

Auctions: theoretical background and empirical applications in Natural resources

Main outline:

- (1) Some relevant auction theory (background)
- (2) Application and examples

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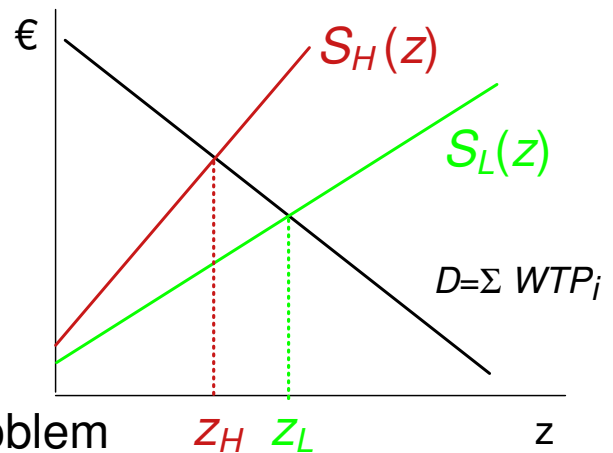
Motivation and background (1)

- High level of conflict in many resource conflicts
 - ▶ Kaldor-Hicks central in promoting efficiency
 - ▶ ... but efficiency gains not sufficient if some involved/affected party feels unjustly treated
- How to identify the necessary level of compensation to keep parties happy?
 - ▶ projects that meet the benefit-cost test should contain room for "making at least one person better off without making anyone else worse off"
 - ▶ auctions - correctly designed for the problem at hand = a possible solution:
 - ▶ nobody bids to become worse off

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... motivation and background (2)

- Low cost important
- Identifying least cost compensation needed for voluntary **supply** of land for conservation purposes \Rightarrow auctions



- ▶ "classical" matching problem

- Legitimacy (taxpayers' money =: truth-telling)
- "Bonus": auction methods on the demand side: making contingent valuation more believable

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... motivation and background (3)

- Auctions: usually sellers seeking to identify buyers to get the most for what they sell
- Reverse (procurement) auctions
(= buyer seeks to identify least cost provider)
 - ▶ f.ex. bids for building roads, bridges etc.
- This presentation: mostly frame issues in the reverse format (supply of env. services from private lands), but concepts applicable for wider set of issues (like nonmarket valuation)

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Multiple unit auctions (1)

- Only sealed bid formats of interest
 - ▶ open bid formats too prone to strategic bidding
- Multiple units/contracts auctioned ⇒
 - ▶ revenue equivalence not expected to hold
 - ▶ ... but auction organizers still interested in revenue properties
- Strategic bidding more likely to occur:
 - ▶ first price auctions: discriminatory price (each bidder pays/gets according to his/her bid)
 - ▶ N-price auctions: uniform price (all winners pay/receive the same price, Nth price)

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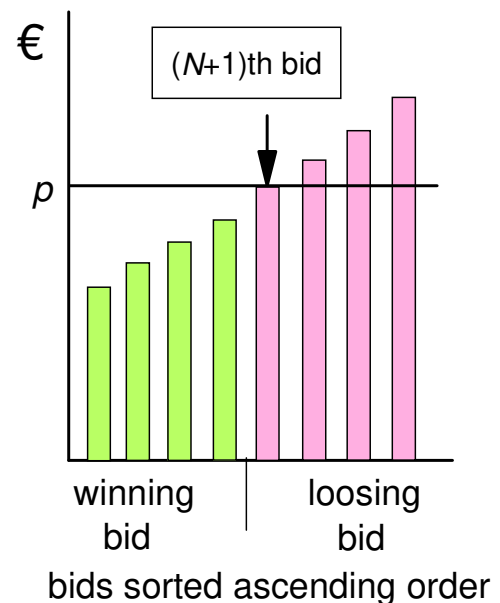
... multiple unit auctions (2)

