Regulating Disclosure: The Value of Discretion

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Motivation

- Contracting is personalized
    - ex: credit, insurance, digital marketplaces
- Concern: info $+$ market power $\Rightarrow$ price discrimination
- Information regulation
    - Prohibit / require disclosure (redlining regulation) — "preventative"
    - Info ownership & voluntary disclosure (GDPR) — "redistributive"
- Which is better?

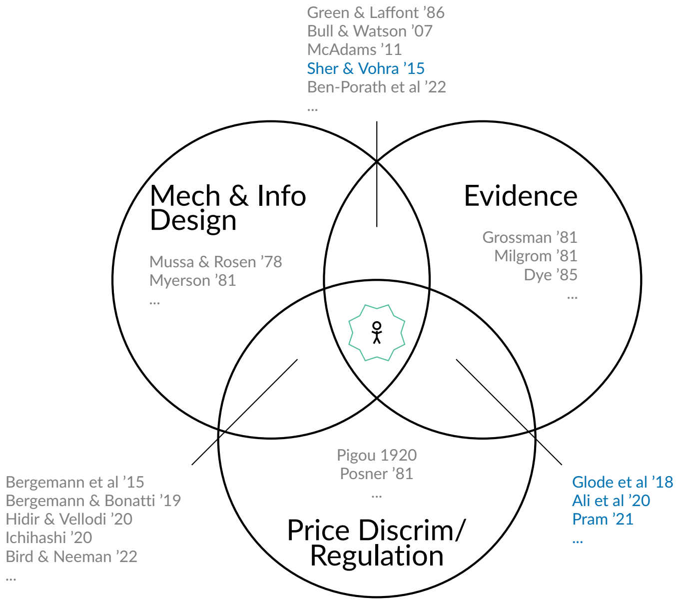
This Paper: Regulating Information Disclosure

- Prohibiting & requiring disclosure $\approx$ info design
- Focus: voluntary disclosure + market power
- Q1: How does voluntary disclosure affect the distribution of surplus?
- Q2: When is voluntary disclosure a good policy tool?
- Framework: regulator with one instrument
  - Consumer's disclosure to monopolistic seller (mech designer)
  - Seller responds to regulation

Results

- Voluntary disclosure $\rightarrow$ bargaining power $\rightarrow$ CS $\uparrow$ $\times$
- Friction: seller tradeoff of incentivizing disclosure vs. optimally pricing
- A1: voluntary disclosure may lead to lowest CS
  - Externality: some consumers benefit at expense of others
- A2: (conditions) voluntary is weakly dominated
  - for *any* regulator objective
- Policy: seller's response to frictions may undermine policy goals

Literature



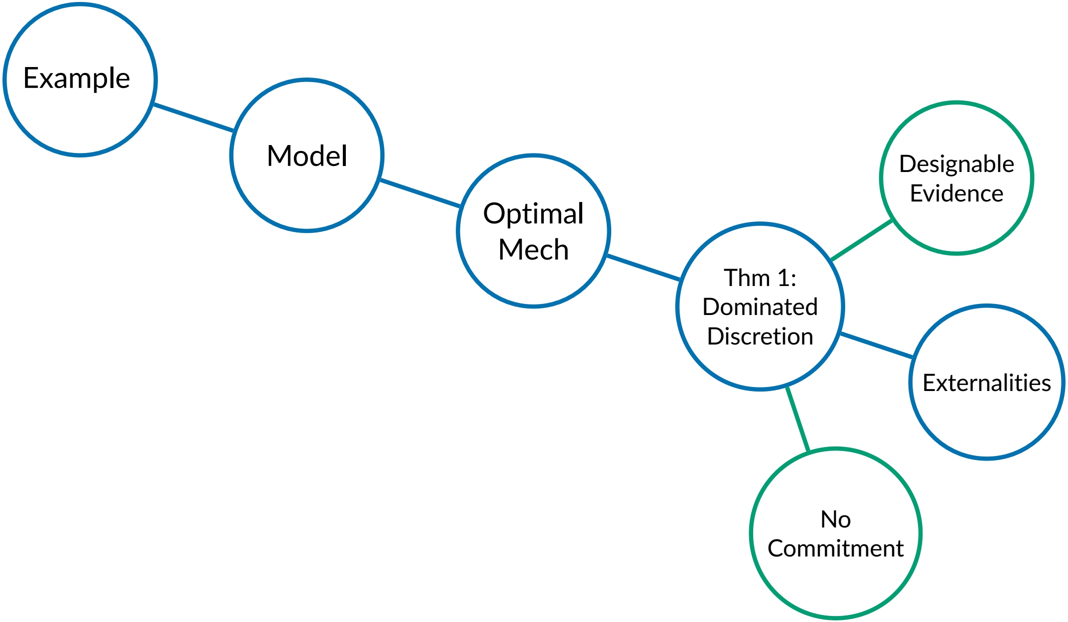
Green & Laffont '86
Bull & Watson '07
McAdams '11
Sher & Vohra '15
Ben-Porath et al '22
...
Mech & Info Design
Mussa & Rosen '78
Myerson '81
...
Evidence
Grossman '81
Milgrom '81
Dye '85
...
Pigou 1920
Posner '81
...
Price Discrim/ Regulation
Bergemann et al '15
Bergemann & Bonatti '19
Hidir & Vellodi '20
Ichihashi '20
Bird & Neeman '22
...
Glode et al '18
Ali et al '20
Pram '21
...

