Trading in Decentralized Markets with Adverse Selection
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INTRODUCTION

Questions this paper addresses

▶ How do asset markets recover from a freeze (low trade volume)?
▶ What are the dynamics for prices and trading volumes during the recovery?
▶ Did US government subsidization of asset purchases in 2009 help to unfreeze asset markets?

Main contributions

▶ Showing how a frozen asset market can thaw endogenously.
▶ Providing predictions for the duration and dynamics of an asset market’s recovery from a freeze.
▶ Showing that an asset subsidy program may worsen a freeze.
**Environment**

- **Time**: discrete and infinite.
- **Agents**: equal masses of infinitely lived buyers and sellers.
- **Assets**:
  - each seller is endowed with a single indivisible asset
  - an asset is either high \((H)\) or low \((L)\) quality
  - \(q_t\): fraction of \(H\) assets in period \(t\)
  - Type \(j\) asset: gives utility \(u_j\) to buyer and disutility \(c_j\) to seller when traded
- **Assumptions**
  - Always gains from trade: \(u_j > c_j\ \forall j\)
  - Sellers of \(H\) assets won’t accept prices for \(L\) assets: \(c_H > u_L\)
  - Gains from trade are larger for \(H\) assets: \(u_H - c_H > u_L\)
**ENVIRONMENT**

- **Discount factors:** Each agent draws a new discount factor $\delta$ each period from $F(\delta)$ with support $[\underline{\delta}, \bar{\delta}] \in [0, 1)$

- **Matching and trade:**
  - Each buyer is randomly matched with a seller each period
  - Buyer makes a take-it-or-leave-it offer
  - If seller accepts agents realize their utilities and exit
STRATEGIES

Sellers

- The strategy for a seller with asset type \( j \) is a sequence of accept/reject rules \( a_j = \{ a^j_t \}_{t=0}^\infty \).
  \[
  a^j_t : [\delta, \delta] \times [0, u_H] \rightarrow \{0, 1\}
  \]
- \( V^j_t \): value for seller with \( j \) asset at the start of \( t \) (\( \delta \) unknown)
- Optimal rule: \( a^j_t(\delta, p) = 1 \) if \( p - c_j \geq \delta V^j_{t+1} \)

Buyers

- A buyer’s strategy is a sequence of price offers \( p = \{ p_t \}_{t=0}^\infty \).
  \[
  p_t : [\delta, \delta] \rightarrow [0, u_H]
  \]
- \( V^B_t \): buyer’s value at the start of period \( t \)
- Buyer’s problem: for all \( \delta \in [\delta, \delta] \)
  \[
  \max q_t \left[ \Pr\{ a^H_t(\delta', p) = 1 \} (u_H - p) + (1 - \Pr\{ a^H_t(\delta', p) = 1 \}) \delta V^B_{t+1} \right] \\
  + (1 - q_t) \left[ \Pr\{ a^L_t(\delta', p) = 1 \} (u_L - p) + (1 - \Pr\{ a^L_t(\delta', p) = 1 \}) \delta V^B_{t+1} \right]
  \]
**Equilibrium Definition**

Preliminaries

- **Focus on symmetric pure strategies**
- **$T$: the period in which the market “clears” (all assets have been traded)**

**Equilibrium Definition** An equilibrium is a strategy profile $\sigma^* = \{p_t^*, a_t^{L*}, a_t^{H*}\}_{t=0}^{\infty}$ and a law of motion $\{q_t^*\}_{t=1}^{T(\sigma^*)}$ such that for all $t \leq T(\sigma^*)$

1. $p_t^*(\delta)$ solves the buyer’s problem for all $\delta \in [\underline{\delta}, \overline{\delta}]$;
2. For all $j \in \{L, H\}$, for all $\delta \in [\underline{\delta}, \overline{\delta}]$ and for all $p \in [0, u_H]$, $a_t^{j*}(\delta, p)$ maximizes seller utility; and
3. $q_t^*(\sigma^*)$ satisfies the law of motion

$$q_{t+1} = \frac{q_t(1 - \Pr\{\text{asset sells|H asset}\})}{q_t(1 - \Pr\{\text{asset sells|H asset}\}) + (1 - q_t)(1 - \Pr\{\text{asset sells|L asset}\})}$$
**Properties of All Equilibria**

1. The highest price that’s offered is $c_H$. All sellers accept this price.
   - Any price higher than $c_H$ can be undercut and owners of both asset types will accept.

