Knowing your Lemon before You Dump it

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Motivation

- Many situations where decision to "engage" carries info about what's at stake
  - trade
  - partnerships
  - entry
  - marriage
  - ...
- **Negative inferences**
  - lemons (Akerlof)
- **Positive inferences**
  - anti-lemons (Spence)

Motivation

- Typical assumption:
    - Exogenous information
- Many problems of interest: **Endogenous information**
    - acquisition
    - attention
    - cognition
- Example: Info asset owner collects depends on mkt price

This Paper

- Generalized lemons (and anti-lemons)
  - **endogenous information**
- Information choices
  - type of strategic interaction
  - opponent's beliefs over selected information
- Two forces shaping **expectation conformity**
  - effect of information on **severity of adverse selection**
  - effect of **friendliness of opponent's reaction** on value of information
- **Expectation traps**
- **Policy implications**

Literature

- **Endogenous info in lemons problem**
  - Dang (2008), Thereze (2024), Lichtig and Weksler (2023)

    $\rightarrow$ EC, $\neq$ bargaining game, timing, CS
- **Payoffs in lemons problem**
  - Levin (2001), Bar-Isaac et al. (2018), Kartik and Zhong (2024)...

    $\rightarrow$ incentives analysis
- **Policy in mkts with adverse selection**
  - Philippon and Skreta (2012), Tirole (2012), Dang et al (2017)...

    $\rightarrow$ endogenous information
- **Endogenous info in private-value bargaining**
  - Ravid (2020), Ravid, Roesler, and Szentes (2021)...

    $\rightarrow$ interdependent payoffs, competitive mkt

Plan

1. Introduction
2. Model
3. Expectation Conformity and Expectation Traps
4. Policy Interventions
5. Flexible Information
6. Equilibrium under Entropy Cost
7. Conclusions

Model

Model

- **Players**
  - Leader
  - Follower
- **Choices**
  - Leader:
    - information structure, ρ (more below)
    - two actions:

      - **adverse-selection-sensitive**, $a = 1$ ("engage")

      - adverse-selection insensitive, $a = 0$ ("not engage")
  - Follower:
    - reaction, $r \in \mathbb{R}$ (e.g., price offer)

Model

- **State**
  - $\omega \sim$ prior G
  - mean: ω_0

- **Payoffs**
  - leader: $\delta_L(r, \omega) \equiv u_L(1, r, \omega) - u_L(0, \omega)$

    - affine in ω

    - increasing in r (higher r: friendlier reaction)

    - decreasing in ω

    - benefit of friendlier reaction (weakly) increasing in state: $\frac{\partial^2 \delta_L}{\partial \omega \partial r} \geq 0$

    (benefit of higher r largest in states in which L's value of engagement lowest)

  - follower: $\delta_F(r, \omega) \equiv u_F(1, r, \omega) - u_F(0, \omega)$

    - affine in ω

Akerlof Example

- Leader: seller
  - $u_L(1,\ r,\ \omega) = r$ (price)
  - $u_L(0,\ r,\ \omega) = \omega$ (asset value)
  - $\delta_L(r,\ \omega) = r - \omega$
- Follower: competitive buyer
  - $u_F(0, \omega) = 0$
  - $u_F(1,\ r,\ \omega) = \omega + \Delta - r$
  - $\delta_F(r,\ \omega) = u_F(1,\ r,\ \omega)$

Model

- **Information structures:** $\rho \in \mathbb{R}_+$
  - cdf $G(m;\rho)$ over posterior mean m (mean-preserving-contraction of G)
  - $C(\rho)$: information-acquisition cost

MPS

Definition

Information structures consistent with **MPS order** (mean-preserving spreads) if, for any $\rho' > \rho$, any $m^* \in \mathbb{R}$,

$$\int_{-\infty}^{m^*} G(m;\rho')dm \geq \int_{-\infty}^{m^*} G(m;\rho)dm$$

with $\int_{-\infty}^{+\infty} G(m;\rho')dm = \int_{-\infty}^{+\infty} G(m;\rho)dm$

- MPS order and Blackwell informativeness:
  - $G(\cdot;\rho)$ obtained from experiment $q_\rho : \Omega \to \Delta(Z)$
  - $G(\cdot;\rho')$ obtained from experiment $q_{\rho'} : \Omega \to \Delta(Z)$
  - If $\rho' > \rho$ means $q_{\rho'}$ Blackwell more informative than q_ρ, then

$$G(\cdot;\rho') \succeq_{MPS} G(\cdot;\rho)$$

(Rotations)

Model

- For any (ρ, r), **leader engages** (i.e., $a = 1$) iff

$$m \leq m^*(r)$$

  with

$$\delta_L(r,\ m^*(r)) = 0$$

- Truncated mean:

$$M^-(m^*;\ \rho) \equiv \mathbb{E}_{G(\cdot;\,\rho)}[m|m \leq m^*]$$

- $r(\rho)$: eq. reaction when info is ρ (assumed unique)
- **Assumption (lemons):**

$$\frac{dr(\rho)}{d\rho} \overset{\text{sgn}}{=} \frac{\partial}{\partial \rho} M^-\left(m^*(r(\rho));\ \rho\right)$$

