Silvester van Koten & Bert Willems. Auctions for Renewables and Default: The Problem of Unfulfilled Contracts

Abstract

- Presentation

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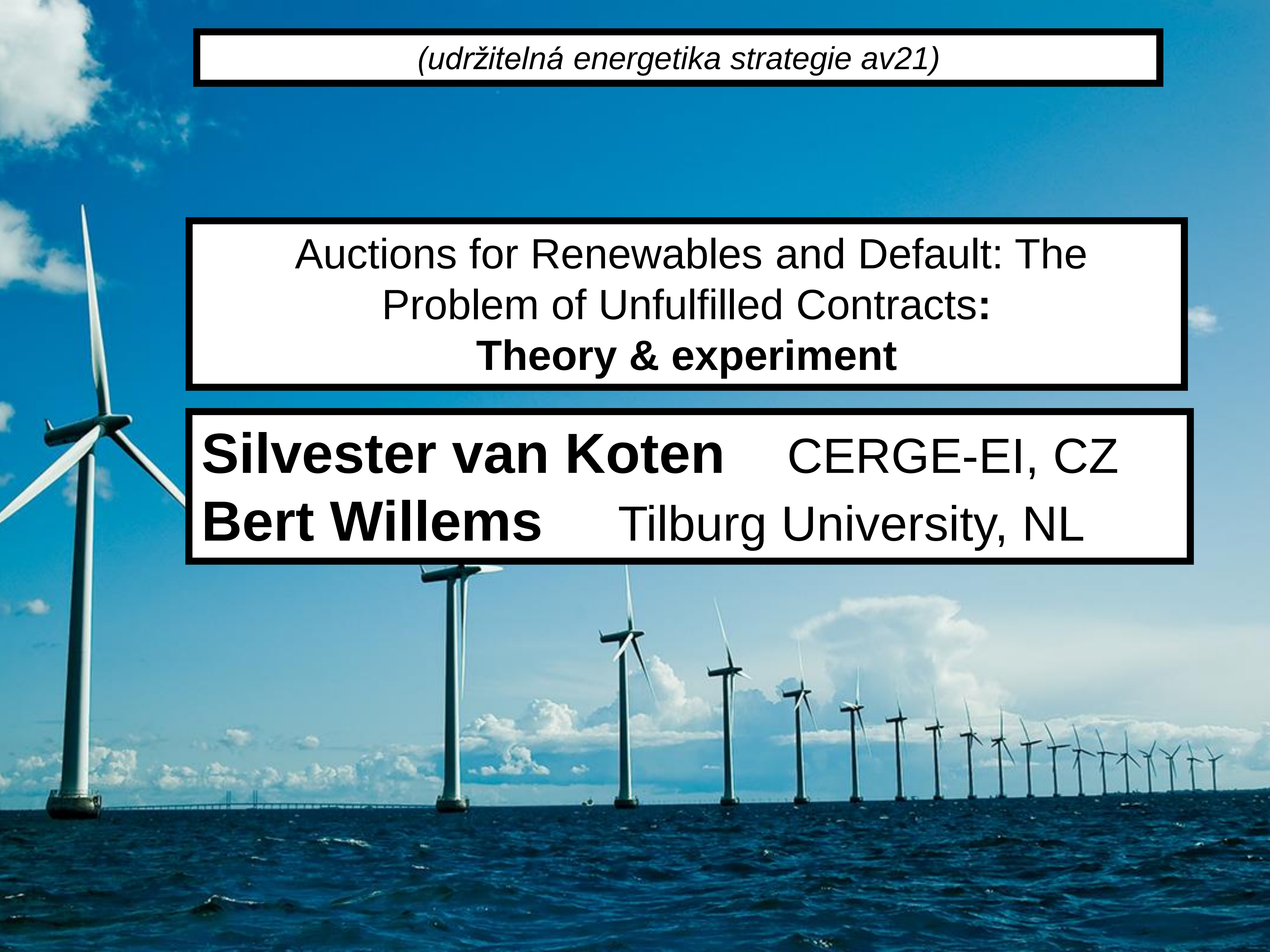
Support for renewable power plants is increasingly allocated with market-based methodologies using procurement auctions. While auctions are known to have attractive efficiency properties, experience shows that they have a significant drawback: Many renewable projects awarded in the auction are not implemented and realized. The winning bidders default on their project. The literature suggests that bidders may be overly optimistic about their future abilities and costs.

