Knowing your Lemon before You Dump it

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Motivation

- Situations where decision to "engage" carries information about what is at stake
  - trade
  - partnerships
  - entry
  - marriage
  - ...
- Lemons (Akerlof)
  - *negative inferences*
- Anti-lemons (Spence)
  - *positive inferences*
- **Endogenous information**
  - information acquisition/attention
  - cognition

This Paper

- Generalized lemons (and anti-lemons)
    - **endogenous information**
- Information choices
    - type of strategic interaction
    - opponent's beliefs over selected information (**expectation conformity**)
        - effect of information on severity of adverse selection
        - effect of friendliness of opponent's reaction on value of information
- **Expectation traps**
- **Disclosure and cognitive style**
- **Welfare and policy implications**
- **Equilibrium analysis and comparative statics**

Literature – Incomplete

- **Endogenous info in lemons problem**
  - Dang (2008), Thereze (2022), 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 (2023)...
    $\rightarrow$ 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)...
    $\rightarrow$ lemons problem, competitive mkt
- **Expectation conformity**
  - Pavan and Tirole (2022)
    $\rightarrow$ different class of games (generalized lemons and anti-lemons)
- **Mandatory disclosure laws**
  - Pavan and Tirole (2023b)
    $\rightarrow$ endogenous information

Plan

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, $r \in \mathbb{R}$

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 $\int_{-\infty}^{+\infty} G(m;\rho')dm = \int_{-\infty}^{+\infty} G(m;\rho)dm = \omega_0$.

- 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

Definition

Information 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 $m \geq m_\rho$

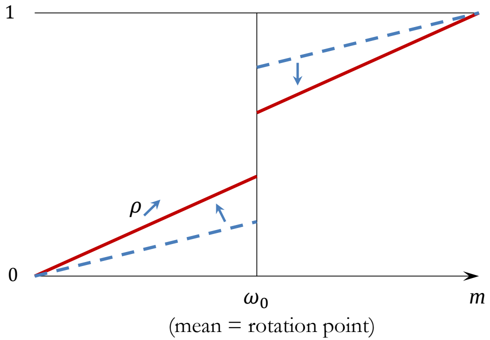
- Diamond and Stiglitz (1974), Johnston and Myatt (2006), Thereze (2022)...

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 $G(\cdot; \rho)$...

Model

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

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

with

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

- $r(\rho)$: eq. reaction under information ρ
(assumed to be unique)

- **Assumption (lemons):**

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

where

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

Akerlof Example

- Engagement threshold: $m^*(r) = r$

- Equilibrium price $r(\rho)$: solution to

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

- Lemons:

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

  - always if $G(m; \rho)/g(m; \rho)$ increasing in m

Other applications

- Partnerships
- Entry
- Marriage
- OTC mkts
- ...

Plan

Expectation Conformity

Effect of information on adverse selection

- $r(\rho)$: eq. reaction under information ρ
- $M^{-}(m^{*};\rho) \equiv \frac{\int_{-\infty}^{m^{*}} m dG(m;\rho)}{G(m^{*};\rho)}$

Definition

Information

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

Effect of information on adverse selection

$$\frac{\partial}{\partial \rho} M^{-}(m^{*};\, \rho) \overset{\text{sgn}}{=} A(m^{*}; \rho)$$

where

$$A(m^{*}; \rho) \equiv \left[m^{*} - M^{-}(m^{*};\, \rho)\right] G_{\rho}(m^{*}; \rho) - \int_{-\infty}^{m^{*}} G_{\rho}(m; \rho) dm$$

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

- Two channels through which information affects AS:
  - prob. of trade, $G_{\rho}(m^{*}; \rho)$
  - dispersion of posterior mean, $\int_{-\infty}^{m^{*}} G_{\rho}(m; \rho) dm$
- $\mathrm{A}(\rho) \equiv A(m^{*}(r(\rho)); \rho)$: **adverse-selection effect**

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 information choice
  - $\rho^\dagger$: 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 information at ρ if $B(\rho; \rho^\dagger) > 0$
  - lowers value of information at ρ if $B(\rho; \rho^\dagger) < 0$

Effect of unfriendlier reactions on value of information

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

- Two channels through which, starting from $r(\rho^{\dagger})$, reduction in r affects value of information 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

- L's value function when actual information is ρ and F expects information $\rho^\dagger$:

$$V_L(\rho; \rho^\dagger) \equiv \Pi(\rho; r(\rho^\dagger))$$

Definition

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

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

Key forces...

