Benefits of Restricting Trading Opportunities in a Dynamic Lemons Market

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  - High frequency trading.
- Toxic assets and a role for TARP like interventions.

Related Literature

- **Static:**
  - Akerlof (1970), Samuelson (1984)
- **Dynamic**: Markets for lemons and signaling
  - Noldeke and vanDamme 1990 and Swinkels 1999
  - Jansen and Roy (2002), Daley and Green (2012).
  - Matching: Guerrieri and Shimer (2011-13). Chang (2012)
- **Government Interventions:**
  - Philipon and Skreta (2012)
  - Tirole (2012)

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- $\Omega \subset [0, T]$ denotes the set of times that the market is open.
  - "Infrequent trading": $\Omega_I = \{0, T\}$
  - Continuous trading: $\Omega_C = [0, T]$
- If trade happens at time t at a price p_t then the payoffs are :

$$\textit{Seller}: \quad \left(1 - e^{-rt}\right) c + e^{-rt} p_t$$

$$\text{Buyer:} \quad e^{-rt}\left(v(c) - p_t\right)$$

Equilibrium Definition

A competitive equilibrium of this market is a pair of functions $\{p_t, k_t\}$ for $t \in \Omega$. These functions must satisfy:

1. Zero profit condition: $p_t = E\left[v\left(c\right)|c \in \left[k_{t-}, k_t\right]\right]$

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2. Seller's optimality
3. Market Clearing: in any period the market is open $p_t \geq v\left(k_{t-}\right)$.

Equilibrium with Infrequent Trading

Proposition (Infrequent/Restricted Trading)

For $\Omega = \{0, T\}$ *there exists a competivie equilibrium* $\{p_0, k_0\}$. *Equilibria are a solution to:*

$$p_0 = E\left[v(c)\,|c \in [0, k_0]\right] \quad (1)$$

$$p_0 = \left(1 - e^{-rT}\right) k_0 + e^{-rT} v(k_0) \quad (2)$$

If $\frac{f(c)}{F(c)}(v(c) - c) - \frac{e^{-rT}}{1-e^{-rT}} v'(c)$ *is strictly decreasing then the equilibrium is unique.*

1. Buyers break-even condition.
2. Seller's optimality condition.

Equilibrium with Continuous Trading

With continuous trading, $\Omega_C = [0, T]$.

- No atoms (follows from $p_t \geq v(k_{t-})$) & the zero profit condition imply:

$$p_t = v(k_t).$$

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- These conditions yield a differential equation for the cutoff type

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

with the boundary condition $k_0 = 0$.

Equilibrium with Continuous Trading

Proposition (Continuous trading)

For $\Omega = [0, T]$ the competitive equilibrium is the unique solution to:

$$\begin{aligned} p_t &= v(k_t) \\ k_0 &= 0 \\ r(v(k_t) - k_t) &= v'(k_t)\,\dot{k}_t \end{aligned}$$

Example:

Let c be distributed uniformly over $[0,1]$ and $v(c) = \frac{1+c}{2}$.

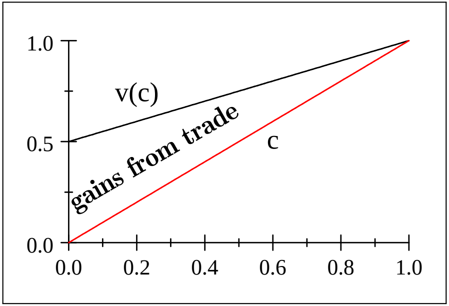


Figure 1

Example: Trading Opportunities and Equilibrium

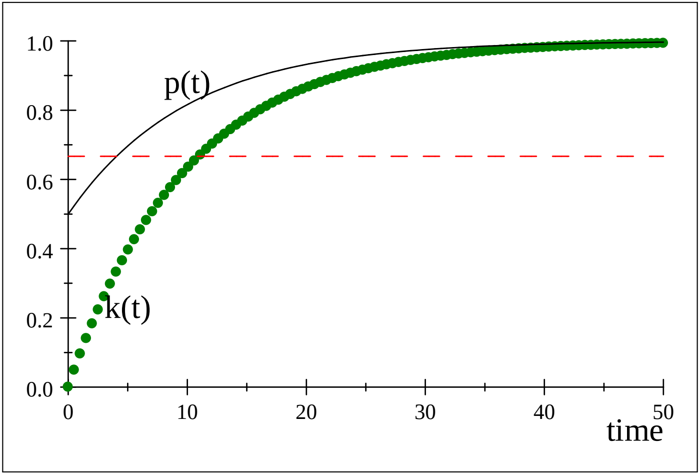
The solution for $\Omega_I = \{0, T\}$ is:

$$k_0 = \frac{2 - 2e^{-rT}}{3 - 2e^{-rT}} \qquad p_0 = \frac{4 - 3e^{-rT}}{6 - 4e^{-rT}}$$

The solution for $\Omega_C = [0, T]$ is:

$$\begin{aligned} k_t &= 1 - e^{-rt} \\ p_t &= \frac{1 + (1 - e^{-rt})}{2} \end{aligned}$$

Example: Dynamics of Trade



Which is more efficient?