In this paper, we use theory, numerical simulations, and economics experiments to analyze and compare the performance of procurement auctions for support for renewable power plants. We specifically study two measures proposed for regulators/auctioneers to improve the performance of such procurement auctions, Financial Pre-Qualification (FPQs) and Physic Pre-Qualification (PPQs). Both measures require auction participants to commit before the start of the auction. For the FPQ, the commitment takes the form of a financial bond that is returned when the project is implemented or when the bidder loses the auction. For the PPQ, the commitment takes the form of making a pre-investment by implementing a part of the project before the auction. The latter method is presently used for onshore wind auctions in Germany.

Our theoretical and numerical analyses show that, without measures, incentives support a strategy based on overly optimistic bidding followed by a possible default. In addition, we show that it does not matter if expected ex-post cost shocks (after the auction) are positive or negative: Both identically increase the risk of default. Our analyses further indicate that of the two measures investigated, the FPQ is vastly superior to the PPQ. The experimental part of our research is in development.



(udržitelná energetika strategie av21)

Auctions for Renewables and Default: The Problem of Unfulfilled Contracts: **Theory & experiment**

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Procurement auctions

Problems:

- Bidders win contracts, but do not realize them
  - Pay fine or go bankrupt
    - (Del Río 2017; Del Río and Linares 2014; Matthäus 2020)
- They see the contract as an option
- Why especially renewable power projects?
  - Implementing the contract takes years
  - In the meantime the costs of construction change
    - Cost shock after the conclusion of the auction
    - Cost shock can be cost-increasing or cost decreasing!

Procurement auctions

What to do?

- Use Pre-Qualification
  - Financial (FPQ)
    - Bidder must deposit funds with the auctioneer
      - Proportion δ of total cost
    - Funds are returned conditional on delivery or losing auction
    - Basically a penalty
  - Physical (PPQ)
    - Bidder must build part of the project
      - Representing proportion δ of total cost
      - These are mostly sunk costs (not returned)
    - Have value only if win auction and deliver
      - Remaining costs for delivery are now less by δ
      - Non-delivery means lose sunk cost

Procurement auctions

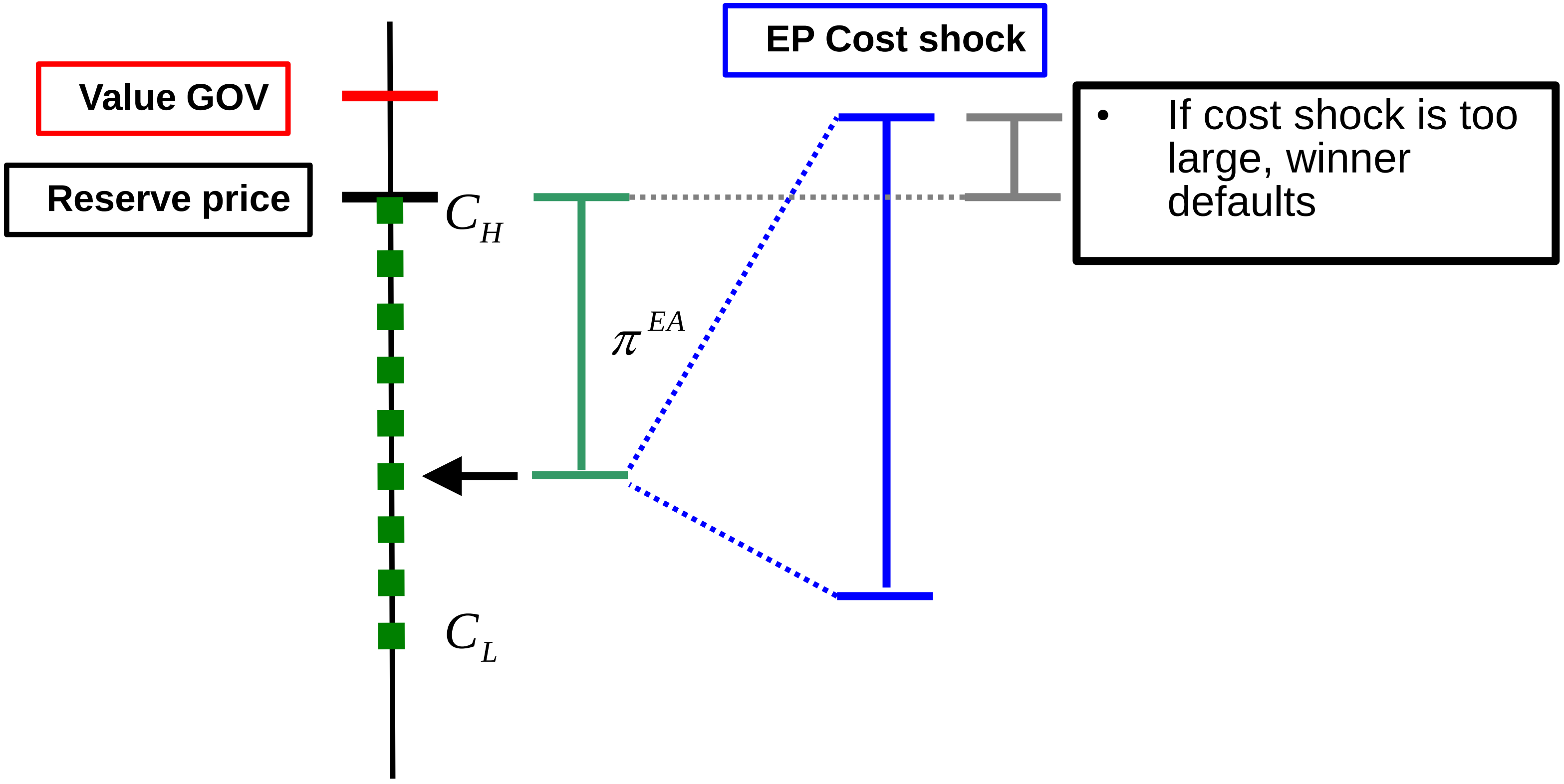
- FPQ
  - Makes total sense
  - Like penalties on non-performance

