

Comparison of simultaneous and combinatorial auction designs in fisheries quota market: An initial analysis

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Outline

- Background
- Studied auction designs
- Experimental setting
- Results
- Concluding remarks

Background

- Individual Transferable Quotas (ITQ) are often used to manage fisheries.
- Usually ITQs are initiated by governmental fishing authorities and then sell or distribute quotas, which can be fractions of the TAC or a specific weight.
- When distributed, the quotas are tradable between the fishermen.
- Auctions are often recommended as a market mechanism to distribute quotas to their most efficient use.

Background

- Auction is a market mechanism with an explicit set of rules that determines resource allocation and prices on the basis of bids from the market participants (McAfee and McMillan, 1987).
- There are few studies focusing on the effectiveness of different auction based instruments to allocate ITQs. For example,
 - Moxnes (2010)
 - Anderson and Holland (2006)
 - Anderson (2004)
 - Anderson and Sutinen (2006)
 - Anferova et al. (2005)
 - Chu (2009)
- Most studies have evaluated auction designs in simplified settings by focusing on a single fishery or region.

Research objective

- Study performances of auction designs when fishers have complementarities or interdependence in their valuations for quotas.

Research objective

- We have envisaged two sources of synergy or complementarities in valuations of quotas: economies of scale and economies of scope.
 - ▣ **Economies of scale** refers to the situation when a fisher is willing to pay more for multiple permits for the same region.
 - ▣ **Economies of scope** refers to the situation when a fisher is willing to pay more for permits covering different regions together.

Research objective

$$v_i^m = \pi_i^m \cdot \left(\sum I_i^m \right)^{\alpha_i} \cdot \left(1 + \sum I_i^n \right)^{\beta_i}$$

Here

v_i^m	Maximum value bidder i is willing to pay for a permit for site m
I_i^m	Number of permits under consideration by bidder i for site m
π_i^m	Stand alone value for a permit for fishing in site m
α_i	Economies of scale parameter for bidder i
I_i^n	Number of permits won by bidder i for site n
β_i	Economies of scope parameter for i

Selected auction design

- Selected design
 - ▣ Simultaneous multiple round auction of Cramton (2006))
 - ▣ Iterative combinatorial auction design of Aparicio et al. (2008)

Selected auction design

- In a simultaneous auction, separate auctions are run in parallel for individual regions.
 - ▣ Example: \$4 for A, \$3 for B
- In a combinatorial auction, a fisherman can purchase a combination of quotas (or a package quota) for different regions in the same auction.
 - ▣ Example: \$7 for AB