- Anti-lemons:

$$\frac{dr(\rho)}{d\rho} \overset{\text{sgn}}{=} -\frac{\partial}{\partial \rho} M^-\left(m^*(r(\rho));\ \rho\right)$$

Akerlof Example

- Engagement threshold: $m^*(r) = r$
- Equilibrium price $r(\rho)$: solution to

$$r = M^-(r;\rho) + \Delta$$

- Lemons:

$$\frac{dr(\rho)}{d\rho} \overset{\text{sgn}}{=} \frac{\partial}{\partial\rho} M^-\left(r(\rho);\, \rho\right)$$

  - always if $g(m;\rho)/G(m;\rho)$ decreases in m (**Monotone Hazard Rate**)

Plan

Expectation Conformity and Expectation Traps

Effect of information on adverse selection

- Truncated mean

$$M^{-}(m^*; \rho) \equiv \frac{\int_{-\infty}^{m^*} m dG(m; \rho)}{G(m^*; \rho)}$$

Definition

Information

- **aggravates adverse selection** if $\frac{\partial}{\partial \rho} M^{-}(m^*;\ \rho) < 0$
- alleviates adverse selection if $\frac{\partial}{\partial \rho} M^{-}(m^*;\ \rho) > 0$

Effect of information on adverse selection

- Let
$$G_\rho(m;\rho) \equiv \frac{\partial}{\partial\rho} G(m;\rho)$$

- **Effect of info on AS**:
$$\frac{\partial}{\partial\rho} M^{-}(m^*;\ \rho) \overset{\text{sgn}}{=} A(m^*;\rho)$$
where
$$A(m^*;\rho) \equiv \left[m^* - M^{-}(m^*;\ \rho)\right] G_\rho(m^*;\rho) - \int_{-\infty}^{m^*} G_\rho(m;\rho)dm$$

- Two channels through which info affects AS:
  - prob. of trade: $G_\rho(m^*;\rho)$
  - dispersion of posterior mean: $\int_{-\infty}^{m^*} G_\rho(m;\rho)dm$
- **Adverse Selection Effect**: $\mathrm{A}(\rho) \equiv A(m^*(r(\rho));\rho)$

Effect of unfriendlier reactions on value of information

- L's payoff under information ρ and reaction r:

$$\begin{aligned}\Pi(\rho; r) &\equiv \sup_{a(\cdot)} \left\{ \int_{-\infty}^{+\infty} a(m)\, \delta_L(r, m) dG(m; \rho) \right\} \\ &= G(m^*(r); \rho)\delta_L(r, M^-(m^*(r);\ \rho))\end{aligned}$$

- **Benefit of friendlier reaction** effect
  - ρ: actual choice (by L)
  - $\rho^\dagger$: anticipated choice (by F)

$$B(\rho; \rho^\dagger) \equiv -\frac{\partial^2}{\partial\rho\partial r}\Pi(\rho; r(\rho^\dagger))$$

- Starting from $r(\rho^\dagger)$, reduction in r
  - raises value of info at ρ if $B(\rho; \rho^\dagger) > 0$
  - lowers value of info at ρ if $B(\rho; \rho^\dagger) < 0$

Effect of unfriendlier reactions on value of information

- **Benefit of friendlier reaction**:

$$B(\rho;\rho^\dagger) \quad = \quad -\frac{\partial \delta_L(r, m^*(r(\rho^\dagger)))}{\partial r} G_\rho\Big(m^*(r(\rho^\dagger);\rho\Big)$$

$$+\int_{-\infty}^{m^*(r(\rho^\dagger))} \frac{\partial^2 \delta_L(r,m)}{\partial r \partial m} G_\rho(m;\rho)dm$$

- Two channels through which, starting from $r(\rho^\dagger)$, reduction in r affects value of info at ρ:
    - prob. of trade: $G_\rho\Big(m^*(r(\rho^\dagger);\rho\Big)$
    - dispersion of posterior mean: $\int_{-\infty}^{m^*(r(\rho^\dagger))} \frac{\partial^2 \delta_L(r,m)}{\partial r \partial m} G_\rho(m;\rho)dm$

Expectation Conformity

Definition

Expectation conformity holds at $(\rho, \rho^\dagger)$ iff

$$\frac{\partial^2 \Pi(\rho; r(\rho^\dagger))}{\partial \rho \partial \rho^\dagger} > 0$$

- Complementarity between anticipated and actual investment in info

Key forces...

- $\mathrm{A}(\rho^\dagger) \overset{\mathrm{sgn}}{=} \frac{\partial}{\partial \rho} M^-(m^*(r(\rho^\dagger)); \rho^\dagger)$: **adverse-selection effect**

- $B(\rho; \rho^\dagger) = -\dfrac{\partial^2 \Pi(\rho; r(\rho^\dagger))}{\partial \rho \partial r}$: **benefit-of-friendlier-reactions effect**

Expectation Conformity

Proposition

Assume MPS.

