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ELICITING RESERVATION PRICES: BECKER–DeGROOT–MARSCHAK MECHANISMS *vs.* MARKETS*

Peter Bohm, Johan Lindén and Joakim Sonnegård

The Becker–DeGroot–Marschak (BDM) mechanism is used in experimental economics as an incentive-compatible procedure for eliciting reservation prices. It is found here, where seller prices are elicited, that the mechanism is sensitive to the choice of upper bound of the randomly generated buyout prices. Hence, the mechanism cannot be generally incentive compatible in practice. Two ways to specify the upper bound are identified which make the BDM mechanism yield mean seller prices that do not differ from those generated in an incentive-compatible market. The experimental market used here is designed so that traders are unable to influence transaction prices, even when the market is small.

An important task of experimental economics is to design institutions for eliciting values that people place on commodities. One area in which this is potentially of practical use concerns public goods, for which the market mechanism is of little help. A number of laboratory tests and some real-world tests of demand-revealing mechanisms for such goods have been carried out (for an overview, see Davis and Holt, 1993, Chapter 6, and for a real-world test, see Bohm, 1984). Another such area concerns sealed-bid auctions, where alternatives to the traditional and imperfectly demand-revealing first-price auction have been tested, primarily the second-price auction proposed by Vickrey (1961); see, e.g., Smith (1982) for a summary. Within the field of experimental economics itself, procedures are needed that provide incentives for subjects to reveal truthfully the values they assign to private goods. A leading approach has been the Becker–DeGroot–Marschak (1964) (BDM) mechanism, which is the principal object of the tests reported in this paper.

The BDM mechanism has been used for eliciting minimum seller prices as well as maximum buyer prices. Here, as in the original paper by BDM, we focus on eliciting minimum seller prices for a commodity. Subjects are each given a unit of a commodity and asked to state their minimum price for selling it. A buying price is drawn from some random distribution made known to the sellers. If the buying price exceeds or equals the selling price, the seller receives the buying price and gives up the object; otherwise, the seller retains the object. In the original BDM setting, the objects were lotteries with induced probabilities defined over induced prizes denominated in cash, and the values elicited interpreted as certainty equivalents (see also similar applications in Grether and Plott, 1979, Kachelmeier and Shehata, 1992, and Wilcox, 1993). The mechanism has later been used for objects other than lotteries, e.g. plants (as in Boyce *et al.* 1992) and claims redeemable in the future (Lazo *et al.* 1992).

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In our study, the commodity used is a regular consumer good with a well-defined market price – a card entitling the bearer to a given quantity of petrol.

It is straightforward to show that in the BDM institution, subjects have a dominant strategy in revealing the value of non-risky objects truthfully (see, e.g., Davies and Holt (1993), p. 461).[1] The principle is essentially the same as that of a perfect market or a second-price auction, in that the subject cannot influence the buyout price. In this paper, we are interested in whether the behavioural 'drawing power' of the truth-telling incentives of the BDM institution varies with its design in the following respect.

In most applications of the BDM mechanism, the buyout-price range has been given a liberal upper bound, in some cases such that buyout prices well exceed what any real buyer could be expected to be willing to pay. For example, in Grether and Plott (1979), subjects were asked to state selling prices for gambles with equiprobable buyout prices from $0, 0·01, 0·02, etc. up to $9·99, although the (highest) prize in 10 gambles out of 12 did not exceed $9 and in seven gambles did not exceed $5. Take, as a case in point, the gamble in which there is a 35/36 chance of winning $4 and 1/36 chance of losing $1, a gamble with an expected value of $3.86. When confronted with the BDM mechanism, subjects were explicitly told that 'your best interest is served by accurately representing your preference. The best thing you could do is be honest' (Grether and Plott (1979), p. 637). At the same time, subjects were informed that there is a buyer (the experimenter delegating his demand to a BDM mechanism) potentially willing to pay up to $9.99. The question can be raised whether the latter piece of information could contaminate the advice that the subject should not try to sell at a price above his true selling price, which even for the most risk-loving person would not exceed $4 for this particular gamble. A confused seller may think, for example, that since there is a 50% chance that the buyer will pay $5 or more, perhaps he should state $5 as his selling price.

The relevance of the possible contamination of the incentive-compatibility properties of the BDM mechanism by unrealistically high upper bounds is exemplified in a study by Lazo *et al.* (1992). Subjects who were given a certificate redeemable for $20 10 weeks later were asked to state their selling prices with equiprobable BDM buyout prices from $0, 0·25, 0·50, etc. up to $30. Some 25% of the subjects stated a minimum selling price of $20 or more. These clearly unlikely prices play a significant role for the primary result in Lazo *et al.*, namely a reported large difference between average selling prices (or willingness to accept) and average buying prices (willingness to pay), the latter generated using a corresponding BDM mechanism.

In the experiments reported in this paper, the BDM mechanism is tested for three different designs of the upper bound to the buyout-price range. The mean seller prices from these three BDM versions are compared to those obtained from another institution, a market where real buyers confront the sellers. We attempt to design the market institution so as to provide incentives for truthful

[1] As shown by Karni and Safra (1987), this dominant-strategy argument fails when subjects have non-linear risk preferences and the object is risky.

reporting of seller (and buyer) reservation prices when the market is small. The mean seller price elicited by the BDM version, for which the upper bound of the buyout price clearly exceeds the real outside market price for the commodity, is found to surpass the mean seller reservation price on the experimental market. By contrast, the mean seller prices of BDM versions with an upper bound equal to the outside market price or with an upper bound specified only as 'the maximum price we believe any real buyer would be willing to pay' did not deviate significantly from the experimental market price.

