Data Sharing with Dynamic Contracts

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Motivation

- Incumbent firms learn about customers by observing past behaviors/outcomes
  - E.g. credit, insurance (health, car, ...), employment
- Informational monopoly ex-post: advantage over competitors
- Growing set of policies regulates disclosure and use of proprietary data
  - Open banking, GDPR data ownership, community rating in health insurance
- Questions:
  - Should incumbents be forced to share information?
  - How to design optimal disclosure?

This paper

- Two-period economy:
  - symmetric (lack of) information in period 1
  - informed incumbent in period 2
- Design of *public disclosure policy*: map from consumer's history to public signal
- Two cases:
  - One-sided commitment: incumbent commits to long-term contract
  - Two-sided lack of commitment: contracts are sequentially optimal
- Two applications with extensions:
  - Open banking — with switching to more productive entrants (e.g. fintech)
  - Health insurance — with ban on use of past info (community vs. experience rating)

Main results

- One-sided commitment: **no information** is optimal
  - Minimize high type's outside option, maximize cross-subsidization
- Two-sided lack of commitment: **partial information** may be optimal
  - No cross-subsidization for *any* disclosure policy
  - Coarse "bad news" rating governs intertemporal smoothing; **full info never optimal**
- Applications: design lessons for open banking and health insurance

Plan for the talk

- Model
- Value of outside option for given information policy
- Optimal info disclosure
  - One-sided commitment
  - Two-sided lack of commitment
  - Spot-contract benchmark
- Application 1: Open banking and switching
- Application 2: Health insurance and community rating

MODEL

Environment

- $t = 1, 2$, each divided in sub-periods am, pm
- Continuum of consumers and firms
- Income 0 in am; $y_t \in \{y_L, y_H\}$ in pm
  - $y_1 \sim \pi_1(y_1)$ and $y_2 \sim \pi_2(y_2|y_1)$ with $\pi_2(y_H|y_H) > \pi_2(y_H|y_L)$
- Expected incomes

$$Y_1 \equiv \sum_{y_1} \pi_1(y_1)\, y_1, \qquad Y_{2i} \equiv \sum_{y_2} \pi_2(y_2|y_i)\, y_2 \quad i = H, L$$

- Assume $Y_{2H} > Y_1 > Y_{2L}$

Preferences

- Firms risk-neutral, pm discounted at 1
- Consumers:
  - Linear within period, pm discounted at $\beta < 1$: (in the pm, $c = 0$ after y_L)

$$C_t = c_{t,am} + \beta\, \pi(y_H|\cdot)\, c_{t,pm}, \qquad c \geqslant 0$$

    - Gains from front-loading; consumption *distorted* whenever $c_{pm} > 0$
    - Impatience is source of screening cost, as in Rothschild–Stiglitz
  - Risk-averse across periods and states, u strictly concave:

$$u(C_1) + \sum_{y_1} \pi_1(y_1)\, u(C_2(y_1))$$

    - Gains from consumption smoothing

Information and market structure

Period 1:

- Firms offer $(c_{1,am}, c_{1,pm})$; consumer signs with one firm (*incumbent*)
- y_1 observed by consumer and incumbent only
- *Public disclosure policy* (M, μ): everyone observes $m \sim \mu(\cdot|y_1)$

Period 2:

- Incumbent (Stackelberg leader) offers contract conditional on (y_1, m)
- *Outsiders* offer menus conditional on m only
- Firms may withdraw posted contracts at cost $\varepsilon \geqslant 0$ (Netzer–Scheuer, 2014)
- Consumers choose: stay or switch

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Want: public disclosure policy that maximizes ex-ante welfare

VALUE OF OUTSIDE OPTION FOR GIVEN INFORMATION POLICY

Outside option: Miyazaki–Wilson value

Consumption offered by outsiders to high types with signal m, given share of high types $s(m) = \frac{\mu(m|y_H)\pi_1(y_H)}{\sum_{y_1}\mu(m|y_1)\pi_1(y_1)}$:

$$C_H^o(s) = \max_{c_{am}, c_{pm}, C_L^o} c_{am} + \beta\pi_2(y_H|y_H)c_{pm}$$

subject to non-negative profits, incentive compatibility, and participation:

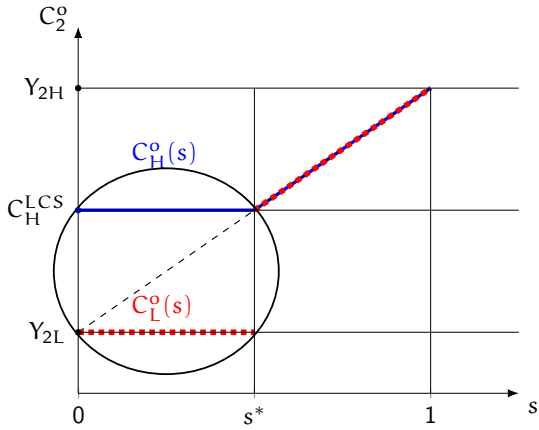
$$s[Y_{2H} - c_{am} - \pi_2(y_H|y_H)c_{pm}] + (1-s)[Y_{2L} - C_L^o] \geqslant 0$$

$$C_L^o \geqslant c_{am} + \beta\pi_2(y_H|y_L)c_{pm}, \qquad C_L^o \geqslant Y_{2L}$$