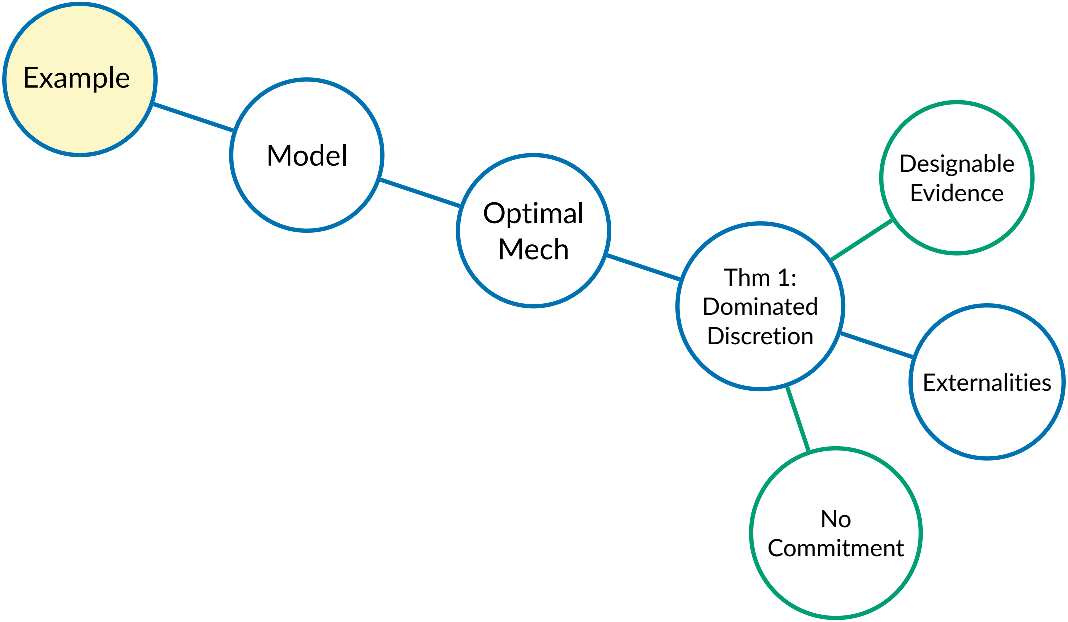
Contribution

- Known: $\exists$ equilibrium where voluntary disclosure $>$ no disclosure
- This paper:
  - Welfare effects of voluntary disclosure with market power
  - Disentangles two effects

$$(\textit{voluntary} - \textit{none}) = \underbrace{(\textit{voluntary} - \textit{required})}_{\text{Info Control}} + \underbrace{(\textit{required} - \textit{none})}_{\text{Contractible info}}$$

  - (secondary) methodological, “no value to commitment” results


Example
Model
Optimal Mech
Thm 1: Dominated Discretion
Designable Evidence
Externalities
No Commitment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Peet’s Coffee

Peet's Coffee

- Locals and MBA Students
- Value $\theta \in \{1, 2, 3\}$
- Student ID cards
- $R(\theta)$ = revenue

		$\theta = 1$	$\theta = 2$	$\theta = 3$
Total	Pr	$\frac{3}{7}$	$\frac{3}{7}$	$\frac{1}{7}$
	R	1	$\frac{8}{7}$	$\frac{3}{7}$
Locals	Pr	$\frac{3}{7}$	0	$\frac{1}{7}$
	R	$\frac{4}{7}$	$\frac{2}{7}$	$\frac{3}{7}$
MBAs	Pr	0	$\frac{3}{7}$	0
	R	$\frac{3}{7}$	$\frac{6}{7}$	0

Peet's Coffee

IDs	Locals	MBAs
Prohibited	2	2
Required	1	2
Voluntary	2	2

		$\theta = 1$	$\theta = 2$	$\theta = 3$
Total	Pr	$\frac{3}{7}$	$\frac{3}{7}$	$\frac{1}{7}$
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	R	$\frac{3}{7}$	$\frac{6}{7}$	0

