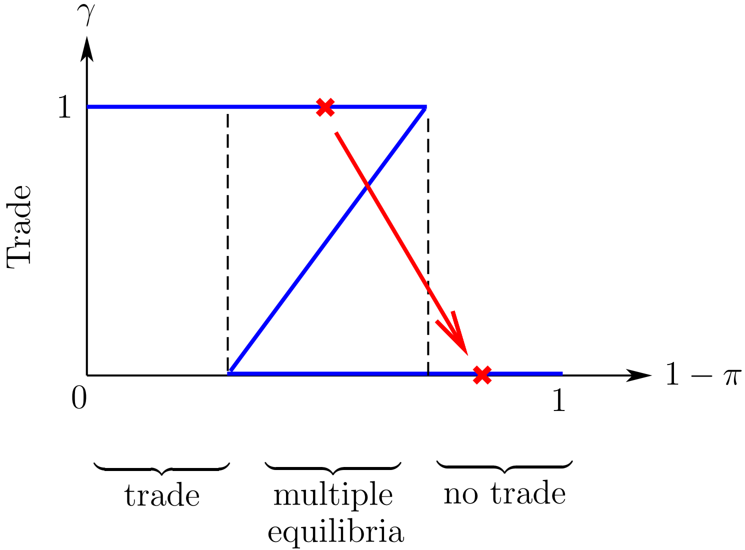
Steady State Equilibrium



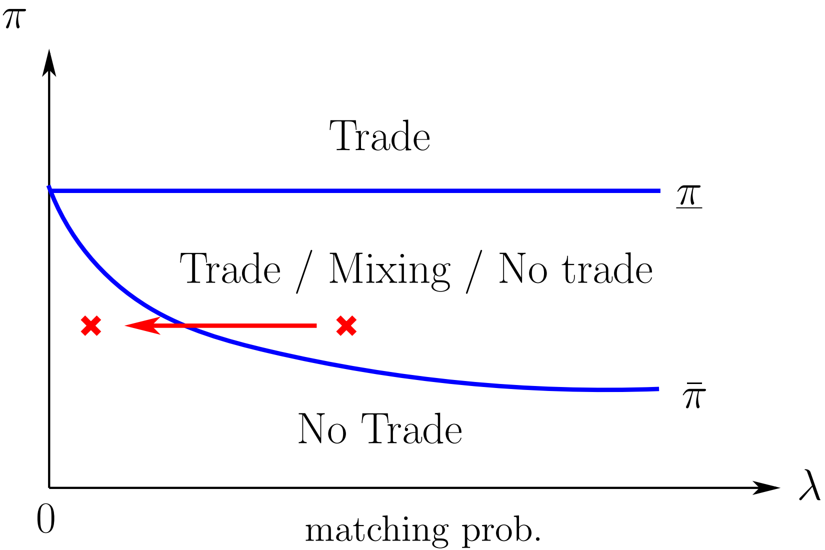
Steady State Equilibrium



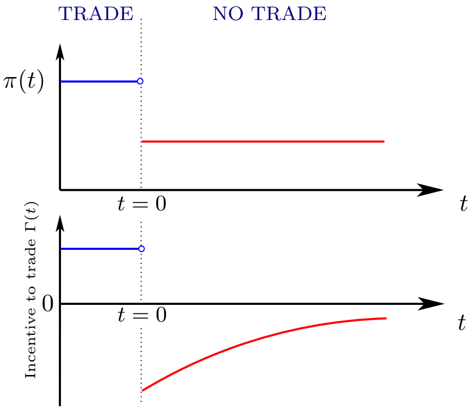
Comparative Statics: Adverse selection ↑ (π ↓)



Comparative Statics: Trading frictions ↑ (λ ↓)



Unanticipated Shock to Quality π Freezes the Market



Proposition

Suppose $\pi(0) < \frac{r\underline{\pi}}{r+\lambda(1-\underline{\pi})}$. *The unique equilibrium has no trade at any* t.