- Multiple units sold
 - ▶ seller wants to collect maximum revenues for the items sold
- Procurement auctions = buying multiple units
 - ▶ multiple contracts for supplying a good/service to be awarded to the lowest bidders
 - ▶ = get the least costly overall supply of the N units
- Additional public policy objective
 - ▶ truth-telling desirable property ... but it costs
 - ▶ decision rule: $E(\text{benefits truth}) \geq E(\text{costs truth})$

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Uniform price auctions - a primer (1)

- How it works: individual bids b_i
 - ▶ (for now) assume $b_i = c_i$
 - ▶ price determined by the $N+1$ bid
- $b_i \leq p \Rightarrow$ gets contract for p = "trade" occurs
 - ▶ rent for producer i : $p - b_i$
- $b_i > p \Rightarrow$ no "trade"
 - ▶ no change in rents for producer i



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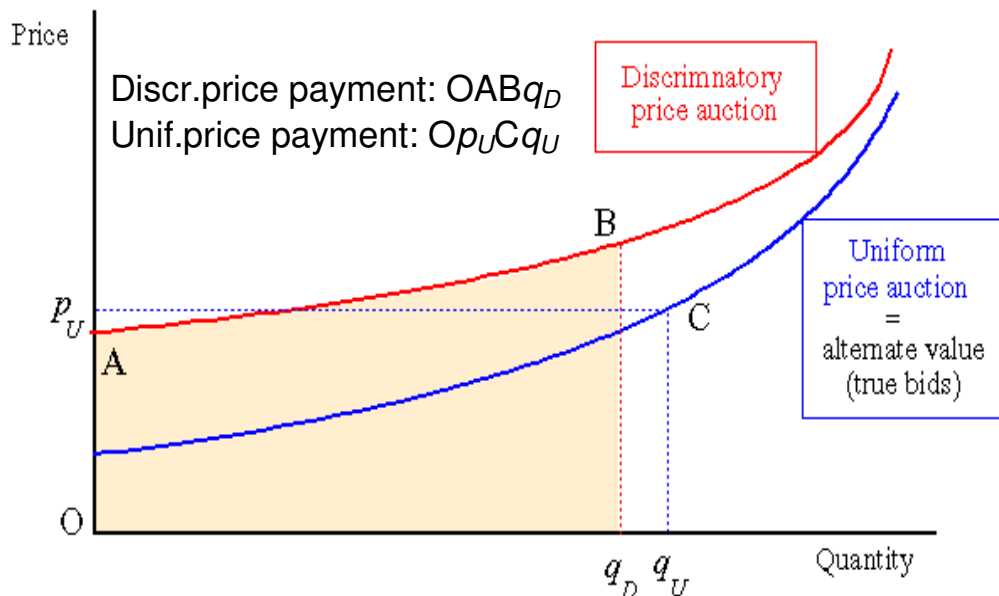
... uniform price auctions ... (2)

- Provide true bid:
 - ▶ $b_t \leq p \Rightarrow$ welfare improving "trade": $\Delta \pi > 0$
 - ▶ $b_t > p \Rightarrow$ no "trade" (best outcome): $\Delta \pi = 0$
- Provide false bid:
 - ▶ $b_f \leq p < b_t \Rightarrow$ welfare decreasing "trade": $\Delta \pi < 0$
 - ▶ $b_f > p \geq b_t \Rightarrow$ no "trade" (sub-optimal): $\Delta \pi = 0$ when welfare improving "trade" could have occurred
- Weakly dominant strategy to bid truthfully
 - ▶ parallels to BDM (but price is set endogenously)

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... uniform price auctions ... (3)