$V_H^o = u(C_H^o)$ and $V_L^o = u(C_L^o)$ are equilibrium outcome absent informed incumbent

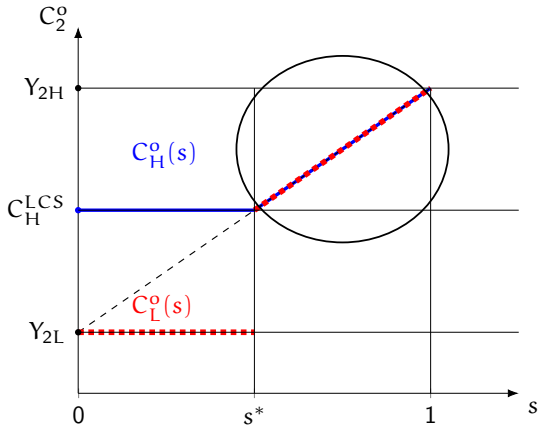
Characterization

Value of outside offers



If $s < s^*$: least-cost separation, $C_L^o = Y_{2L}$, distorted high type, $c_{pm} > 0$

Value of outside offers



If $s > s^*$: pooling, $C_H^o = C_L^o = sY_{2H} + (1-s)Y_{2L}$, no distortions, $c_{pm} = 0$

Participation constraints faced by the incumbent

- To retain consumers, incumbent must offer

$$C_2(y_H, m) \geqslant C_H^o(s(m))$$
$$C_2(y_L, m) \geqslant Y_{2L}$$

- Incumbent withdraws its offer if outsiders cream-skim

- Hence outsiders cannot poach consumers in equilibrium

Equilibrium details

ONE-SIDED COMMITMENT

Optimal contract with commitment

- The equilibrium contract delivers undistorted consumption ($c_{pm} = 0$) and solves

$$\max_{C_1, C_2} \; u(C_1) + \sum_{y_1} \pi_1(y_1) \sum_{m} \mu(m|y_1)\, u(C_2(y_1, m))$$

subject to non-negative profits,

$$Y_1 - C_1 + Y_2 - \sum_{y_1} \pi_1(y_1) \sum_{m} \mu(m|y_1)\, C_2(y_1, m) \geqslant 0$$

and the ex-post participation constraints,

$$C_2(y_H, m) \geqslant C_H^o\,(s(m))$$
$$C_2(y_L, m) \geqslant Y_{2L}$$

Optimal disclosure policy reveals no information

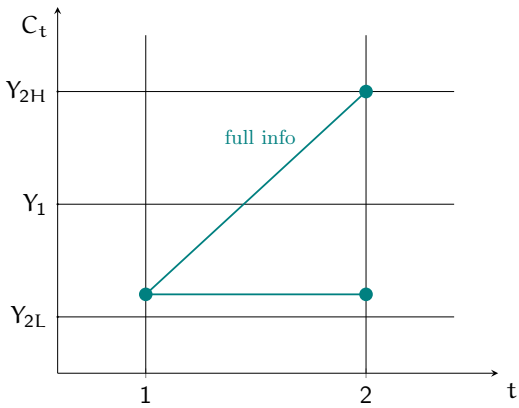
Prop 1 When the firm has commitment, optimal disclosure policy reveals no info

1. Same signal to all high-types ($C_H^o(s)$ convex $\Rightarrow$ dispersion burns resources)
2. No-info relaxes participation constraint and maximizes cross-subsidization

Proof

Consumption profile with one-sided commitment

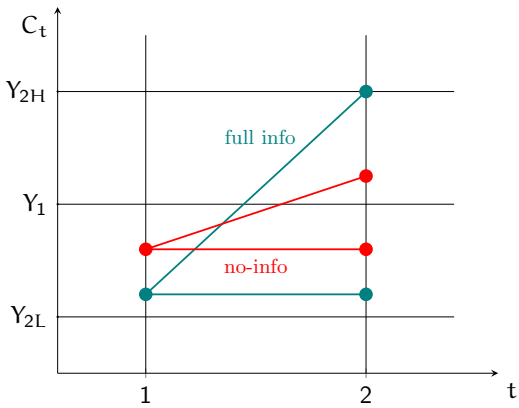
Full info: $C_2(y_H) = Y_{2H}$, minimal cross-subsidization



Back-loaded, downward rigid à la Harris–Holmstrom (1982), Thomas–Worrall (1988)

Consumption profile with one-sided commitment

No info: smaller rise after y_H, higher C_1 and $C_2(y_L)$



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TWO-SIDED LACK OF COMMITMENT