Intervention

Intervention (Q, P, T)

MMLR: private/public agents who

- still subject to asymmetric information
- can commit to buy Q units of assets at a price P at time T
- have deep pockets (e.g. enforce taxation)

Intervention (Q, P, T)

To restore trade in the long-run (SS):

- Size of Purchase
  - ◇ Need to absorb sufficient bad assets:

$$Q \geq S \frac{\bar{\pi} - \pi(0)}{\bar{\pi}}$$

- Terms of Purchase
  - ◇ Price set to induce (only) bad sellers to sell:

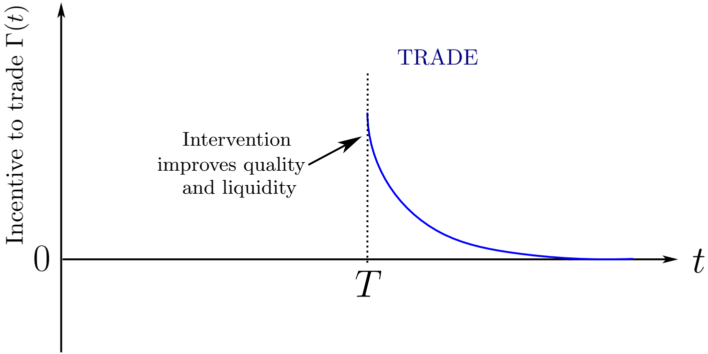
$$v_s - v_b(T) > P \geq v_\ell(T) - v_b(T) > 0$$

- Commit to intervene (and not to resell)

Trade Dynamics

Proposition

Continuous full trade after a minimum intervention $(P_{\min}, Q_{\min})$ is an equilibrium.

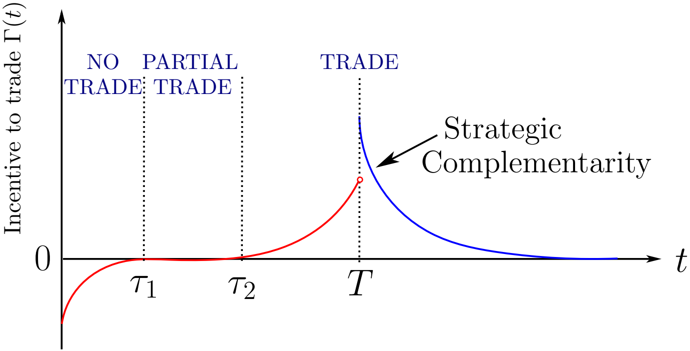


A minimum intervention ensures continuous trade in $[T, \infty)$.

Announcement Effect

Proposition

All equilibria before T can be characterized by two breaking points τ_1 and τ_2.



Partial and full recovery before intervention in $[0, T)$.

Optimal Intervention

Social Welfare

Suppose MMLR finances asset purchase by taxation:

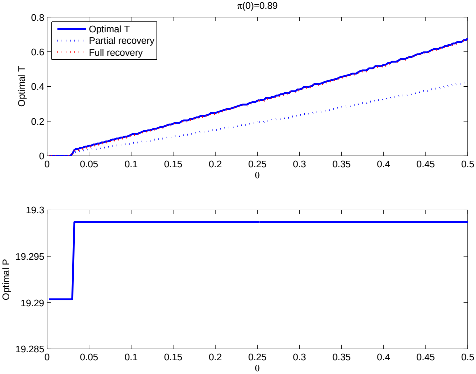
$$W = \underbrace{\int (\mu_o(t)\delta - \mu_s(t)(\delta - x))e^{-rt}dt}_{\text{benefit of liquid market}} - \theta \underbrace{\cdot P \cdot Q \cdot e^{-rT}}_{\text{cost of intervention}}$$

with $\theta \geq 0$ capturing the cost of tax distortion

Need to balance the trade-off between

- social cost of illiquid market
- financial loss of intervention

Optimal Policy (T, P, Q)



