Costs and Benefits of Dynamic Trading in a Lemons Market

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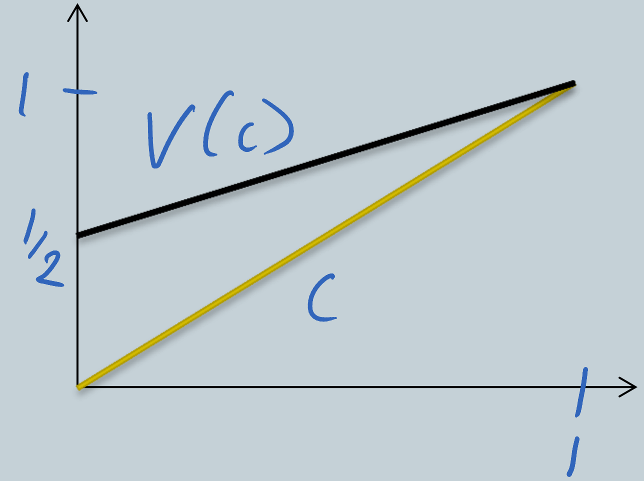
EXAMPLE

Example

- There is a seller and a competitive buyer market
- seller has an asset that yields him a payoff flow rc
- c is private information, distributed $U[0,1]$
- A competitive market of buyers. Each values asset at NPV of $v(c)=(1+c)/2$
- Type becomes public at T
- Common discount rate r



Example: Restricted Trading

- If the only opportunities to trade are at $t \in \Omega = \{0, T\}$.
  - *This is almost the classic static lemons problem*
  - *It would be efficient for all types to trade, but adverse selection implies inefficiency*
  - *Equilibrium:* (p_0, k_0)*:*

$$p_0 = E\left[v(c) \,|\, c \leq k_0\right]$$

$$p_0 = (1-\delta)\, k_0 + \delta \frac{1+k_0}{2}$$

$$\delta = e^{-rT}$$

Example: Restricted Trading

The solution is $k_0 = \frac{2-2\delta}{3-2\delta}$ and $p_0 = \frac{4-3\delta}{6-4\delta}$.

- Expected gains from trade:

$$S_0 = \int_0^{k_0} (v(c) - c)\,dc + \delta \int_{k_0}^{1} (v(c) - c)\,dc = \frac{4\delta^2 - 11\delta + 8}{4(2\delta - 3)^2}$$

Example: Continuous Trading

- If between 0 and T there are more opportunities to trade, this pattern of trade is not consistent with eq.

- If markets are open continuously, $t \in \Omega = [0, T]$, equilibrium is characterized by: p_t, k_t :