No cross-subsidization in period 2

Lemma For any signal m, consumption is undistorted ($c_{pm} = 0$) and

$$C_2(y_H, m) = C_H^o(s(m)) \leqslant Y_{2H}, \qquad C_2(y_L, m) = Y_{2L}$$

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Lemma For any signal m, consumption is undistorted ($c_{pm} = 0$) and

$$C_2(y_H, m) = C_H^o(s(m)) \leqslant Y_{2H}, \qquad C_2(y_L, m) = Y_{2L}$$

- Incumbent knows y_1: no IC constraint, retains high types *profitably*
- Outsiders anticipate that whoever switches must be a low type

  $\Rightarrow$ no transfers to low types, for *any* disclosure policy

Equilibrium outcome

Lemma Given (M, μ), the equilibrium outcome is

$$C_1 = Y_1 + \pi_1(y_H) \sum_m \mu(m|y_H)\left(Y_{2H} - C_H^o(s(m))\right)$$

$$C_2(y_L, m) = Y_{2L}, \qquad C_2(y_H, m) = C_H^o(s(m))$$

- Period-1 competition rebates expected ex-post profits up front
- Disclosure only moves C_1 and $C_2(y_H, m)$: intertemporal smoothing

Solving for optimal disclosure

Bad-news structure: $m \in \{g, b\}$

- All high-income and a fraction $1 - \mu$ of low-income consumers have $m = g$
  - Single signal for high types is optimal since $C_H^o(s)$ convex
- Implementable consumption levels: $C_{2H} = C_H^o(s(g))$, $s(g) \in [\pi_1(y_H), 1]$

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Simplified problem:

$$\max_{C_{2H}} \quad u(C_1(C_{2H})) + \pi_1(y_H)\, u(C_{2H}) + \pi_1(y_L)\, u(Y_{2L})$$

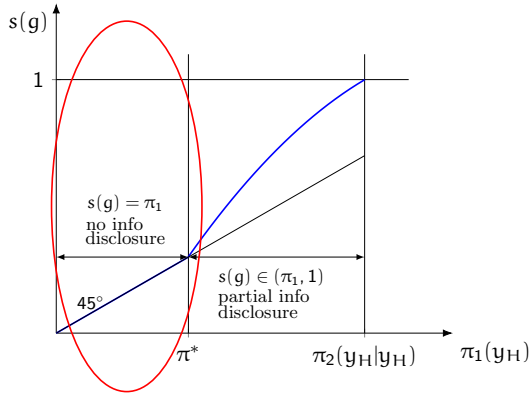
subject to

$$C_1(C_{2H}) = Y_1 + \pi_1(y_H)\,[Y_{2H} - C_{2H}], \qquad C_{2H} \in [C_H^o(\pi_1(y_H)),\ Y_{2H}]$$

Optimal disclosure policy

Prop 2 There exists a cutoff π^* such that:

i. $\pi_1(y_H) < \pi^*$: $C_1 < C_{2H}$ and **no info** is optimal

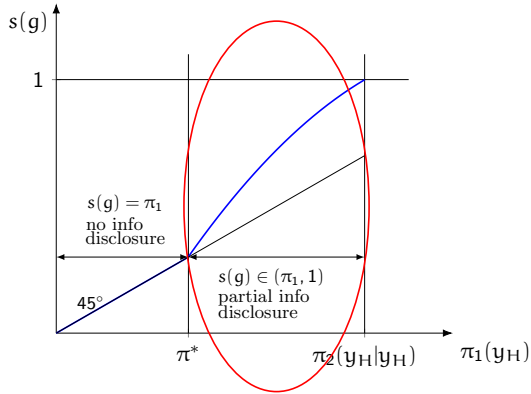


Proof

Optimal disclosure policy

Prop 2 There exists a cutoff π^* such that:

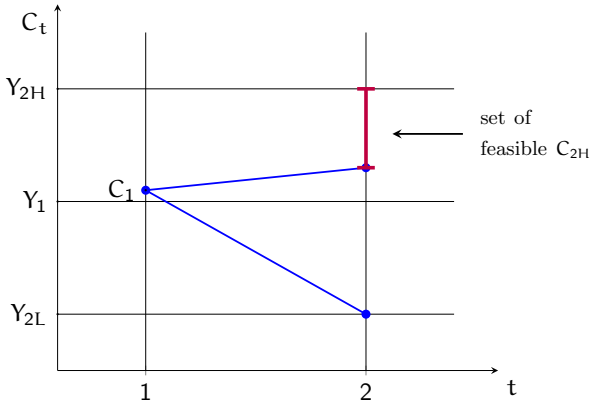
ii. $\pi_1(y_H) \geqslant \pi^*$: $C_1 = C_{2H}$ and **partial info**, $\mu(b|y_L) \in (0,1)$