- $\mathrm{A}(\rho^\dagger) \stackrel{sgn}{=} \frac{\partial}{\partial \rho} M^-(m^*(r(\rho^\dagger)); \rho^\dagger)$: **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 order.

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

(ii) Information aggravates AS at $\rho^\dagger$ *(i.e.,* $\mathrm{A}(\rho^\dagger) < 0$*) for Uniform, Pareto, Exponential* $G(\cdot; \rho)$*, or, more generally, when* $G_\rho(m^*(r(\rho^\dagger); \rho^\dagger) < 0$.

(iii) Lower r *raises incentive for information at* $(\rho, \rho^\dagger)$ *(i.e.,* $\mathrm{B}(\rho; \rho^\dagger) > 0$*) if* $G_\rho(m^*(r(\rho^\dagger); \rho) < 0$.

(iv) Therefore EC at $(\rho, \rho^\dagger)$ *if*

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

(v) Suppose, for any m^*, $M^-(m^*; \rho)$ *decreasing in* ρ *(e.g., 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* $(\rho, \rho^\dagger)$.

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.

Non-directed search in Akerlof model

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

$\rightarrow$ seller **engages more selectively**, $G_\rho(m; \rho^\dagger) < 0$

$\rightarrow$ exacerbated AS (lower $M^-(m^*(r(\rho^\dagger)); \rho^\dagger)$)

$\rightarrow$ **lower price**

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

$\rightarrow$ higher value in learning state

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 information $\rho^{\dagger} \rightarrow$ no effect on AS
- No EC

Gains from Engagement

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

- Previous result driven by AS
- Fixing r,

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

- Hence, marginal value of information 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

Plan

Expectation Traps

Expectation Traps

Proposition

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

Expectation Traps: Non-direct search in Akerlof model

- 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 $m^* > \omega_0$, $G_\rho(m^*; \rho) < 0 \Rightarrow \mathrm{A}(\rho) < 0$ (info aggravates AS)
- Seller better off in low-information eq.

Expectation Traps

- **Expectation traps**
  - driven by AS effect
    - friendliness of F's reaction decreasing in L's information
  - expectation traps emerge **even if information is free**
- Contrast to private values + screening (Ravid et al. 2022)
  - equilibria Pareto ranked
  - eq. payoffs increasing in informativeness of signal

plan

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, m^*
  - friendliness of F's reaction, r
  - information, ρ

Subsidies: Akerlof

- Subsidies optimal in Akerlof model when
  1. Small cost λ of public funds
  2. Information aggravates AS ($\mathrm{A}(\rho) < 0$)
  3. CS of eq. same as BR: Subsidies reduce information

- Proposition 6 (in paper) identifies precise conditions for optimality of subsidies/taxes in generalized lemons/anti-lemons problems.

Subsidies: Double Dividend

Corollary

In Akerlof model, endogeneity of information calls for **larger** *subsidy when information reduces prob. of trade.*

- Same condition for EC
- **Double dividend** of subsidy
  - more engagement
  - less information acquisition
- Implication for Gov. asset repurchases programs: more generous terms

Plan

Flexible Information

Flexible

- **Entropy** cost:
  - 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

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

    where I^q is mutual information between z and ω

- **Max-slope** cost:
  - 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)