- PPQ
  - Notice: all bidders that enter the auction pay δ
  - Is like an **auction with entry cost**!
  - Sounds like nonsense
  - Why study it at all?
  - Used in Germany, proposed in other countries

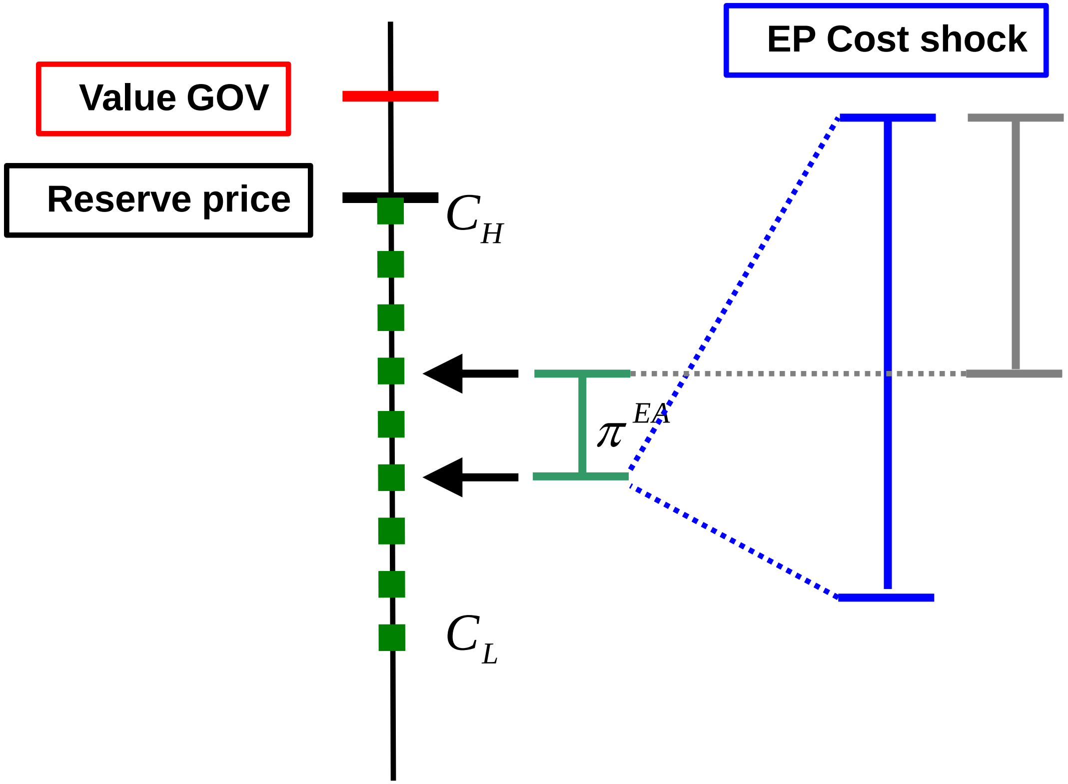
- Analyzing the problem.
- Model with private costs and a **common** shock
  - 1 contract,
  - bidders with different costs (private costs)
  - A common cost shock
  - default possible