Peet's Coffee

IDs	Locals	MBAs
Prohibited	2	2
Required	1	2
Voluntary	3	2

- Voluntary is dominated
- Externality
- Ex-post suboptimality

		$\theta = 1$	$\theta = 2$	$\theta = 3$
Total	Pr	$\frac{3}{7}$	$\frac{3}{7}$	$\frac{1}{7}$
	R	1	$\frac{8}{7}$	$\frac{3}{7}$
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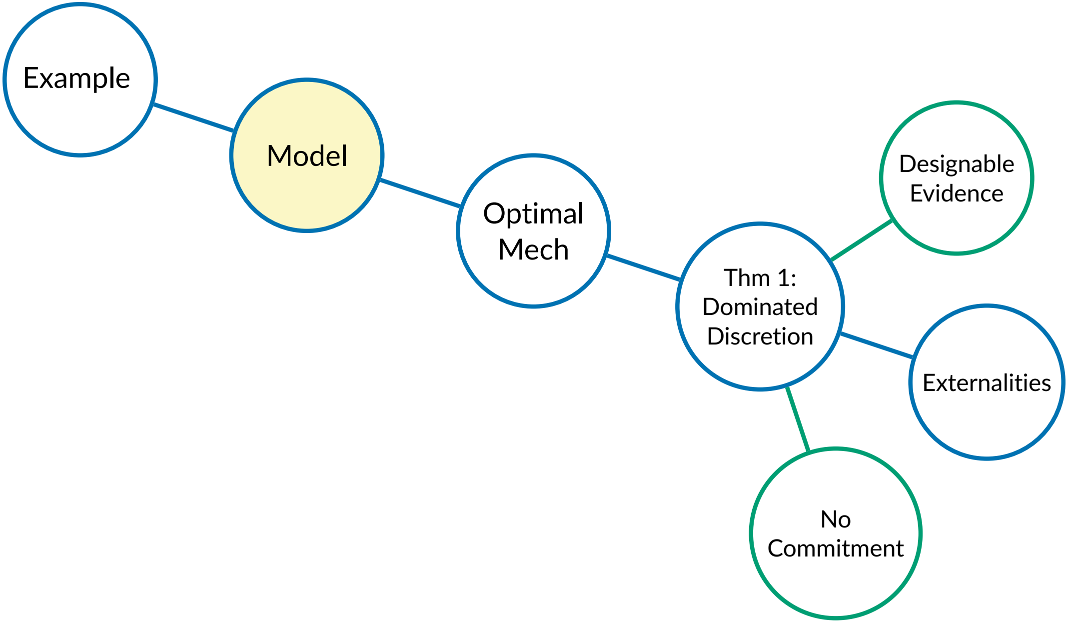
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Model: Timing & Summary

Seller (she) $+$ Buyer (he) with private valuation and evidence

1. Disclosure regulation
2. Seller commits to mechanism to maximize revenue
3. Buyer's report + disclosure $\rightarrow$ trade and transfer

Unit-Demand Buyer: Info and Preferences

- Valuation: $\theta \in \Theta = [\underline{\theta}, \overline{\theta}] \subseteq \mathbb{R}$
    - Probability of trade, transfer: $(q, t) \in [0, 1] \times \mathbb{R}$
    - Payoff: $q \cdot \theta - t$
- Evidence: set of realizations E with "null" element $e_0 \in E$
    - Student IDs: $E = (e_0, e_{MBA})$
- Joint distribution over $(\Theta \times E)$
    - Probability $p(e)$
    - Posterior beliefs $G(\cdot|e) \in \Delta(\Theta)$

Regulation

- Today: “Opt-out” policies
- Regulation is a correspondence $\gamma : E \to 2^E$, where $\gamma(e) \subseteq \{e, e_0\}$
- $\gamma(e)$: the set of allowable disclosures when agent has e
  - Voluntary: $\gamma(e) = \{e, e_0\}$
  - Mandated: $\gamma(e) = \{e\}$
  - Prohibited: $\gamma(e) = \{e_0\}$

Seller's Mechanism

- WLOG: direct mechanism, truthful reports & full disclosure

$$q : \Theta \times E \to [0,1] \quad t : \Theta \times E \to \mathbb{R}$$

- Seller problem:

$$\begin{aligned} \max_{q,t} \quad & \mathbb{E}_{(\theta,e)}[t(\theta,e)] \\ s.t. \quad & \text{IC}(\theta,e) \quad \forall \theta, e \\ & \text{IR}(\theta,e) \quad \forall \theta, e \end{aligned}$$

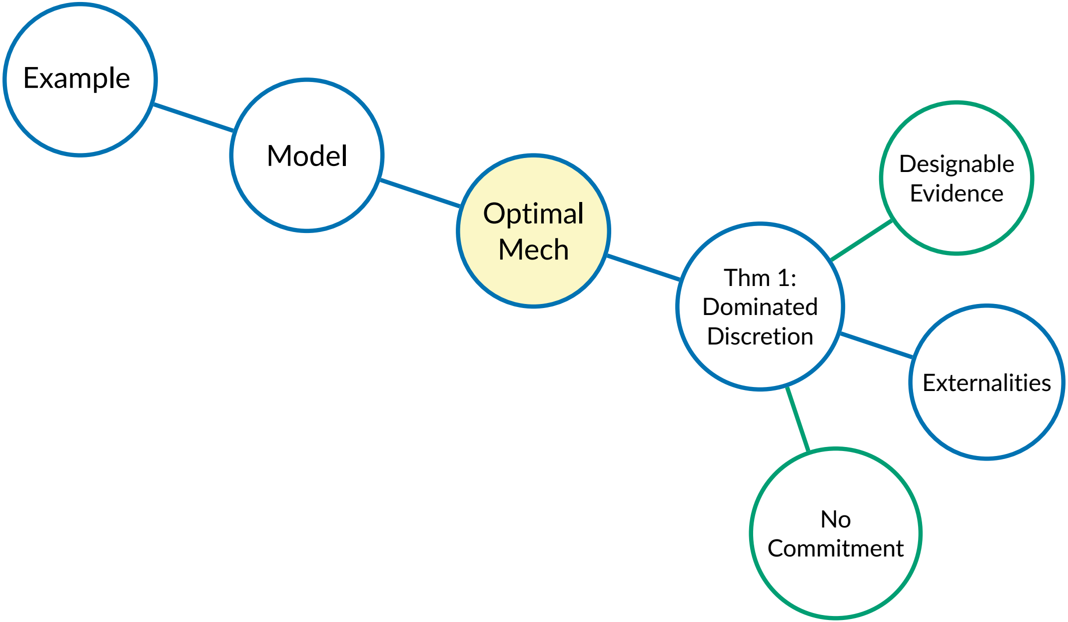
- Mechanism induces outcome $O : \Theta \to \Delta([0,1] \times \mathbb{R})$