Proof

Logic: intertemporal smoothing

i. Low $\pi_1\,(y_H)$: If no info $\Rightarrow C_1 < C_{2H}$



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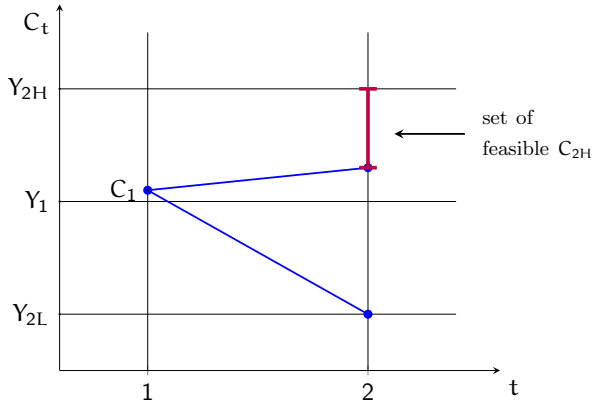

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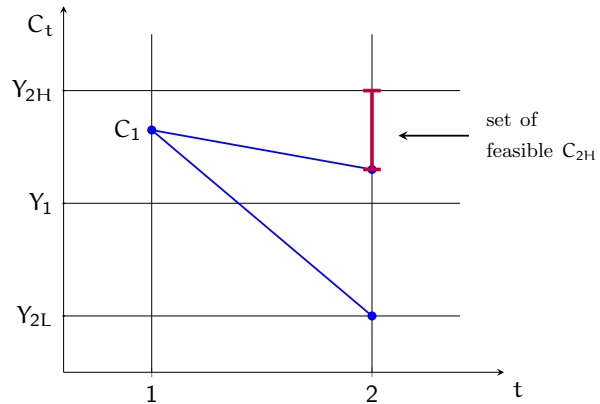
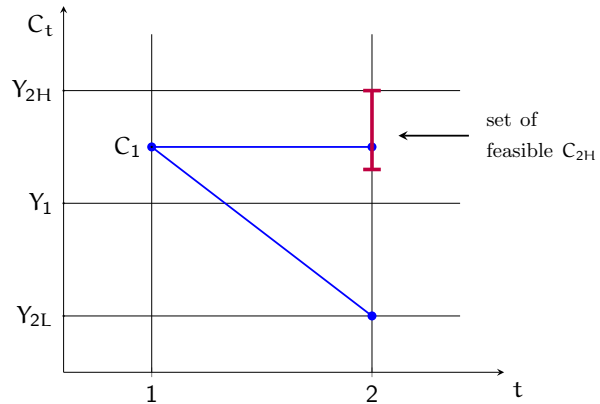
ii. High $\pi_1\,(y_H)$: If no info $\Rightarrow C_1 > C_{2H}$



Note: C_1 grows faster than $C_H^o\,(\pi_1(y_H))$ as $\pi_1(y_H)$ rises

Logic: intertemporal smoothing

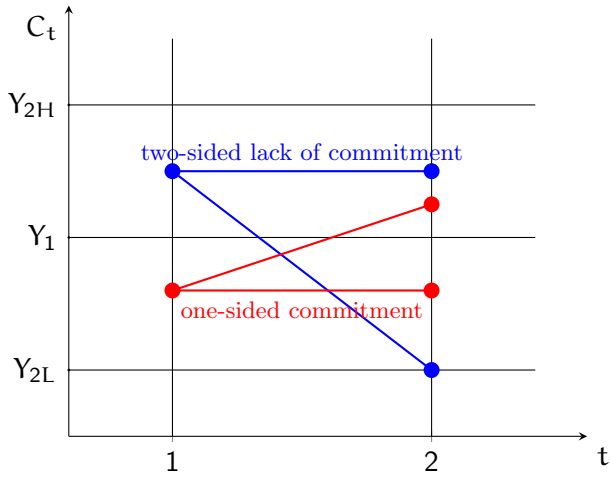
ii. High $\pi_1(y_H)$: Optimal info = partial info and $C_1 = C_{2H}$



Note: C_1 grows faster than $C_H^o(\pi_1(y_H))$ as $\pi_1(y_H)$ rises $\Rightarrow$ *more* info if better pool

Consumption profile

"Inverse" of Harris–Holmstrom result: front-loaded, upward rigid



Extensions

Same qualitative results under:

- **Observable outcome, unobservable signal**
  - Outsiders see $\mathtt{y}_1$; incumbent and consumer also see a private signal $\tilde{\mathtt{y}}_1$
  - Same optimal structure conditional on each observable history
- **Discrimination among consumers with same history**
  - Incumbent extracts more from (almost all) high types
  - Bad-news structure unchanged
  - More ex-post profits $\Rightarrow$ *more* info disclosed
- **Hidden action**
  - Income driven by innate type and effort (e.g. investment in human capital)
  - Bad-news structure unchanged
  - Spreading values provides incentives $\Rightarrow$ *more* info disclosed

Taking stock

So far:

- With commitment: no disclosure, to protect cross-subsidization
- Without commitment: "bad news", intertemporal smoothing, full info never optimal

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Next: use the model to study open banking and health insurance regulation

