Liquidity and Crises in Financial Markets

OTC Markets III

U of Basel, HS 2012

Market Freeze during the Crisis

Three stories:

1. liquidity hoarding and runs on liquidity
2. contagion across markets
3. adverse selection

Why were OTC markets affected?

Was the gov't response appropriate?

Liquidity Shock

Weill (2010) – no ability or not optimal

- borrowing constraints for MM
- temporary liquidity support is appropriate
- it might not be optimal to have "market continuity"

Lagos, et al. (2010) – no incentive

- temporary shock with random recovery
- MM reluctant to amass large positions that are hard to unwind
- search frictions and bargaining compound problem

Adverse Selection

OTC markets are fragile due to

- opaqueness of assets
- bilateral bargaining
- search frictions

Both, sunspots and fundamental shocks matter.

It can be socially optimal for a "Market-maker-of-last-resort" to intervene.

This involves losses if market freezes due to fundamental reasons.

Model

S (indivisable) assets:

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

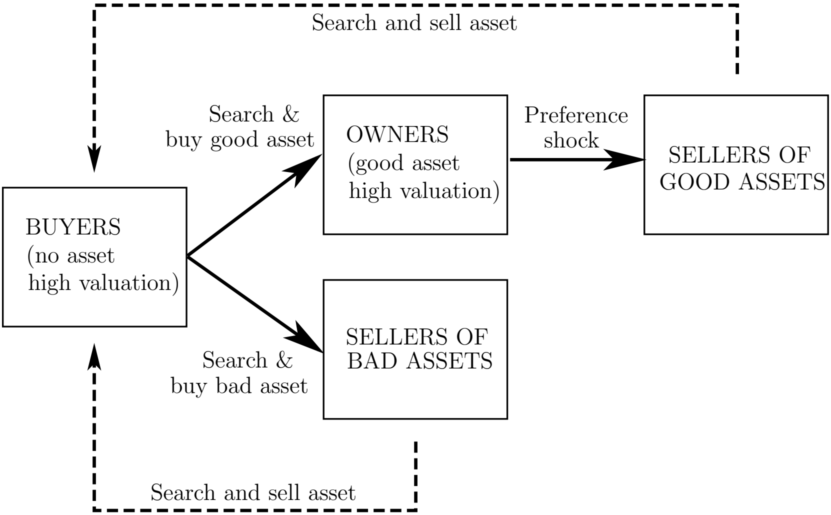
Continuum of anonymous investors:

- risk-neutral and discount future at rate r
- start with high valuation at δ (buyers)
- later switches to lower valuation $\delta - x$ (sellers)
- Poisson Process w. arrival rate $\kappa > 0$

Trading:

- random, bilateral matching: Poisson Process w. rate λ
- buyers make take-it-or-leave-it offers

"Life-cycle"


Search and sell asset
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
Search and sell asset

Flow Equations

Pooling contract given by $(p(t), \gamma(t))$ dominates separating contract.

$p(t)$ – price at which an asset is traded

$\gamma(t)$ – probability that an asset is traded (conditional on a trade meeting)

$$\begin{aligned} \dot{\mu}_o(t) &= -\dot{\mu}_s(t) = \kappa\mu_o(t) + \gamma(t)\lambda\mu_b(t)\mu_s(t) \\ \dot{\mu}_\ell(t) &= -\gamma(t)\lambda\mu_b(t)\mu_\ell(t) + \gamma(t)\lambda\mu_b(t)\mu_\ell(t) = 0 \\ \dot{\mu}_b(t) &= 0 \end{aligned}$$

Value Functions

$$
\begin{aligned}
rv_o(t) &= \delta + \kappa(v_s(t) - v_o(t)) + \dot{v}_o(t) \\
rv_s(t) &= \delta - x + \gamma(t)\lambda\mu_b(t)\max\{p(t) + v_b(t) - v_s(t), 0\} + \dot{v}_s(t) \\
rv_\ell(t) &= \gamma(t)\lambda\mu_b(t)\max\{p(t) + v_b(t) - v_\ell(t), 0\} + \dot{v}_\ell(t) \\
rv_b(t) &= \max_{\gamma(t)} \lambda\gamma(t)(\mu_s(t) + \mu_\ell(t)) \cdot \\
&\quad \max\{\max_p \tilde{\pi}(p)v_o + (1 - \tilde{\pi}(p) - p(t) - v_b(t), 0\} + \\
&\qquad +\dot{v}_b(t)
\end{aligned}
$$

Bargaining

Buyer makes a take-it-or-leave-it offer.

Average quality of the asset purchased is given by

$$\tilde{\pi}(t) = \begin{cases} \frac{\mu_s(t)}{\mu_s(t)+\mu_\ell(t)} & \text{if } p(t) \geq v_s(t) - v_b(t) \\ 0 & \text{if } p(t) < v_s(t) - v_b(t). \end{cases}$$

Why? Pooling implies that a lemon always accepts an offer that a seller accepts.

