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2015-16

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Vickrey Auction vs BDM: Difference in bidding behaviour and the impact of other-regarding motives*

Niall Flynn Christopher Kah⋆ Rudolf Kerschbamer‡

December 10, 2015

Abstract

In an experiment we first elicit the distributional preferences of subjects and then let them bid for a lottery, either in a Becker-DeGroot-Marschak *(BDM)* mechanism or a Vickrey auction *(VA)*. Standard theory predicts that altruistic subjects underbid in the *VA* – compared to the *BDM* – while spiteful subjects overbid in the *VA*. The data do not confirm those predictions. While we observe aggregate underbidding in the *VA*, the result is not driven by the choices of altruistic subjects.

JEL-Classification: C91; C72.

Keywords: Distributional preferences; BDM; Vickrey auction.

1 Motivation and related literature

Deviations of bids from true valuations in second-price private-value or 'Vickrey' auctions (*VA*; Vickrey, 1961) has been a recurrent theme, see, e.g., Kagel, Harstad, and Levin (1987) or Kagel and Levin (1993). The more recent literature has attributed this finding, at least partially, to spite. Andreoni, Che, and Kim (2007) find that bids increase in rivals' (known) valuations, which is consistent with the spite explanation. With unknown

*We thank Martin Strobel and Markus Walzl for helpful discussions. Financial support from the Austrian Science Fund (FWF) through grant no. P-22669 is gratefully acknowledged.

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valuations but costly signals about the latter, Cooper and Fang (2008) also report evidence consistent with the spite hypothesis. If spite, or any form of *distributional* preferences, is causal for non-sincere bidding in the *VA*, then deviations of bids from true valuations per construction should be absent in the *BDM* mechanism (Becker, DeGroot, and Marschak, 1964) – which, under standard assumptions, is strategically equivalent to the *VA*. Intuitively, in the *BDM*, the decision is made in isolation and the outcome has only consequences for the decision maker, whereas in the *VA*, the outcome is also affected by the behaviour of a rivalling bidder, and by changing the own bid, a subject influences the monetary outcome for *both* parties involved. To test the impact of distributional preferences on bidding behaviour in the lab, we first elicit the distributional preferences of subjects and then let them bid for lottery tickets either in a *BDM* or in a *VA*. We then compare the bids across the two mechanisms. We observe underbidding in the aggregate in the *VA*, but the experimental data do not confirm our predictions at the individual level.

Our contribution to the existing literature is two-fold. First, by keeping all details except for the treatment variation constant across treatments, our experimental design allows for a neat comparison of *BDM* and *VA* bids at the aggregate level; and secondly, by classifying subjects into distributional preference types and comparing their bidding behaviour across mechanisms, our design allows for a clean test of the hypotheses that distributional preferences are causal for a potential treatment difference.[1] Keeping the number of bidders constant across the two mechanisms seems indispensable as the probability that a bidder becomes pivotal decreases in the number of rivals and because with a higher probability of pivotality, we expect bidders to perform higher cognitive effort as their actions are more likely to influence the final monetary payoff distribution.[2] Keeping instructions comparable across treatments also seems important because framing effects are known to potentially influence the behaviour in the lab (see, e.g., Levin et al., 1998).

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[1] For a comprehensive survey of distributional preferences, see, e.g., Fehr and Schmidt (2006) and the references mentioned therein.

[2] Rutstrom (1998) reports *BDM* bids being significantly below *VA* bids. However, the recruiting procedure is not constant across mechanisms and the number of bidders in the *VA* is not constant across sessions. See Kagel and Levin (1993) for a significant effect of increasing the number of bidders in *VA*.

2 Experimental setup and theoretical predictions

The experiment consists of two treatments – the *BDM* treatment and the *VA* treatment – implemented in a between-subject design and paid under random lottery incentives. Each treatment consists of two parts, and subjects know that only one part is payoff-relevant:[3]

1. In part 1, we elicit the distributional preferences of subjects with the *Equality Equivalence Test (EET)* by Kerschbamer (2015) and then we expose them to an incentivised survey.
2. In part 2, a lottery ticket (giving either $w = 12$ EUR or 0 EUR with equal probabilities) is auctioned off under either the *BDM* or the *VA*. Subjects' initial endowment in part 2 is $e = 12$ EUR.[4]

EET: This procedure exposes each subject to a number (in our case 10) choices between two allocations each specifying a payoff for the subject and a payoff for a randomly assigned anonymous second subject. In half of the choices, there is *advantageous* inequality (the deciding subject is ahead in monetary terms), in the other half there is *disadvantageous* inequality (the deciding subject is behind in monetary terms). From the choices of the subject x- and y-scores measuring the benevolence in the two domains of inequality are calculated. A higher x-score (y-score) means more benevolence in the domain of disadvantageous (advantageous) inequality. These scores jointly determine the distributional type of the subject.

BDM: In the *BDM* each subject i is asked to submit a bid b_i, then a random price p_i is drawn. The allocation rule is:

(i) if $b_i > p_i$: subject i buys the lottery ticket at price p_i;

(ii) if $b_i < p_i$: subject i keeps the endowment;

(iii) if $b_i = p_i$: either (i) or (ii) is implemented with equal probability.