- Common costs makes “bidders curse” possible

1 bidders enters



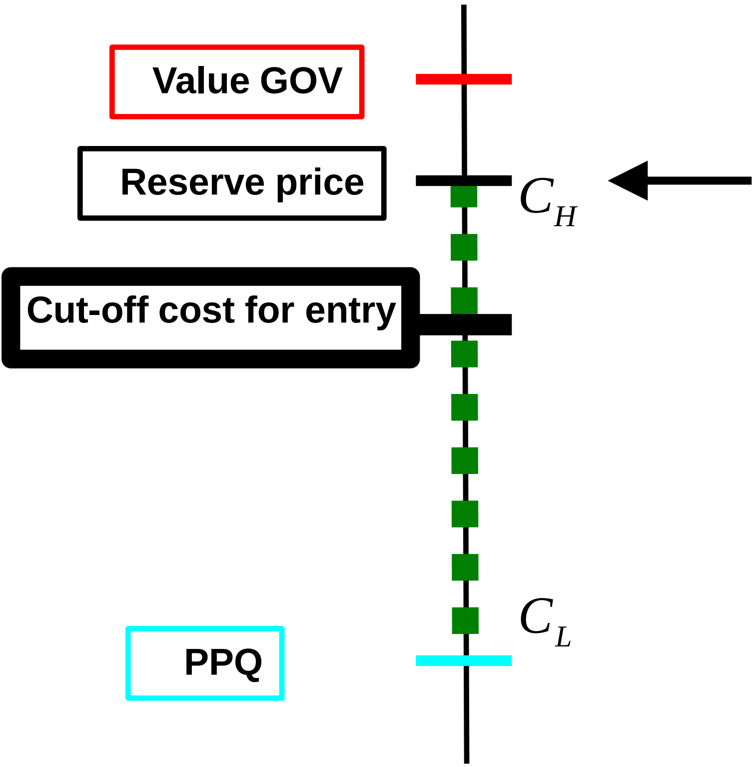
>2 bidders enters



- Small cost shock may lead to default

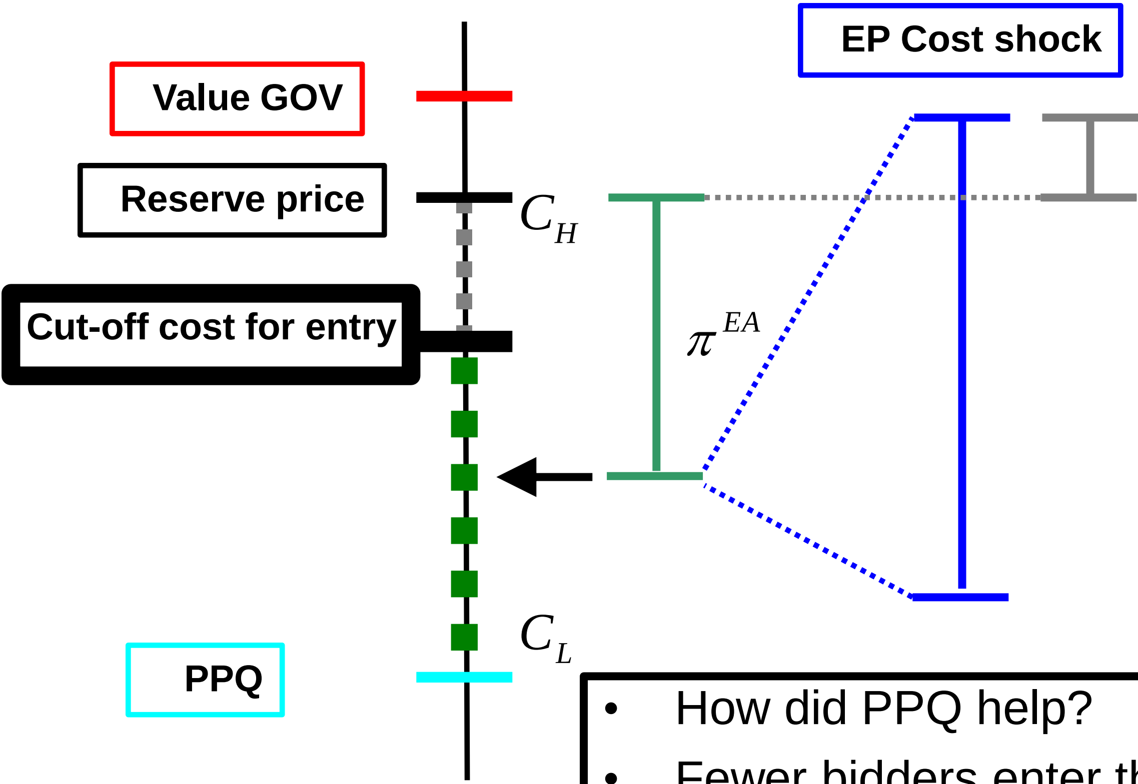
- Analyzing PPQ
  - Selling 1 contract
  - Many bidders with different costs
  - Must invest before entering auction

PPQ



- If enters,
  - Wins with Pr=0
  - Thus Eπ=-δ
- Thus does not enter!