$$\begin{aligned} p_t &= v(k_t) \\ r(p_t - k_t) &= \dot{p}_t \end{aligned}$$

Example: Continuous Trading

- Solution: $k_t = 1\text{-}e^{-rt}$

The total surplus from continuous trading is

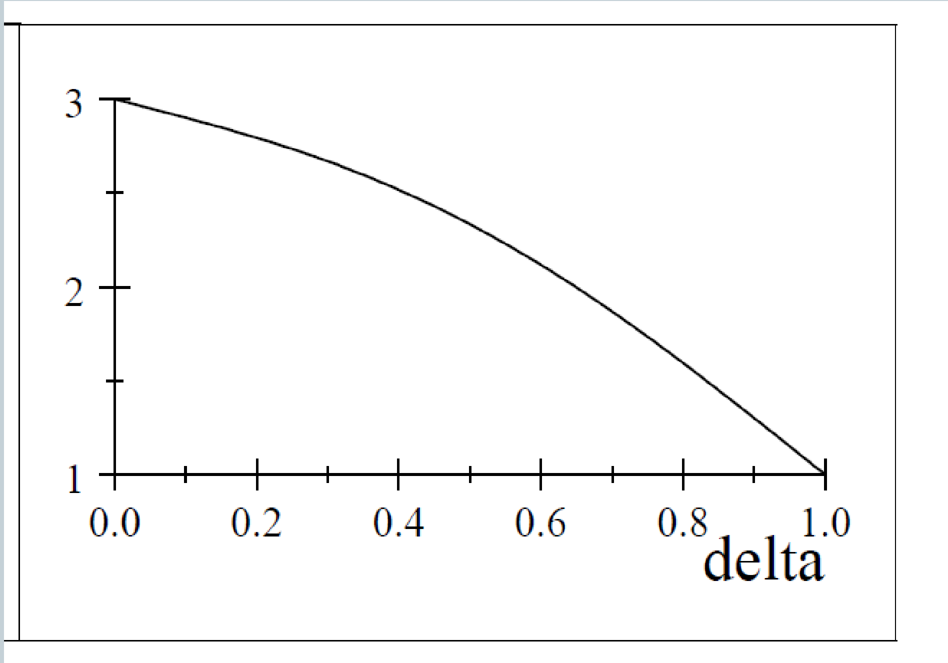
$$\begin{aligned} S_C &= \int_0^T e^{-rt}\left(v\left(k_t\right)-k_t\right)\dot{k}_t dt + e^{-rT}\int_{k_T}^1 \left(v\left(c\right)-c\right)dc \\ &= \int_0^T e^{-rt}\left(\frac{1}{2}e^{-rt}\right)\left(re^{-rt}\right)dt + e^{-rT}\int_{1-e^{-rT}}^1 \left(\frac{1-c}{2}\right)dc \\ &= \frac{1}{12}\left(2+\delta^3\right). \end{aligned}$$

How does frequent trading affect total surplus?

Comparison of DLW

- How does dynamics affect the DWL?

$$\frac{S_{FB} - S_C}{S_{FB} - S_0}$$



For $rT \approx \infty$, the continuous-time trade has 3xDLW

Theme of this paper: dynamics tend to increase DWL

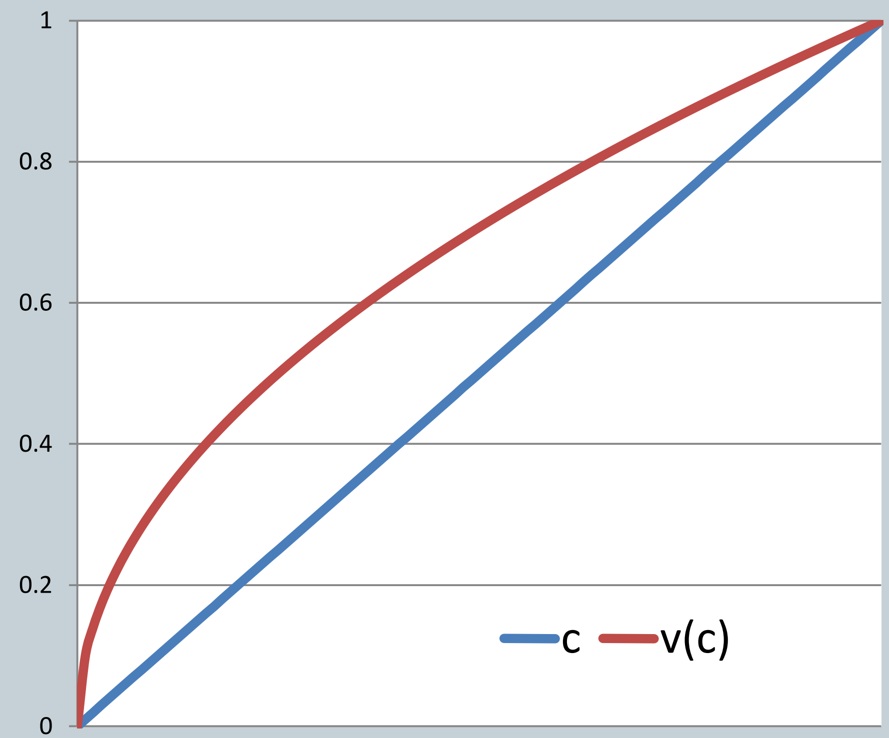
Example 2

- $c \sim U[0,1]$, $v(c) = \sqrt{c}$, $T = \infty$

- Continuous-time trading: no trade

- One-time trading:

types [0, 4/9] trade.



Is this just avoiding costly signaling?

Can the continuous market dominate?

- If T is large and there are strict gains from trade everywhere, total volume of trade is higher with dynamic trading.
  - Continuous trading good for overall liquidity.
  - But loss of welfare due to discounting costs.