If price is too low, only lemon will accept the offer.

But then it's not worth for the buyer to make an offer.

This implies in steady state:

$$
\begin{aligned}
v_s &= \frac{\delta - x}{r} \\
v_o &= \frac{1}{r+\kappa}\left(\delta + \kappa v_s\right) \\
v_\ell(t) &= \frac{\lambda\gamma(t)}{\lambda\gamma(t)+r} v_s + \dot{v}_\ell(t)
\end{aligned}
$$

Hence: The value of a lemon is time-dependent.

Dynamics are then driven by $v_\ell(t)$ and $\tilde{\pi}(t)$.

Decision to Buy an Asset

1. Buyers need to offer $p \geq v_s - v_b$ to induce a seller to sell taking into account the average quality of assets $\tilde{\pi}$ (pooling).

2. Buyer will make an offer if and only if surplus from trade is positive.

$$\Gamma(t) \equiv \underbrace{\tilde{\pi}(t)v_o + (1-\tilde{\pi}(t))v_\ell(t)}_{\text{expected value of the asset}} - \underbrace{v_s}_{p(t)+v_b(t)} \geq 0$$

3. Buyer decides on the probability of trading at time t:

$$\gamma(t) = \begin{cases} 0 & \text{if } \Gamma(t) < 0 \\ \in [0,1] & \text{if } \Gamma(t) = 0 \\ 1 & \text{if } \Gamma(t) > 0. \end{cases}$$

Equilibrium

We have to determine two functions:

- trading strategy, $\gamma(t) : I\!R \to [0, 1]$
- average quality of assets for sale, $\tilde{\pi}(t) : I\!R \to [0, 1]$

The trading strategy must be a subgame-perfect Nash equilibrium: It is optimal given $\tilde{\pi}(t)$ and the future decisions $\gamma(\tau)$ for all $\tau > t$.

How the quality evolves over time is driven by $\gamma(t)$ and the law of motion for μ_s and μ_ℓ.

Quality vs. Resale Effect

$$\frac{\Gamma}{(1-\tilde{\pi}(t))v_s} = \underbrace{\frac{\tilde{\pi}(t)}{1-\tilde{\pi}(t)}}_{\text{quality effect}} \left(\frac{v_o}{v_s} - 1\right) + \underbrace{\left(\frac{v_\ell(t)}{v_s} - 1\right)}_{\text{resale effect}}$$

Trading dynamics are driven by two fundamental forces:

Quality vs. Resale Effect

$$\frac{\Gamma}{(1-\tilde{\pi}(t))v_s} = \underbrace{\frac{\tilde{\pi}(t)}{1-\tilde{\pi}(t)}}_{\text{quality effect}} \left(\frac{v_o}{v_s} - 1\right) + \underbrace{\left(\frac{v_\ell(t)}{v_s} - 1\right)}_{\text{resale effect}}$$

Trading dynamics are driven by two fundamental forces:

- Strategic Substitutability: $\tilde{\pi}(t)$ depends on trading decisions in the past

  No trade in the past $\Longrightarrow$ avg. quality $\tilde{\pi}(t)$ increases over time

Quality vs. Resale Effect

$$\frac{\Gamma}{(1-\tilde{\pi}(t))v_s} = \underbrace{\frac{\tilde{\pi}(t)}{1-\tilde{\pi}(t)}}_{\text{quality effect}} \left(\frac{v_o}{v_s} - 1\right) + \underbrace{\left(\frac{v_\ell(t)}{v_s} - 1\right)}_{\text{resale effect}}$$

Trading dynamics are driven by two fundamental forces:

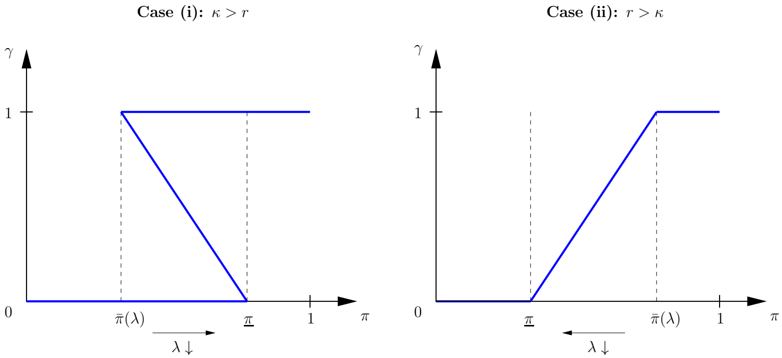
- Strategic Substitutability: $\tilde{\pi}(t)$ depends on trading decisions in the past

  No trade in the past $\Longrightarrow$ avg. quality $\tilde{\pi}(t)$ increases over time

- Strategic Complementarity: $v_\ell(t)$ depends on future trading decisions $(\lambda\gamma(t))$

  No trade in the future $\Longrightarrow$ low incentive to buy

Steady State



$\underline{\pi}$: existence of a no-trade SS equilibrium ($\gamma = 0$)

$\bar{\pi}$: existence of a trade SS equilibrium ($\gamma = 1$)

Do search frictions matter?