- *EC at* $(\rho, \rho^\dagger)$ *iff* $\mathrm{A}(\rho^\dagger)B(\rho;\rho^\dagger) < 0$.
- *Info aggravates AS at* $\rho^\dagger$ *(i.e.,* $\mathrm{A}(\rho^\dagger) < 0$*) for Uniform, Pareto, Exponential, or, more generally, when it reduces prob of trade perceived by* F*, i.e.,* $G_\rho(m^*(r(\rho^\dagger);\rho^\dagger) < 0$.
- *Starting from* $r(\rho^\dagger)$*, reduction in* r *raises value for info at* r *(i.e.,* $\mathrm{B}(\rho;\rho^\dagger) > 0$*) if more info reduces prob of trade perceived by L, i.e.,* $G_\rho(m^*(r(\rho^\dagger);\rho) < 0$.
- *Therefore EC at* $(\rho, \rho^\dagger)$ *if , no matter whose perspective one takes, more info reduces prob of trade:*

$$\max\left\{G_\rho(m^*(r(\rho^\dagger));\rho^\dagger), G_\rho(m^*(r(\rho^\dagger));\rho)\right\} < 0$$

- *Suppose* $M^-(m^*;\rho)$ *decreases in* ρ *(Uniform, Pareto, Exponential) and* $\partial^2\delta_L(r,m)/\partial r\partial m = 0$ *(e.g., Akerlof). Then,* $G_\rho(m^*(r(\rho^\dagger);\rho) < 0$ *NSC for EC at* $(\rho, \rho^\dagger)$.

EC under non-directed search in Akerlof model

- Akerlof model under non-directed search (ρ=prob. seller learns state)

$$G(m;\rho) = \begin{cases} \rho G(m) & \text{for } m < \omega_0 \\ \rho G(m) + 1 - \rho & \text{for } m \geq \omega_0 \end{cases}$$

Corollary

EC holds holds at $(\rho, \rho^\dagger)$ iff $r(\rho^\dagger) > \omega_0$, i.e., iff gains from trade Δ large.

EC under non-directed search in Akerlof model

- Large Δ : $r(\rho^\dagger) > \omega_0$
- Increase in info $\rho^\dagger$ (anticipated by F)

  $\rightarrow$ seller **engages more selectively**
  (when uninformed: always; when informed iff: $\omega \leq r(\rho^\dagger)$)

  $\rightarrow$ lower prob. of trade perceived by F:$G_\rho(r(\rho^\dagger); \rho^\dagger) < 0$

  $\rightarrow$ aggravation of AS: $\mathrm{A}(\rho^\dagger) < 0$

  $\rightarrow$ **lower price**

  $\rightarrow$ higher cost for S of parting with valuable item

  $\rightarrow$ higher value in learning state at ρ: $B(\rho; \rho^\dagger) > 0$

- Hence, $\mathrm{A}(\rho^\dagger)B(\rho; \rho^\dagger) < 0$

  $\rightarrow$ **Expectation conformity!**

EC under non-directed search in Akerlof model

- Small Δ: $r(\rho^\dagger) < \omega_0$
- S engages only when **informed** and $\omega < r(\rho^\dagger)$
- Variations in anticipated info $\rho^\dagger$ $\rightarrow$ no effect on truncated mean

$$M^-(r(\rho^\dagger);\rho) \equiv \frac{\int_{-\infty}^{m^*} m dG(m;\rho)}{G(m^*;\rho)} = \omega_0$$

- **Adverse selection effect:** $\mathrm{A}(\rho^\dagger) = 0$
- **No expectation conformity**

(Gains from Engagement)

Expectation Traps

Proposition

Suppose ρ_1 *and* $\rho_2 > \rho_1$ *are eq. levels and info aggravates AS (i.e.,* $\mathrm{A}(\rho) < 0$ *for all* $\rho \in [\rho_1, \rho_2]$*). Then L better off in low-info equilibrium* ρ_1*. Converse true when info alleviates AS, i.e.,* $\mathrm{A}(\rho) > 0$*.*

(Example: Akerlof-direct-search)

(Disclosure)

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Policy Interventions

Subsidies to Trade

- Welfare (competitive F):

$$W \equiv \int_{-\infty}^{m^*} (\delta_L(r,m) + s)\, dG(m;\rho) - C(\rho) - (1+\lambda)sG(m^*;\rho)$$

  where

  - s: subsidy to trade
  - λ: **cost of public funds** (DWL of taxation)

- Subsidy impacts:
  - engagement threshold: $m^* = r + s$
  - friendliness of F's reaction: r
  - information: ρ

Subsidies: Akerlof

- **Eq. with subsidy** s: $(r^*(s), \rho^*(s))$
- Engagement threshold: $m^*(s) = r^*(s) + s$
- Optimality of subsidizing/taxing trade?

Proposition

Subsidizing trade optimal when

$$\frac{\partial}{\partial m^*} M^-(r^*(0); \rho^*(0)) + \frac{\partial}{\partial \rho} M^-(r^*(0); \rho^*(0)) \frac{d\rho^*(0)}{ds} > \lambda.$$

Taxing trade optimal when inequality reversed.