We graph the ratio $\frac{S_{FB}-S_C}{S_{FB}-S_I}$ for our example:

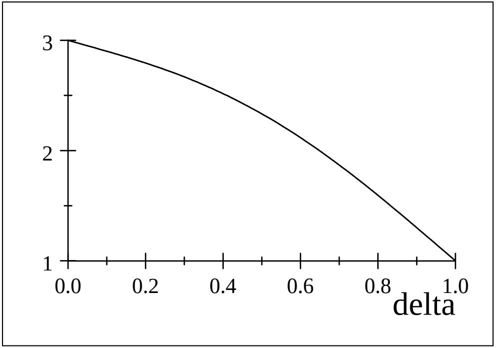


Figure 3: Efficiency

When the private information is long lived the efficiency loss with continuous trading is three times higher than with infrequent trading!!!

Is it about restricting wasteful signaling?

- In Spence's signaling model the first best outcome is achieved by closing down the school.
- Here restricting trading opportunities comes at a cost because some types will never trade as a result.
- Restricting trading opportunities may actually be welfare reducing.

Is this result robust?

Proposition

There exist $v(c)$ and $F(c)$ such that for T large enough the continuous trading market generates more gains from trade than the infrequent trading market

- Proof by Example: $v(c) = \frac{1+c}{2}$ but $F(c)$ with a lot of mass for $c \in [0, \varepsilon]$ little mass for $c \in [\varepsilon, k_0]$ and a lot of mass for $c \in (k_0, 1)$.

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- Mass above k_0 : unrealized surplus with infrequent trading reached with continuous trading after some delay.

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What can we say about the optimality of restricting trade in general?

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Back to the General Setup:

What can we say about the optimality of restricting trade in general?

1. Closing the market **briefly** after **innitial** trade always good. **Pareto**
2. Infrequent trading optimal under certain (fairly general) conditions.
3. Closing the market **briefly** at other times is a wash.

Closing the Market Briefly after Initial Trade

Suppose we start from continuous trading and we introduce a short pause of length Δ after the initial trade.

$$\Omega^{EC} = \{0, [\Delta, T]\}$$

Theorem

For every r, T, $F(c)$, and $v(c)$, there exists $\Delta > 0$ such that the early closure market design $\Omega^{EC} = \{0\} \cup [\Delta, T]$ yields higher gains from trade than the continuous trading design $\Omega_C = [0, T]$.

Closing the Market Briefly after Initial Trade

Proof.

To establish that early closure increases efficiency of trade we show an even stronger result: that for small Δ with Ω^{EC} there is more trade at $t = 0$ than with Ω_C by $t = \Delta$.
Let k_Δ^{EC} be the highest type that trades at $t = 0$ when the design is Ω^{EC}.
Let k_Δ^{C} the equilibrium cutoff at time Δ in design Ω_C. Then the stronger claim is that for small Δ, $k_\Delta^C < k_\Delta^{EC}$. Since $\lim_{\Delta\to 0} k_\Delta^{EC} = \lim_{\Delta\to 0} k_\Delta^{C} = 0$.
So it is sufficient for us to rank:

$$\lim_{\Delta\to 0} \frac{\partial k_\Delta^{EC}}{\partial \Delta} \text{ vs. } \lim_{\Delta\to 0} \frac{\partial k_\Delta^{C}}{\partial \Delta}$$

Indeed we can show:

$$\lim_{\Delta\to 0} \frac{\partial k_\Delta^{EC}}{\partial \Delta} = 2 * \lim_{\Delta\to 0} \frac{\partial k_\Delta^{C}}{\partial \Delta}$$

□

When Infrequent Trading is Optimal

Definition

We say that the environment is *regular* if $\frac{f(c)}{F(c)}\frac{v(c)-c}{1-\delta+\delta v'(c)}$ and $\frac{f(c)}{F(c)}\left(v\left(c\right)-c\right)$ are decreasing.

- A sufficient condition is that $v''\left(c\right)\geq 0$ and $\frac{f(c)}{F(c)}\left(v\left(c\right)-c\right)$ is decreasing.
- Similar to the standard condition in optimal auction theory/pricing theory that the virtual valuation/marginal revenue curve be monotone.
- The static problem of a monopsonist buyer choosing a cutoff (or a probability to trade, $F\left(c\right)$), by making a take-it-or-leave-it offer equal to $P\left(c\right)=\left(1-\delta\right)c+\delta v\left(c\right),$ *there* $\frac{f(c)}{F(c)}\frac{v(c)-c}{1-\delta+\delta v'(c)}$ decreasing guarantees that the marginal profit crosses zero exactly once.