- Both applications feature forces that remove the incumbent's advantage:
  - switching to better entrants
  - ban on using past information
- Preliminary step: optimal disclosure in a static economy with spot contracts

Removing the informational monopoly: spot contracts

Static model with symmetrically uninformed firms in period 2

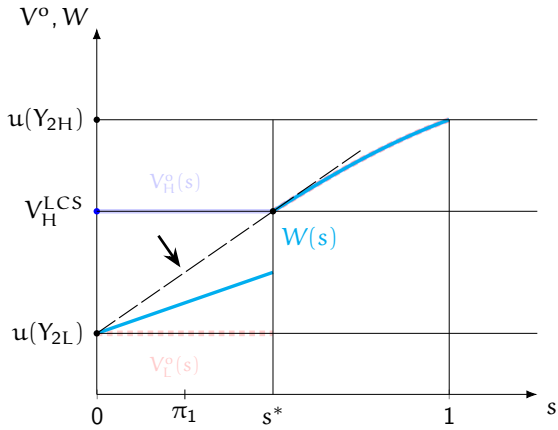
Outcome: $C_1 = Y_1$, Miyazaki–Wilson contract in period 2

- Cross-subsidization restored: low types get $V_L^o(s) \geqslant u(Y_{2L})$

Disclosure motive switches from intertemporal smoothing to cross-subsidization:

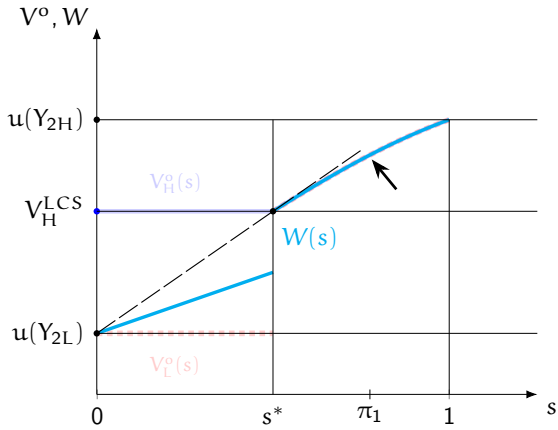
$$\max_{p(s)} \sum_s p(s) W(s), \quad W(s) = sV_H^o(s) + (1-s)V_L^o(s), \quad \text{s.t.} \quad \sum_s p(s)\, s = \pi_1(y_H)$$

Optimal disclosure with spot contracts



- If $\pi_1 < s^*$: partial info, signals with shares 0 and s^* (concavification à la GK)

Optimal disclosure with spot contracts



- If $\pi_1 \geqslant s^*$: no information, to maximize cross-subsidization

APPLICATION 1: OPEN BANKING

Bank lending

Consumers are borrowers, firms are lenders:

$$b = c_{am}, \qquad R = \frac{y_H - c_{pm}}{b}$$

- Incumbent banks better informed: internal assessments predict returns (Beyhaghi et al., 2024)
- Model prediction: rates start low, rise within relationship (Ioannidou–Ongena, 2010)

Implications for open banking

- Unrestricted open banking (full information sharing) never optimal
  - Holds even with borrower opt-in: do not grant data ownership to consumers

- Partial open banking welfare-improving when pool of borrowers is good
  - Coarse credit rating pools all high types with some low types

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- Partial open banking welfare-improving when pool of borrowers is good
  - Coarse credit rating pools all high types with some low types
- Next we introduce fintech: entrants provide extra benefits (e.g. digital services)
  - in benchmark model: all consumers are retained
  - with fintech: high types might switch, weakening adverse selection
  - how should optimal disclosure respond to the entry of fintech?

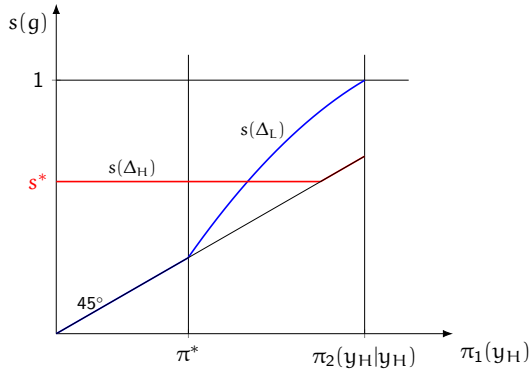
Switching to fintech entrants

- Entrants deliver utility benefit: Miyazaki–Wilson values shift to $V_i^o(s) + \Delta$
- All low types switch; high types switch iff $V_H^o(s) + \Delta > u(Y_{2H})$, i.e. $s \geqslant \hat{s}(\Delta)$
- Focus on $\Delta \leqslant \bar{\Delta}$: at $\bar{\Delta}$, all high types leave for any info

  $\Rightarrow \hat{s}(\Delta) > s^*$: when high types switch, the entrant's pool cross-subsidizes
  - for those s that induce switching, outcomes as under spot contracts

Optimal disclosure with switching

High $\pi_1(y_H)$: less info when Δ increases (to preserve cross-subsidization)
Low $\pi_1(y_H)$: more info when Δ increases (to induce cross-subsidization)