Subsidies: Akerlof

- Subsidies optimal when

  1. Small cost λ of public funds
  2. Information aggravates AS $(\mathrm{A}(\rho) < 0)$
  3. CS of eq. same as BR: Subsidies disincentivize info acquisition

Subsidies: Double Dividend

- Optimal subsidy w. endogenous info: s^*
- Eq. with optimal subsidy: $(\rho^*(s^*), r^*(s^*))$
- Suppose info is exogenous and equal to $\rho^*(s^*)$
- Optimal subsidy under exogenous info $\rho^*(s^*)$: s^{**}
- Question: $s^{**} >? < s^*$

Proposition

Assume that, when $\rho = \rho^*(s^*)$, distribution of posterior mean has MHR:

$$\frac{g(m;\rho)}{G^*(m;\rho)} \qquad \text{decreasing in } m.$$

Further assume info reduces prob of trade and hence aggravates AS: when $m^* = r^*(s^*) + s^*$and $\rho = \rho^*(s^*)$,

$$G_\rho(m^*;\rho) < 0.$$

Then optimal subsidy larger with endogenous info:

$$s^{**} < s^*.$$

Subsidies: Double Dividend

- Same conditions as for EC:
  - **larger** subsidy **when info reduces prob. of trade**
- **Double dividend** of subsidy
  - more engagement ($\Rightarrow$ less AS $\Rightarrow$ higher r $\Rightarrow$ more trade)
  - less info acquisition ($\Rightarrow$ less AS $\Rightarrow$ higher r $\Rightarrow$ more trade)
- Implication for Gov. asset buyback programs: **more generous terms**
  - **Gov should offer to purchase assets at higher price!**

Plan

Flexible Information

Flexible Information

- Purpose of extension:
  1. Robustness
  2. Alternative order over investments when experiments not rankable
  3. Eq. analysis
     1. expectation traps
     2. **(novel form of) mkt breakdown**

Flexible Information

- **Entropy**:
  - ρ parametrizes MC of entropy reduction (alternatively, capacity)
  - L invests in ability to process info (MC or capacity)
  - then chooses experiment $q : \Omega \to \Delta(Z)$ at cost

$$C(\rho) + \frac{1}{\rho} I^q$$

  where I^q is mutual information between z and ω

- **Max-slope**:
  - ρ parametrizes max slope of stochastic choice rule $\sigma : \Omega \to [0, 1]$ specifying prob. L engages
  - L chooses ρ at cost $C(\rho)$
  - then selects experiment $q : \Omega \to \Delta(Z)$ and engagement strategy $a : Z \to [0, 1]$ among those inducing stochastic choice rule with slope less than ρ

- Key insights similar to those under MPS order

(Prop-FI)

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Equilibrium Under Entropy Cost

Inner Problem

- Without loss: binary experiments/recommendations ($q(1|\omega) = \mathbb{P}(a = 1|\omega)$)

- L's **inner problem** (given ρ)

$$\sup_{q(1|\cdot):\Omega\to[0,1]} \int (r-\omega)q(1|\omega)dG(\omega) + \mathbb{E}[\omega] - \frac{I^q}{\rho}$$

  where

$$I^q = \int \phi(q(1|\omega))dG(\omega) - \phi(q(1))$$

  is **entropy reduction**, with

$$\phi(q) \equiv q\ln(q) + (1-q)\ln(1-q)$$

- $q(1) \equiv \int q(1|\omega)dG(\omega)$ is total prob of engagement

Optimal Signal

- When interior, $q(1|\cdot)$ solves **functional equation**:

$$r - \omega = \frac{1}{\rho}\left[\ln\left(\frac{q(1|\omega)}{1-q(1|\omega)}\right) - \ln\left(\frac{q(1)}{1-q(1)}\right)\right]$$

with $q(1) \equiv \int q(1|\omega)dG(\omega)$

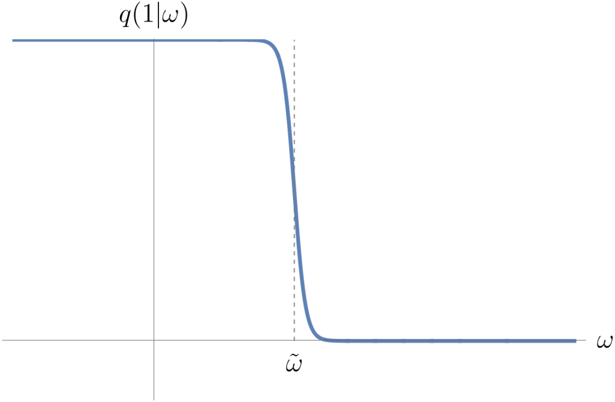
- Let $\tilde{\omega} \in \mathbb{R}$ solve the **(non-functional) equation**

$$\tilde{\omega} = r + \frac{1}{\rho}\ln\left(\frac{\int \frac{1}{1+\exp(\rho(\omega-\tilde{\omega}))}dG(\omega)}{1-\int \frac{1}{1+\exp(\rho(\omega-\tilde{\omega}))}dG(\omega)}\right)$$

