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 δ *each period* from $F(\delta)$ with support $[\underline{\delta}, \overline{\delta}] \in [0, 1)$
- *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 $\mathbf{a}_j = \{a_t^j\}_{t=0}^{\infty}$.

$$a_t^j : [\underline{\delta}, \overline{\delta}] \times [0, u_H] \to \{0, 1\}$$

- V_t^j: value for seller with j asset at the start of t (δ unkown)
- Optimal rule: $a_t^j(\delta, p) = 1$ if $p - c_j \geq \delta V_{t+1}^j$

Buyers

- A buyer's strategy is a sequence of price offers $\mathbf{p} = \{p_t\}_{t=0}^{\infty}$.

$$p_t : [\underline{\delta}, \overline{\delta}] \to [0, u_H]$$

- V_t^B: buyer's value at the start of period t
- Buyer's problem: for all $\delta \in [\underline{\delta}, \overline{\delta}]$

$$\max_{p_t(\delta)} q_t \big[\Pr\{a_t^H(\delta', p) = 1\}(u_H - p) + (1 - \Pr\{a_t^H(\delta', p) = 1\})\delta V_{t+1}^B\big]$$

$$+(1 - q_t)\big[\Pr\{a_t^L(\delta', p) = 1\}(u_L - p) + (1 - \Pr\{a_t^L(\delta', p) = 1\})\delta V_{t+1}^B\big]$$

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

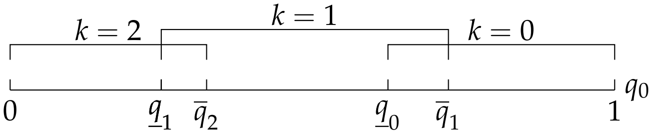
$$q_{t+1} = \frac{q_t(1 - \Pr\{\text{asset sells}|H \text{ asset}\})}{q_t(1 - \Pr\{\text{asset sells}|H \text{ asset}\}) + (1 - q_t)(1 - \Pr\{\text{asset sells}|L \text{ asset}\})}$$

Properties of All Equilibria

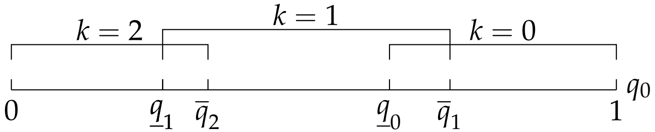
1. The highest price that's offered is c_H. All sellers accept this price.
   - Any price higher than c_H can be undercut and owners of both asset types will accept.
2. $p < c_H$ will only be accepted by an L seller.
3. For $\delta < \hat{\delta}_t$ all buyers offer $p = c_H$. For $\delta \geq \hat{\delta}_t$, $p \downarrow$ in δ.
   - 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:

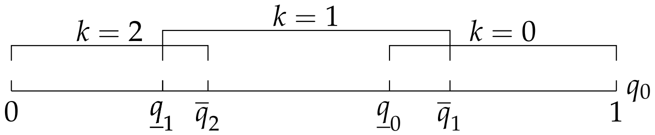


Number of periods k for market to clear for $q_0 \in (0, 1)$



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 $\underline{q}_0$: the most patient buyer is indifferent between offering p_h or p_l when everyone else offers p_h.
  - For q_0 close to $\underline{q}_0$, 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 σ if
  - (i) $q_1 \geq \underline{q}^0$,
  - (ii) the most patient buyer strictly prefers to offer p_l 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 $\underline{q}_1$.
  - Condition (ii) determines the upper bound.
- $k = 2$ for an eq'm strategy profile σ if
  - (i) $q_1 \in [\underline{q}_1, \overline{q}_1) \cap (0, 1)$,
  - (ii) the most patient buyer strictly prefers to offer p_l 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 a 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 gov.
- 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 2^{nd} effect can outweigh the 1^{st} effect $\rightarrow$ the market takes longer to clear

- A sunset clause on the policy can mitigate this.