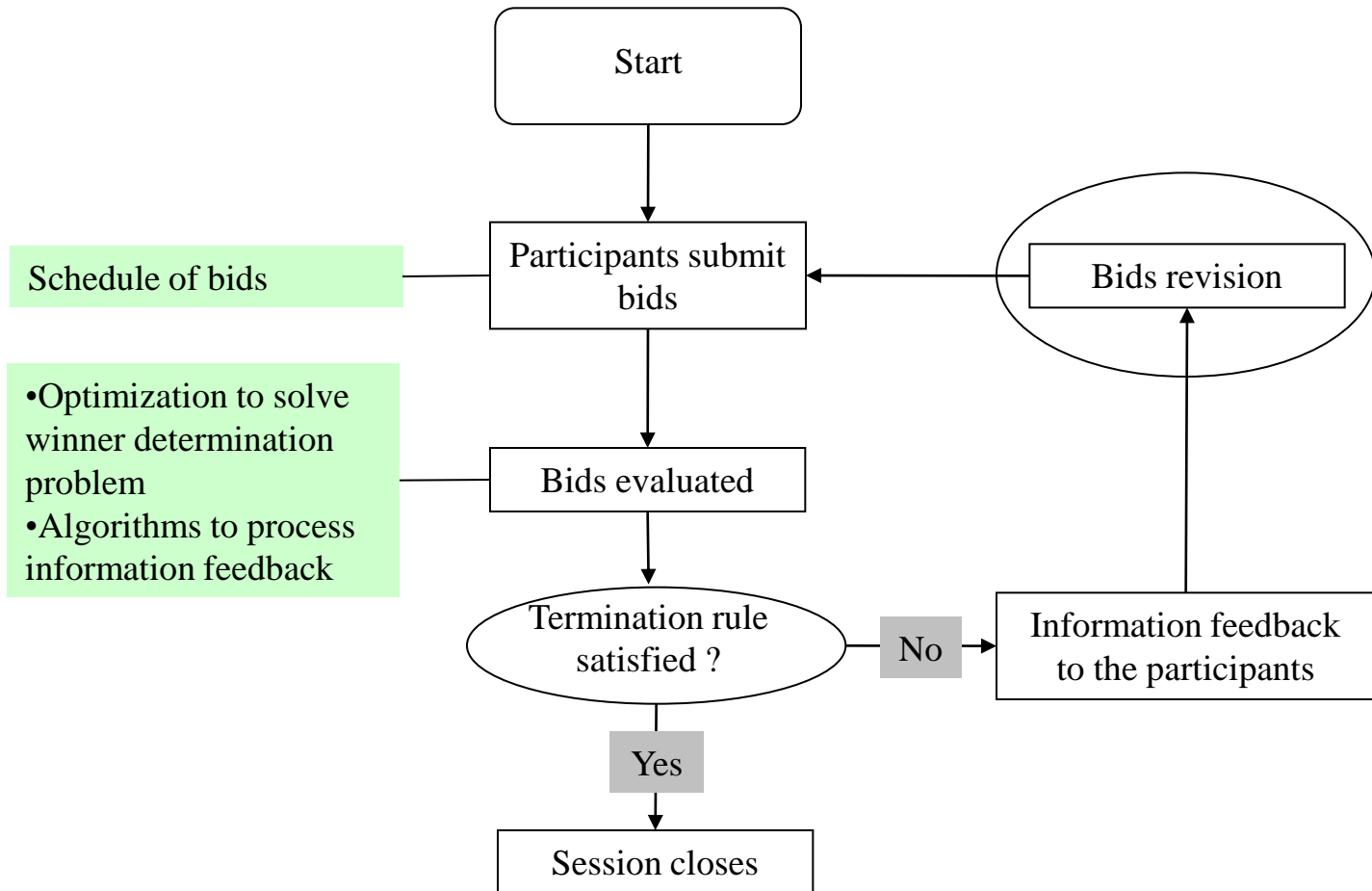
Comparison using numerical analysis



Agent based model

- The agent based model incorporates two types of agents representing the actual players in a real auction. These are:
 - Fishers bidding for ITQs for region A and B. Each fisher has a budget (or maximum willingness to pay) associated with different combinations of ITQs.
 - Auctioneer (agency), which selects winning fishers to allocate a fixed number of permits while maximizing revenue.

Auction Steps



Test sets

- Test 1: 8 bidders, capacity to bid on 4 permits each, 9 scenarios, 2 bidders could be winner optimally

Economies of scope		Economies of scale	
	0	0.5	1
0	0.32	0.64	1.28
0.5	0.72	1.43	2.86
1	1.6	3.2	6.4

Test sets

- Test 2: 8 bidders, capacity to bid on 4 permits each, 12 scenarios, 2 competition level

	DR12.5	DR50
HS0	0.32	1.28
HS12.5	1.431084	2.391084
HS25	1.431084	3.502167
HS50	1.431084	5.724334
HS75	1.431084	5.724334
HS100	1.431084	5.724334

Performance measures

- **Allocative efficiency (AE)**: It is measured as the ratio of the total valuation of an allocation X to the maximum total valuation X^* :
 - ▣ Allocative efficiency = total valuation of the winning projects / maximum total valuation X^*