- There exists $\underline{r}(\rho), \overline{r}(\rho)$ s.t. seller's **optimal signal**

$$q(1|\omega) = \begin{cases} 0 \quad \forall\omega \quad \text{if } r \leq \underline{r}(\rho) \\ \frac{1}{1+\exp(\rho(\omega-\tilde{\omega}))} \quad \text{if } r \in (\underline{r}(\rho), \overline{r}(\rho)) \\ 1 \quad \forall\omega \quad \text{if } r \geq \overline{r}(\rho) \end{cases}$$

Logistic Signal

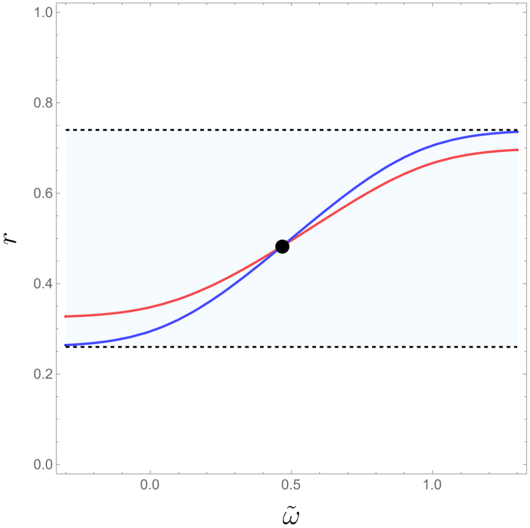


(Interior) Equilibria of Inner Game

Best-response analysis in $\mathbb{R}^2$

$$\begin{cases} \tilde{\omega} = r + \frac{1}{\rho} \ln \left(\frac{\int \frac{1}{1+\exp(\rho(\omega-\tilde{\omega}))} dG(\omega)}{1-\int \frac{1}{1+\exp(\rho(\omega-\tilde{\omega}))} dG(\omega)} \right) & \text{(seller's reaction)} \\ \\ r = \frac{\int \frac{\omega}{1+\exp(\rho(\omega-\tilde{\omega}))} dG(\omega)}{\int \frac{1}{1+\exp(\rho(\omega-\tilde{\omega}))} dG(\omega)} + \Delta & \text{(buyer's reaction)} \end{cases}$$

(Interior) Equilibria of Inner Game



$$\omega \sim U[0,1], \quad \rho = 8, \quad \Delta = 0.2, \quad r^* \approx 0.5, \quad \tilde{\omega}^* \approx 0.5$$

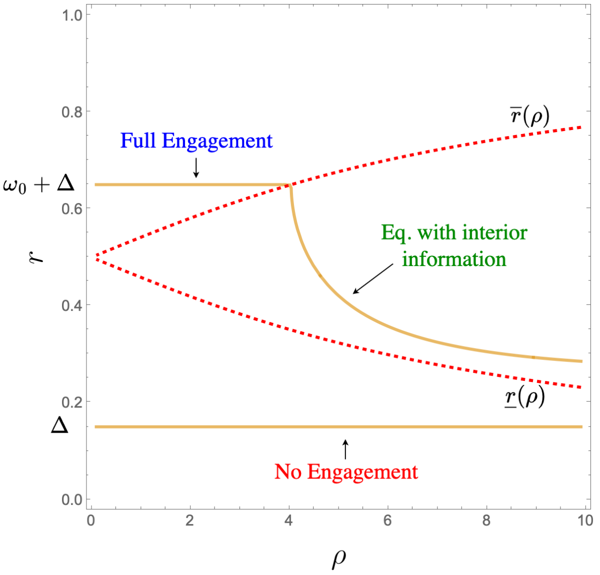
Multiple Equilibria of Inner Game

- Interior solutions can coexist with corner solutions
  - equilibria in which **no info** is acquired
- In case of no engagement, need to specify buyer's *off-path* beliefs
  - Following beliefs consistent with most refinements:

$$q^{\dagger}(1|\omega) = \begin{cases} 1 & \text{if } \omega = 0 \\ 0 & \text{if } \omega > 0 \end{cases}$$

- Buyer offers: $r_N \equiv \mathbb{E}[\omega|a = 1; q^{\dagger}] + \Delta = \Delta$
- If $\Delta < \underline{r}(\rho)$, equilibrium with no trade
- Novel form of **mkt breakdown** (with **no info** acquired on path)

Multiple Equilibria of Inner Game



Outer Game

- Seller first trains herself in processing information (formally, chooses ρ)
- Given ρ, seller selects signal flexibly
- Seller's payoff

$$\Pi(r, q; \rho) \equiv \int_{\omega} (r - \omega) q(1|\omega) dG(\omega) + \mathbb{E}[\omega] - \frac{I^q}{\rho} - C(\rho)$$

