

Transparency in sequential common-value trade

Andre Speit and Justus Preusser
EEA-ESEM 2023

Introduction

- Consider a decentralized market for a single common-value good.
- Buyers arrive sequentially.
- Implications of market transparency?

Introduction

- Consider a decentralized market for a single common-value good.
- Buyers arrive sequentially.
- Implications of market transparency?
- This paper:
 1. Seller is initially uninformed and makes price offers.
 2. Buyers with private signals arrive sequentially.
 3. Players learn about value from rejected price offers.
- Large frictionless market: With commitment, full surplus extraction.
- Compare three regimes:
 - Seller's time-on-the-market and past offers are public.
 - Public time, private offers.
 - Neither time nor offers are public.

Introduction

- Consider a decentralized market for a single common-value good.
- Buyers arrive sequentially.
- Implications of market transparency?
- This paper:
 1. Seller is initially uninformed and makes price offers.
 2. Buyers with private signals arrive sequentially.
 3. Players learn about value from rejected price offers.
- Large frictionless market: With commitment, full surplus extraction.
- Compare three regimes:
 - Seller's time-on-the-market and past offers are public.
 - Public time, private offers.
 - Neither time nor offers are public.
- In extreme regimes, there exists an equilibrium with full surplus extraction.
- In intermediate regime, buyers may enjoy rents in all equilibria.

(Some) related literature

- Fuchs, Öry, and Skrzypacz (2016), Hörner and Vieille (2009), Kaya and Liu (2015), Kaya and Roy (2022a,b, 2023), and Kim (2017)
 - These papers: long-lived player informed, short-lived players uninformed and make offers.
 - This paper: all initially uninformed, long-lived seller makes offers.
- Vairo and Dworzak (2023).
 - Pre- vs. post-trade transparency.
- Kakhbod and Song (2022).
 - Pooling equilibria with informed long-lived player.

Model

- One seller with one unit of indivisible good. Reservation value 0.
- Set of potential buyers is \mathbb{N} .
- Buyers have common valuation $v \in \{v_\ell, v_h\}$, where $0 < v_\ell < v_h$.
- π_0 : prior probability of $v = v_h$.
- $v_0 = \pi_0 v_h + (1 - \pi_0) v_\ell$: prior expected value.
 v_0 is maximal surplus from trade.
- Initially, all players are uninformed about v .
- Buyers have conditionally iid. signals from finite set S .
- f_ω : pmf. of signals in state ω .
- Signals have full support and MLRP holds:
 - $\frac{f_h(s)}{f_\ell(s)}$ is increasing in s .

Trade protocol

- Periods indexed by $i \in \mathbb{N}$.
- In period i , the seller and buyer i are active.
- Timing in period i :
 1. The seller sets TIOLI price p_i .
 2. Buyer i arrives to market with probability $\lambda \in (0, 1)$.
Learns p_i and s_i . Then decides whether to accept p_i .
 3. **Note:** Buyer i does not know past prices or signals, but knows the period is i .
 4. Game stops if buyer i accepts. Game moves to next period if i does not arrive or rejects.
 5. Arrivals unobservable to others, independent of v and signals, and independent across agents.
- No discounting or search costs.
- Consider PBE where trade happens with non-zero probability in each period.

Preliminaries

- Seller's pure strategy is sequence of prices.
- Suppose buyers believe that seller plays pure strategy $(p_i)_i$.
Suppose seller plays $(p_i)_i$.
- By MLRP, buyer i 's valuation increases in s_i .
- Thus $(p_i)_i$ induces sequence $(\sigma_i)_i$ of signal cutoffs:
 - Buyer i accepts p_i if and only if $s_i \geq \sigma_i$.
- Let $x_i(\sigma_i)$ be indicator for i arriving to market and $s_i \geq \sigma_i$.
- Therefore:

$$p_i \leq \mathbb{E}[v | x_1(\sigma_1) = \dots = x_{i-1}(\sigma_{i-1}) = 0, s_i = \sigma_i].$$

- Buyer i 's posterior valuation conditional on trading:

$$\mathbb{E}[v | x_1(\sigma_1) = \dots = x_{i-1}(\sigma_{i-1}) = 0, s_i \geq \sigma_i].$$

Preliminaries

- Necessary condition for full surplus extraction: No buyer enjoys information rents:

$$\begin{aligned} & \mathbb{E}[v|x_1(\sigma_1) = \dots = x_{i-1}(\sigma_{i-1}) = 0, s_i = \sigma_i] \\ & = \mathbb{E}[v|x_1(\sigma_1) = \dots = x_{i-1}(\sigma_{i-1}) = 0, s_i \geq \sigma_i]. \end{aligned}$$

- Let $\bar{s} = \max S$.
- By the MLRP, full surplus extraction requires $\sigma_i = \bar{s}$ for all i .
- Benchmark: If the seller can commit, or if prices are public, then then equilibrium is unique and the seller extracts the full surplus.
- What if prices are private and the seller cannot commit?