PPQ - 1 bidders enters



- If cost shock is too large, winner wont realize the project!

- How did PPQ help?
- Fewer bidders enter thanks to cut-off cost
- Expected price for bidders is now higher
  - Chance on being the only bidder higher
  - Difference between lowest and 2nd lowest bid higher
- Bidders basically “randomize” hoping to be the only one
- **This explains under subscription outcomes in the German auctions!**

PPQ

- Analyze the profit of a bidder winning the auction and receiving price P

$$
\begin{aligned}
U_{win} &= E_\xi \{\max(P - C - \xi, -\delta)\} \\
&= E\{\max(P - C + \delta - \xi, 0)\} - \delta \\
&= \int_{\xi_L}^{P-C+c} (P - C + \delta - \xi) dG(\xi) - \delta
\end{aligned}
$$

Analyze optimal bidding

$$b \leq C - \delta$$

PPQ

- Analyze the utility of the auctioneer
  - Utility of the project minus the payment

$$U = \sum_{n=1}^{N_{tot}-1} \underbrace{Q_{n+1} \cdot U_{n+1}}_{A} + \underbrace{Q_1 U_1}_{B}$$

$$U_{n+1} = \int_{\underline{C}}^{C_E} \left[\int_{C}^{C_E} \frac{n+1}{p} (V + \delta - \hat{C}) G(\hat{C} - C) J_n'(\hat{C}) d\hat{C} \right] dF(C)$$

$$U_1 = (V - B) \cdot \int_{\underline{C}}^{C_E} G(B - C + \delta) dF(C | C < C_E)$$

$$Q_{n+1} = \binom{N_{tot}}{n+1} p^{n+1} (1-p)^{N_{tot}-n-1}$$

FPQ

- Parlane 2003 for SPA:

$$u[P,C] = E_{\bar{s}}\left[\max[-\delta^{FPQ}, P-(C+s)]\right]$$

$$u\left[P[C], C\right] = 0$$

- Continuing the analysis, we find:

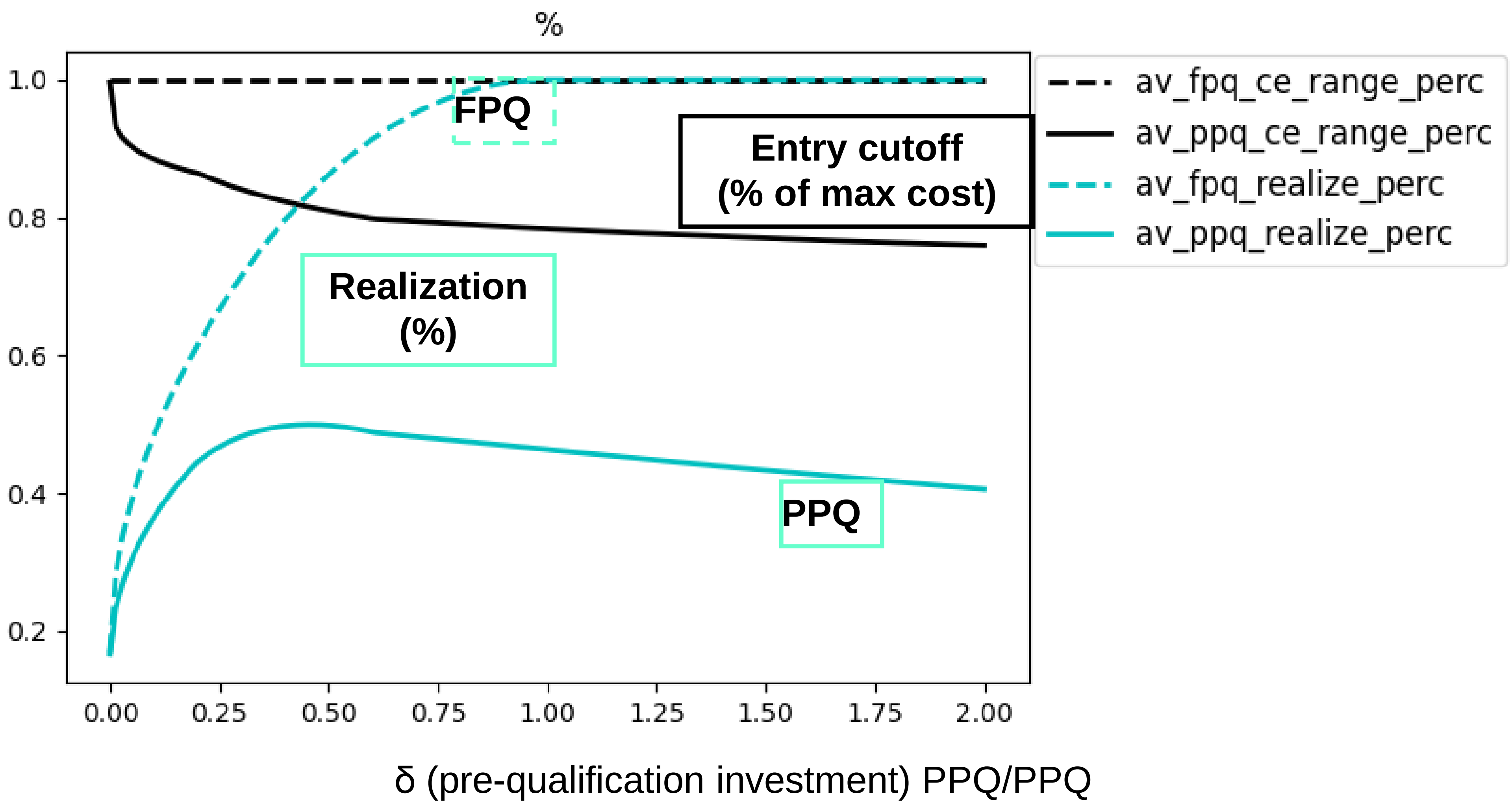
$$P[C] = \{P : \int_{\xi_L}^{P-C+\delta} G[\xi]d\xi = \delta\}$$