Outer Game: Interior Equilibrium

- Necessary conditions for interior equilibrium:

$$q^{\rho,r}(1|\omega) = \frac{1}{1+\exp(\rho(\omega-\tilde{\omega}))} \ \forall\ \omega \qquad \text{(logistic signal)}$$

$$\tilde{\omega} = r + \frac{1}{\rho} \ln\left(\frac{\int \frac{1}{1+\exp(\rho(\omega-\tilde{\omega}))} dG(\omega)}{1-\int \frac{1}{1+\exp(\rho(\omega-\tilde{\omega}))} dG(\omega)}\right) \qquad \text{(position parameter)}$$

$$\frac{I^{q^{\rho,r}}}{\rho^2} = C'(\rho) \qquad (\textbf{optimality} \text{ of } \rho)$$

$$r = \frac{\int \frac{\omega}{1+\exp(\rho(\omega-\tilde{\omega}))} dG(\omega)}{\int \frac{1}{1+\exp(\rho(\omega-\tilde{\omega}))} dG(\omega)} + \Delta \qquad \text{(buyer's break even)}$$

$$r \in (\underline{r}(\rho), \overline{r}(\rho)) \qquad \text{(interior signal)}$$

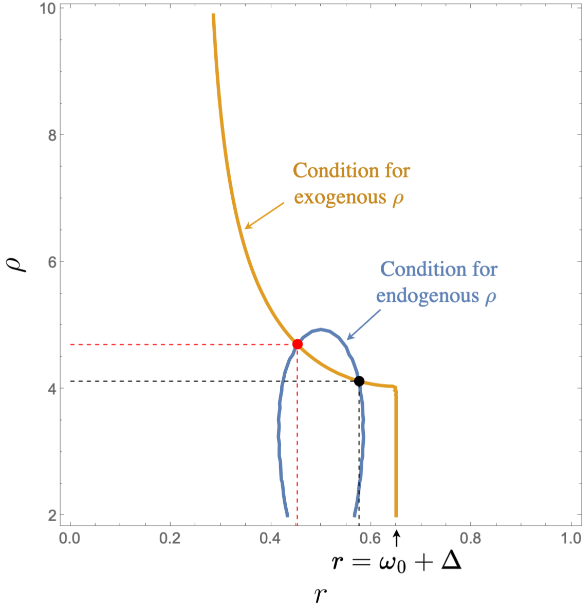
Outer Game: Numerical Example

- Assume

$$C(\rho) = \frac{a\rho^2}{2K}$$

- Graphs below: $a \approx 1.5, K = 1,000$, and $\Delta = 0.15$

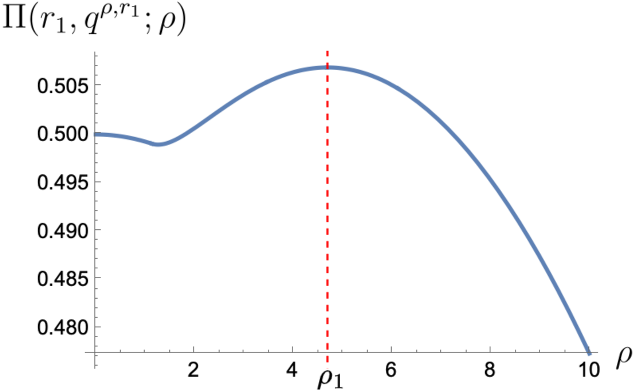
Necessary Conditions: Graphical Analysis



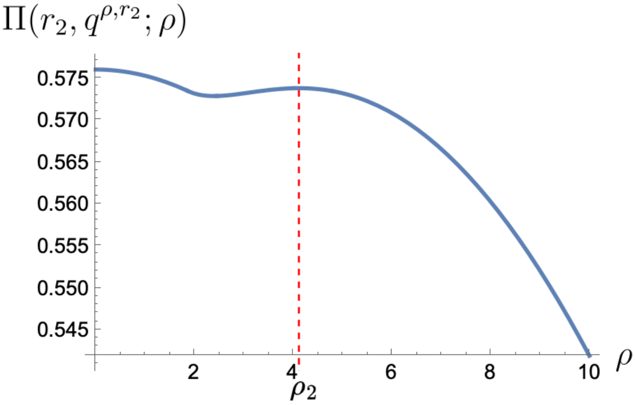
Candidate (Interior) Equilibria

- Two candidate interior equilibria:
- $\rho_1 = 4.7, \text{ and } r_1 \approx 0.45$ (S invests a lot; B offers low price)
- $\rho_2 \approx 4.12, \text{ and } r_2 \approx 0.58$ (S invests less; B offers higher price)