Full information never optimal

Arbitrary Δ: 3 signals

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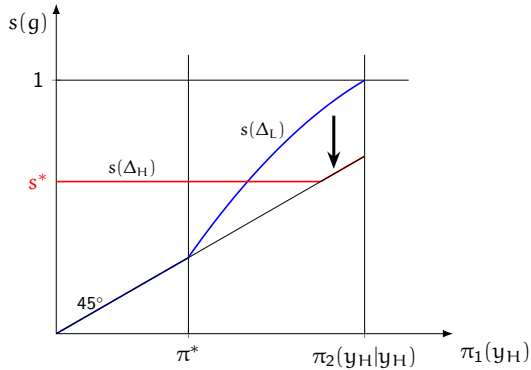

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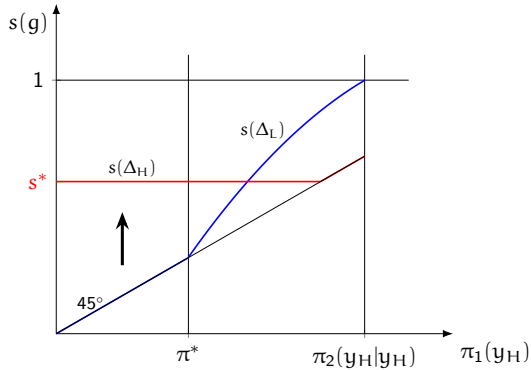

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APPLICATION 2: HEALTH INSURANCE

Health insurance

Firms are insurers, consumers are policyholders:

- am = bad-health state, pm = good-health state, with income y_H ($y_L = 0$)
- Contract = coverage X_t and premium P_t:

$$c_{t,am} = X_t, \qquad c_{t,pm} = y_H - P_t$$

  - Coverage pays out in bad health; premium paid out of income in good health

- $\beta < 1$: resources more valuable in bad health
- Model prediction: premiums subsidized early, rise with tenure (reclassification risk)

Community vs. experience rating

Community rating (ACA) bars pricing on $y_1 \Rightarrow$ spot contracts with(out) info design

Prop 4 Experience rating dominates if pool unhealthy, community rating if healthy

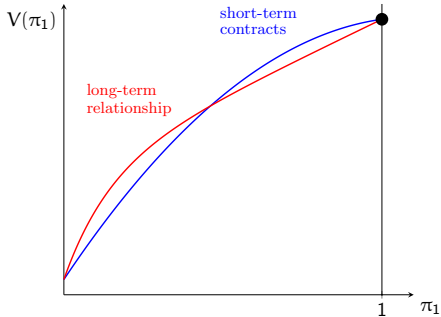
Proof

Community vs. experience rating

Community rating (ACA) bars pricing on $y_1 \Rightarrow$ spot contracts with(out) info design

Prop 4 Experience rating dominates if pool unhealthy, community rating if healthy

Healthy pool: large gains from cross-subsidization under spot contracts



Proof

Community vs. experience rating

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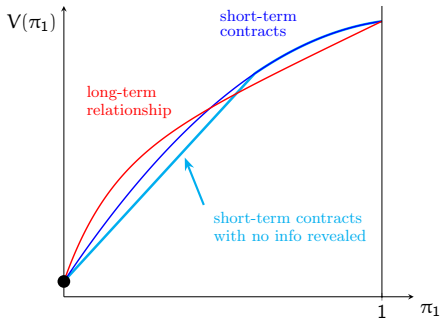
Prop 4 Experience rating dominates if pool unhealthy, community rating if healthy

Unhealthy pool: little cross-subsidization to gain; rents finance early premium discounts



vs. HHW 2015 (static): near-full disclosure optimal; dynamics call for coarse rating

Proof

Conclusion

- Optimal disclosure in economy where incumbent acquires ex-post info advantage
- With commitment: no info, to maximize cross-subsidization
- Without commitment: partial info, coarse "bad news", intertemporal smoothing
- Applications
  - Credit: no data ownership transfer, less info with fintech entry
  - Health: community vs. experience rating depends on pool health; coarse rating optimal even under experience rating
- Future work: optimal disclosure with costly entry

ADDITIONAL SLIDES

Related literature

- Dynamic contracts with limited commitment: Harris–Holmstrom (1982), Thomas–Worrall (1988), Hendel–Lizzeri (2003), Balke–Lamadon (2022)
  - Here: outside option endogenous to information design
- Asymmetric learning by incumbents: Sharpe (1990), Kahn (2013), de Garidel-Thoron (2005), Mukherjee (2008)
  - Here: optimal disclosure without firm commitment $\Rightarrow$ *partial* info optimal
- Information design: Kamenica–Gentzkow (2011); in adverse-selection economies: Garcia–Tsur (2021), Immorlica et al. (2022)
  - Here: dynamic, payoffs set in equilibrium, objective depends on the whole posterior
- Equilibrium notion: Miyazaki (1977), Wilson (1977), Netzer–Scheuer (2014)
  - Here: informed incumbent
- Open banking and data: Babina et al. (2024), He et al. (2023), Jones–Tonetti (2020); health insurance: Handel–Hendel–Whinston (2015)
  - Here: dynamic contracts, smoothing interacts with cross-subsidization

