Concordance among Holdouts

Scott Duke Kominers

Department of Economics, Harvard University and Harvard Business School

(joint work with E. Glen Weyl, Harvard Society of Fellows)

Market Design Workshop

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The Holdout Problem

- Holdout is pervasive.
    - Perfect complements problems
        - land assembly, corporate acquisitions, spectrum recovery
    - All trade dries up as $N \to \infty$.
- Institutions for reducing holdout are primitive.
    - Takings; voting-based procedures
- Sharp contrast to the case of auctions for substitutes, where even naïve designs are efficient as $N \to \infty$ (Bulow & Klemperer (1996))

Our Contributions

1. Introduce holdout as a market design problem
   - Design goals
     - straightforwardness, bilateral efficiency, partial property rights
2. Propose a class of solutions
   - Design principle — “Concordance” — which ensures key goals
   - Concordance mechanisms: a market design for holdout

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    - Market Design Goals
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    - Other Concordance Mechanisms
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6. Conclusion

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Design Goals: The Ideal

1. Fully Efficient: mechanism captures all gains from trade
   - Sale $\iff b \geq \sum_i v_i \equiv V$
2. Protects Individual Property Rights: no seller sells below value
   - Sale $\implies$ each seller i receives at least v_i
3. Budget-balanced
   - No transfers to/from the market-maker

Design Goals: Our Proposal

1. Straightforward for Sellers: truthful play dominant
   - $r^\star(v_i) = v_i$; dominant-strategy equilibrium
2. Bilaterally Efficient: as efficient as bilateral trade
   - Sale $\iff o^\star(b) \geq V$
3. Protects Partial Property Rights
   - Collective PR: community not forced to sell for less than V
   - Approximate Individual PR: seller i receives at least $\frac{s_i(V - v_i)}{1 - s_i}$
4. Self-financing
   - No transfers from the market-maker

Examples of Holdout

1. Land assembly
   - Eminent domain/takings
     - Government assesses and pays compensation ($\Longrightarrow$ corruption)
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3. Other examples
   - Debt settlements; Spectrum reassembly; Multi-plaintiff lawsuits; Patent pools; Art collections
   - Heller (2008) gives a whole book of examples

Cournot's Intuition

Very few commodities are consumed in just the form in which they are left in the hands of the first producer...

[S]everal raw materials are generally brought together in the manufacture of each of these products...

[T]he more there are of articles thus related, the higher the price determined by the division of monopolies will be, than that which would result from the fusion or association of monopolists.

—Cournot (1838)

The Concordance Principle

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  1. Sellers merge and divide revenues
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- Concordance Principle is analogous
  1. Sellers divide offer into previously-specified shares
  2. Each seller pays a pigouvian tax for externalities
- Formally: A mechanism satisfies the Concordance Principle if
  0. Offer accepted when $o \geq R \equiv \sum_i r_i$
  1. $r_i = s_i o$ is "no influence"

     $\Longrightarrow$ Sale $\iff$ $o \geq R_i \equiv \frac{\sum_{j \neq i} r_j}{1 - s_i}$

     $\Longrightarrow$ Noninfluential sellers $\{$pay no tax, get at least $s_i o$ in sale$\}$
  2. Influential sellers may pay a tax to encourage truthfulness
     - $r^\star(v) = v$; $o^\star(b)$ is monopsonist-optimal offer

Mechanism Design

$$\begin{array}{rl} & \text{Concordance principle} \\ + & \text{Auction enforcement} \\ \hline & \text{Concordance mechanism} \end{array}$$

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Gross	2.0	3.1	4.1	5.1	6.1	7.1	8.1	9.2	10.2	1.0

- You want to buy the farms and build an airfield (worth $b = 90$)
  - Offer $o = 56 < o^{\star}(b)$
- Straightforward Concordance (Externality Tax)
  - Shares perfectly observed $\implies$ no taxes ($\implies$ full PRs)

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    - Sale occurs; Farmer 10 is pivotal ($R_{10} \approx 56.84$) and is taxed his externality ($\tau_{10} = (1 - \frac{1}{20})|56.84 - 56| \approx .8$).

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Theorem

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Proof

- Sellers report truthfully; buyer gives monopsonist-optimal offer
- Outcome same as bilateral bargain (Myerson-Satterwaite (1981)) between buyer and single seller with value V
- Uncertainty about $V = \sum_i v_i$ vanishes as $N \to \infty$

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Concordance mechanisms preserve collective and approximate individual property rights.