- Further solving:

Theorem 1. *The solution is then given by:*

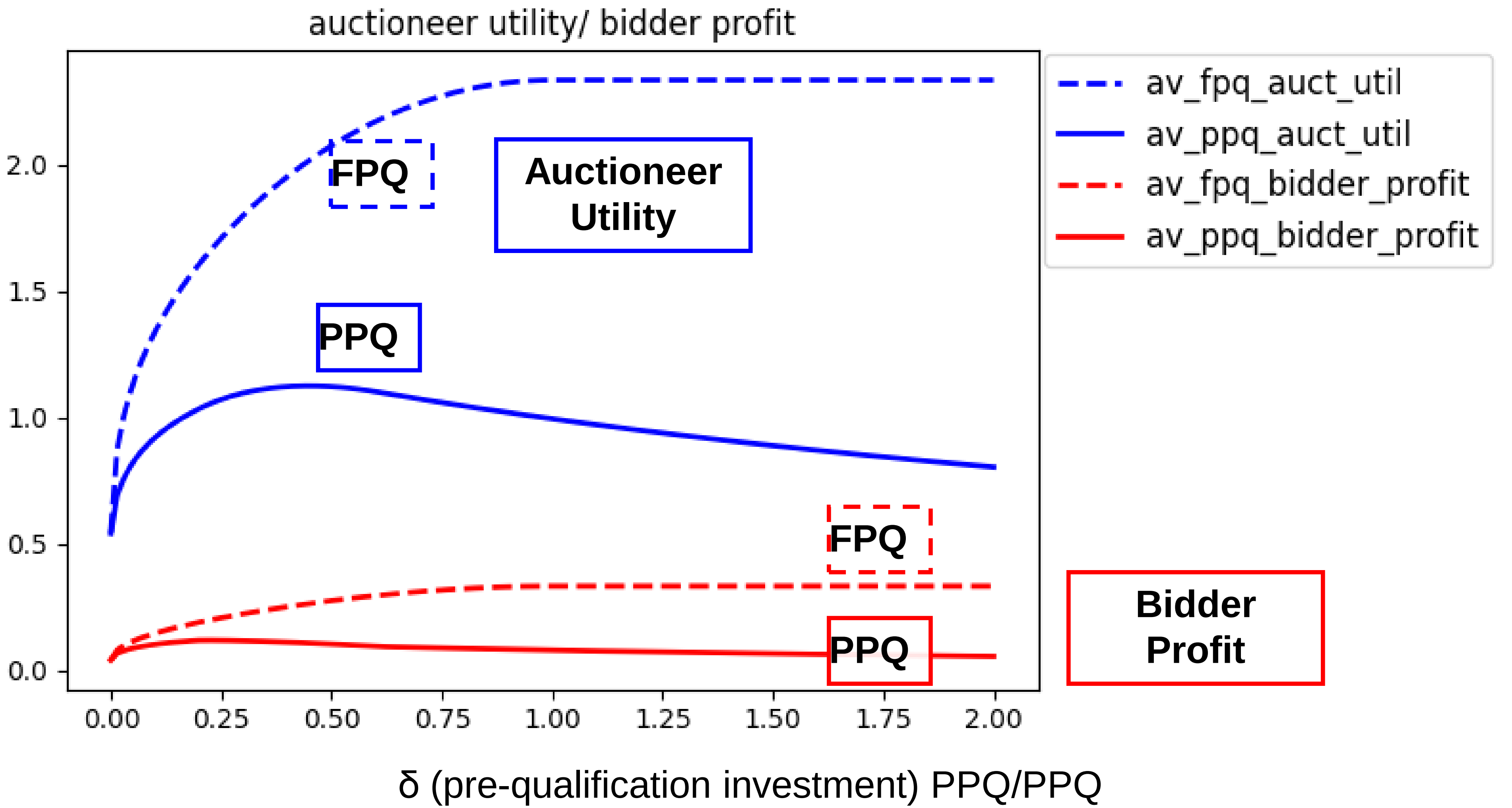
$$P[C] = \begin{cases} \{P : \int_{\underline{\xi}}^{P-C+\delta} G[\xi]d\xi = \delta\} & \text{if } \delta \leq \int_{\underline{\xi}}^{\bar{\xi}} G[\xi]d\xi \\ C + \bar{\xi} - \int_{\underline{\xi}}^{\bar{\xi}} G[\xi]d\xi & \text{if } \delta > \int_{\underline{\xi}}^{\bar{\xi}} G[\xi]d\xi \end{cases}$$