- Regulator preference $\succeq$ over outcomes

Model: Timing & Summary

Monopoly seller & unit-demand buyer (θ, e)

1. Disclosure regulation
2. Seller commits to mechanism to maximize revenue
3. Buyer's report + disclosure $\rightarrow$ trade and transfer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Optimal Mechanism Characterization

- *In*voluntary disclosure (no discretion): posted price for each $e \in E$
- Voluntary disclosure: ?
- Construction Steps:
  1. Characterize extreme points of IC mechanisms
  2. Identify seller's value function and recover optimal prices

Analysis: Simplifying the Problem

- Consider $E = (e_0, e_1)$ and voluntary disclosure
- Notation: $q_i(\theta) := q(\theta, e_i)$ and $t_i(\theta) := t(\theta, e_i)$
- Sufficient: two kinds of IC constraints, no double-deviations
  1. "within e": (θ, e) doesn't misreport to (θ', e) $\Leftrightarrow$ envelope + monotonicity

$$U_i(\theta) = \theta q_i(\theta) - t_i(\theta) = U_i(\underline{\theta}) + \int_{\underline{\theta}}^{\theta} q_i(s)ds$$

  2. "across e": (θ, e_1) doesn't misreport to (θ, e_0) $\Leftrightarrow$ $U_1(\theta) \geq U_0(\theta)$

Program

- Remaining: $(U_i(\cdot))_{i=0,1}$

$$\max_{U_i(\cdot)} \quad \mathbb{E}[\text{virtual surplus}]$$
$$s.t. \quad U_i(\cdot) \text{ increasing, convex, and } U_i' \in [0,1]$$
$$U_1(\theta) \geq U_0(\theta) \quad \forall\theta$$
$$U_0(\underline{\theta}) \geq 0$$

- Friction

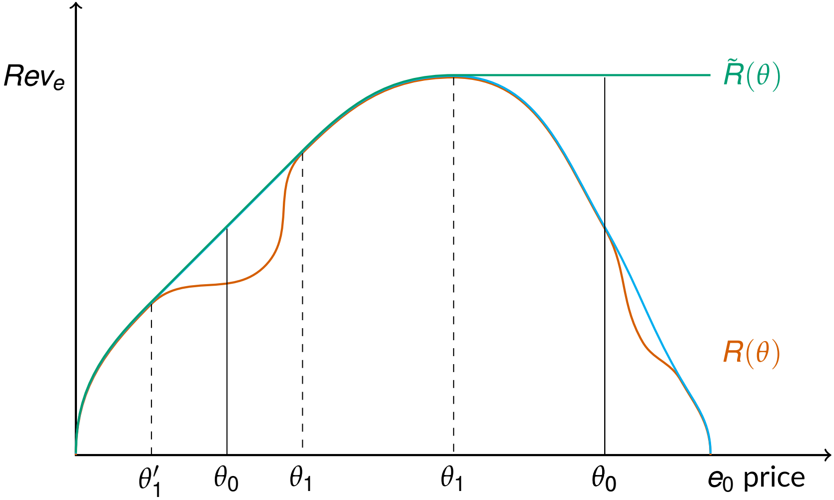
x Usual approach: study dual

- Obs: objective is linear and constraint set is convex $\rightarrow$ extreme points
    - Disclosure constraint related to a "majorization" constraint

Optimal Mechanism with Voluntary Disclosure

- No disclosure (e_0): posted price
- Disclosure $(e \neq e_0)$: alternative posted price with probabilistic discount
  = randomization over at-most two prices

Thought Experiment: Max Revenue Given Non-Disclosure Price



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Seller's Value Function

- $R_e(\theta)$:= posted-price revenue $:= \theta(1 - G(\theta \mid e)) \cdot p(e)$
- $\tilde{R}_e(\theta)$:= monotone concave envelope of R_e
  - Smallest concave and non-decreasing function above R_e
- Prop: $\tilde{R}_e(\theta_0)$ is the max revenue from e given a fixed price θ_0
- Corr: Seller's revenue $= \max_{\theta_0} R_0(\theta_0) + \sum_e \tilde{R}_e(\theta_0)$

