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

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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 ($\lambda$) and adverse selection ($\pi$)
   - 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 → 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 $\pi$ 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 $\kappa$
- benefits from reallocating assets from sellers to buyers

Frictional Asset Trading:
- Finding a counterparty takes time: matching rate $\lambda$
- bilateral trades: buyers offer price $p(t)$ to seller
Flows

BUYERS
(no asset
high valuation)

SEARCH &
buy good asset

OWNERS
(good asset
high valuation)

Preference
shock

SELLERS OF
GOOD ASSETS

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

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

$$\frac{\tilde{\pi}(t)}{1 - \tilde{\pi}(t)} \left( \frac{v_o}{v_s} - 1 \right) + \left( \frac{v_\ell(t)}{v_s} - 1 \right)$$

Strat. Compl.

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

No trade in future $\Rightarrow$ unable to resell assets in future $\Rightarrow$ low incentive to buy now
**Dynamic Strategic Complementarity**

Now

![Diagram showing the interaction between S and B assets]

Future

No trade in future $\Rightarrow$ unable to resell assets in future $\Rightarrow$ low incentive to buy now

(Note: lower $\lambda$ $\rightarrow$ weaker strat. compl.)
Steady State Equilibrium

Trade

(adverse selection)

1

γ

1

0

1 − π

- trade

- multiple equilibria

- no trade
Steady State Equilibrium

The diagram illustrates the steady state equilibrium in a trade context, where the trade variable is denoted along the horizontal axis and the parameter γ along the vertical axis. The equilibrium points are categorized into:

- **Trade**: Indicates a scenario where trade is present.
- **Multiple Equilibria**: Represents situations with more than one equilibrium point.
- **No Trade**: Denotes cases where trade is absent.

The graph shows the transition points and their implications for trade and γ values.
Comparative Statics: Adverse selection $\uparrow (\pi \downarrow)$
Comparative Statics: Trading frictions $\uparrow$ ($\lambda \downarrow$)

Trade

Trade / Mixing / No trade

No Trade

matching prob.

$\pi$

$\lambda$

$0$
Unanticipated Shock to Quality $\pi$ Freezes the Market

Proposition

Suppose $\pi(0) < \frac{r \pi}{r + \lambda(1 - \pi)}$. 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 \((P_{\text{min}}, Q_{\text{min}})\) 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 $\tau_1$ and $\tau_2$."

Partial and full recovery before intervention in $[0, T)$.\]
Optimal Intervention
Social Welfare

Suppose MMLR finances asset purchase by taxation:

\[ W = \int (\mu_o(t)\delta - \mu_s(t)(\delta - x))e^{-rt} dt - \theta \cdot P \cdot Q \cdot e^{-rT} \]

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 \((T, P, Q)\)

\(\theta \) low: intervene immediately with minimum \(P\) and \(Q\)

\(\theta \) 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)
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 $\pi \leq \pi$, there is a no-trade equilibrium (i.e. $\gamma = 0$).
- If $\kappa < r$, the steady state equilibrium is unique, with the equilibrium for $\pi \in (\pi, \bar{\pi})$ being in mixed strategies.
- If $\kappa > r$, for $\pi \in (\bar{\pi}, \pi)$, 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 $\pi = \frac{r+\kappa}{\xi r + \kappa}$
Proposition

A market freeze in steady state when

- lemons problem is severe ($\pi$ small)
- trading friction is high ($\lambda$ small)
- trade surplus is small ($x$ small)
- number of buyers is small ($\mu_b$ 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 $\mu_s$ and $\mu_\ell$. 

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 $\pi$: Regulations that support the creation of more transparent, standardized and well designed financial instruments.

- Increase $\lambda$: Policies that strengthen the market infrastructure.

- Private commitment and enforcement: improve clearing and settlement processes to facilitate loss-sharing (e.g. CCP).