Type interpretation

Unobservable types $\theta \in \{\theta_L, \theta_H\}$ with $\Pr(y_H|\theta_H) = \pi_H(\theta_H) > \pi_H(\theta_L)$, prior $\rho(\theta_H)$

All agents learn from income history; after y_1:

$$\rho(\theta_H|y_H) = \frac{\rho(\theta_H)\pi_H(\theta_H)}{\sum_\theta \rho(\theta)\pi_H(\theta)} > \rho(\theta_H) > \rho(\theta_H|y_L)$$

Maps exactly to Markov economy:

$$\pi_1(y_H) = \sum_\theta \rho(\theta)\pi_H(\theta), \qquad \pi_2(y_H|y_1) = \sum_\theta \rho(\theta|y_1)\pi_H(\theta)$$

Implication: $Y_1 = Y_2$ by construction (martingale beliefs)

back

Equilibrium details: withdrawal and Stackelberg

Withdrawal stage (Netzer–Scheuer, 2014):

- Guarantees pure-strategy continuation equilibrium for any m
- Kills cream-skimming deviations behind Rothschild–Stiglitz non-existence
- $\varepsilon > 0$ selects zero-profit (Miyazaki–Wilson) outcomes absent incumbent

With informed incumbent, uniqueness additionally requires Stackelberg leadership:

- Incumbent posts first; offers $C_H^o(s(m))$ to high types, deters outsiders' $\{C_H^o, C_L^o\}$
- Simultaneous moves: outsider posting the MW menu attracts *only* low types

$$0 > -\varepsilon > -\pi_1 (y_L)\, \mu (m|y_L) \left(C_L^o (s(m)) - Y_{2L}\right)$$

  so outsiders withdraw; equilibrium can unravel
- With $\varepsilon = 0$: our outcome is the one minimizing incumbent's period-2 profits

back

Miyazaki–Wilson value: characterization

IC and zero profits bind; substituting out C_L^o and c_{am}, objective is linear in c_{pm}:

$$sY_{2H} + (1-s)\,Y_{2L} + [\beta\pi_2(y_H|y_H) - s\pi_2(y_H|y_H) - (1-s)\,\beta\pi_2(y_H|y_L)]\,c_{pm}$$

Coefficient sign flips at $s^* = \beta\kappa$, where

$$\kappa \equiv \frac{\pi_2(y_H|y_H) - \pi_2(y_H|y_L)}{\pi_2(y_H|y_H) - \pi_2(y_H|y_L)\,\beta} < 1$$

- $s < s^*$: raise c_{pm} until PC binds ($C_L^o = Y_{2L}$): least-cost separation

$$c_{pm} = \kappa(y_H - y_L), \qquad c_{am} = \pi_2(y_H|y_H)(y_H - y_L)(1-\kappa) + y_L$$

- $s \geqslant s^*$: $c_{pm} = 0$, pooling: $c_{am} = C_L^o = sY_{2H} + (1-s)Y_{2L}$
- s^* increasing in β and in $\pi_2(y_H|y_H) - \pi_2(y_H|y_L)$

Proof of Prop 1

Choose distribution p over s subject to $\sum_s p(s)s = \pi_1(y_H)$; claim: $p^*(\pi_1(y_H)) = 1$

Case 1: $\bar{V}_H \equiv \sum_s p(s)sV_H(s)/\pi_1(y_H) \geqslant V_H^o(\pi_1(y_H))$

- By convexity of u^{-1}, delivering $\bar{V}_H$ with a single signal saves resources
- Rebate savings to period 1 $\Rightarrow$ improvement

Case 2: $\bar{V}_H < V_H^o(\pi_1(y_H))$

- No-info PC binds; disclosing info lowers *both* value to high types and profits:

$$\sum_s p(s)s\, u^{-1}\left(V_H(s)\right) \geqslant \sum_s p(s)s\, C_H^o(s) > \pi_1(y_H)\, C_H^o(\pi_1(y_H))$$

  first inequality from ex-post PC, second from convexity of $C_H^o(s)$

- No info raises V_H *and* lowers its cost $\Rightarrow$ improvement

back

Proof of Prop 2: the cutoff

Condition for no-info regime: consumption under no info still back-loaded,

$$C_H^o(\pi_1) \geqslant Y_1 + \pi_1 (Y_{2H} - C_H^o(\pi_1)) \qquad (\star)$$

Let $K(s) \equiv C_H^o(s)$ and

$$f(\pi_1) \equiv K(\pi_1) - [\pi_1 y_H + (1-\pi_1) y_L + \pi_1 (Y_{2H} - K(\pi_1))]$$