! Simplifies to 1-dimensional maximization

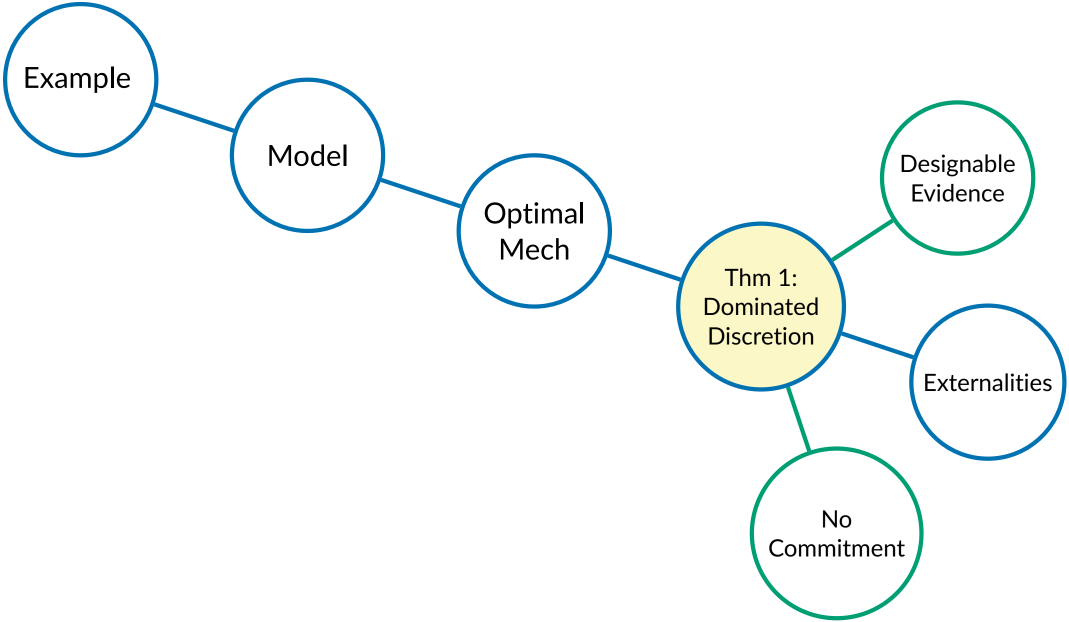
Empirical Consequences

- Voluntary disclosure $\rightarrow$ price variation (randomization)
- Empirically: mixed findings on price discrimination vs price variation
  - Price variation *is* a result of price discrimination
  - Comparing average prices insufficient
  - Observed prices not ex-post optimal

Disparate Effects on Consumer Surplus

- Consumer surplus: compared to a full-disclosure benchmark
  - Consumers without evidence (weakly) harmed
  - Consumers with evidence (weakly) benefit

$\rightarrow$ Data ownership may hurt privacy-conscious consumers through prices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No Value to Discretion in Regular Environments

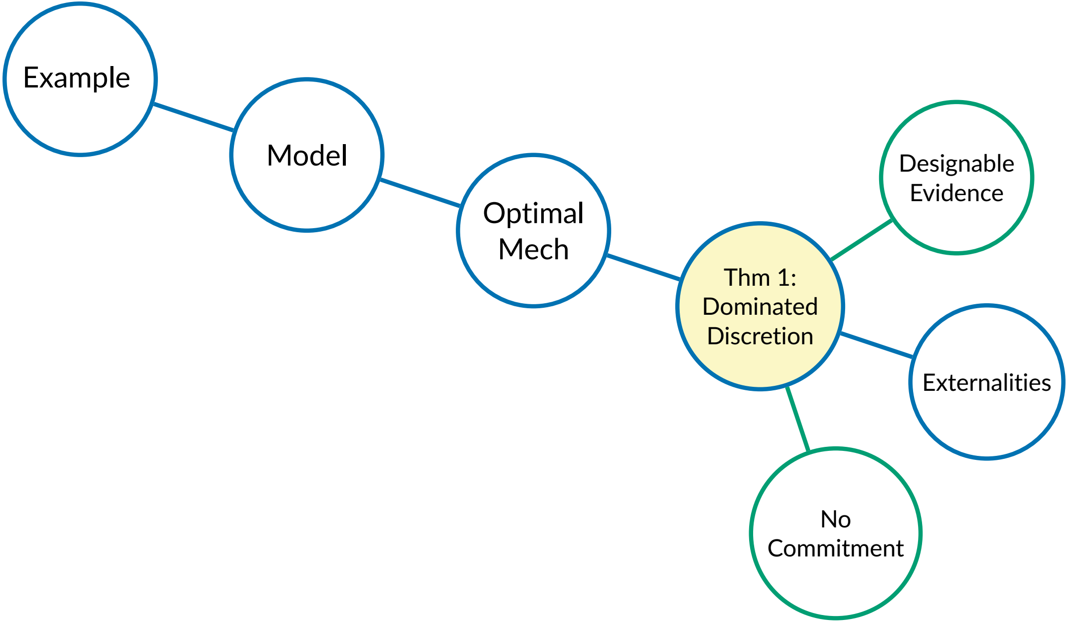
- [Assumption] Regularity: R_e is concave for all $e \in E$
- Non-discretionary: $\Gamma^{ND} = \{\gamma : |\gamma(e)| = 1 \quad \forall e \in E\}$
- Discretionary: $\Gamma^D = \Gamma \setminus \Gamma^{ND}$
- $O(\gamma)$: outcome in seller-optimal mechanism under γ
- Thm: Assume regularity. All outcomes are achievable without discretion.