Equilibrium under Entropy Cost

- **Seller's problem**

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

where

$$I^q = \int_{\omega} \phi(q(1|\omega)) dG(\omega) - \phi(q(1))$$

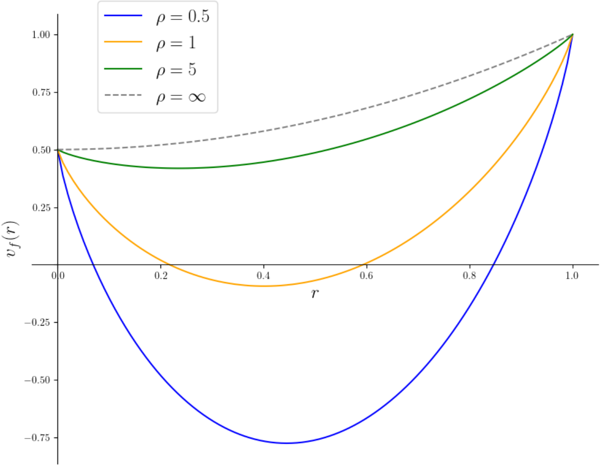
is entropy reduction, with

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

$$q(1) \equiv \int_{\omega} q(1|\omega) dG(\omega)$$

Value of "Full Information"

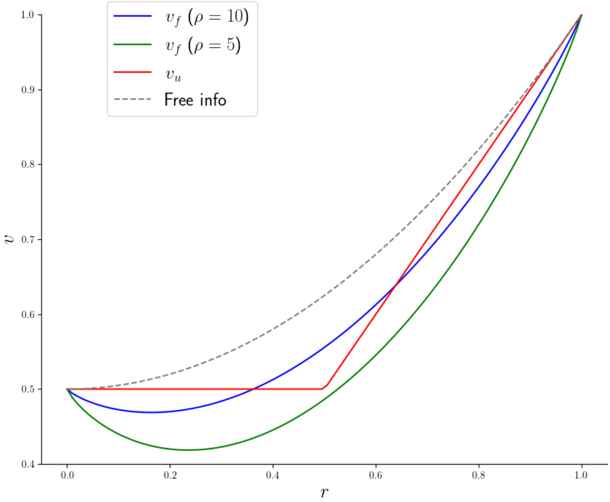
$$q(1|\omega) = \mathbb{I}\{\omega \leq r\}$$



$$\omega \sim U[0, 1]$$

Losses maximal for intermediate prices

Value of Information



$$\omega \sim U[0,1]$$

Full info better than no info for intermediate r and low MC

Seller's Optimality

- If
$$\int_\omega e^{\rho(r-\omega)}g(\omega)d\omega \le 1, \quad \int_\omega e^{-\rho(r-\omega)}g(\omega)d\omega > 1$$
never engage $\rightarrow q(1) = 0$

- If
$$\int_\omega e^{-\rho(r-\omega)}g(\omega)d\omega \le 1, \quad \int_\omega e^{\rho(r-\omega)}g(\omega)d\omega > 1$$
always engage $\rightarrow q(1) = 1$

- If
$$\int_\omega e^{\rho(r-\omega)}g(\omega)d\omega > 1, \quad \int_\omega e^{-\rho(r-\omega)}g(\omega)d\omega > 1$$
interior solution with some information acquisition

Seller's Optimality - Interior Solution

- Interior $q(1|\omega)$ solves functional eq.

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

with

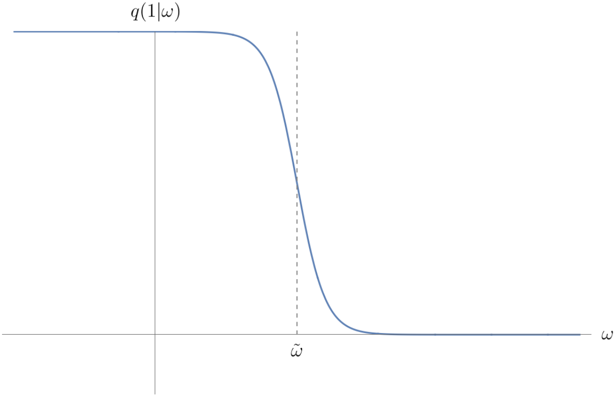
$$q(1) = \int_{\omega} q(1|\omega) dG(\omega)$$