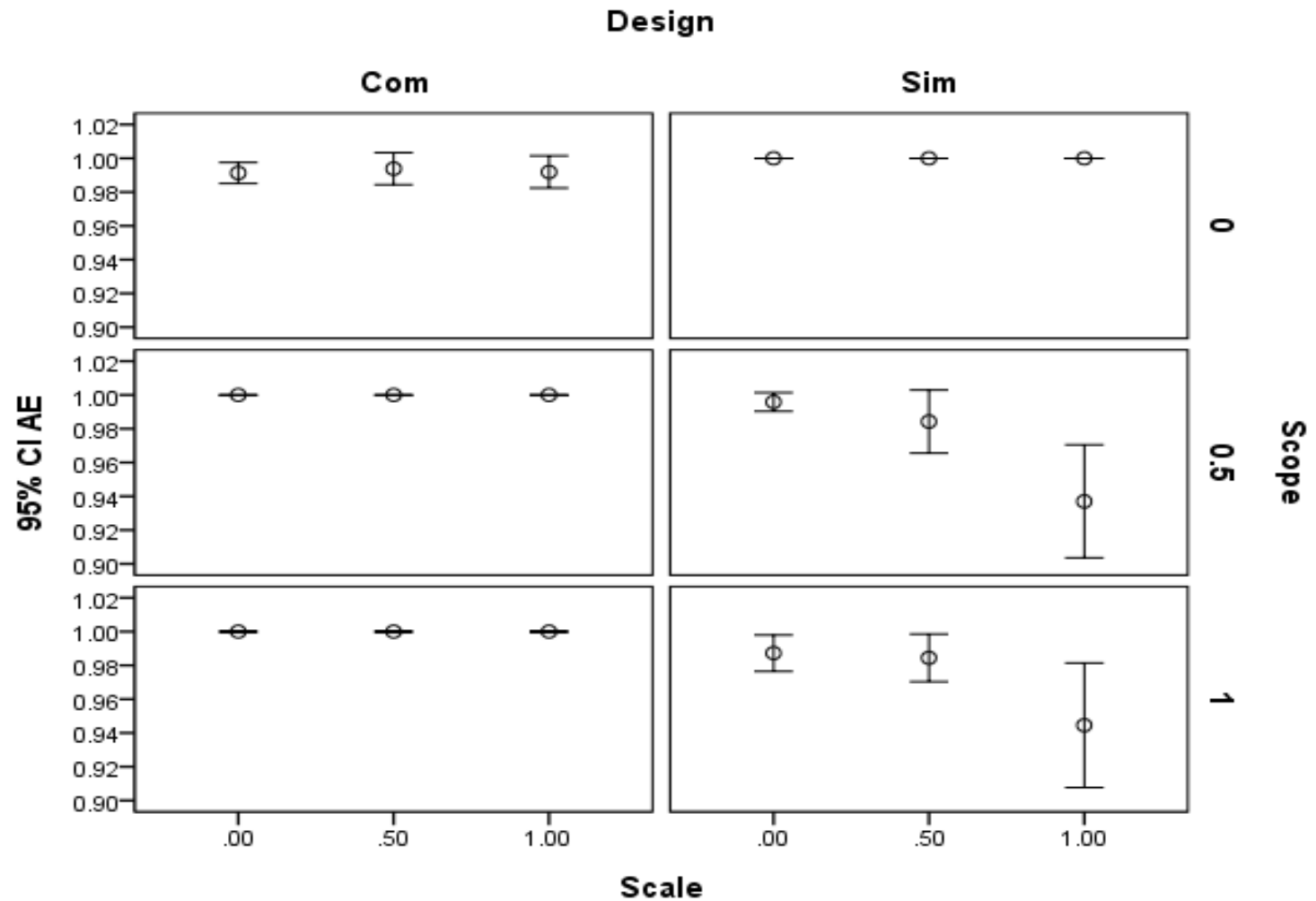
- **Degree of rent extraction (RE)**: It shows the degree of overpayment or rent to the bidders:
 - ▣ Rent Extraction = $1 - \text{auctioneer's revenue} / \text{maximum total valuation } X^*$

- **Speed of an auction (Speed)**: Number of rounds taken to reach final level of RE