$$\bigcup_{\gamma \in \Gamma^D} O(\gamma) \subseteq \bigcup_{\gamma \in \Gamma^{ND}} O(\gamma)$$

- Intuition: concavity $\implies$ no randomization & ex-post optimality

Consequences of Regularity

- Corr: for any regulator $\succeq$, WLOG no discretion
  - No *additional* benefit to giving consumers the option to disclose
  - $\Rightarrow$ Should focus on what must be disclosed (contractible)
- Consumers w/o evidence (e_0) worst-off under voluntary
- In irregular cases, voluntary disclosure may be uniquely optimal ▸ example
  - Necessary: R_e non-concave for some $e \neq e_0$
- Interpretation: seller acts *as-if* some disclosure is required [Formal]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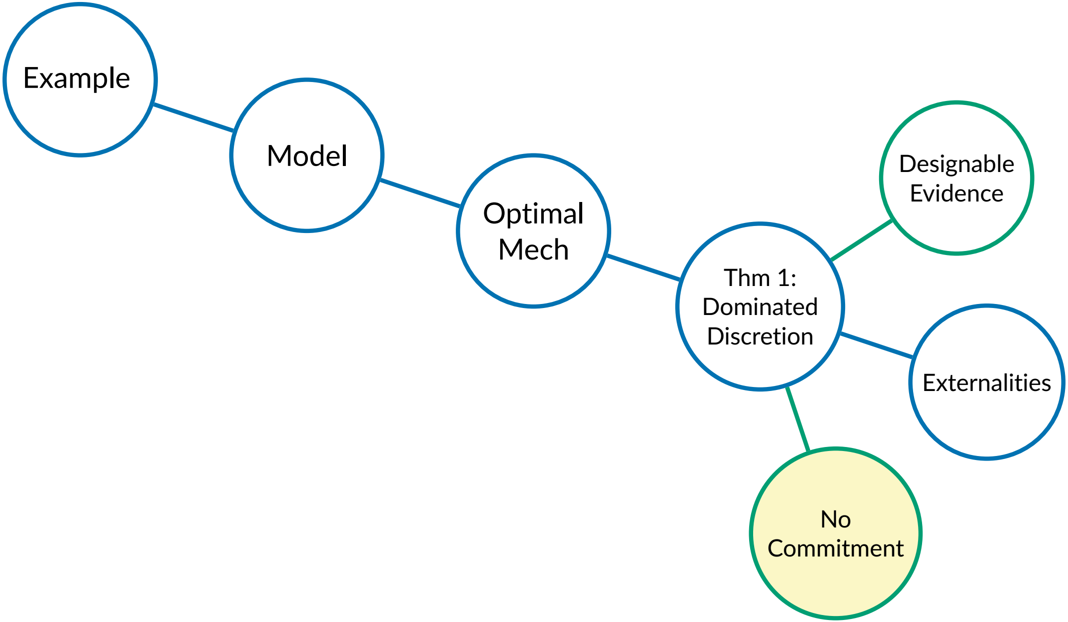

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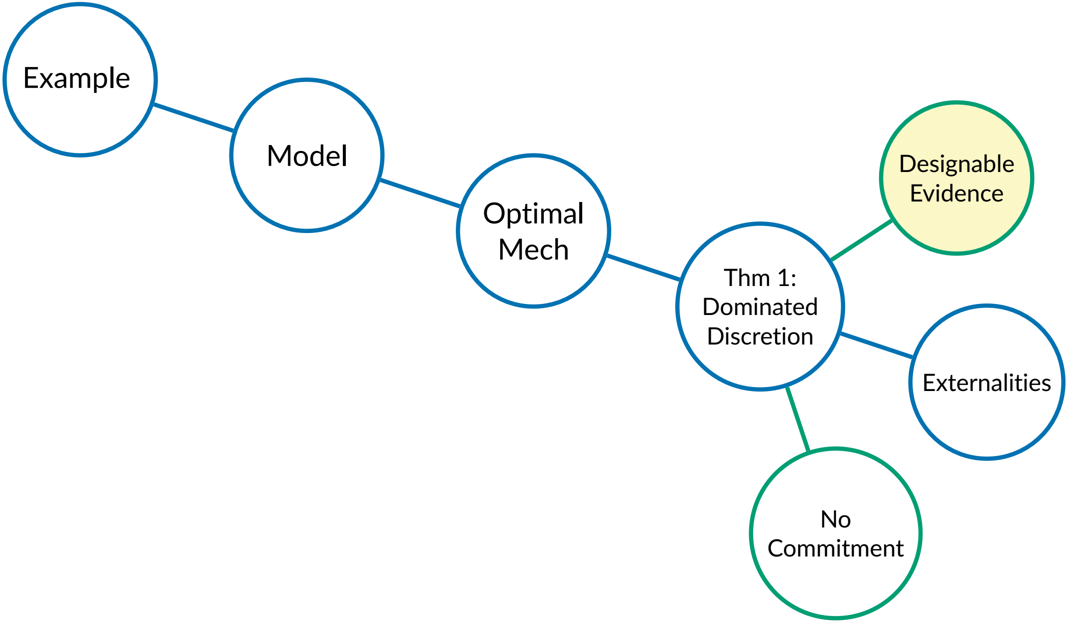
The (No-)Value of Commitment

