Price guarantee and subsidy in windfarm auctions

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Wind power

- Worldwide challenge ahead: renewable-energy transition
- Wind power is an important renewable-energy technology
- Governments worldwide have opened locations for wind farms
- Aims: Promoting wind energy, efficiency, transparency, revenue
- Tool: Auctions (globally, 2.17 GW in Q2 2020)
  - US: cash auction (ascending clock)
  - UK: contract for difference auction, royalty+cash auction (pay-as-bid)
  - Germany: strike price auction (pay-as-bid)

How to auction wind farm licenses?

Auction design problem

- Selecting the most cost-efficient electricity producer
- Inducing the winning electricity producer to build and maintain the windfarm

Policy instruments

- Price guarantee
- Price subsidy

Method

- Lab experiment

Our setting mimics real-life features of wind-farm auctions

- Uncertain electricity price in the future, which implies uncertain revenue for bidders
- The winner invests before knowing the electricity price
- Bidders face a common uncertainty about how costly it is to build the windfarm
- Bidders differ in production efficiency
- Bidders are protected by limited liability

Our setting

- n bidders
- First-price sealed-bid auction (pay-as-bid)
- Bidder i's payoffs when winning: $pq_i - \frac{(q_i)^2}{2\gamma_i} - X$
- Fixed costs $X = \frac{1}{n}\sum_{i=1}^{n} x_i$
    - x_i: bidder i's private signal about the fixed costs
    - $x_i \sim U[0,300]$ i.i.d.
- Productivity γ_i private information
    - $\gamma_i \sim U[6,10]$ i.i.d.
- Electricity price $p \sim U[10,20]$

Experimental design

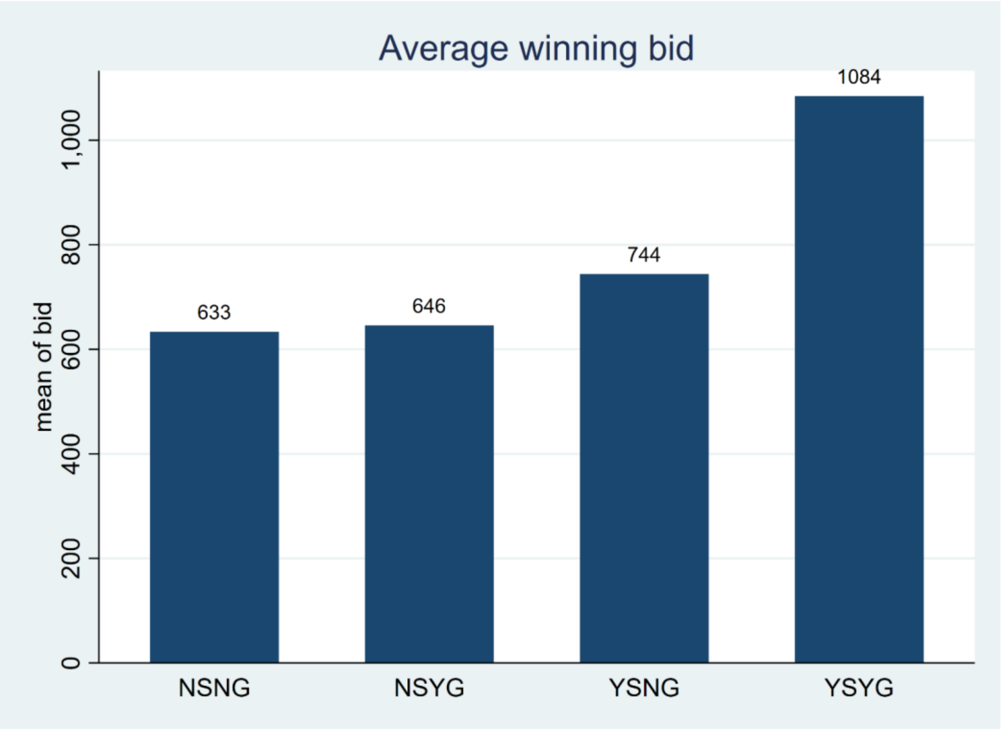
	No price guarantee	Price guarantee
No subsidy	$p \sim U[10,20]$	$\bar{p} = 15$
Subsidy	$p + s \sim U[13,23]$	$\bar{p} + s = 18$