- Let $\tilde{\omega} \in \mathbb{R}$ solve

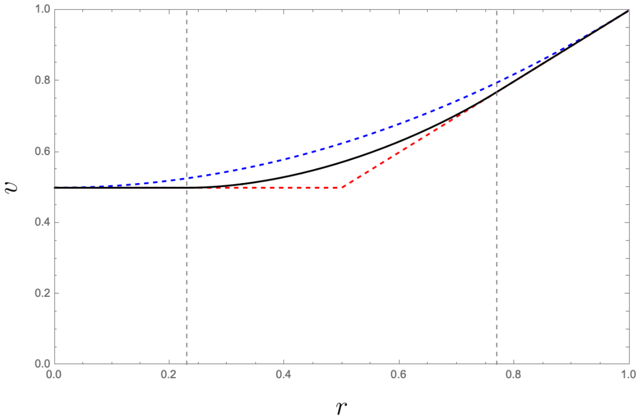
$$\tilde{\omega} = r + \frac{1}{\rho}\ln\left(\frac{\int_{\omega} \frac{1}{1+e^{\rho(\omega-\tilde{\omega})}} dG(\omega)}{1 - \int_{\omega} \frac{1}{1+e^{\rho(\omega-\tilde{\omega})}} dG(\omega)}\right)$$

Seller's Optimality - Interior Solution

$$q(1|\omega) = \frac{1}{1 + e^{\rho(\omega - \tilde{\omega})}}, \qquad \tilde{\omega} = r + \frac{1}{\rho} \ln\left(\frac{q(1)}{1 - q(1)}\right)$$



Seller's Optimality - Value of Information



$$\omega \sim U[0,1], \quad \rho = 10, \quad \underline{r} \approx 0.23, \quad \overline{r} \approx 0.77$$

- Dashed blue line: free full information
- Dashed red line: no information
- Black line: **optimal signal**

Equilibrium

There exists $\underline{r}, \overline{r}$ such that seller's optimality:

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

Buyer's optimality:

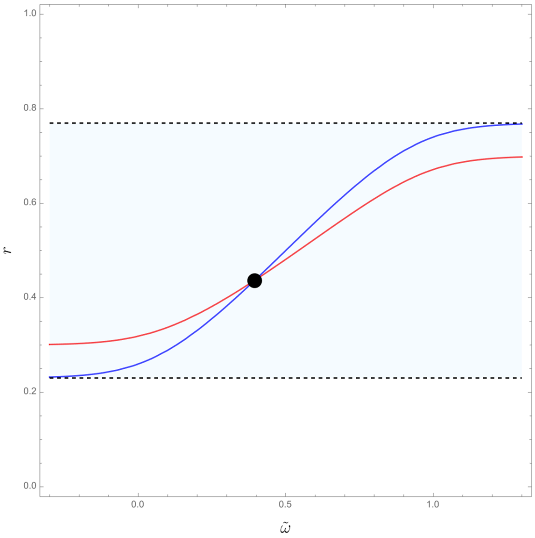
$$r = \int_{\omega} \omega \frac{q(1|\omega)}{\int_{\omega} q(1|\omega) dG(\omega)} dG(\omega) + \Delta$$

Equilibrium - Interior

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

$$\begin{cases} \tilde{\omega} = r + \frac{1}{\rho} \ln \left(\frac{\int_\omega \frac{1}{1+e^{\rho(\omega-\tilde{\omega})}} dG(\omega)}{1-\int_\omega \frac{1}{1+e^{\rho(\omega-\tilde{\omega})}} dG(\omega)} \right) & (seller) \\ \\ r = \int_\omega \omega \frac{\frac{1}{1+e^{\rho(\omega-\tilde{\omega})}}}{\int_\omega \frac{1}{1+e^{\rho(\omega-\tilde{\omega})}} dG(\omega)} dG(\omega) + \Delta & (buyer) \end{cases}$$