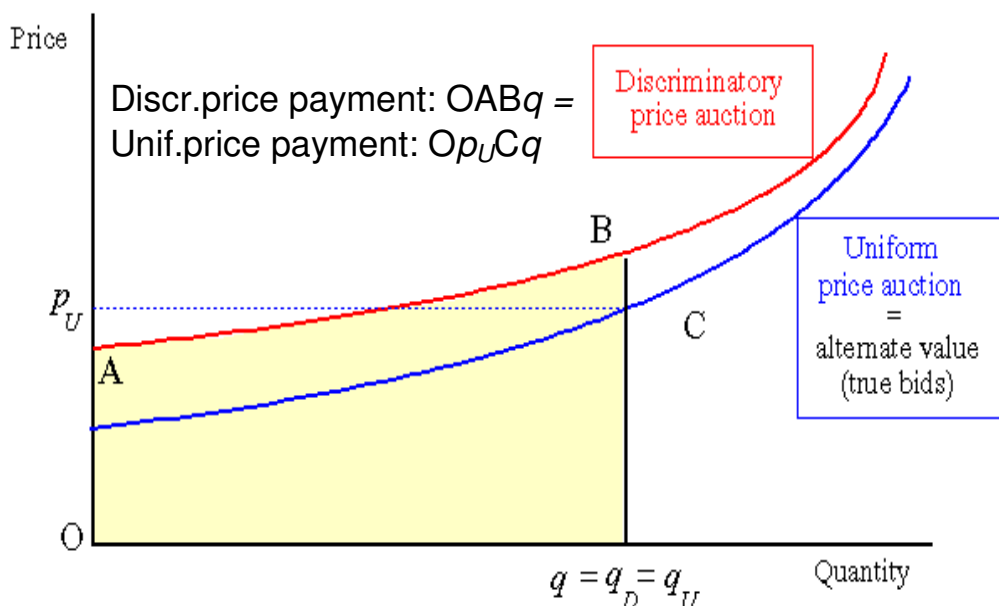
- Revenue - truthtelling tradeoff
case 1: agency is revenue constrained



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... uniform price auctions ... (4)

- Revenue - truthtelling tradeoff
case 2: agency has quantity target



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Discriminatory or uniform price?

- Multi unit/contract procurement auctions:
 - ▶ experimental evidence:
payments(uniform) > payments(discriminatory)
 - ▶ public funds scarce \Rightarrow most favor discriminatory auctions
- ... but with uniform price auctions:
 - ▶ truth-telling rents conceded are known
- ... and uniform (same) prices to all suppliers
 - ▶ appeal to fairness (all paid the same for providing the good)
 - ▶ familiarity with markets

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Possible trouble areas (1)

- Repeated auctions
 - ▶ learning (price on last round anchors bids, observed in discriminatory price auctions)
 - ▶ only one auction + offer uniform payment that is lower than auction price (to preserve incentives to participate in auction)
- What to auction
 - ▶ careful description of contract terms
(= what is included, what are requirements)
 - ▶ for how long (eternity or limited time horizon?)
 - ▶ if for limited time, what happens at renewal time?

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... possible trouble areas (2)

- New info. \Rightarrow new attributes \Rightarrow new auctions
What to do with habitats already contracted?
 - ▶ Under discriminatory price auction: strategic bids
 - ▶ Under uniform price auction:
 - \rightarrow no additional management needed \Rightarrow bid = 0
 - \rightarrow supplier still guaranteed rent unless $N+1$ bid = 0
- ... but what is the value added?
 - ▶ legitimacy of payments when no effort included?
Additionality issues!
- Spatial coordination
 - ▶ agglomeration bonuses or "centralized" planning?