Entry & Realization Probability



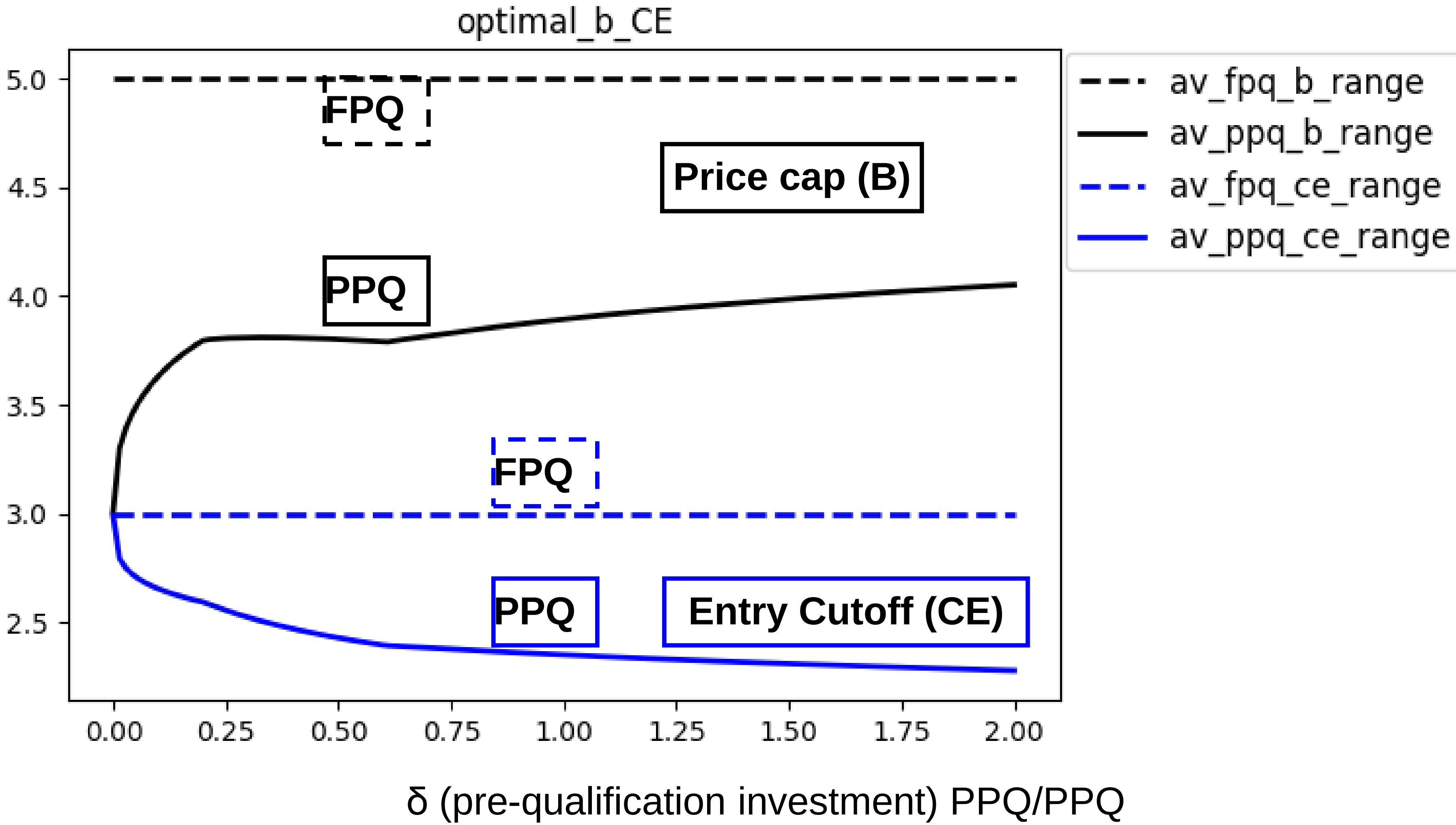
N=2, vuu=6, B=opt_, c=[2 3], s=[0 2]