Tradeoff: with *restricted trading* realized gains from trade are higher for low types (no delay);
with *continuous trading* they are larger for high types (if T is long enough).

Can the continuous market dominate?

Proposition: For some distributions and parameters the market with *continuous trading*, $\Omega=[0,T]$, generates higher expected gains from trade for large T than a market with only $\Omega=\{0,T\}$.

Interpretation: Not just avoidance of costly signaling.

Motivation and Literature

Motivation

- Asset sales are a source of financing for firms, particularly in financial distress.
  - Asymmetric information →inefficiency.

- Role of governments:
  - Toxic asset problem. A shock increases gains from trade and asymmetric information at the same time.
  - Governments can subsidize trades to improve efficiency (TARP)
  - This paper: They can also affect timing of trades to improve efficiency.
  - Transparency of transactions as another market design tool

- Related:
  - IPO markets (and lock-up periods)
  - Individual sales of firms in financial distress

Related Literature

Akerlof 70, Samuelson 84 – static problems

Dynamic Markets for lemons:

Janssen and Roy 99, Daley and Green 11

Partial government intervention:

Philipon and Skreta 12, Tirole 12

Timing of trade:

Coase conjecture; Vayanos 99, Du and Zhu 13, Pancs 12

Papers about transparency

Hörner and Vielle 2006, Kaya and Liu 2012, Fuchs, Öry and Skrzypacz

General Model

General problem

- c distributed over [0,1] according to $f(c)$ (strictly positive and differentiable)
- $v(c)$ increasing and differentiable.
- $v(c) > c$ for $c < 1$ and $v(1) = 1$
- At T type becomes public (deterministic)
  - Alternative: at a Poisson arrival rate λ information becomes public

(Partial) Market Design Without Transfers

General problem

Many possible market designs: Ω is the grid of times market is open.

Examples:

- Restricted/Infrequent trading $\Omega=\{0,T\}$
- Continuous trading $\Omega=[0,T]$
- Early closure (lock-up): $\Omega=\{0\}\cup[\Delta,T]$
- Late closure $\Omega= [0,T-\Delta] \cup\{T\}$

Question: how do equilibria with these designs compare with respect to efficiency?

Competitive Equilibrium

Given the market design, a *competitive equilibrium* is a mapping from t in Ω to prices and cutoffs s.t.:

1. Zero profit condition
2. Seller optimality
3. Market Clearing → $p_t \geq v(k_{t-})$

Optimality of Restricting Trading Opportunities

1) Benefits of lock-ups

Early closure

Theorem 1: For small Δ, early closure design $\Omega=\{0\}\cup[\Delta,T]$, improves welfare over continuous-time trading, $\Omega=[0,T]$.

Formally: for any $v(c)$, $F(c)$ and r there exists $\Delta^*>0$ such that for all $\Delta < \Delta^*$ the equilibrium surplus with $\Omega=\{0\}\cup[\Delta,T]$ is higher than with $\Omega=[0,T]$.

Moreover, for small Δ, it is a Pareto-improvement.

Sketch of proof

It is sufficient to show that k_0^{EC} in early closure is higher than k_Δ in the continuous-time trading.

- The equilibrium condition for continuous-time trading:

$$r\left(v\left(k_t\right)-k_t\right)=v'\left(k_t\right)\dot{k}_t$$

- For small Δ that means:

$$k_\Delta \approx r\Delta\frac{v\left(0\right)}{v'\left(0\right)}$$

Sketch of proof

- With early closure equilibrium condition is:

$$E\left[v(c) \mid c \le k_0\right] = (1 - e^{-r\Delta})k_0 + e^{-r\Delta} v(k_0)$$

- For small Δ we get:

$$k_0^{\ EC} \approx r\Delta \frac{2v(0)}{v'(0)}$$

- The cutoff is **twice as high** as in cont. trading!

Sketch of proof

- With early closure equilibrium condition is:

$$E\left[v(c)\,|\,c\leq k_0\right]=(1-e^{-r\Delta})k_0+e^{-r\Delta}v(k_0)$$

- The cutoff is **twice as high** as in cont. trading!