- Between subjects
- Fixed groups, $n = 3$, 16 groups per treatment (4x16x3=192 participants)
- 25 rounds
- Subjects start with an endowment €12
- Bidder's payoff = max {endowment + earnings over 5 random rounds, €4}

Hypotheses (based on risk averse bidders)

- The government's expected payoff: $G = E\{\lambda q + b^{(1)} - sq\}$
- Subsidy: $s = 3, \lambda = 7$
- H1: G is greater with subsidy than without
- H2: G is greater with price guarantee than without

First glance at the data



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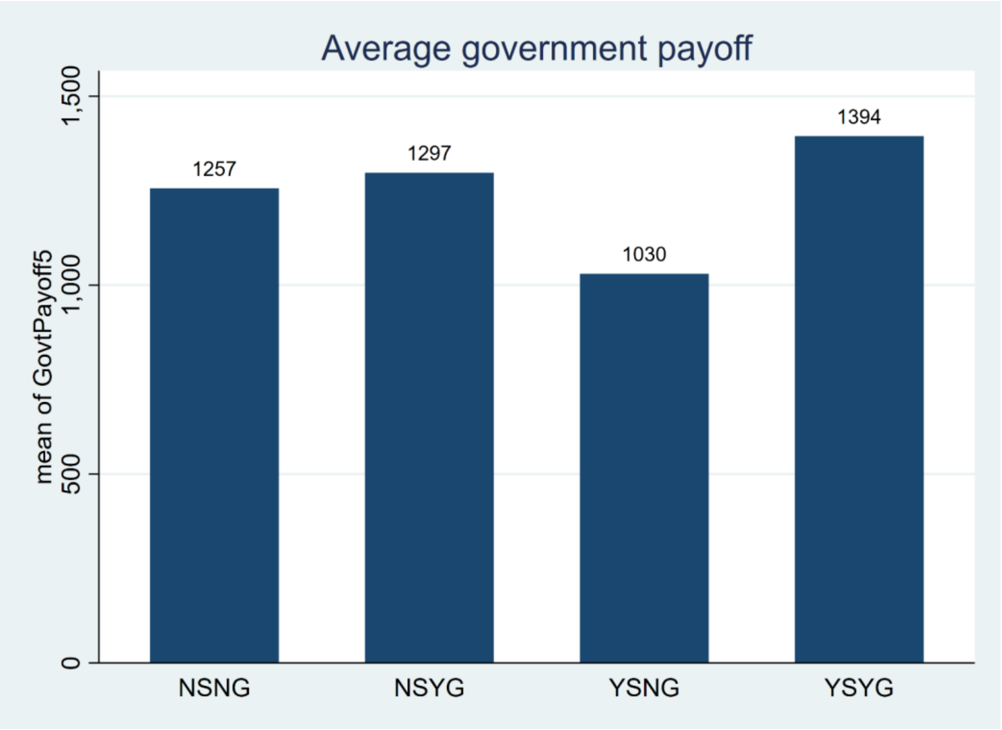