[3] See Appendix B for the experimental instructions. If part 1 was payoff-relevant, one of the 10 choices was paid.

[4] We include control questions to overcome possible obstacles caused by these mechanisms.

***VA*:** In the *VA* subjects are randomly assigned to pairs. In each pair, the subjects – denoted i and j with $i \neq j$ – are asked to submit bids b_i and b_j. The allocation rule is:

(i) if $b_i > b_j$: subject i buys the lottery ticket at price b_j, while subject j keeps the endowment;

(ii) if $b_i < b_j$: subject j buys the lottery ticket at price b_i, while subject i keeps the endowment;

(iii) if $b_i = b_j$: either (i) or (ii) is implemented with equal probability.

Let $f_i(\cdot)$ be strictly increasing and normalise $f_i(0) \equiv 0$. In the *BDM*, the unique admissible bid, b_i^*, is implicitly defined by

$$\frac{1}{2} f_i\left(e + w - b_i^*\right) + \frac{1}{2} f_i\left(e - b_i^*\right) = f_i(e). \tag{2.1}$$

Let (x_i, x_j) denote the final monetary allocation. In the *VA*, the utility for selfish is – as in the *BDM* – of the form $u_i^{\text{self}} = f(x_i)$. Thus, $b_i = b_i^*$ is a weakly dominant strategy for selfish in the *VA*. Sincere bidding is *not* necessarily a weakly dominant strategy for non-selfish subjects in the *VA*. An altruist i's utility increases in the monetary payoff of j, i.e., $u_i^{\text{alt}} = f(x_i) + g(x_j)$, where $g(\cdot)$ is strictly increasing. Conversely, under spite, we have $u_i^{\text{spite}} = f(x_i) - g(x_j)$, where $g(\cdot)$ is again strictly increasing. We assume that if x_j is good (bad), i.e., altruism (spite), i is more (less) risk-averse in j's monetary gains than in her own. Empirical evidence includes, e.g., Chakravarty et al. (2011) or Mengarelli et al. (2014). Restricting ourselves to admissible bids, we can prove (see Appendix A for details):

Proposition 1. *In the* VA*,*

(i) selfish subjects never have an incentive to deviate from b_i^**;*

(ii) altruistic subjects never have an incentive to overbid relative to b_i^**, and might have an incentive to underbid;*

(iii) spiteful subjects never have an incentive to underbid relative to b_i^**, and might have an incentive to overbid.*

From Proposition 1 and the fact that selfish and altruistic subjects combined comprise the majority in experimental data (see, e.g., Kerschbamer, 2015), we derive:

Theoretical Prediction 1. *Comparing bids across treatments,*

(i) selfish subjects will not change their bids, while altruistic (spiteful) types will underbid (overbid) in VA relative to the BDM;

(ii) in the aggregate, we expect underbidding in the VA relative to the BDM.

3 Results

We conducted all sessions in paper-and-pen at the University of Innsbruck in October and November 2013 and collected $n = 320$ observations – 146 in the *BDM* and 174 in the *VA*. We classify subjects as

(i) *selfish*, if $-0.5 \leq x$-score ≤ 0.5 and $-0.5 \leq y$-score ≤ 0.5;

(ii) *alruistic*, if x-score ≥ 0 and y-score ≥ 0;

(iii) *spiteful*, if x-score ≤ 0 and y-score ≤ 0.[5]

Table 1 reports mean bids by types and treatments, and the p-values for t-tests comparing mean bids.[6]

	n	Mean bid BDM	Mean bid VA	$BDM - VA$	p-value (t-test)
All	320	4.77	4.18	0.59	0.070
Selfish	118	5.12 (n=65)	4.11 (n=53)	1.01	0.054
Altruist	231	4.50 (n=105)	4.24 (n=126)	0.26	0.485
Spiteful	30	6.43 (n=14)	4.59 (n=16)	1.83	0.100

Table 1: Comparison of mean bids by types and treatments.

We observe a difference in aggregate bidding behaviour, which is significant at the 10% level. Given the relatively large share of altruists in the population, one might be tempted to see the predictions of Proposition 1 confirmed. We cannot reconcile the aggregate treatment difference with data at the individual level, though. For both selfish and spiteful types, we observe a significant (at the 10% level) change in bids,

[5] Scores between -0.5 and +0.5 are compatible with selfishness and other types. We classify subjects as selfish whenever they are *potentially* selfish resulting in "double-counting" several observations.

[6] We only include those types for which a prediction as embodied in Proposition 1 exists.

while for altruists there is no significant difference. This contradicts our theoretical predictions.

4 Conclusion

Our experimental design allows for a genuine comparison of *BDM* and *VA*, both at the aggregate level and at the level of the distributional type. While we observe a behavioural difference between the two mechanisms at the aggregate level, the difference cannot be explained by a purely consequentialist utility function of the form $u_i(x_i, x_j) = f(x_i) \pm g(x_j)$. Such functions seem to be well-suited to explain behaviour in simple decision problems like dictator games, but less suited to explain behaviour in market environments such as the *VA*.

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ISSN 1993-4378 (Print)
ISSN 1993-6885 (Online)