Let's focus on $r > \kappa$. Then the complementarity dominates the quality effect.

For $\lambda \to \infty$:

- Acquiring a lemon is not very costly, ...
- ... but the quality of assets in the market is small.
- It is easier to sustain to trade, ...
- ... but at the expense of fragility.

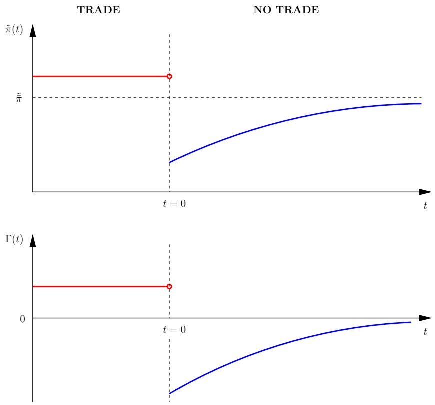
For $\lambda \to 0$:

- Acquiring a lemon is very costly, ...
- ... but the quality of assets in the market is high.
- Multiplicity complete disappears.

Multiplicity driven entirely by complementarity, but search frictions determine how strong it is.

Shock to Quality

Quality falls unexpectedly to $\pi(0) < \underline{\pi}\left(\frac{r}{r+\lambda(1-\underline{\pi})}\right)$.



Intervention

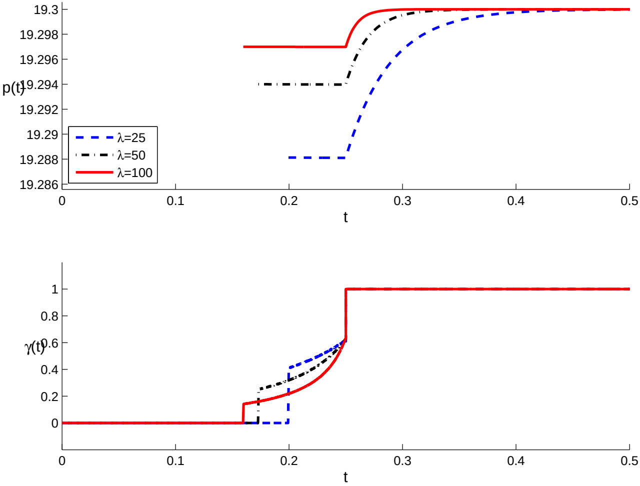
MMLR is a large player that ...

- has deep pockets
- is also subject to asymmetric information
- can commit to a policy announced at time $t = 0$

Policy:

- time of intervention – $T \in [0, \infty)$
- quantity of lemons bought – $Q \in \left[S\left(1 - \frac{\pi(0)}{\bar{\pi}}\right), S(1 - \pi(0))\right]$
- purchase price – $P \in [v_\ell(T), v_s]$

Announcement Effect



Equilibrium Prices and Trading Dynamics – $T = 0.25$, Q_{min}, $P_{\min}$

Intuition – Market Recovery

The surplus function $\Gamma(t)$ jumps at T for two reasons.

First, an intervention constitutes an option value V_I for lemons that disappers at T:

$$\begin{aligned}
\lim_{t \nearrow T} v_\ell(t) &= \frac{Q}{S(1-\pi(0))} P(T) + \left(1 - \frac{Q}{S(1-\pi(0))}\right) v_\ell(T) \\
&= \underbrace{\frac{Q}{S(1-\pi(0))} \left(P(T) - v_\ell(T)\right)}_{V_I \in [0, v_s - v_\ell]} + v_\ell(T) \\
&= v_\ell(T^-) \geq v_\ell(T)
\end{aligned}$$

Second, with no trade, the quality of assets also starts improving, but jumps up at T.

But, people take into account $V_I \geq 0$ and anticipate the quality jump. Thus, they start trading *before* the intervention.

Intuition – Price Recovery

Prices need to support trading in equilibrium with an intervention. They are given by

$$p(t) = v_s - v_b(t).$$

When trading starts again, they jump up discretely.

With partial trading before the intervention, The expected surplus $\Gamma(t)$ remains at 0, but $v_b(t)$ increases due to discounting. Hence, price need to fall.

After the intervention, the quality of assets declines monotonically to its new steady state level. Hence, prices need to increase monotonically.

Optimal Intervention

Trade-off between better allocation of assets and deadweight cost of losses for MMLR.

One can get the following insights:

1. For continuous markets, it is optimal to intervene immediately, but at a minimal scale.
2. Higher search frictions imply earlier intervention.
3. It is never optimal to buy more than the minimum quantity. Why? Deadweight costs as surplus is shifted from future buyers to lemon holders at T.
4. It is optimal to either intervene at the lowest or the highest price.
5. For sufficiently high social costs, do not intervene.