θ low: intervene immediately with minimum P and Q
θ high: postpone T and increase P to generate announcement effects

Role of Trading Friction

In a market with higher trading frictions ($\lambda \downarrow$), strategic complementarity weak

1. market freeze: more likely
2. policy announcement effects: smaller
3. optimal policy: more aggressive

Conclusion

We develop a framework to think about how to react to a market freeze. We find:

1. Informational and trading frictions are key for the emergence of a market freeze.
2. Asset purchases can resurrect the market, with announcement effects being important.
3. Optimal intervention trades-off the social costs of illiquid markets and financial loss.
4. Successful intervention relies on MMLR's ability to commit and to enforce loss sharing.

Appendix

Market Freeze

- During the sub-prime crisis, the market for asset-backed commercial paper (ABCP) experienced a sudden freeze in August, 2007. (Acharya, Gale and Yorulmazer, 2009)
- "[T]he complete evaporation of liquidity in certain market segments of the US securitization market has made it impossible to value certain assets fairly regardless of their quality or credit rating. . . Asset-backed securities, mortgage loans, especially sub-prime loans don't have any buyers. . .Traders are reluctant to bid on securities backed by risky mortgages because they are difficult to sell on." (Bloomberg, 9 August 2008)

Back

Temporary Shocks

Quality shock is temporary

- MMLR can make profits by reselling assets (optimally design exit strategy)
- MMLR performs actual market-making by alleviating selling pressure when the market shuts down
- To ensure continuous market, not necessarily optimal to intervene immediately

Pooling Equilibrium

Buyers make same offers to both types:

- Trading only with good asset sellers is not feasible because bad asset sellers can always imitate
- Trading only with bad asset sellers is not profitable because there is no trade surplus
- Making separating offers requires trading with bad sellers with a high probability and a higher price, which dominated by a pooling offer

Value Functions

$$rv_o(t) = \delta + \kappa(v_s(t) - v_o(t)) + \dot{v}_o(t)$$

$$rv_s(t) = \delta - x + \gamma(t)\lambda\mu_b(t)\max\{p(t) + v_b(t) - v_s(t), 0\} + \dot{v}_s(t)$$

$$rv_\ell(t) = \lambda\mu_b\gamma(t)\max\{p(t) + v_b(t) - v_\ell(t), 0\} + \dot{v}_\ell(t)$$

$$rv_b(t) = \lambda(\mu_s(t) + \mu_\ell(t))\max\{\max_p \tilde{\pi}(p)v_o + (1 - \tilde{\pi}(p))v_\ell(t) - p - v_b(t), 0\} + \dot{v}_b(t).$$

Quality Effect

The average quality of assets in the market:

$$\tilde{\pi}(t) = \frac{\mu_s(t)}{\mu_s(t) + \mu_\ell(t)}$$

evolves according to

$$\dot{\mu}_s(t) = \kappa\mu_o(t) - \gamma(t)\lambda\mu_b(t)\mu_s(t)$$

Quality Effect depends on past trading decisions:

