

Concordance among Holdouts

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Motivation

Holdout problems pervasive in the world

- Land assembly, corporate acquisitions, spectrum
- Everyone seems to agree can wreak havoc
- We estimate $\approx 10\%$ of global GDP NPV in DWL

Yet institutions for doing this primitive

- Takings, voting-based procedures, etc.
- Contrast with sophistication of design of auctions

Auction theory based on rich tradition of competition theory

- But holdout problem also goes back to Cournot
- Yet his insights have not been applied there
- And indicate that design is far more important here

Goal: draw on this rich tradition for pressing problem

- 1 Understanding and attention from unifying literatures
- 2 Build on Cournot's insight to propose class of solutions

Plan for the talk

- 1 Cournot's theory and the literature
- 2 Model
- 3 Our solution: the Concordance principle (after *concours*)
- 4 Applications: land assembly and more
- 5 Mechanisms
 - Straightforward Concordance
 - Bayes-Nash, All-pay and First-price Concordance
 - X-plurality
- 6 Public goods and collaboration
- 7 Directions for future research

Cournot's theorem and its critics

- Cournot: monopoly reduces production to raise price
- Competition gradually gives full efficiency
- Bergstrom (78)'s corollary: collaboration eliminates trade
 - Dual to competition: little impact on *quantity*
 - Free-rider (Samuelson 54), commons (Hardin 68)
- Quickly challenged
 - 1 Dupuit (1844): just regulate monopoly down to cost
 - 2 Bertrand (1883): one firm enough to hold to cost
 - 3 Lindahl (19): public goods efficiency with right shares
- Cracks in counterarguments
 - Samuelson (54): Lindahl prices require lots of information
 - Baron-Myerson (82): regulating means knowing cost

Mechanism design and Cournot's redemption

- Myerson-Satterthwaite (82): if sale is not certain
 - ⇒ Someone must determine price
 - Whoever does will Cournot distort allocation
 - ⇒ With both side uncertain distortion inevitable
- Vindicates Cournot in competition also
 - Double auction (Bertrand w uncertain costs)...
 - Converges gradually like Cournot competition
- Mailath-Postelwaite (90) extend to collaboration
 - Requiring consent of all + uncertainty+no subsidies
 - ⇒ Bargain eventually impossible
 - ⇒ Enough holdouts imply sale impossible
 - ⇒ Elimination of strategic incentives to holdout insufficient
 - Fundamental tension of efficiency and property rights:
 - Offer must pay all near max for any chance of sale

Market design and our contribution

- ⇒ Auctions fix themselves, holdout design crucial
- Yet huge literature on auctions, very little on holdout
 - Except abstract literature on public goods but...
 - All impractical, not applied for good reasons
 - Assume symmetric information, multiple equilibria etc
 - Bailey (94) has nice *reducio ad absurdum*
 - All potentially applicable ones way off
 - 1 Naïve VCG abrogates all property rights
 - 2 Those protecting property rights suffer holdout problem
 - Goal: Strike reasonable balance between efficiency, PRs
 - Totally open problem
 - Focus on holdout: special structure, PRs important
 - Main reason for our contribution

A model

Basic model (language of land assembly)

- Buyer has private information value b for *whole plot only*
 - Submits offer o , recommended $o^*(\cdot)$
- Seller i has private information value v_i for *her plot only*
 - Reports reserve value r_i , recommended $r^*(\cdot)$
- Each seller has expected share of total value s_i
 - Can be anything exogenous or from buyer
 - Better \implies better PRs
- A *mechanism* is transaction procedure
- A basic requirement for mechanism is *self-financing*
 - Never requires external subsidies
 - Very important to avoid fraud
 - More ambitious: budget balance

Criteria for judging mechanisms

- 1 *Straightforward*: simple strategy always best
- 2 *Fully efficient*: all gains from trade
- 3 *Bilaterally efficient*: as efficient as bilateral trade
 - Solves holdout, but not monopoly
- 4 *Asymptotically efficient*: efficiency as $N \rightarrow \infty$
 - Converts from collaboration to competition
- 5 *Individual property rights*: never have to sell below v_i
 - Investment incentives, legal/philosophical reasons
- 6 *Collective PR*: community never forced to sell below V
 - Maintain collective incentives(?), satisfy some legal norms
- 7 *Approximate individual PR*: never below $\frac{s_i(V-v_i)}{1-s_i}$
 - Maintain observable, subjectively valued investments(?)
- 8 *Share-incentive compatible*: buyer tells true shares