- Disclosure game
  1. Buyer makes cheap-talk report θ and disclosure e
  2. Seller best-responds with a posted price
  3. Buyer chooses to purchase or not
- Thm: (Regularity) $\exists$ pure-strategy eqm with same revenue as optimal mech
- Thm: (R_0 concave) $\exists$ mixed-strategy eqm with same revenue as optimal mech
  - "No value to commitment" result based on *distributional* assumptions end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Regulator-Designed Evidence

- Regulator may be able to design the information content of evidence
  - Index inputs and weights (e.g., credit scores)
  - Coarsen or refine existing information
- Fix prior $F \in \Delta(\Theta)$
- Regulator can additionally choose E, and joint dist over $(\Theta \times E)$
- $\mathcal{G} :=$ all feasible posterior beliefs distributions

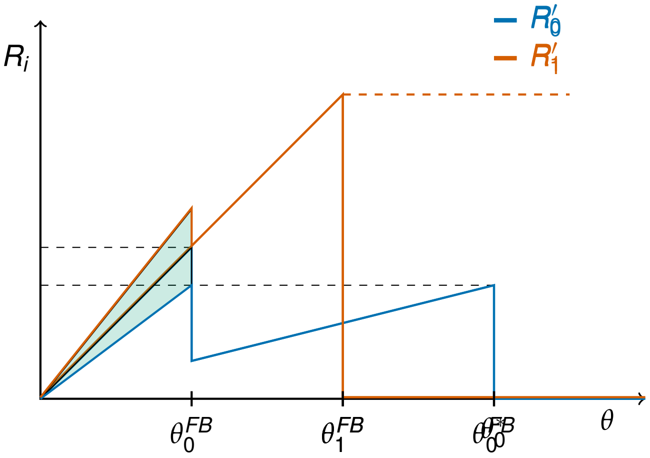
Theorem 2: WLOG Full Disclosure

- Full disclosure: $\gamma^F(e) = \{e\}$ for all $e \in E$
- Theorem: Full Disclosure is WLOG (no regularity)

$$\bigcup_{G \in \mathcal{G}} O(\gamma^F, G) = \bigcup_{\gamma \in \Gamma} \left(\bigcup_{G \in \mathcal{G}} O(\gamma, G) \right)$$

- $\supseteq$ by construction
  - Key: information rents to higher θ *and* e replicated by changing joint distribution
  - Challenge: need to preserve prior distribution of buyers
  - Approach: work directly in space of price-revenue curves ▸ Example ▸ Skip

Sketch: Voluntary to Full Disclosure

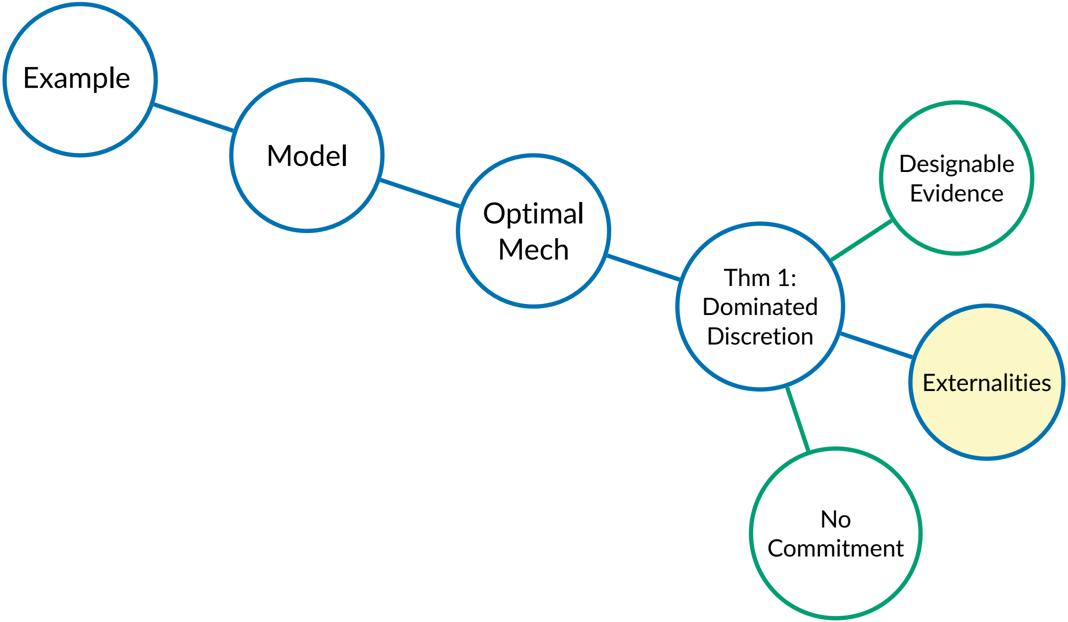


To Check:

- Bayes plausibility
- Valid CDF operations
- θ_1^{FB} optimal

Interpretation

- Evidence design and disclosure regulation are substitutes
  - ! Not true in all environments
- Full disclosure $\implies$ market segmentation
- Voluntary disclosure $\implies$ *endogenous* market segmentation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Externalities Under Voluntary Disclosure

