Conservation Auctions and Compliance: Theory and Evidence from Laboratory Experiments

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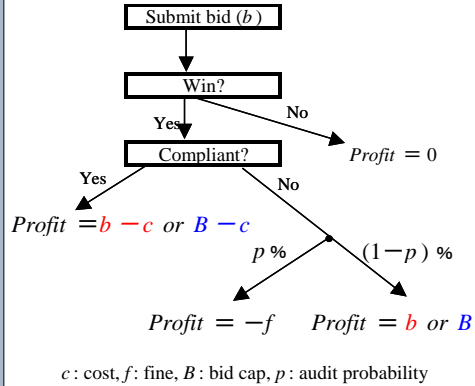
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Abstract

A number of agri-environmental conservation policies are faced with the problem of imperfect monitoring. This provides farmers an incentive for noncompliance, in which they receive subsidies without implementing the conservation scheme. In this article, bidding behaviors and auction performances are compared for discriminatory-price (DP) and uniform-price (UP) auction in an imperfect monitoring environment. Our laboratory experiments show that although DP has certain advantages in terms of reducing policy costs, UP results in a superior overall performance when compliance behavior is taken into account.

Theoretical Predictions

```
Submit bid (b)
        |
      Win? --- No ---> Profit = 0
        | Yes
   Compliant?
   Yes /    \ No
```

$Profit = b - c$ or $B - c$

p % $(1-p)$ %

$Profit = -f$ $Profit = b$ or B

c : cost, f : fine, B : bid cap, p : audit probability

Main assumptions:
- Long-run equilibrium where bidders can predict the bid cap.
- More than one winner maintains compliance and more than one winner does not. This situation can be replicated by setting parameters p or f appropriately.
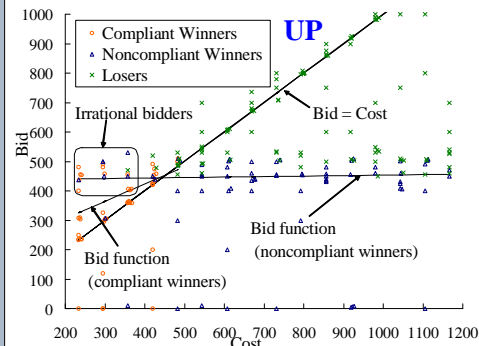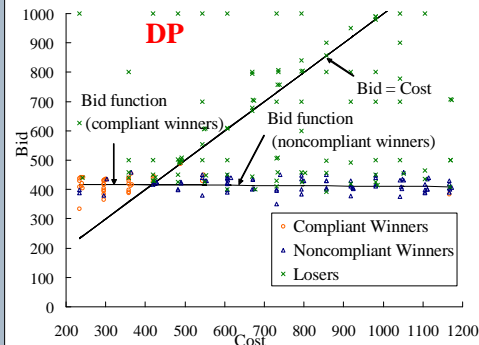- Parameters p and f are constant .

compliant bidders   noncompliant bidders

winners   losers

$Z \equiv pf /(1-p)$

(Table — DP vs UP)
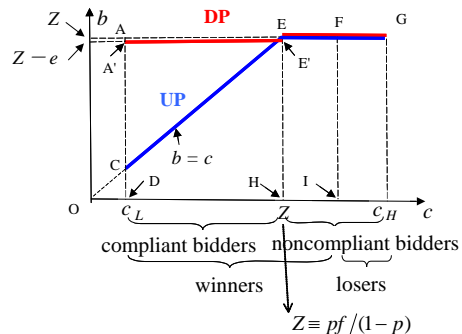
		DP		UP
(1)	**Bid cap**	Z	$=$	Z
(2)	**Budget**	A'E'HD+EFIH	$\approx$	AFID
(3)	**No. of compliant winners**	DH	$=$	DH
(4)	**Efficiency**	(3)/(2)	$\approx$	(3)/(2)

Since e approaches zero in the equilibrium, (A'E'HD+EFIH) approaches AFID. Therefore, the efficiencies of the two auction formats are equalized.

Experimental Analysis

Settings
- Subjects were undergraduate students in the faculty of economics from Shiga University in Japan.
- In each session, the subjects were organized into group of sixteen, and six sessions were conducted (three sessions for each of the two auction formats); therefore, totally, there were 96 subjects.
- The rule of the auction was similar to the theoretical settings. Each session consisted of 25 rounds, typically lasted 90 minutes, and the average earnings were about US$25.
- α = 15%, f = −$3000, hence Z = $529. Costs c were spread uniformly between $233 and $1167 with an average of $700.