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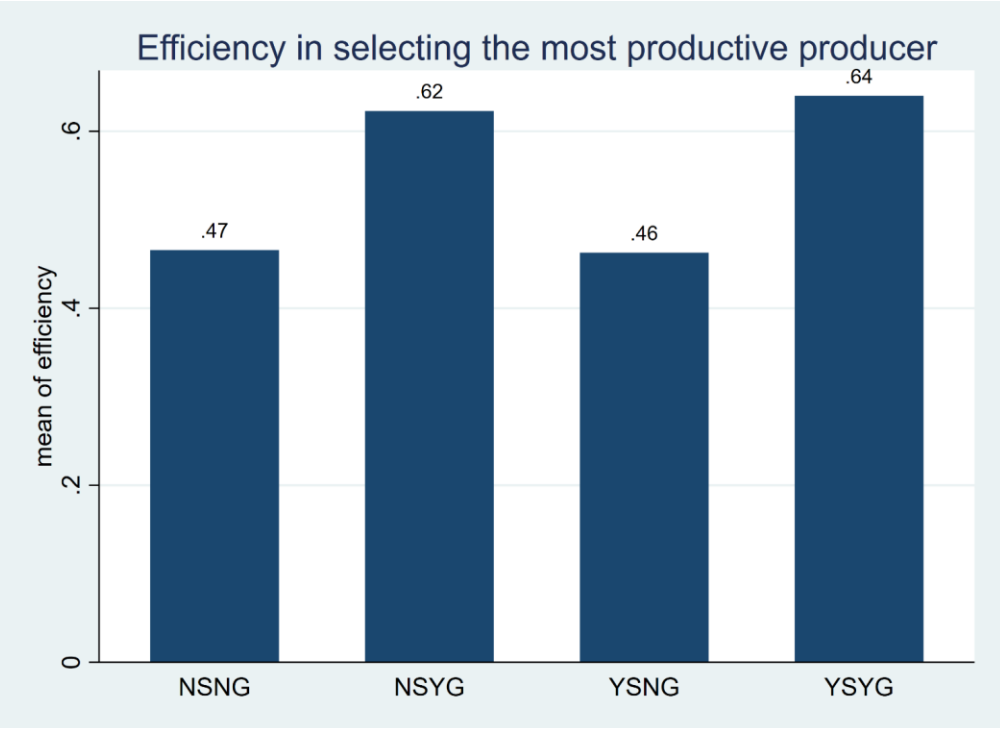

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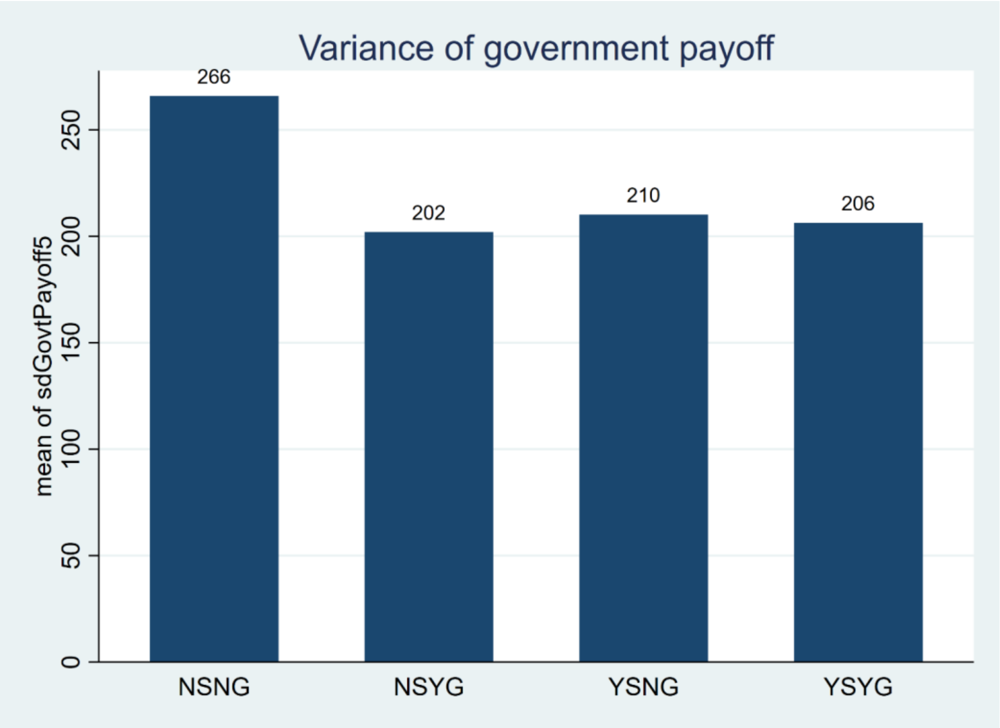

Conclusion (preliminary)

- **Government payoff** greater with **price guarantee**
  - The price guarantee boosts efficiency
  - The price guarantee boosts bids
- **Government payoff** only greater with **subsidy** in the case of a price guarantee
- The price guarantee and the subsidy combined dampen **government payoff volatility**
- The auction + price guarantee + subsidy is easy to implement and may revolutionize the way in which windfarm locations are allocated