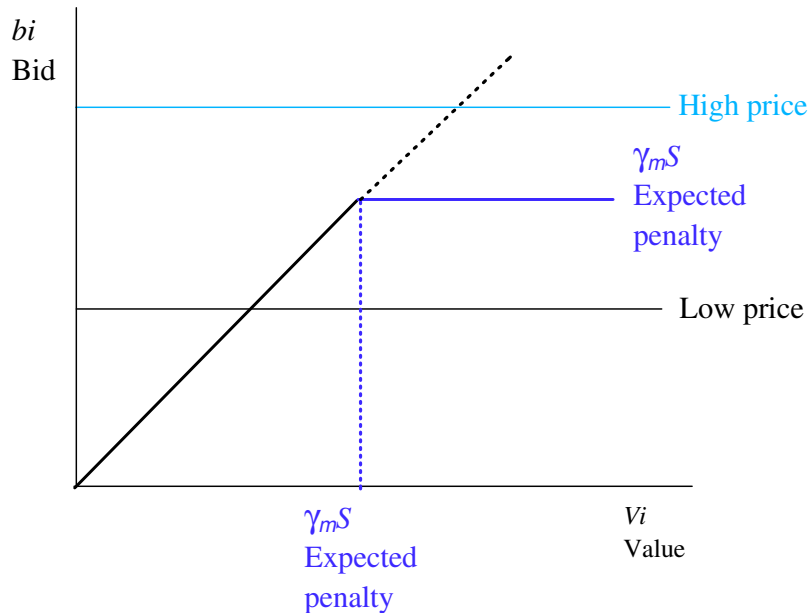
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Bidding and compliance behavior (1)

- Bidding and compliance strategies
 - ▶ Low value relative to the expected punishment:
bid: weakly dominant strategy to bid true value, v_i
compliance: always comply
 - ▶ High value relative to expected punishment:
weakly dominant strategy to bid the expected penalty, $\gamma_m S$,
which in this case is less than the true value, v_i
if one gets the contract ($= \gamma_m S < p^A$) \Rightarrow never comply
- Gives a "kinked" bid curve and dubious compliance behavior for the high end bids

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... bidding and compliance (2)



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Auctions - a quick summary

- Multi unit (contract) auctions
- Focus: truthtelling = uniform price auctions
 - ▶ ... and it costs
 - ▶ ... but information rents given away known
- Discriminatory auctions may cost less, but
 - ▶ no way of telling size of strategic bias without conducting comparative study with truthtelling
- Young and growing area

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Applications - a brief summary (1)

- Australian Bush tender scheme (Stoneham *et al.* 2003)
 - ▶ discriminatory price auction
 - ▶ large initial cost savings over fixed rate payments
 - ▶ ... that have diminished over time as landowners have become more familiar with the auction mechanism
- US conservation reserve program
 - ▶ some use of auctions, promising results
- FAO "Roles of agriculture" project
 - ▶ PES applications w/ auctions, promising results

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... applications - brief summary (2)

- Australian development offset scheme - a double auction scheme (Stoneham and Plott, in progress)
 - ▶ developers can develop an area if they can secure area of similar or higher biodiv. characteristics
 - ▶ developers and landowner enters reservation bids
 - ▶ market mimicked to match landowner supply and developer demands
- Auctions and the environment
 - ▶ many new applications expected

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Two of my own applications

- Auctioning biodiversity management contracts with Steve Polasky
- Multiunit auctions used in contingent valuation at the infantile (pre-natal?) stage

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(1) Auctioning biodiv.contracts

- Setting:
 - ▶ in addition to having better information on the costs of management restrictions, landowners have better prior information than the regulator on conservation benefits on their own land
- Participation fee \Rightarrow low provision cost landown.
 - ▶ with more reliable information about the presence of preservation worthy habitats bid, while the others choose not to participate

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How it works

- N-price auction format makes it weakly dominant strategy to enter bid equal to true opportunity costs, i.e., $x_i = C_i$
- Landowners with a more reliable signal (stronger prior belief) on a habitat being preservation worthy (= passes the survey) will have a smaller "markup"
 - ▶ indifference price: $Y_i = C_i + w/\alpha_i$
 - ▶ all other things equal, more of landowners with reliable prior beliefs will enter the auction

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Results

- Matches plots with high preservation value and low costs
 - ▶ the survey fee drives out bidders with uncertain beliefs by creating a higher markup: w/α_i
 - ▶ reduces sites that needs to be monitored
 - ▶ assigns plots to low cost providers
- Not manipulation free, but manipulation unlikely
 - ▶ successful manipulation requires massive info. on behalf of manipulative agent
 - ▶ collusive manipulation (local commons, Seabright JEP 1993) - among the things we are looking into