DP
Bid function (compliant winners)
Bid function (noncompliant winners)
Bid = Cost
- Compliant Winners
- Noncompliant Winners
- Losers

UP
- Compliant Winners
- Noncompliant Winners
- Losers
Irrational bidders
Bid = Cost
Bid function (noncompliant winners)
Bid function (compliant winners)

Results

		21-25R			
		DP		UP	
(1)	**Bid cap**	436	<	479	**
(2)	**Budget**	3316	<	3828	**
(3)	**No. of compliant winners**	2.7	<	3.3	*
(4)	**Efficiency (×10^{-4})**	8.0	<	8.8	
(5)	No. of low cost bidders	3.9	<	4.4	
(6)	No. of low cost winners	3.1	<	4.1	**
	Winning rate = (6)/(5)	81%	<	94%	**
(7)	No. of low cost & compliant winners	2.5	<	3.3	*
	Compliance rate = (7)/(6)	80%	<	82%	

Contrary to the theoretical predictions, experimental results show that all indices are smaller in the DP.

Why are the bid cap and budget lower in the DP?

The bid caps are lower than theoretical prediction ($529), implying a negative expected profit for noncompliant bidders. Several candidate explanations for this.
- Risk attitudes.
- Nonstandard preferences, such as *spite* or *joy of winning*.
- Winner's curse.

Why are there fewer compliant winners in the DP?

For high-cost bidders ($c > bid\ cap$), maintaining compliance leads to a negative profit. Therefore, they do not maintain compliance in the event of winning the auction. Only low-cost bidders ($c < bid\ cap$), are willing to maintain compliance. In this sense, low-cost bidders are candidates for being compliant winners.
Two reasons for fewer compliant winners…
- Less low-cost bidders in DP. This is because the bid cap is lower in the DP
- The rate of winning of low-cost bidders is lower in DP.

Why are the low-cost bidders less likely to win in the DP?

Above the cost range up to $400 or $500 in the DP, bids are stretched horizontally around $400 or $450 (see the figure on the left). This bidding pattern is in line with the theory. In contrast, some deviation from the theory can be observed in the rate of winning.
In theory, low-cost bidders in the DP predict the bid cap precisely, and they all win the auction by getting their bids as close as possible to the bid cap. In reality, however, a closer look at bid patterns shows that some low-cost bidders overestimate the bid cap, faultily submit bids that exceed the bid cap, and lose the auction. As a result, 10% or more low-cost bidders miss a chance to be awarded a contract.
On the other hand, low-cost bidders in the UP rarely overbid, since their dominant strategy is to bid their own cost. Thus, the rate of winning in the UP is almost 100%, just as the theory predicts.
To summarize, prediction error caused lower rate of winning in the DP.

Robustness Check

Robustness is checked by Monte Carlo simulations. To do so, the bid functions and compliance function are estimated.
The bid functions are given as, b = f (cost, the lagged bid cap, sex and grades at university). They are estimated separately for low-cost/high-cost bidders, rational/irrational bidders, and UP/DP.
The compliance function is given as, compliance dummy (0 or 1) = f (price-cost, auction format dummy, sex and grades at university).
Using these functions, we ran Monte Carlo simulations and found that even after controlling for the bidders' characteristics, UP outperforms DP.

Results

		Case1			Case2		
		DP		UP	DP		UP
	Expected bid cap	436		479	457		457
(1)	**Bid cap**	433	<	477	457	<	457
(2)	**Budget**	3231	<	3812	3421	<	3657
(3)	**No. of compliant winners**	2.4	<	3.0	2.6	<	2.9
(4)	**Efficiency (×10^{-4})**	7.5	<	7.9	7.7	<	7.9
(5)	No. of low cost bidders	3.8	<	4.3	4.1	<	4.1
(6)	No. of low cost winners	3.0	<	3.8	3.3	<	3.6
	Winning rate = (6)/(5)	78%	<	88%	81%	<	89%
(7)	No. of low cost & compliant winners	2.4	<	3.0	2.6	<	2.9
	Compliance rate = (7)/(6)	80%	<	79%	80%	<	80%

Conclusion

- Simple theoretical analysis shows that the number of compliant winners, total fiscal budget, and efficiency are all equalized between the UP and DP in the long-run equilibrium where bidders can predict the bid cap.
- On the contrary, laboratory auctions and simulations show that the DP has an advantage in reducing the fiscal budgets. However, the UP leads to more compliant winners, thereby higher efficiency (defined as the ratio of the number of compliant winners to the budget).
- The mechanism lying behind this is the prediction error. Since precise prediction of the bid cap is not easy in reality, some low-cost bidders, or potentially compliant bidders, faultily overbid and lose the auction in the DP. In consequence, the DP is more likely to cause adverse selection, with more noncompliant bidders being awarded contracts.
- The most important implication of our study is that we should not evaluate auctions using just superficial performances when compliance behavior may matter. If we rely on the fiscal budget, it indicates that the DP outperforms the UP. However, the conclusion can be quite different if compliance behavior is considered. Under an imperfect monitoring environment, compliance behavior can be crucial to determine auction performances.

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