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Concordance + Vickrey-Clarke-Groves + Cavallo (2006)

1. Straightforward for sellers (VCG proof)
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Still, Straightforward Concordance has some problems:

- Imperfect budget-balance; collusion
- Monetary payments, risk and individual budgets

Other Concordance Mechanisms

1. Bayes-Nash Concordance (BNC)
   - Expected Externality mechanism $\implies$ Bayes-Nash implementable
   - Budget-balanced; Strictly preserves collective property rights
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4. Other possibilities: core-nearest, other package auction rules

X-plurality

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  - $X = 0 \sim$ eminent domain: pay market value (minimum)
  - X midrange $\sim$ corporate acquisitions; Heller and Hills (2008)
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- Simple, balanced, straightforward, no extra money/risk
- Protects X percent of property rights
- X must match with distribution of values
- Raises many issues
  - Share-weighting, right X, small population, trade distortion

Comparing Mechanisms

	Finances	Simplicity	Efficiency	Property Rights	Risk and Budgets	Share incentive	Collusion	Practical Issues
SC	Self-financing, asymptotically balanced	Straight-forward for sellers, implementable	Bilateral, asymptotic	Collective, asymp. strict collective, approx. individual	High	Yes	Moderate?	
BNC	Balanced budget	Implement-able	Bilateral, asymptotic	Strict collective, approximate individual	Low	Yes	Low?	Requires detailed knowledge of valuations
APC	Balanced budget	Approx. implementable with small sellers?	Bilateral, asymptotic	Same as BNC	Low	Yes	None?	
FPC	Balanced budget	Very complex, likely unimplementable	Bilateral, asymptotic	Same as BNC	Moderate	Yes	Very low?	
X-plurality (low X)	Budget balanced	Like SC	Too many sales	None	None	Yes	None	
X-pluarlity (mid X)	Budget balanced	Like SC	If percentile matches mean	X of shares, approximate individual if efficient	None	No	High?	
X-plurality (high X)	Budget balanced	Like SC	Holdout: no asymp. gains	Near-perfect individual	None	Yes	Very high?	

Recap

1. We introduced holdout as a market design problem
   - Achievable design goals
     - straightforwardness, bilateral efficiency, partial property rights
2. We proposed a class of solutions
   - Concordance principle and associated mechanisms

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   - Optimal X for X-plurality
   - Measuring losses to holdout
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   - Partial property rights
   - Limited, privately-known budgets (Pai and Vohra (2009))
3. Broader directions
   - Other Concordance mechanisms
   - Non-Concordance solutions, other PRs
   - Imperfect complements; competing groups
     1. Price theory analysis
     2. Mechanism design analysis
     3. Practical solutions/extensions

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- Holdout is a fundamental of complements design
  - not just a strategic problem
- To solve holdout, we must solve the basic problem(!)

Historical Holdout

The law [in preindustrial France] granted every owner of grazing rights a veto over the enclosure. Compensating the owners for their grazing rights—one solution suggested by that bit of economics known as the Coase theorem—was impractical. It would be difficult to specify what the grazing rights were worth, and each owner had reason to exaggerate their value. Each one, indeed, could hold out and threaten to block the enclosure in the hope of gaining a share of the farmers gains. The veto, in short, transformed the owners of grazing rights into monopolists and left the farmer at their mercy. The price he would need to pay for their consent could easily make artificial meadows a losing proposition. *(Hoffman (1988))*

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Historical Holdout

The law [in preindustrial France] granted every owner of grazing rights a veto over the enclosure. Compensating the owners for their grazing rights—one solution suggested by that bit of economics known as the Coase theorem—was impractical. It would be difficult to specify what the grazing rights were worth, and each owner had reason to exaggerate their value. Each one, indeed, could hold out and threaten to block the enclosure in the hope of gaining a share of the farmers gains. The veto, in short, transformed the owners of grazing rights into monopolists and left the farmer at their mercy. The price he would need to pay for their consent could easily make artificial meadows a losing proposition. (Hoffman (1988))

In England enclosures [...] had faced the hurdle of unanimity until private acts of Parliament let owners of four-fifths of the land override minority opposition. Common by the 1760s, the English procedure greatly reduced bargaining costs and facilitated both enclosure and more general improvements. (Hoffman (1988))

Property Rights

Theorem

Concordance mechanisms preserve collective and approximate individual PRs.