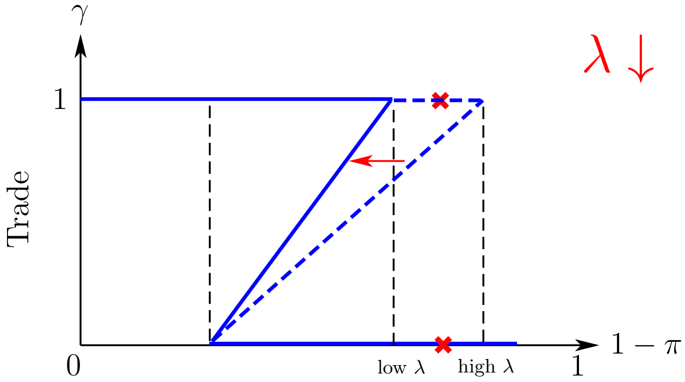
No trade $\gamma(t) = 0$

$\Rightarrow \mu_s \Uparrow$ over time

$\Rightarrow$ quality $\tilde{\pi}(t) \Uparrow$ over time

$\Rightarrow$ buyers' trade surplus $\Uparrow$

Steady State Equilibrium: $\lambda \downarrow$



Steady State Equilibrium

Proposition

- *For any given* $\pi \in (0,1)$*, a steady state equilibrium exists.*
- *If* $\pi \geq \bar{\pi}$*, there is a full-trade equilibrium (i.e.* $\gamma = 1$*).*
- *If* $\pi \leq \underline{\pi}$*, there is a no-trade equilibrium (i.e.* $\gamma = 0$*).*
- *If* $\kappa < r$*, the steady state equilibrium is unique, with the equilibrium for* $\pi \in (\underline{\pi}, \bar{\pi})$ *being in mixed strategies.*
- *If* $\kappa > r$*, for* $\pi \in (\bar{\pi}, \underline{\pi})$*, there are three steady state equilibria including a mixed strategy one.*

where $\xi = \frac{\delta}{\delta - x}$, $\bar{\pi} = \frac{\kappa(r+\kappa)+\lambda\mu_b(r+\kappa)}{\kappa(\xi r+\kappa+\lambda\mu_b(\xi-1))+\lambda\mu_b(r+\kappa)}$ and $\underline{\pi} = \frac{r+\kappa}{\xi r+\kappa}$

Proposition

A market freeze in steady state when

- *lemons problem is severe (π small)*
- *trading friction is high (λ small)*
- *trade surplus is small (x small)*
- *number of buyers is small (μ_b small)*

The market is frozen forever (with zero price, no trade).

Welfare cost: unable reallocate good assets from sellers to buyers.

Definition of Equilibrium

An equilibrium is given by measurable functions $\gamma(t) : \mathbb{R} \to [0,1]$ and $\tilde{\pi}(t) : \mathbb{R} \to [0,1]$ such that

1. for all t, the strategy $\gamma(t)$ is optimal taking as given $\gamma(\tau)$ for all $\tau > t$
2. $\tilde{\pi}(t)$ is generated by $\gamma(t)$ and the law of motion for μ_s and μ_ℓ.

Back

Why a CB/Gov't can do better than the market?

- Unlike private agents, a large player
  - Care about social welfare
    - willing to internalize trading externalities
  - Able to commit to intervene
  - Able to finance intervention (deep pocket)
- Private agents not willing/able to intervene

Private Sector Involvement

- Successful intervention relies on
  - (a) ability to finance intervention
  - (b) willingness to intervene
- private market maker will not intervene optimally
- Liquidity provision can solve (a) but not (b) due to trading externalities

Incomplete information

- CB uncertain about the nature and severity of crisis
  - Future research on price discovery process
  - Uncertain about cause of crisis
    (e.g. self-fulfilling or fundamental)
    - combination standing facilities and asset purchases?
  - uncertain about fundamentals
    (e.g. fundamental price of an asset)
    - make use of market forces (e.g. reverse auction)?

Choice Between Different Types of Instruments

- Type of Intervention:
  - lowering of collateral standards
  - long(er)-term lending
  - direct asset purchases
- Should have multiple instruments
- To handle different market failures in different situations
- Maintain flexibilities to reduce moral hazard
- Lending facility provides liquidity to market participants, but may not always induce them to take the right actions to internalize externalities

Moral Hazard

Ex-post intervention to handle a market freeze:

- If moral hazard is a big concern, MMLR should commit not to intervene in response to market freeze caused by endogenous quality problem.

Ex-ante policy/regulation to avoid a market freeze:

- Increase π: Regulations that support the creation of more transparent, standardized and well designed financial instruments.
- Increase λ: Policies that strengthen the market infrastructure.
- Private commitment and enforcement: improve clearing and settlement processes to facilitate loss-sharing (e.g. CCP).