Knowing your Lemon before You Dump it

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IAST

Motivation

- Strategic situations where decision to "engage" carries information
  - trade
  - partnerships
  - entry
  - marriage
  - ...
- Lemons (Akerlof)
  - negative inferences
- Anti-lemons (Spence)
  - positive inferences
- **Endogenous information**
  - acquisition
  - 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**

Literature – Incomplete

- **Endogenous info in lemons problem**
  - Dang (2008), Thereze (2022), Lichtig and Weksler, (2023)
    $\rightarrow$ EC, $\neq$ bargaining game, timing, CS (gains from interaction, disclosure, policy)
- **Payoffs in lemons problem**
  - Levin (2001), Bar-Isaac et al. (2018), Kartik and Zhong (2023)...
    $\rightarrow$ incentives analysis
- **Policy in lemons mkts**
  - 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 (2023a)
    $\rightarrow$ endogenous information

Plan

1. Introduction
2. Model
3. Expectation Conformity
4. Expectation Traps
5. Policy Interventions
6. Flexible Information

Model

Model

- **Players**
  - Leader
  - Follower
- **Choices**
  - Leader:
    - information structure, ρ
    - 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: $\frac{\partial^2 \delta_L}{\partial \omega \partial r} \geq 0$
  - 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
  - $u_F(0, \omega) = 0$
  - $u_F(1,\ r,\ \omega) = \omega + \Delta - r$
  - $\delta_L(r,\ \omega) = u_F(1,\ r,\ \omega)$

Model

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

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

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 in fictitious game with exogenous information ρ

- **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: $\frac{dr(\rho)}{d\rho} \overset{\text{sgn}}{=} \frac{\partial}{\partial\rho} M^-\left(m^*(r(\rho));\ \rho\right)$
  - always if $G(m;\rho)/g(m;\rho)$ increasing in m

Plan

1. Introduction
2. Model
3. Expectation Conformity
4. Expectation Traps
5. Policy Interventions
6. Flexible Information

Expectation Conformity

Effect of cognition on adverse selection

- $r(\rho)$: eq. reaction with exogenous cognition 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 cognition 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 when actual cognition is ρ and reaction is r:

$$\Pi(\rho; r) \quad = G(m^*(r); \rho)\delta_L(r, M^-(m^*(r); \rho))$$

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

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

- 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

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

- Two channels through which, starting from $r(\rho^{\dagger})$, reduction in r affects value of information at ρ:
  - prob. of trade, $G_{\rho}\left(m^*(r(\rho^{\dagger});\rho\right)$
  - 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 $\rho^\dagger$:

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

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...

- $\mathrm{A}(\rho^{\dagger}) \overset{sgn}{=} \frac{\partial}{\partial \rho} M^{-}(m^{*}(r(\rho^{\dagger})); \rho^{\dagger})$: **adverse-selection effect**
- $B(\rho; \rho^{\dagger}) = -\frac{\partial^2 \Pi(\rho; r(\rho^{\dagger}))}{\partial \rho \partial r}$: **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* $(\rho, \rho^\dagger)$.

Plan

1. Introduction
2. Model
3. Expectation Conformity
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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

- **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 the signal

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1. Introduction
2. Model
3. Expectation Conformity
4. Expectation Traps
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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,m^*
  - friendliness of F's reaction, r
  - cognition, 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 acquisition

- 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

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Flexible Information

Flexible information

- **Entropy** cost of cognition:
  - 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** of stochastic choice rule:
  - ρ parametrizes max slope of stochastic choice rule $\sigma : \Omega \to [0,1]$ specifying prob. she 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

Conclusions

- Endogenous information in mks with adverse selection
- Expectation conformity
  - prob of engagement decreasing in information
  - 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!