Equilibrium - Example



$$\omega \sim U[0,1], \quad \rho = 10, \quad \Delta = 0.2, \quad r^* \approx 0.44, \quad \tilde{\omega}^* \approx 0.4$$

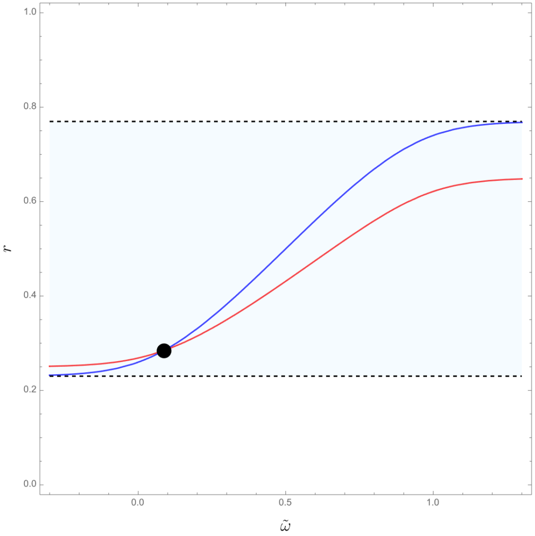
Multiple Equilibria: Corner and Interior

- Interior solutions can coexist with corner solutions with **no information acquisition** and **no engagement**
- Need to specify buyer's *off-path* beliefs

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

- Buyer offers: $\mathbb{E}[\omega|a = 1; q^{\dagger}] + \Delta = \Delta$
- If $\Delta < \underline{r}$ seller does not deviate
- In previous slide: interior equilibrium with $\tilde{\omega}^* \approx 0.4$ ($q(1) \approx 0.4$) and $r^* \approx 0.44$
- Also have a "corner" equilibrium with $q(1|\omega) = 0 \ \forall \omega$ and $r^{**} = \Delta = 0.2 < \underline{r} \approx 0.23$

Comparative Statics - Lower Δ



$\omega \sim U[0,1], \quad \rho = 10, \quad \Delta = 0.15, \quad r^* \approx 0.28, \quad \tilde{\omega}^* \approx 0.09$

Endogenous cost of entropy reduction

- Seller first invests in absorbing information
- $C(\rho)$: Cost of ρ
- Given ρ, seller chooses any signal
- Total cost:

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

- Advantage of this formalism: higher ρ plays role similar to "more info" with rigid info
- Interaction between seller's choice and buyer's expectation in $(\rho, \rho^{\dagger})$ as in baseline model

Plan

1. Introduction
2. Model
3. Expectation Conformity
4. Expectation Traps
5. Disclosure and Cognitive Style
6. Policy
7. Flexible Information
8. Anti-lemons
9. Conclusions

(Anti-lemons)

Conclusions

- Endogenous information in mks with adverse selection
- Expectation conformity
  - prob of engagement decreasing in informativemess of signal
  - large gains from interaction
- Expectation traps
- Welfare and policy implications
  - endogeneous info: larger subsidies

Conclusions

- Ongoing work:
  - bilateral information acquisition
  - public information disclosures
  - ...

Most Important Slide

THANKS!

Disclosure

- Suppose L can prove signal informativeness above $\hat{\rho}$
- Hard Information
- $\hat{\rho}(\rho^*)$: hard information disclosed in eq. supporting ρ^*
- **Regularity**: Equilibrium supporting ρ^* is regular if, after disclosing $\hat{\rho} < \hat{\rho}(\rho^*)$, informativeness of L's signal lower than ρ^*
- Monotone equilibrium selection

Disclosure

Proposition

Assume information 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, eq. in disclosure game supporting $\rho^{*} > \sup\{eq.\rho$ no disclosure game$\}$
  - sustained by F expecting large ρ when F 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.