2. $p < c_H$ will only be accepted by an $L$ seller.

3. For $\delta < \hat{\delta}_t$ all buyers offer $p = c_H$. For $\delta \geq \hat{\delta}_t$, $p \downarrow$ in $\delta$.
   - Impatient agents want an asset now and offer a high price to ensure this.
   - More patient agents offer lower prices, avoiding the chance of paying $c_H$ for an $L$ asset.

4. Fraction of $H$ assets increases over time
   - $L$ assets sell at a fast rate because their sellers accept more prices.

5. The market clears in finite time.
   - Market clears when every buyer offers $p = c_H$.
   - It is not optimal for buyers to offer low prices and $L$ sellers to reject these forever.
Equilibrium Characterization

- **Assumption:** Agents can only offer two prices, \( p_h = c_H \) and some \( p_l \in (0, u_L) \).
  - Makes the model tractable.
- Initial fraction of \( H \) assets, \( q_0 \), determines how long it takes for the market to clear.
- For some values of \( q_0 \) there are multiple equilibria.
- An example:

\[
\begin{array}{cccc}
0 & q_1 & \bar{q}_2 & 1 \\
\hline
k = 2 & k = 1 & k = 0
\end{array}
\]

Number of periods \( k \) for market to clear for \( q_0 \in (0, 1) \)
Number of periods $k$ for market to clear for $q_0 \in (0, 1)$

- $k = 0$ if $q_0$ is sufficiently high
  - Average asset quality high enough $\rightarrow$ optimal for all buyers to buy now.
  - Lower bound $q_0$: the most patient buyer is indifferent between offering $p_h$ or $p_l$ when everyone else offers $p_h$.
  - For $q_0$ close to $q_0$, buyer’s actions are complementary $\rightarrow$ multiple equilibria.
Number of periods $k$ for market to clear for $q_0 \in (0, 1)$

**$k = 1$ for an eq’m strategy profile $\sigma$ if**

(i) $q_1 \geq q_0$,
(ii) the most patient buyer strictly prefers to offer $p_1$ at $t = 0$,
(iii) agents behave per the $k = 0$ equilibrium at $t = 1$.

- Conditions (i) and (iii) $\rightarrow$ market clears at $t = 1$.
- Condition (i) determines the lower bound $q_1$.
- Condition (ii) determines the upper bound.

**$k = 2$ for an eq’m strategy profile $\sigma$ if**

(i) $q_1 \in [\underline{q}_1, \bar{q}_1) \cap (0, 1)$,
(ii) the most patient buyer strictly prefers to offer $p_1$ at $t = 0$,
(iii) agents behave per the $k = 1$ equilibrium for $t \geq 1$. 
Properties of the Equilibria

- The time it takes for the market to clear is weakly decreasing in the initial fraction of good assets \( (q_0) \).
- The average trading price increases over time.
**Asset Subsidy Program**

*Policy:* Public-Private Investment Program for Legacy Assets.

- Gov. provided non-recourse loans to private investors to purchase certain assets.
- Investors had to cover a minimum fraction of the purchase price themselves.
- An investor could either (i) repay the loan or (ii) forfeit the asset to the government.
- It’s leverage without the downside risk.

*Model*

- Any agent can borrow a fraction \((1 - \gamma)\) of the purchase price for an asset.
- A buyer observes an asset’s payoff and then repays the loan or gives the asset to the government.
- Financing of the policy is not modeled.
Effects of the Policy

The policy has two effects

1. More buyers are willing to offer $p_h$.
   - Why? Because don’t pay the full price.
   - Effect: The thresholds (for $q_0$) for each equilibrium region decrease $\rightarrow$ the time the market takes to clear weakly decreases.

2. More sellers reject $p_l$
   - Why? More agents offer $p_h$ $\rightarrow$ sellers who reject $p_l$ today are more likely to get $p_h$ tomorrow $\rightarrow$ more sellers reject $p_l$.
   - Effect: The thresholds for some equilibrium regions can increase.

The 2nd effect can outweigh the 1st effect $\rightarrow$ the market takes longer to clear
   - A sunset clause on the policy can mitigate this.