- f convex: $f'' = (1+\pi_1)K'' + 2K' \geqslant 0$
- $f(0) = K(0) - y_L > 0$ and
  $f(\pi_2(y_H|y_H)) = -(1+\pi_2(y_H|y_H))(Y_{2H} - K(\pi_2(y_H|y_H))) < 0$
- Single crossing at $\pi^* \in (0, \pi_2(y_H|y_H))$: $(\star)$ holds iff $\pi_1 \leqslant \pi^*$

back

Proof of Prop 2: single signal for high types

Suppose two signals m_1, m_2 with $\mu^*(m_j|y_H) > 0$ and different values; let $\bar{V} = \sum_m \mu^*(m|y_H) V_H^o(s(m))$

- If $\bar{V} \geqslant V_H^o(\pi_1)$: replace with $\{g, b\}$, $V_H^o(s(g)) = \bar{V}$
  - Convexity of $h \equiv u^{-1}$: same expected utility in period 2 at lower cost, rebated to period 1

- If $\bar{V} < V_H^o(\pi_1)$: no-info policy dominates because

$$F(V) \equiv u(Y_1 + \pi_1 [Y_{2H} - h(V)]) + \pi_1 V$$

  is increasing in V for $V < V_H^o(\pi_1)$ when $(\star)$ fails:

$$F'(V) = \pi_1 \left[1 - \frac{u'(C_1(V))}{u'(h(V))}\right] > 0 \text{ since } C_1(V) > h(V)$$

- Interior optimum: $u'(C_1) = u'(C_{2H}) \Rightarrow C_1 = C_{2H} = \frac{Y_1 + \pi_1 Y_{2H}}{1+\pi_1}$; recover $\mu(b|y_L)$ from $V_H = V_H^o(s(g))$

Regulation, commitment, and data ownership

Is a regulator needed?

- No: period-1 incumbent with a commitment technology for reporting would choose the optimal disclosure policy

Is commitment to reporting needed?

- Yes, when info disclosure optimal: ex-post, no-info maximizes incumbent's profits
- Stronger notion than credibility in Lin–Liu (2024): incumbent wants to swap signals across types

Can consumers own the data instead?

- Consumer with reporting technology but no commitment: high types disclose y_H
- Unraveling (Grossman, 1981; Milgrom, 1981) $\Rightarrow$ full info $\Rightarrow$ welfare loss

back

Community vs. experience rating: marginal values

At $\pi = \pi_1(y_H) = 0$:

$$\left.\frac{\partial V^{ST}}{\partial \pi}\right|_{\pi=0} = u'(y_L)(y_H - y_L) + \left[V_H^{LCS} - u(Y_{2L})\right] + \frac{1-s^*}{s^*}\left[V_H^{LCS} - u(Y_{2L})\right]$$

$$< u'(y_L)(y_H - y_L) + \left[V_H^{LCS} - u(Y_{2L})\right] + u'(y_L)\left(Y_{2H} - C_H^{LCS}\right) = \left.\frac{\partial V^{LT}}{\partial \pi}\right|_{\pi=0}$$

ST consumes extra resources in period-2 at $u'(Y_{2L})$ vs. LT in period 1 at $u'(y_L) > u'(Y_{2L})$

At $\pi = 1$ (with $\pi_1 \leqslant \pi_2(y_H|y_H)$):

$$\left.\frac{\partial V^{ST}}{\partial \pi}\right|_{\pi=1} = u'(y_H)(y_H - y_L) + u'(Y_{2H})\left[Y_{2H} - Y_{2L}\right]$$

$$< u'(y_H)(y_H - y_L) + \left[u(Y_{2H}) - u(Y_{2L})\right] = \left.\frac{\partial V^{LT}}{\partial \pi}\right|_{\pi=1}$$

Strict concavity of u: LT losing the value for low types costs more than ST worse pool

Switching: three-signal program

Continuation value at share s:

$$W(s;\Delta) = sV_H^o(s) + (1-s)V_L(s) + \Delta, \quad V_L(s) = \begin{cases} V_L^o(s) & s \geqslant \hat{s}(\Delta) \\ u(Y_{2L}) & s < \hat{s}(\Delta) \end{cases}$$

Optimal policy solves

$$\max_{s_{in}, s_{out}, p_0, p_{in}, p_{out}} u(Y_1 + p_{in}s_{in}[Y_{2H} - h(V_H^o(s_{in}) + \Delta)]) + p_0 W(0;\Delta) + p_{in}W(s_{in};\Delta) + p_{out}W(s_{out};\Delta)$$

subject to $p_{in}s_{in} + p_{out}s_{out} = \pi_1(y_H)$, $s_{in} \in (0, \hat{s}(\Delta))$, $s_{out} \in [\hat{s}(\Delta), 1]$, where $h \equiv u^{-1}$

- Retained high types must be paid $V_H^o(s_{in}) + \Delta$: switching option includes the benefit
- One switcher signal enough: no profits above $\hat{s}(\Delta)$ and W concave there
- One stayer signal enough: same logic as Prop 2