Defining the Concordance principle

- Cournot had many right intuition, so we follow him...
- Two part solution to collaboration
 - 1 Merge and divide revenues
 - 2 Internalize others' profits (Groves-Loeb 79)
- In honor of that, Concordance principle is analogous:
 - 1 Divide offer in pre-specified shares
 - 2 Pay Pigouvian tax for any externalities from influence
- More formally mechanism satisfies CP if
 - 1 Offer accepted when $o > R \equiv \sum_i r_i$
 - 2 $r_i = s_i o$ is no influence, o v. $R_i \equiv \frac{\sum_{j \neq i} r_j}{1 - s_i}$ determines sale
 - 3 Un-influential sellers pay no tax, get at least $s_i o$ on sale
 - 4 Influential sellers may pay tax to encourage truth
 - Sellers asked for truth, buyer for monopsonist-optimal offer

Properties of Concordance mechanisms

Theorem

CMs are bilaterally and asymptotically efficient.

- Use collective decision rule just like community
- If some independence, asymmetric information dissipates

Theorem

CMs protect collective and approximate individual PRs.

- Group can have everyone but one be indifferent
 - ⇒ Pay no taxes, group-efficient decision
- Each individual can exert no influence
 - ⇒ No taxes, at least share of at least R_i

Land assembly and corporate acquisitions

Two primary applications

1 Land assembly

- Problems arise often, reason for eminent domain/takings
 - Government assesses land values, pays compensation
 - Obvious incentives, set-up for understatement (corruption)
 - But relative valuations reasonable? Gives shares
- Global/historical role: England v. France, developing world
- Many of our notions match up naturally
 - Property rights, efficiency and public use, shares

2 Corporate acquisitions

- Values from downward-sloping investment demand
- To protect minority shareholders, buy from everyone
- Voting rules standard for deciding
- Collective property rights protect collective investments

Other applications and aggregate value

Many other applications

- Debt settlement
- Spectrum reassembly
- Patent pools
- Art collections
- Heller (08) has a whole book of examples

How much in total? Can only guess

- \$100's of billions land, trillions acquisitions/settlement
- 20% potential gains (10% mark-up w linear demand)
- Assume one-quarter lost to holdout (very conservative)
- Easily NPV of trillions of dollars lost to deadweight
- ≈ 10% of global annual GDP
- Compared to 1% estimate by Lucas (03) for *all* cycles
- Compared to other market design (auctions, matching...)

Straightforward Concordance (SC)

- Taxes are key part of CMs: otherwise not implementable
- Exactly how charged defines individual mechanisms
- Simplest is Vickrey-Clarke-Groves:
 - 1 Pay Pigouvian tax based on others' reports
 - 2 If pivotal to sale, pay $(1 - s_i)|R_i - o|$
 - 3 Receive refund of

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

- 4 Rest follows from Concordance principle

Uniqueness/optimality of SC

SC is

- 1 Straightforward for sellers: VCG proof
- 2 Self-financing: refund is set-up this way
- 3 Implementable: buyers recommended optimal offer

In fact unique/optimal in sense that

- Green-Laffont (77) extension
 - Any straightforward Concordance = SC w different refund
- Refund maximal w SF and no discrimination
 - Simple extension of Cavallo (2006)
- Still VCG has some problems
 - Imperfect balance and collusion (merger/de-merger)
 - Monetary payments, risk and individual budgets

Bayes-Nash Concordance (BNC)

- These go away if we can calculate externalities
- If expectations, just charge average externality but...
 - Violates Wilson doctrine, how to do in practice?
 - Incentive properties depend on risk preferences
- Bayes-Nash Concordance
 - 1 Pay tax $(1 - s_i) E_{\mathbf{v}_{-i}} [| V_i - o | 1_{(V_i - o)(V - o) < 0} | v_i = r_i]$
 - 2 Receive refund $s_i \sum_{j \neq i} E_{\mathbf{v}_{-j}} [| V_j - o | 1_{(V_j - o)(V - o) < 0} | v_j = r_j]$
 - 3 Otherwise just from Concordance principle
- Not straightforward but implementable and
 - 1 Budget-balanced
 - 2 Strict collective property rights
 - 3 Taxes independent so helps deter collusion(?)
 - 4 Taxes averaged so reduces risk, individual budget problems
- But how to make work in practice?