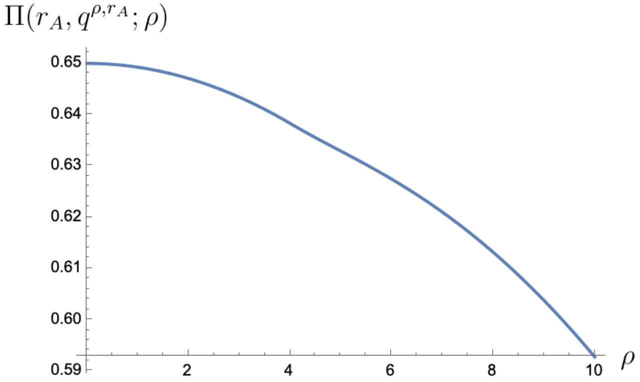
Sufficiency: low price r_1



Sufficiency: high price r_2

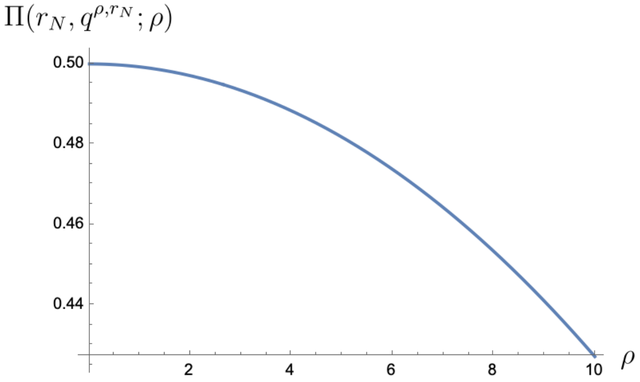


Corner 1: full engagement



$\rho = 0, r_A = \omega_0 + \Delta = 0.65$

Corner 2: mkt breakdown



$\rho = 0, r_N = \Delta = 0.15$

Multiple Equilibria: Welfare Analysis

- Three equilibria in this example
- **Interior**: $\rho^* > 0,\ r^* < \omega_0$
- **Corner with engagement**: $\rho_A = 0,\ r_A = \omega_0 + \Delta$
- **Corner with no engagement**: $\rho_N = 0,\ r_N = \Delta$
- Equilibria Pareto ranked:

$$(\rho_N, r_N) \prec (\rho^*, r^*) \prec (\rho_A, r_A)$$

- **Expectation traps**
- **Mkt breakdown** despite
  - zero MC when no info acquired
  - positive price when seller (off path) puts asset on sale
  - flexible info

Conclusions

- Endogenous information in mks with adverse selection
- **Expectation conformity**
  - prob of engagement decreasing in informativeness of signal
  - large gains from interaction
- Expectation traps
- Welfare and policy implications
  - endogeneous info: **larger subsidies/more generous programs**
- EC under flexible info with entropy or max-slope
- Mkt break down under flex info

Conclusions

- Future work:
  - bilateral information acquisition (**complementarity vs substitutability**)
  - implication for public information disclosures (**stress test design**)
  - ...

Most Important Slide

THANK YOU!

Rotations

Definition

Info structures are **rotations** (or "simple mean-preserving spreads") if, for any ρ, there exists rotation point m_ρ s.t.

- $G(m;\rho)$ increasing in ρ for $m \leq m_\rho$
- $G(m;\rho)$ decreasing in ρ for $m \geq m_\rho$

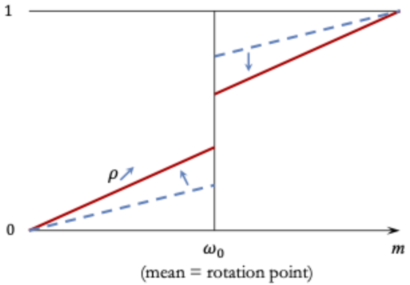
- Diamond and Stiglitz (1974), Johnston and Myatt (2006), Thereze (2022)...

Rotations Example: Non-directed Search

- L learns state with prob. ρ (nothing with prob. $1-\rho$)

$$G(m;\rho) = \begin{cases} \rho G(m) & \text{for } m < \omega_0 \\ \rho G(m) + 1 - \rho & \text{for } m \geq \omega_0 \end{cases}$$

- Rotation point: prior mean ω_0



Rotations

- Combination of rotations need not be a rotation
- But any MPS can be obtained through sequence of rotations
- Other (notable) examples
  - G Normal and $s = \omega + \varepsilon$ with $\varepsilon \sim N(0, \rho^{-1})$
  - Pareto, Exponential, Uniform $G(\cdot; \rho)$...

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Gains from Engagement

Definition

Info structures are **rotations** (or "simple mean-preserving spreads") if, for any ρ, there exists rotation point m_ρ s.t.

- $G(m;\rho)$ increasing in ρ for $m \leq m_\rho$
- $G(m;\rho)$ decreasing in ρ for $m \geq m_\rho$

Proposition

Suppose info structures are rotations and L's payoff is $\delta_L(m,r) = \tilde{\delta}_L(m,r) + \theta$. For all $(\rho, \rho^\dagger)$, there exists $\theta^*(\rho, \rho^\dagger)$ s.t., for all $\theta \geq \theta^*(\rho, \rho^\dagger)$, EC holds at $(\rho, \rho^\dagger)$.

- EC more likely when gains from engagement are large.