A profitable deviation

- Consider candidate equilibrium where seller extracts surplus.
- So, buyers believe that seller induces cutoff \bar{s} in each period, and prices are

$$\bar{p}_i = \mathbb{E}[v | x_1(\bar{s}) = \dots = x_{i-1}(\bar{s}) = 0, s_i = \bar{s}].$$

- For $s^* \neq \bar{s}$, let

$$p_1^* = \mathbb{E}[v | s_1 = s^*].$$

p_1^* is highest price that induces s^* as period 1 cutoff.

Note: Buyer 1 does not update on seller's action.

- Consider deviation from $(\bar{p}_1, \bar{p}_2, \bar{p}_3, \dots)$ to $(p_1^*, \bar{p}_2, \bar{p}_3, \dots)$.

A profitable deviation

- Consider deviation from $(\bar{p}_1, \bar{p}_2, \bar{p}_3, \dots)$ to $(p_1^*, \bar{p}_2, \bar{p}_3, \dots)$.
- Deviation induces cutoffs $(s^*, \bar{s}, \bar{s}, \dots)$.
- Prices are:
 - $\mathbb{E}[v|s_1 = s^*]$ for $i = 1$.
 - $\mathbb{E}[v|x_1(\bar{s}) = x_2(\bar{s}) = \dots = x_{i-1}(\bar{s}) = 0, s_i = \bar{s}]$ for $i \geq 2$.
- Compare to posterior valuations of buyers conditional on trading at cutoffs $(s^*, \bar{s}, \bar{s}, \dots)$.
 - $\mathbb{E}[v|s_1 \geq s^*]$ for $i = 1$.
 - $\mathbb{E}[v|x_1(s^*) = x_2(\bar{s}) = \dots = x_{i-1}(\bar{s}) = 0, s_i = \bar{s}]$ for $i \geq 2$.
- Buyer 1 gets information rent.
- For $i \geq 2$, buyer i overpays if rejection of s^* induces more pessimistic belief than rejection of \bar{s} .

Failure of surplus extraction

Let (g_h, g_ℓ) be continuous, strictly positive densities on $[0, 1]$ with MLRP. Consider a sequence of finite approximations $(S_k, f_{h,k}, f_{\ell,k})_{k \in \mathbb{N}}$ of (g_h, g_ℓ) .

Proposition

If k is sufficiently large and the signal structure is $(S_k, f_{h,k}, f_{\ell,k})$, then there is no equilibrium where the seller extracts the full surplus v_0 .

Equilibrium existence

- Equilibrium exists (in possibly mixed strategies) in nearby game where:
 - Seller announces cutoffs.
 - Intermediaries set prices on behalf of seller to implement cutoffs.
- Equilibrium also exists in nearby game where seller sets prices and sends cheap-talk messages.
- In these equilibria, off-path posterior valuations bounded by most pessimistic posterior valuations that can be induced by cutoff sequence.
- If signals are binary ($|S| = 2$), there is a unique equilibrium with such bounded posteriors. In it, the seller extracts the full surplus.

Unobservable time-on-the-market

- Now suppose:
 - Number n of buyers is finite.
 - Seller incurs costs $c > 0$ for soliciting new buyer.
 - Order of arrivals chosen randomly by Nature and unobserved.
- As $n \rightarrow \infty$ and $c \rightarrow 0$, then profit converges to full surplus along at least one sequence of equilibria.
- Under a restriction on off-path posterior valuations, if $|S| = 2$, then profit converges to full surplus along all sequences of equilibria.

Some open questions

- With multi-unit supply, new belief dynamics possible (Bose et al., 2006; Kaya and Roy, 2022b).
- Welfare-optimal information structure with search frictions?
- Strategic entry of buyers / solicitation by seller?
- Effects of pre-trade transparency with multiple sellers (Vairo and Dworzak, 2023)?

References

-  Bose, Subir, Gerhard Orosel, Marco Ottaviani, and Lise Vesterlund (2006). “Dynamic monopoly pricing and herding”. In: *The RAND Journal of Economics* 37.4, pp. 910–928.
-  Fuchs, William, Aniko Öry, and Andrzej Skrzypacz (2016). “Transparency and distressed sales under asymmetric information”. In: *Theoretical Economics* 11.3, pp. 1103–1144.
-  Hörner, Johannes and Nicolas Vieille (2009). “Public vs. private offers in the market for lemons”. In: *Econometrica* 77.1, pp. 29–69.
-  Kakhbod, Ali and Fei Song (2022). “Public vs. Private offers with informed and forward-looking dealers”.
-  Kaya, Ayca and Qingmin Liu (2015). “Transparency and price formation”. In: *Theoretical Economics* 10.2, pp. 341–383.

-  Kaya, Ayça and Santanu Roy (2022a). “Market screening with limited records”. In: *Games and Economic Behavior* 132, pp. 106–132.
-  — (2022b). “Price Transparency and Market Screening”.
-  — (2023). “Repeated Trading: Transparency and Market Structure”.
-  Kim, Kyungmin (2017). “Information about sellers’ past behavior in the market for lemons”. In: *Journal of Economic Theory* 169, pp. 365–399.
-  Vairo, Maren and Piotr Dworczak (2023). “What type of transparency in OTC markets?”