All-pay (APC) and First-price (FPC) Concordance

- BNC basically pay $f(v_i - s_i; o)$ with $f(0) = 0, f'(x)x > 0$
- Problem how to calculate f ; could just plug in $|x|$
- Equivalent to choose direction, put money on table
- Biggest pool wins: All-pay Concordance like auction
- Retains benefits of BNC over VCGC but...
 - Truthfulness not incentive compatible
 - What does equilibrium even look like?
 - Equivalent to truthfulness as with Revenue Equivalence?
- Similar approach: First-price Concordance
 - Pay surplus if desired outcome (like first-price auction)
 - Other possibility: core-nearest, other package auction rules
- While interesting, more research needed before attractive

X-plurality

- Another basic idea: voting on sale (given shares)
 - 1 Sale occurs iff $\geq X$ of shares favor sale and above min
 - 2 If sale, receive shares of offer; no other money
 - 3 Buyer offers monopsonist-optimal against minimum winning
- Everything proposed or used before special case
 - $X = 0$ is eminent domain: pay market value (minimum)
 - X midrange: corporate acquisitions, Heller-Hills (08)
 - X high: decentralized bargaining, Shapiro-Pincus (07)
- Simple, balanced, straightforward, no extra money/risk
- Protects X percent of property rights
- Large population + X -quantile = mean: like Concordance
 - But hard to hit, generally unclear; failure hits both
- 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	Implementable	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 -plurality (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?	

Public goods

Closely related to public goods

- Good benefits everyone
- Switch signs for binary, quasi-linear public goods
- Voluntary=property rights, Lindahl pricing=perfect shares
- Bergstrom (79)'s *pseudo-Lindahl* equilibrium like ours
 - People pay based on approximation to their shares
 - Quantity determined by demand at true shares
- That literature never found general implementation; why?
 - Focus on very general: income, shapes, heterogeneity
 - Not very "practical" because no focus on applications
 - Voluntary participation not as strong focus
 - Approximations to it only natural in special case
- Lucky for us: gave opening for our contribution

Collaboration

Also equivalent to original Cournot collaboration (constant MC)

- Firms earn $Q(P)(p_i - c_i) - t_i$
- Key difference: sellers in driver's seat now
- Natural version of VCGC here
 - 1 Agree on (measure) demand, shares
 - 2 Each submit cost c_i ; charge monopoly optimal $P^*(C)$
 - 3 Receive revenue share, pay $(1 - s_i) ([P^*(C_i) - C_i] Q[P^*(C_i)] - [P^*(C) - C_i] Q[P^*(C)])$
 - 4 Receive refund
- Analogous properties, but no asymptotic efficiency
 - Property rights become bankruptcy-proofness
- Other mechanisms natural extension
- Public goods with $v_i f(e)$, concave f structure
 - No influence: $v = s_i e$ for general case?

Our plans moving forward

Our paper makes two contributions

- 1 Brings holdout to attention of market design
- 2 First stab at solving the problem

Things we are planning on doing

- 1 For final draft
 - Manipulation: shills, mergers, coalitions of losers
 - Core-nearest Concordance (thanks to Bulow)
- 2 Beyond this paper
 - Better refund and analysis thereof
 - APC/FPC analysis (simulation, analytics)
 - Experiments for explanation, APC/FPC behavior
 - Work with FCC on possible implementation
 - Legal/philosophical/economic foundations of approx. PRs
 - Opened on eminent domain

Directions for future research

1 Analytic extensions

- Implementing BNC
- Optimal X for X -plurality
- Measuring losses to holdout

2 Improving the mechanisms

- Partial property rights
- Limited, privately-known budgets (Pai-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