Gains from Engagement

- Result driven by AS
- Fixing r,

$$\frac{\partial^2 \Pi}{\partial\theta\partial\rho} = G_\rho(m^*(r,\theta);\rho)$$

- Hence, marginal value of info decreases with gains from engagement under suff. condition for EC

$$G_\rho(m^*(r(\rho^\dagger;\theta),\theta);\rho) < 0$$

- Larger gains $\rightarrow$ **smaller benefit from learning state**

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Example: Akerlof-direct-search

- ρ: prob Seller learns state
- G uniform over $[0, 1]$
- $C(\rho) = \rho^2/20$
- $\Delta = 0.25$
- Eq. conditions

$$r = M^{-}(r;\rho) + \Delta$$

$$-\int_r^{+\infty} G_\rho(m;\rho)dm = C'(\rho)$$

- Two equilibria:

$$\rho_1 \approx 0.48 \qquad r_1 \approx 0.69$$

$$\rho_2 \approx 0.88 \qquad r_2 \approx 0.58$$

- For any $m^* > \omega_0 = .5$, $G_\rho(m^*;\rho) < 0$
- Hence, $\mathrm{A}(\rho) < 0$ for all $\rho \in [\rho_1, \rho_2]$ (**info aggravates AS**)
- Seller better off in low-information eq.

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Disclosure

- Suppose L can prove informativeness of her signal exceeds $\hat{\rho}$
  - hard information
- $\hat{\rho}(\rho^*)$: hard information disclosed in eq. supporting ρ^*

Definition (regularity)

Eq. supporting ρ^* regular if, after disclosing $\hat{\rho} < \hat{\rho}(\rho^*)$, informativeness of L's signal expected by F (weakly) below ρ^*

- Monotone equilibrium selection

Disclosure

Proposition

Assume info aggravates AS ($\mathrm{A}(\rho^\dagger) < 0$ *for all* $\rho^\dagger$)

- *Any pure-strategy eq.* ρ *of no-disclosure game also eq. level of disclosure game*
- *Largest and smallest equilibrium levels in regular set of disclosure game also eq. levels of no-disclosure game.*

- Result driven by AS effect
  - disclosing less than eq. level $\rightarrow$ inconsequential
  - disclosing more $\rightarrow$ unfriendlier reactions
- Without regularity, there exist eq. in disclosure game supporting

$$\rho^* > \sup\{\text{eq. } \rho \text{ no disclosure game}\}$$

  - sustained by F expecting larger ρ when L discloses $\hat{\rho} < \hat{\rho}(\rho^*)$

Cognitive Style

- L's cost $C(\rho; \xi)$ decreasing in ξ

Corollary

Suppose L can acquire information cheaply (ξ_H) or expensively (ξ_L) and can disclose only ξ_H (IQ interpretation) or only ξ_L (work load). Further assume that, in eq., player F's reaction is decreasing in posterior that $\xi = \xi_H$. Then L poses as "information puppy dog", i.e., does not disclose in IQ interpretation and discloses in work load one.

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Prop-FI

- $q^{\rho,r}(1|\omega)$: prob. signal recommends $a = 1$ at ω
- $q^{\rho,r}(1)$: tot prob. signal recommends $a = 1$
- Optimal (interior) signal for **entropy**:

$$\delta_L(r,\omega) = \frac{1}{\rho}\left[\ln\left(\frac{q^{\rho,r}(1|\omega)}{1-q^{\rho,r}(1|\omega)}\right) - \ln\left(\frac{q^{\rho,r}(1)}{1-q^{\rho,r}(1)}\right)\right]$$

- Optimal (interior) signal for **max-slope**:

$$q^{\rho,r}(1|\omega) = \begin{cases} 1 & \text{if} \quad \omega \leq m^*(r) - \frac{1}{2\rho} \\ \frac{1}{2} - \rho(\omega - m^*(r)) & \text{if} \quad m^*(r) - \frac{1}{2\rho} < \omega \leq m^*(r) + \frac{1}{2\rho} \\ 0 & \text{if} \quad \omega > m^*(r) + \frac{1}{2\rho} \end{cases}$$

Prop-FI

Proposition

Fix $(\rho, \rho^\dagger)$.

(i) EC holds at $(\rho, \rho^\dagger)$ *iff* $\mathrm{A}(\rho^\dagger)\mathrm{B}(\rho; \rho^\dagger) < 0$.

(ii) Info aggravates AS at $\rho^\dagger$ *if* $q^{\rho, r(\rho^\dagger)}(1|\omega)/q^{\rho, r(\rho^\dagger)}$ *increasing in* ρ *for* $\omega < m^*(r(\rho^\dagger))$, *decreasing in* ρ *for* $\omega > m^*(r(\rho^\dagger))$, *at* $\rho = \rho^\dagger$.

(iii) Reduction in r *at* $r(\rho^\dagger)$ *raises L's value of info at* ρ *if condition in (ii) holds and* $q^{\rho, r(\rho^\dagger)}(1)$ *non-increasing in* ρ.

(iv) Suppose $M^-(m^*(r(\rho^\dagger)); \rho)$ *decreasing in* ρ *at* $\rho = \rho^\dagger$ *and* $\partial^2 \delta_L(r, m)/\partial r \partial m = 0$ *(e.g., Akerlof). Then* $q^{\rho, r(\rho^\dagger)}(1)$ *decreasing in* ρ *at* $\rho = \rho^\dagger$ *NSC for EC at* $(\rho, \rho^\dagger)$.

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