- Dye ('85) evidence structure & voluntary disclosure
  - $E = \Theta \cup \{e_0\}$; precise *identifying* evidence for each θ
  - with prob $p(\theta)$, type θ has e_θ and otherwise e_0
- Prop: if $p' \geq p$, *all* consumers are (weakly) worse under p' than p
  - Any subset of having more evidence hurts all consumers

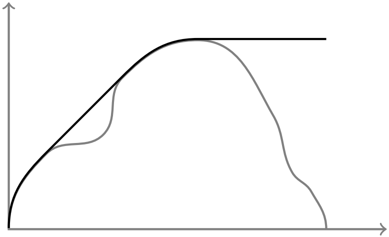
$\Rightarrow$ Banning disclosure $(p = 0)$ *always* improves CS over voluntary disclosure

- Extends to general SM preferences $u(x, \theta)$, $v(x, \theta)$

Conclusion + Ongoing Work

- Disclosure regulation to monopolistic seller
- Seller's response to additional frictions may undermine policy goals
- Info ownership & voluntary disclosure not a *laissez faire* solution
- Ongoing work:
  - Limited regulator knowledge
  - Endogenous evidence acquisition
  - Disclosure regulation + other policy instruments

THANK YOU!



Appendix

General Preferences

- Preferences: $u(x,\theta) - t, \quad v(x,\theta) + t$
- Supermodularity: $u_{x\theta} \geq 0$
- $x^{FB}(\theta) := \mathrm{argmax}_x \, u(x,\theta) + v(x,\theta)$ increasing in θ
- Dye evidence: with prob $p(\theta)$, the type can be *perfectly* disclosed
- Prop: With voluntary disclosure, consumer surplus decreases in p
- Banning disclosure $(p = 0)$ improves CS over *any* voluntary disclosure Back

General Evidence Structures

- Evidence: poset $(E, \triangleright)$
- $e' \triangleright e$ means e' can be misreported as e
- There exists an $\triangleright-$minimal element of E called e_0
- $L(e) := \{e' \in E : e \triangleright e'\}$
- Regulation $\gamma : E \to 2^E$:
  - (Feasibility) $\gamma(e) \subseteq L(e)$
  - (Transitivity) $e'' \in \gamma(e')$ and $e' \in \gamma(e)$ implies $e'' \in \gamma(e)$
  - (Normality) $e', e'' \in \gamma(e)$ implies $e' \vee e'' \in \gamma(e)$
- Theorems 1 and 2 hold. Back

Failure of Theorem 2

	x	y	z
θ_1	(1,1)	(5,0)	(2,2)
θ_2	(5,0)	(1,1)	(2,2)

Table: Payoffs under which Theorem 2 fails

- Suppose type θ_1 can claim to be θ_2 but not conversely
- Optimal: $\theta_1 \rightarrow \frac{1}{2}y + \frac{1}{2}z, \quad \theta_2 \rightarrow x$
- But, under any mandated disclosure policy, z is never optimal Back

Example: Optimal Discretion

Peet's 2.0: Valuable Discretion

- $\Theta = \{1, 2, 3\}$
- Student IDs
- $R(\theta)$ = posted price revenue

		$\theta = 1$	$\theta = 2$	$\theta = 3$
Total	Pr	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{3}$
	R	1	$\frac{4}{3}$	1
Locals	Pr	0	$\frac{1}{3}$	0
	R	$\frac{1}{3}$	$\frac{2}{3}$	0
MBAs	Pr	$\frac{1}{3}$	0	$\frac{1}{3}$
	R	$\frac{2}{3}$	$\frac{2}{3}$	1

Peet's 2.0: Valuable Discretion

Opt mech. prices

IDs	Locals	MBAs
Prohibited	2	2
Required	2	3
Voluntary	2	$(\frac{1}{2}\cdot 1 + \frac{1}{2}\cdot 3)$

- Randomization
- Voluntary max. efficiency
- MBA CS ↑ (w/ ϵ change) ▸ back

		$\theta = 1$	$\theta = 2$	$\theta = 3$
Total	Pr	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{3}$
	R	1	$\frac{4}{3}$	1
Locals	Pr	0	$\frac{1}{3}$	0
	R	$\frac{1}{3}$	$\frac{2}{3}$	0
MBAs	Pr	$\frac{1}{3}$	0	$\frac{1}{3}$
	R	$\frac{2}{3}$	$\frac{2}{3}$	1

Peet's 2.0: Voluntary to Full Disclosure

	e_0	e_1
Voluntary	2	$(\frac{1}{2} \cdot 1 + \frac{1}{2} \cdot 3)$

same *outcome* w mandate:

- $e_0 : (\frac{1}{6}, \frac{1}{3}, \frac{1}{3})$
- $e_1 : (\frac{1}{6}, 0, 0)$

		$\theta = 1$	$\theta = 2$	$\theta = 3$
prior	Pr	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{3}$
	R	1	$\frac{4}{3}$	1
e_0	Pr	0	$\frac{1}{3}$	0
	R	$\frac{1}{3}$	$\frac{2}{3}$	0
e_1	Pr	$\frac{1}{3}$	0	$\frac{1}{3}$
	R	$\frac{2}{3}$	$\frac{2}{3}$	1

back