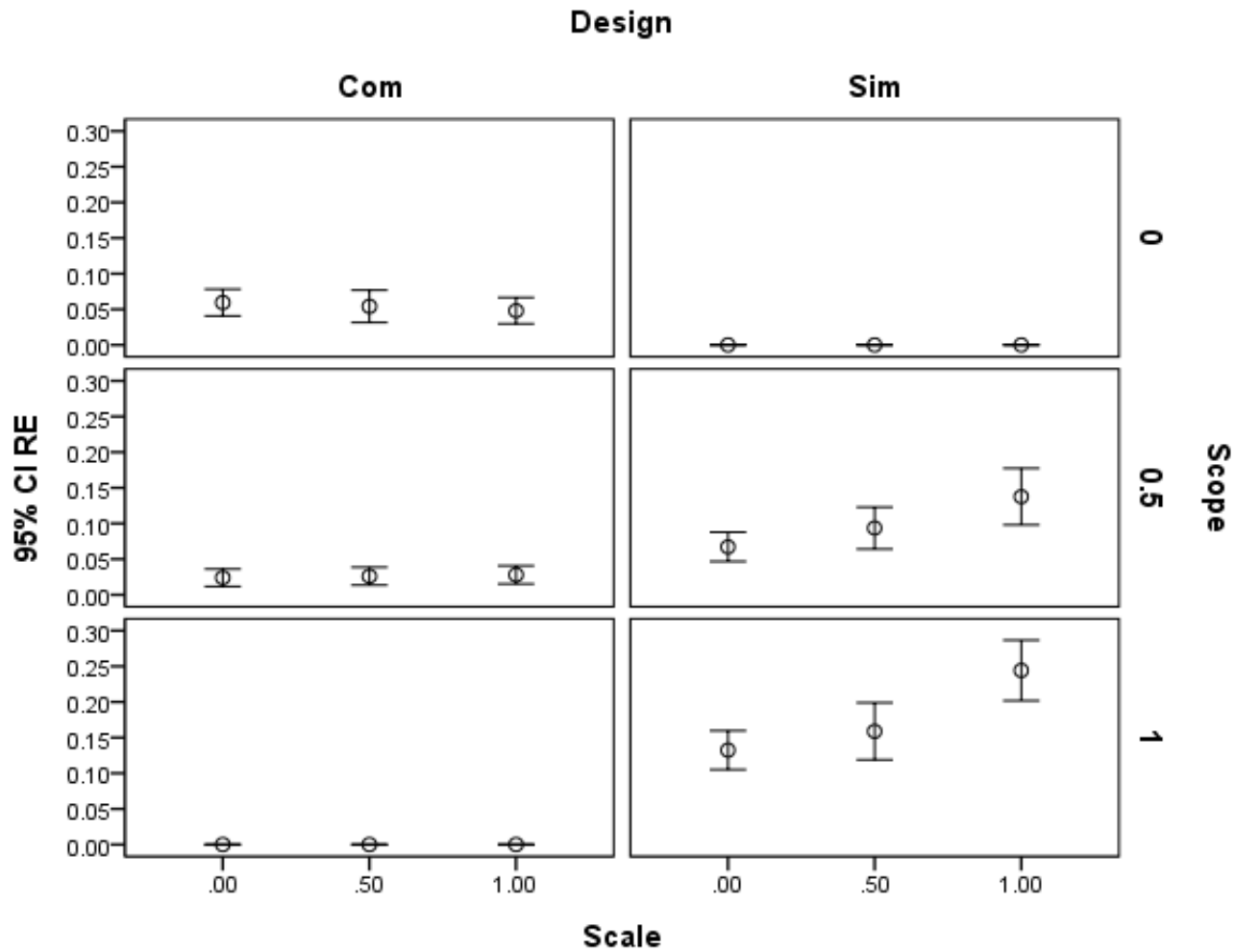
Results



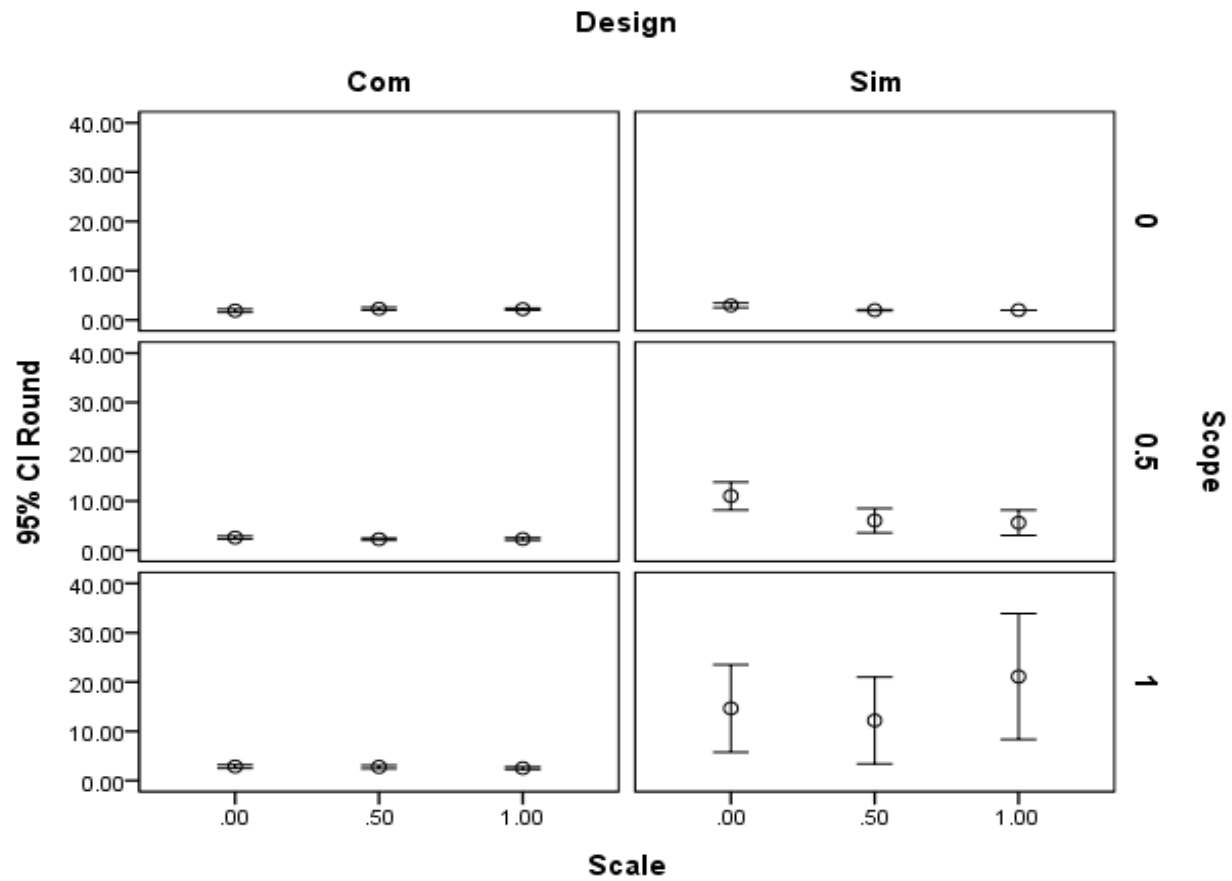
Result: test 1



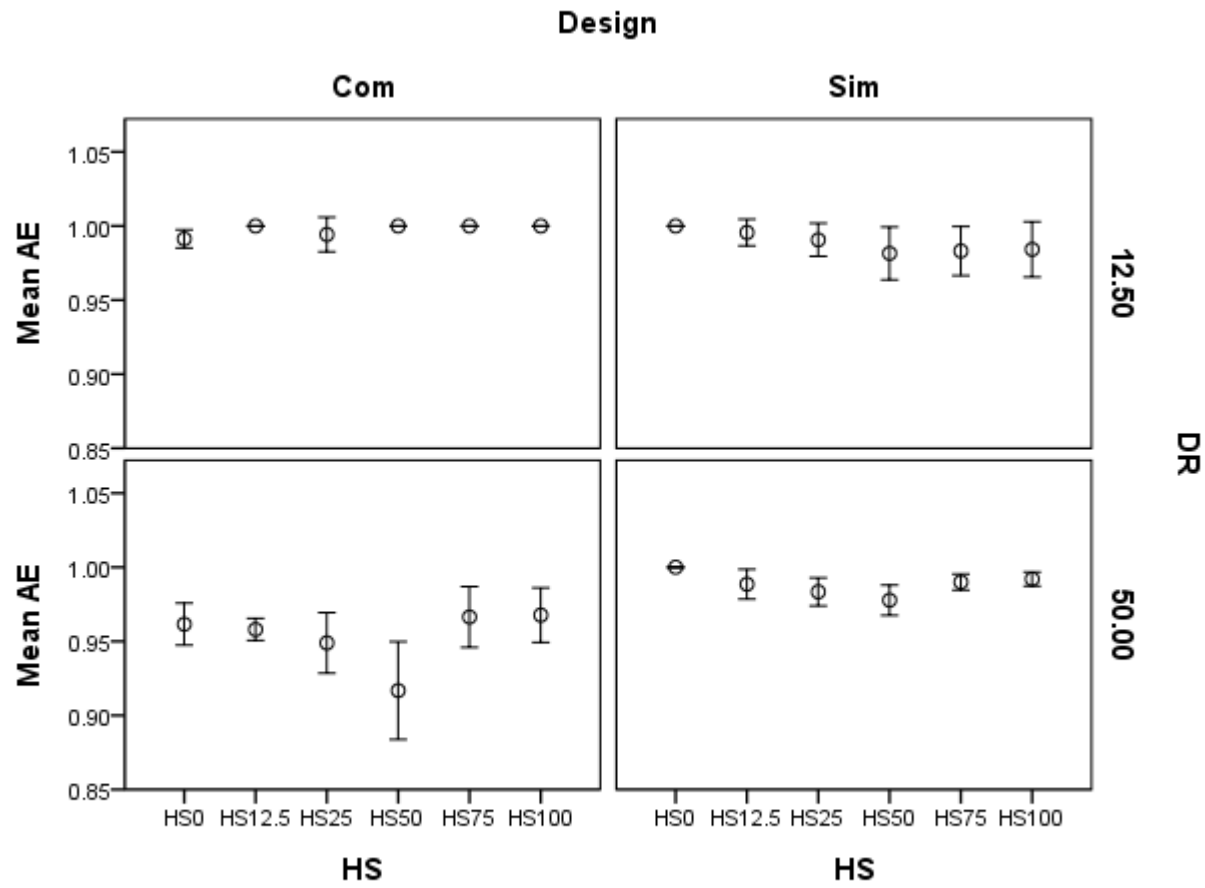
Result: test 1



Result: test 1

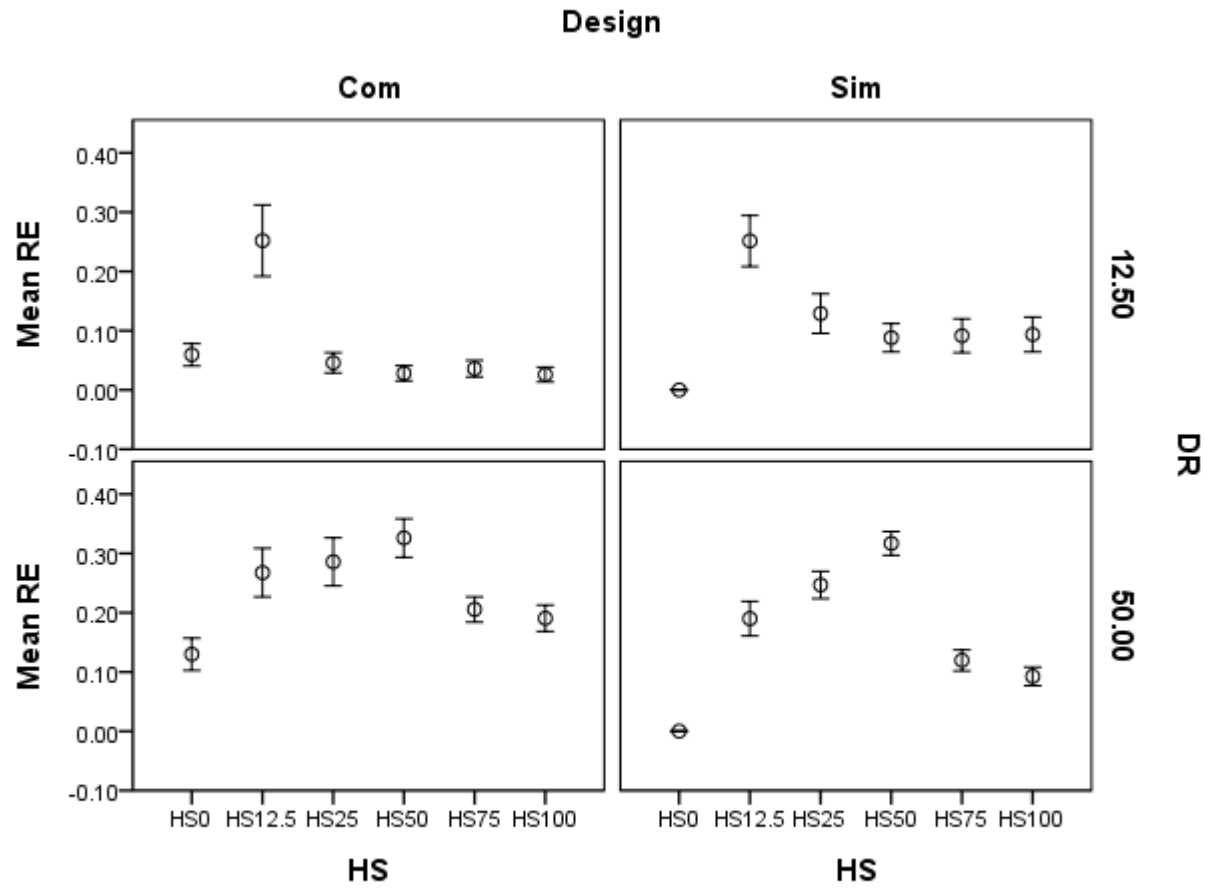


Result: test 2