- Why? Bunching trade in time reduces adverse selection at the time of trade.
- Keeping p_0 fixed, k_0^{EC} grows at the same rate in Δ as in continuous-time trading.
- But bunching increases p_0 at half the speed of the increase of $v(k_0)$, leading to twice more types trading.

Why a Pareto improvement?

- Since $k_0^{\mathrm{EC}} > k_\Delta$, all $c > k_0^{\mathrm{EC}}$ are better off since they trade at the same prices but sooner.
- Type k_0^{EC} is also better off…
- In any equilibrium the payoff is increasing in type

$$U(c) = \max_{c'} (1 - e^{-r\tau(c')})c + e^{-r\tau(c')} p(c')$$

$$\Rightarrow U'(c) = 1 - e^{-r\tau(c)} > 0$$

So, with cont.-time trading type $c < k_0^{\mathrm{EC}}$ gets a payoff

$$U^{\mathrm{C}}(\mathrm{c}) < U^{\mathrm{C}}(k_0^{\mathrm{EC}}) < U^{\mathrm{EC}}(k_0^{\mathrm{EC}}) = U^{\mathrm{EC}}(c)$$

2) General Market Designs

WHAT Ω IS BEST?

General Market

Theorem 2:

If $\frac{f(c)}{F(c)}\frac{v(c)-c}{1-\delta+\delta v'(c)}$ and $\frac{f(c)}{F(c)}\left(v(c)-c\right)$ are decreasing,

then an equilibrium with $\Omega=\{0,T\}$ generates higher expected gains from trade than equilibrium for **any** other Ω.

(no Pareto ranking, mechanism-design proof)

Transparency as a Market Design Tool

Transparency as Design Tool

Corollary: *If conditions of Theorem 2 hold then total anonymity maximizes welfare*

(even if the designer cannot influence Ω).

Notes:

- anonymity makes adverse selection after the first period worse, but it helps ex-ante.
  - Buyers would like to know whether the asset on the market has been traded before and if they do not know, it reduces welfare ex-post.
- Temporary anonymity can be used to implement the lock-up, which is a Pareto-improvement.

Anonymity of rejected offers

- So far we discussed anonymity of trades
- separate design issue: anonymity of offers.

- Several papers point out that keeping (rejected) offers private is likely to increase efficiency.

3) Delaying Interventions

LATE CLOSURE

Late closure

What if we close the market before information release?