Auctioneer Utility



N=2, vuu=6, B=opt_, c=[2 3], s=[0 2]

Pricecap & Entry Cutoff



N=2, vuu=6, B=opt_, c=[2 3], s=[0 2]

Results so far

- Analytics indicate that:
  - Auction is non-competitive with (large) positive probability
    - German wind auction shows this
  - Comparing cost shock distributions that decrease costs with ones that increase costs
    - Their effects are identical! (project realization levels & auctioneer utility)

- Simulations indicate that:
  - For auctioneer utility, optimal pre-commitment level>0
    - Thus, both FPQ & PPQ help (a little)
  - Increasing the PPQ eventually leads to worse outcomes.
    - This not the case for the FPQ
  - FPQ is vastly superior to PPQ
    - Realization
    - Auctioneer utility

Work to do:

- Can formally prove that FPQ > PPQ?
- Experiment

name:**Bert** group: id: us_id:2

Time remaining: **24s** paused

Round:2 Stage:2

1. Decision: enter?

Cost (minus Entry Fee):

82

≤

Max Limit Cost for Entry:

110

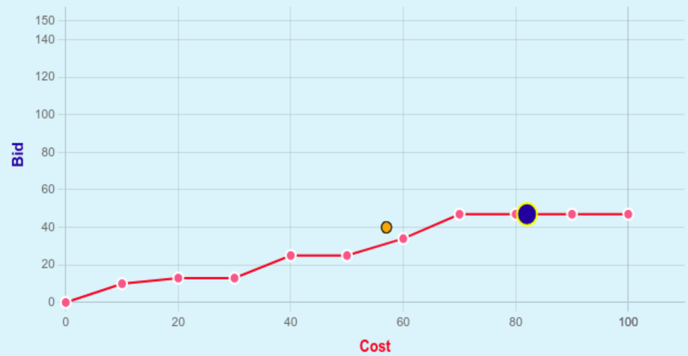
⇓

You entered this round

2. Decision: Bid

N of players:

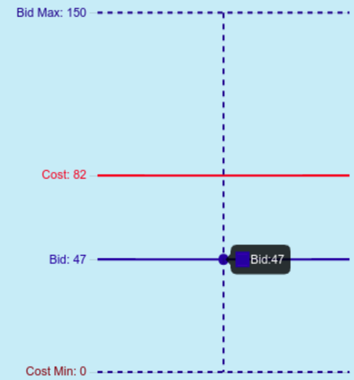
2



Bid:

47

3. Results Round 2



entry fee: -10

Cost -82

Extra cost:

Total cost

Price:

Auction Profit:

net Profit:

History

Round	Max Limit Cost for Entry CLim	Cost (minus Entry Fee) C	I Entered? C<CLim	N of players	Entry Cost EC	Bid B	Price P	I Won B<P	Extra Cost XC	Total Cost (minus Entry Cost) C+XC	I Implemented P>C+XC	Auction Profit A=P-C-XC	Profit of Entry A-EC
2	**110**	82	Yes	2	**10**						---		
1	**110**	57	Yes	2	**10**	**40**	42	Yes	17	74	No	0 *(-32)*	**-10**

- Why such effort in visual representation?
- Subjects generally not very “good” in auctions
    - Bid not according to theory
  - overbid in SPA

	PPQ		FPQ
bid	$v - \delta$		$v+z[\delta]$
Critical entrance v	v_{PPQ}	<<	v_{FPQ}