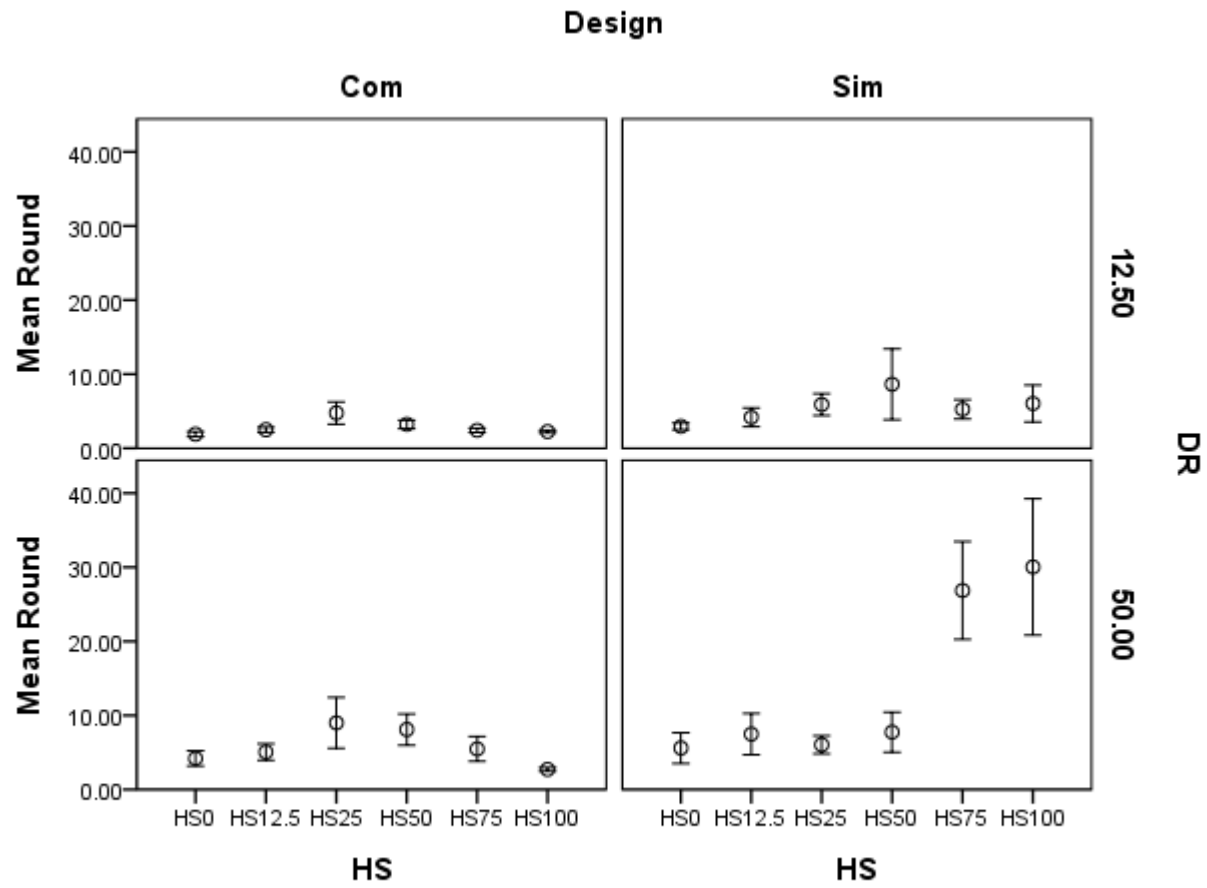
Error Bars: 95% CI

Result: test 2



Error Bars: 95% CI

Result: test 2



Error Bars: 95% CI

Concluding remarks

- Efficiency outcomes of combinatorial auction gradually improve with the increase in both economies of scale and economies of scope.
- Conversely, the efficiency outcomes of simultaneous auction gradually decline with the increase in both economies of scale and economies of scope.
- In high competition environment combinatorial auctions perform better than simultaneous auction in general and it is less sensitive to the changes in proportion of high synergy bidders.
- In low competition environment simultaneous auction performs better than combinatorial auctions.

Thanks