Late closure: $\Omega=[0,T\text{-}\Delta] \cup \{T\}$

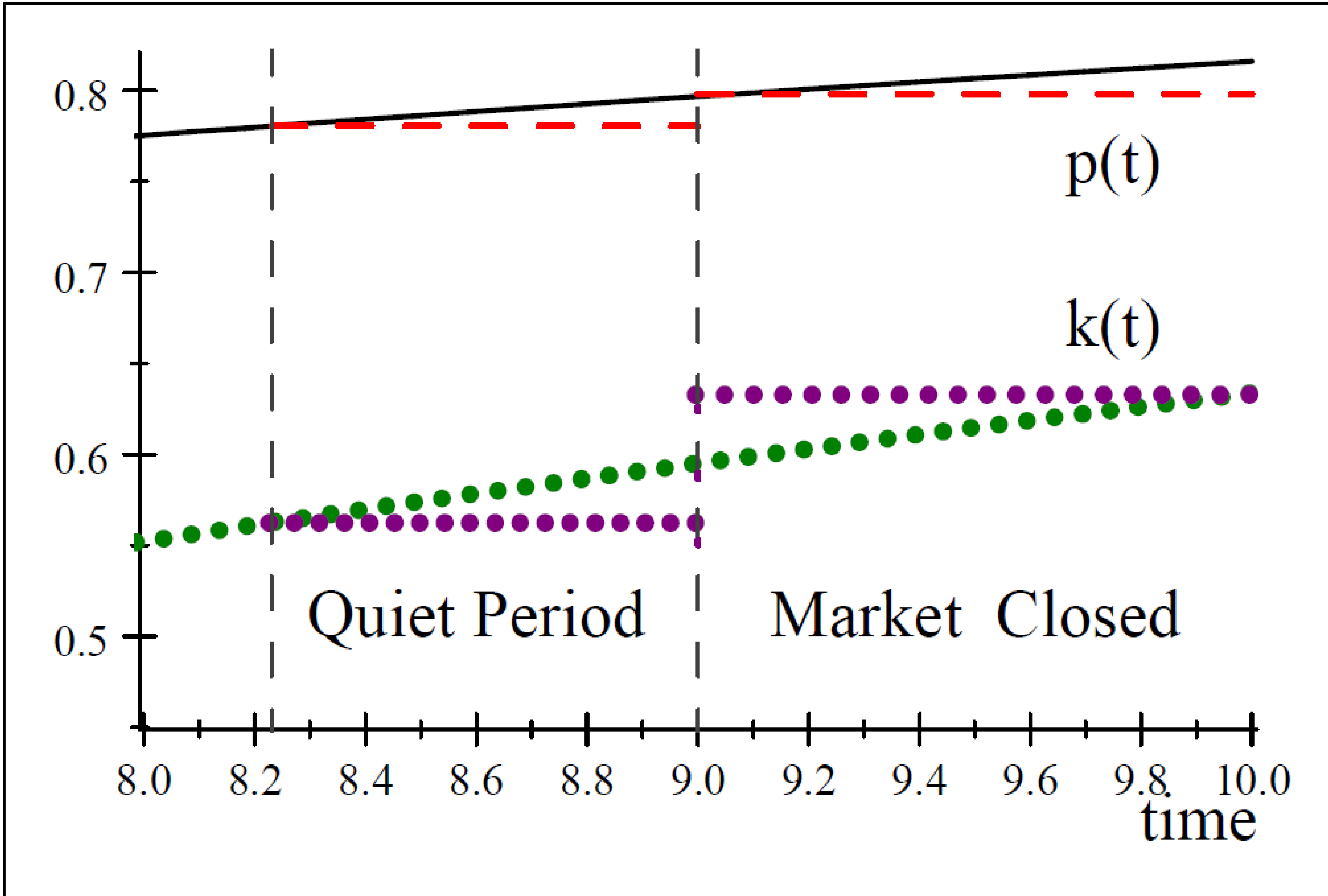
Question: *Does late closure improve welfare?*

Late Closure

Equilibrium:

- at T-Δ an atom of types trades
- As a result, there will be quiet period before the closure of the market.
- Even though the closure speeds up trade, we lose some surplus due to the endogenous quiet period.

$$T = 10 \quad \Delta = 1 \qquad r = 0.1 \qquad v(c) = \frac{c+1}{2} \quad F(c) = c$$



Does surplus go up?

- In general, the first-order effect is zero since the endogenous closure is on the order of Δ, so the gains and losses balance out.

- In general, can go either way
  - In linear case late closure increases surplus
  - But gains are tiny (much lower than in early closure.)

The results apply more generally to any $\Omega=[0,t] \cup [t+\Delta,T]$.

- Morale: delayed interventions additionally freeze the market.

Market Design With Transfers

What if the government can use subsidies and taxes and Ω?

(in progress)

Government Interventions

- If the government has a fixed budget for intervention, what is the best way to spend the money?
  - For example, one big auction with subsidies or a small subsidy on trades over some time window (increasing v(c))?
- Philipon and Skreta (12) and Tirole (12) ask a similar question in a static model.
  - Allow for only one-time purchase and model market as a static equilibrium after the intervention.
  - Show that it is optimal not to intervene beyond the purchase of assets.

Optimal Intervention with Transfers

Using our techniques:

- If the sufficient condition of Theorem 2 holds, it is optimal to subsidize trade only at T=0 but close/tax transactions afterwards (or use anonymity).
- Lockup period can be Pareto-improving.

- Expected future government purchases create atom of trade → endogenous quiet period before the program →welfare losses from delay.

Conclusions

1. Frequent trading makes adverse selection worse since sellers can use delay to signal better assets.
2. Bunching trades in time reduces adverse selection. → benefits of lock-up periods.
3. Transparency policies about trades or offers can reduce DWL.
4. Government interventions to restore liquidity can benefit from additional restrictions of future trading, not just direct subsidies
5. Delayed interventions reduce trade in expectation of them.