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Proof

- Sellers report $s_i V \implies$ sale $\iff o \geq R = \sum_i s_i V = V$
- If seller i reports $r_i = s_i o$ (indifference), then
  - Sale $\iff o \geq R_i = \frac{\sum_{j \neq i} r_j}{1 - s_i}$
  - Seller i receives at least $s_i R_i = s_i \frac{\sum_{j \neq i} v_j}{1 - s_i} = \frac{s_i (V - v_i)}{1 - s_i}$

Efficiency

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1. *There exists an $M > 0$ such that $ns_i^n < M$ for all n, i.*
2. $\left\{ \frac{v_i^n}{s_i^n} \right\}_{i=1}^{n}$ *are i.i.d. across n and i from some distribution with finite support and b is drawn i.i.d. across n.*

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Proof

- $E[V^n] = \mu$; $\mathrm{V}[V^n] < \frac{M^2\sigma^2}{n} \implies \mathrm{p}[V^n - \mu \geq \alpha] \leq \frac{M^2\sigma^2}{M^2\sigma^2 + n\alpha^2} \to 0$
- probability of sale $\operatorname{argmax}_q q(b - S_n(q)) \equiv \tilde{q}_n(b) \to 1$
- inefficiency $\int_\mu^\infty (1 - \tilde{q}_n(b))(b - \mu)h(b)\, db \to 0$
- analogous argument when $b < \mu$

Straightforward Concordance (SC)

Simplest approach: Vickrey-Clarke-Groves

1. If pivotal in sale decision, pay Pigouvian tax of $(1 - s_i)|R_i - o|$
2. Receive refund of

$$s_i \min_{\hat{r}_i} \sum_{j=1}^{N} \left(1_{(\hat{R}_j - o)(\hat{R} - o)} (1 - s_j)|o - \hat{R}_j| \right)$$

3. Rest follows from Concordance principle

Bayes-Nash Concordance (BNC)

Expected Externality

1. Pay tax of $(1 - s_i)E_{\mathbf{v}_{-i}}\left[|V_i - o|1_{(V_i-o)(V-o)<0} \mid v_i = r_i\right]$
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    1. Budget-balanced
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    3. Less risky for sellers; less collusive(?)

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- Not straightforward but implementable and
  1. Budget-balanced
  2. Strictly preserves collective property rights
  3. Less risky for sellers; less collusive(?)
- Violates Wilson doctrine(!)
- Incentive properties depend on risk preferences

All-pay Concordance (APC)

1. Pay tax of $|s_j o - r_j|$
2. Receive refund of

$$s_i \sum_{j \neq i} \frac{|s_j o - r_j|}{1 - s_j}$$

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- BNC $\sim$ pay $f(v_i - s_i o)$ with $f(0) = 0, f'(x)x > 0$
- Problem how to calculate f; could just plug in $|x|$

First-price Concordance (FPC)

1. Pay tax of $\max\left(0, [s_i o - r_i]\, 1_{\text{sale}}, [r_i - s_i o]\, 1_{\text{no sale}}\right)$
2. Receive refund of

$$s_i \sum_{j \neq i} \frac{\max\left([s_j o - r_j]\, 1_{\text{sale}}, [r_j - s_j o]\, 1_{\text{no sale}}\right)}{1 - s_j}$$

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- Once again...
  - Truthfulness not incentive compatible
  - Equilibrium behavior unclear
- Other possibilities: core-nearest, other package auction rules

Public Goods

Holdout problem $\sim$ Closely related to public goods

- Good benefits everyone
- Switch signs for binary, quasi-linear public goods
- Voluntary $\sim$ property rights; Lindahl pricing $\sim$ perfect shares
  - People pay "tax" based on approximation to their shares
  - Quantity provided determined by demand at true shares
- That literature never found general implementation—why?
  - Focus very general: income, shapes, heterogeneity
  - Not very "practical" because no focus on applications
  - Voluntary participation focus
  - Approximations only natural in special case

(Also equivalent to original Cournot collaboration)

Other Proposals for Solving Holdout

1. Weighted Majority Voting
   - Heller and Hills (2008)
   - Extreme: Shapiro and Pincus (2007)
2. Property Self-assessment
   - Bell and Parchomovsky (2007)
   - Plassmann and Tideman (2009)
3. Secret Purchases
   - Kelly (2006)
4. Graduated Density Zoning
   - Shoup (2008)

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