When Infrequent Trading is Optimal

Theorem

If the environment is regular then infrequent trading, $\Omega_I = \{0, T\}$ *, generates higher expected gains from trade than any other market design.*

When Infrequent Trading is Optimal

Proof Outline:

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- We expand the set of possible market designs to **allow for any trading mechanism** that is incentive compatible, does not require the buyers to lose money **on average**.
- For every market design, the equilibrium outcome can be replicated by such a mechanism (but not necessarily vice versa).
- We then show that under the regularity condition infrequent trading replicates the outcome of the best mechanism and hence any other market design generates lower expected gains from trade.

Discussion:

- The proof is constructed requiring only that buyers **break even on average**. That is, we were considering **a relaxed problem** were buyers buying in a given period could potentially subsidize buyers buying in another period.

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- For $T = \infty$ time of trade and probability of trade are essentially equivalent relating to the static result of Samuelson (1984).

Discussion II:Commitment

One way to implement $\Omega_I = \{0, T\}$ in practice may be via an extreme anonymity of the market. In our model we have assumed that the initial seller of the asset can be told apart in the market from buyers who later become secondary sellers. However, if the trades are completely anonymous, even if $\Omega \neq \{0, T\}$, the equilibrium outcome would coincide with the outcome for Ω_I. The reason is that the price can never go up since otherwise the early buyers of the low-quality assets would resell them at the later markets.

Closing the Market Briefly before Information Arrives

Suppose we start from continuous trading and we introduce a short pause of length Δ before T.

$$\tilde{\Omega} = \{[0, T - \Delta,], T\}$$

Closing the Market Briefly before Information Arrives.

Efficiency loss from Endogenous Closure:

1. If the market is closed from $T - \Delta$ to T, there will be an atom of types $[k_{t^*}, k_{T-\Delta}]$ trading at $T - \Delta$.

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3. As a result there need to be "quiet period" before $T-\Delta$: there will be some time interval $[t^*, T-\Delta)$ where despite the market being open, there will be no types that would trade.

$$\left(1-e^{-r(T-\Delta-t^*)}\right)k_{t^*} + e^{-r(T-\Delta-t^*)}p_{T-\Delta} = v(k_{t^*})$$

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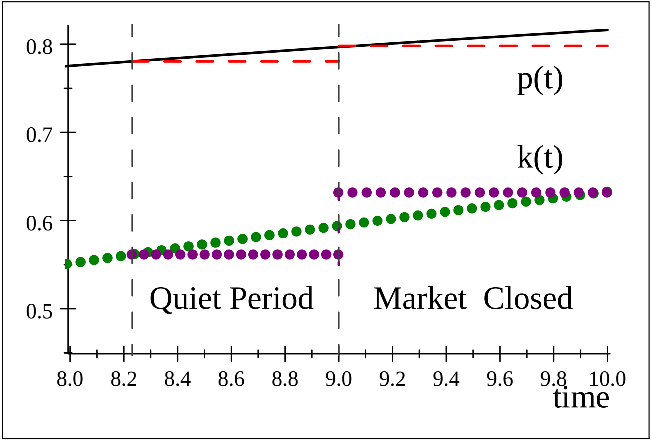
3. As a result there need to be "quiet period" before $T-\Delta$: there will be some time interval $\left[t^*, T-\Delta\right)$ where despite the market being open, there will be no types that would trade.
$$\left(1-e^{-r\left(T-\Delta-t^*\right)}\right)k_{t^*} + e^{-r\left(T-\Delta-t^*\right)}p_{T-\Delta} = v\left(k_{t^*}\right)$$
4. Before t^* the equilibrium outcome remains unchanged

Closing the Market Briefly before Information Arrives

Endogenous Closure:



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

Of Gaps and Government

- We assumed $v(0) > 0$. If instead $v(0) = 0$ then we could have cases in which the is no Ω for which any amount of trade can take place. For example if $F(c) = c$ and $v(c) = \gamma c$ for $\gamma \in (1, 2)$. This model arrises for example if the seller has a higher discount rate than the buyers. Banks in 2009 vs W.Buffet

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  - We are left with $c \in [\varepsilon, 1]$ and now we can let the market take over.
- In general, the surplus/gain from trades far outweighs the government investmentment of $\gamma\varepsilon^2$.
- **Even banks that do not sell to the government benefit from this type of intervention.**

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- When thinking about organizing markets an additional consideration is what information is revealed. Fuchs, **Öry** and Skrzypacz (2013)