Go back

Prop-FI

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

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

- 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) Information aggravates AS at $\rho^\dagger$ *if* $q^{\rho, r(\rho^\dagger)}(1|\omega)/q^{\rho, r(\rho^\dagger)}(1)$ *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 information 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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Anti-lemons

Assumption (**anti-lemons**). Friendliness of F's reaction to an increase in L's information depends negatively on impact of L's information on adverse selection:

$$\frac{dr(\rho^\dagger)}{d\rho^\dagger} \overset{\text{sgn}}{=} -\frac{\partial}{\partial \rho^\dagger}\,\mathrm{M}^-\big(\mathrm{m}^*(\mathrm{r}(\rho^\dagger));\,\rho^\dagger\big).$$

Anti-lemons: Spencian signaling

- L: agent choosing between enrolling in MBA ($a = 1$) or not ($a = 0$)
- Cost of enrolling p
- Disutility from studying: ω
- F: representative of competitive set of employers
- Agent's productivity when employed $\theta = a - b\omega$, $b > 0$
- r : wage offered
- $\delta_L : r - (\omega + p)$
- Engagement threshold: $m^*(r) = r - p$
- Equilibrium $r(\rho)$:

$$r = a - bM^-(m^*(r); \rho)$$

Anti-lemons: Start-up example

- Entrepreneur (L) chooses whether to start a business ($a = 1$) at cost $c_L > 0$
- $1 - \omega$: probability projects succeeds (delivering 1 unit of cash flows)
- L may need to liquidate prematurely with prob. p (as in Diamond and Dybvig (1983))
- r: price offered by competitive investors (F) in case of liquidation
- L's payoff from engagement

$$\delta_L = (1 - p)(1 - m) + pr - c_L$$

- Hence, L engages iff

$$m \leq m^*(r) = \frac{1 - p + pr - c_L}{1 - p}$$

- Value of assets for F: $1 - \omega$
- E. price $r(\rho)$

$$r = 1 - M^{-}(m^*(r); \rho)$$

Anti-lemons: Warfare example

- Country L: potential invader
- ω: probability country F wins fight
- r: probability F surrenders without fighting
- L's payoff in case of victory: 1; L's cost of defeat: c_L

$$\delta_L(r, m) = r + (1 - r)(1 - m - mc_L)$$

- Hence, L engages iff

$$m \leq m^*(r) = \frac{1}{(1 - r)(1 + c_L)}$$

- F's payoff from victory: 1; F's defeat cost c_F drawn from cdf H
- Prob. $r(\rho)$ F surrenders

$$r = 1 - H\left(\frac{M^-(m^*(r); \rho)}{1 - M^-(m^*(r); \rho)}\right)$$

Anti-lemons: Hermalin (1998)'s leadership model

- r: prob F joins leader's project
- $\delta_L(r, m) = (1 - m) + r - c_L$
- $1 - m$: probability project succeeds
- F observes whether L starts project
- F's payoff from joining: $1 - m - c_F$, with c_F drawn from cdf H
- Equilibrium $r(\rho)$

$$r = H\left(2 - M^{-}\left(1 + r - c_L; \rho\right)\right)$$

Anti lemons

Proposition

Assume MPS order and information aggravates AS at $\rho^\dagger$ *(i.e.,* $\mathrm{A}(\rho^\dagger) < 0$*). EC holds at* $(\rho, \rho^\dagger)$ *only if* $G_\rho\left(m^*\left(r(\rho^\dagger)\right); \rho\right) > 0$*, which, in the case of rotations, happens iff*

$$m^*\left(r(\rho^\dagger)\right) < m_\rho.$$

Furthermore, $G_\rho\left(m^*\left(r(\rho^\dagger)\right); \rho\right) > 0$ necessary and sufficient for EC if $\partial^2 \delta_L(m, r)/\partial m \partial r = 0$ (e.g., Spence).

- opposite of lemons case

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