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(2) Auctions and nonmarket valuation

- Motivation: stated preference (CV) nonmarket valuation methods questioned because of "weak link" to the budget constraint
- Idea: make this link stronger through a uniform price auction mechanism where the cutoff is the median voter
- A modified BDM where the cutoff price is set at the median voter
 - ▶ benefit: endogenous setting of the price
 - ▶ anchors to a policy likely to pass a referendum

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Basic idea (1)

- Uniform price multi unit auctions
 - ▶ agents respond to an open question: "what is your WTP to pay for"
 - ▶ payment equals the N+1 highest bid that here is decided by the median bid (= the bid that would pass in a referendum)
- Works (= truthful revelation of WTP) because:
 - ▶ nobody knows *ex ante* the size of the median bid
 - ▶ weakly dominant strategy to provide true WTP because indicated WTP may fall above or below the median bid
 - ▶ ... it "works" like dichotomous choice

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... basic idea (2)

- The Nth (median) bid is revealed when the "auction" has been completed:
 - ▶ Nth ranked bid = the 50th percentile ranked bid
 - ▶ (N+1)th ranked bid = next (lowest) bid < median bid
- Under no uncertainty or "errors" when respondents state their WTP, N+1 ranked bid will pass a referendum
- What is achieved: truthful revelation of WTP and "secured" public support for the policy proposal
 - ▶ contingency: $N \times WTP_{N+1} \geq \text{cost of policy}$

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Truthful revelation

- Closed ended formats truthfully reveal WTP: weakly dominant strategy to respond
 - ▶ **YES** if individual WTP \geq posted bid
 - ▶ **NO** if individual WTP < posted bid
- Driving force for truthful revelation of WTP
 - ▶ no connection : response and expected payment
 - ▶ ... because if bids and payments were connected, agents would start "playing games" ...
- Other truthful revealing mechanisms
 - ▶ Groves-Ledyard (but difficult to implement in practice) and multiple (Nash) equilibria a concern

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Political economy considerations

- Anchors to median voter theorem
 - ▶ consistency valuation question and policy:
N persons bid above the median voter bid \Rightarrow proposal should pass a similar referendum
 - ▶ easy to calculate confidence intervals of median bid (to capture uncertainty)
- Transparency:
 - ▶ revenues from those in favor ($b_i \geq p$) = $N \times p$
 - ▶ "direct" check if revenues $>$ (needed) costs to implement project
 - ▶ budget constraint and welfare linked in a probabilistic manner

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Estimation issues

- Observed bids (open ended) can be estimated by OLS
 - ▶ requires smaller sample sizes than dichotomous choice (logit or probit estimation) for getting stable parameter estimates
- Other estimation benefits
 - ▶ easy welfare change calculations
 - ▶ compared to closed ended/dichotomous choice:
 - "anchoring effects" less of an issue
 - no need to *prior identify* choke price

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Auctions-valuation: Quo vadis?

- Advantages:
 - ▶ transparent on linkage: "revenues collected must exceed costs of project" for implementation:
individual budget introduced in a probabilistic way
 - ▶ incentives for truthful revelation OK
 - ▶ improved econometric properties compared to other truthful revealing stated pref. approaches
- Potential caveats: the limited experiences using Vickrey style auctions in practice
 - ▶ suggests that respondents may have some difficulties understanding the mechanism
 - ▶ practical use a result of the above concern?
(must train respondents how auction works)

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Auctions - summary

- Multi unit (contract) auctions
- Focus: truthtelling = uniform price auctions
 - ▶ ... and it costs
 - ▶ ... but information rents given away known
 - ▶ Morale: incentive compatibility costs (RAMs)
- Discriminatory auctions may cost less, but
 - ▶ truthtelling not guaranteed

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