I. THREE BDM VARIANTS

I.A *Experimental Design*

In most cases where the BDM institution has been used, an upper bound close to realistic buyer prices is not easy to calculate. In the case of the specific gamble mentioned above, it is. For this gamble ($4, 35/36; −$1, 1/36), the expected value of $3·86 would be the obvious upper bound, if all potential buyers were known to be risk averse or at most risk neutral. But since consumers of gambles may certainly be risk lovers, buyer prices up to $3.99 cannot be ruled out, especially given the high probability (35/36) of winning. So, $3.99 would be a credible upper bound in this case. But, in lottery markets with much smaller chances of winning and more substantial prizes than $4, identifying a minimum upper bound is not that easy. This is readily seen for the gamble with the highest prize used by Grether and Plott, a 4/36 chance of winning $40 (and a 32/36 chance of losing $1) with an expected value of $3.56. Here, buyer prices nowhere near $39.99 would seem credible.[2]

For the commodity used in our tests – a card entitling the bearer to 30 litres of 95-octane petrol (or other motor fuel for the same market value) at a petrol station next to the subjects' (university) car park – an upper bound to the buyout-price range was fairly easy to calculate. In fact, this was an important reason for choosing petrol as the commodity for the experiments. Although the card could be used any time within 7 months and the petrol price could, of course, vary over that period, current price would most likely be a relevant yardstick.[3] The current value of 30 litres of petrol was SEK (Swedish kronor) 228, which was reported to the subjects. (This reflected the price at the particular petrol station as well as other stations owned by the same company, one of the biggest in Sweden; the price was not significantly different from that of any other company.) The quantity of petrol chosen was as high as possible,

[2] In Kachelmeier and Shehata (1992), seller prices for similar gambles were elicited consistently with the highest prize as the upper bound to the BDM buyout-price range. Reilly (1982) pointed out that subjects might want to state selling prices all the way up to the highest level of the highest prize and therefore the BDM buyout-price range should be so extended. This is in contrast to the design used by Grether and Plott in some of their lotteries. However, in the Reilly experiments the upper bound was set at a uniform level, implying that it clearly surpassed the highest prize for all lotteries tested except one.

[3] For this reason alone, subjects may regard petrol cards as risky, in which case Karni and Safras's (1987) argument might be important (cf. footnote 1). But Wilcox (1993) shows that Karni and Safras's argument does not explain many observed BDM lottery prices greater than or equal to the lottery's best outcome. As this is the kind of behaviour we focus on here, we ignore the joint hypothesis that subjects have non-expected utility risk preferences and regard the petrol card as a risky object

while still ensuring that most vehicles could take that amount on one occasion. The market value of this quantity was deemed to be high enough for the subjects to find the commodity sufficiently valuable for them to pay attention to the valuation tasks they were asked to fulfil. All subjects were first-semester undergraduates in economics at Stockholm University.[4]

Subjects eventually exposed to the BDM mechanism each received one card at the outset of the experiment.[5] As in Grether and Plott (see also Davis and Holt (1993), p. 490), the subjects were informed about the incentive-compatibility properties of the BDM mechanism, by way of an example. Tests of the following three variants of the BDM design are reported here:

*BDM*225 = buyout-prices range from SEK 5 up to SEK 225
*BDM*300 = an upper bound of SEK 300
BDMU = the upper bound was not reported (but was said not to exceed what we believe any real buyer would be willing to pay).

In all cases the buying price was drawn in increments of SEK 5 from a bingo cage. The group subjected to the *BDM*225 institution was told that 'there are 45 balls in the cage representing buyer prices from SEK 5, 10, 15, 20, etc. to 225'.[6] in *BDM*300, another group was told that 'there are 60 balls in the cage representing buyer prices from SEK 5, 10, 15, 20, etc. to 300'. A third group, confronted with *BDMU*, was told that 'there are balls in the cage representing buyer prices from SEK 5, 10, 15, 20, etc. and upwards. The upper bound is equal to what we think is the maximum price any real buyer would be willing to pay for this card. You are welcome to check the bingo cage at the end of the session.' (The last sentence was also included in the first two BDM versions.)[7] Subjects could not see inside the bingo cage.

The basic premise for the BDM designs is that subjects might regard the upper bound of the buyout-price range as relevant for what seller price to state. The reasons for the design of the three BDM variants are as follows. Since anyone could fill a tank with fuel at the station for SEK 228 that day and probably in the near future as well, SEK 225 was taken to be the upper bound representing the prevailing price.[8] SEK 300 represented the upper bound of a case where the price was noticeably higher than what anyone would be willing to pay for a card (disregarding that anyone would treat the card as a collector's

[4] The experiments were conducted at the end of the subjects' first semester of courses in economics. To our knowledge, none of the subjects had previously participated in any economic experiment.

[5] The subjects were recruited 'for participation in an experiment in economic decision making' and told that the experiment 'takes some 30 minutes' and 'as participants you will earn some money; the amount depends partly on chance, partly on the decisions you make'.

[6] We used different subjects in each test. All groups were randomly selected.

[7] All instructions are available on request.

[8] A subject's valuation of the card might well fall short of current market value of the petrol for a number of reasons, such as the hassle of having to remember to bring the card to the station and a suspicion that the card would not be recognised when presented to the cashier. It should be pointed out that subjects were explicitly and, we think, convincingly told by the experimenter that he personally guaranteed that the cards could be used as stated and that the signature by the petrol station manager on each card was real. Obviously, the value of the card could also be affected by the subject's access to a car; this is explicitly taken into account below.

Table 1
Summary Statistics

	*BDM*225	*BDM*225*F*	*BDM*300	*BDMU*	*MARKET*
No. subjects	22	22	21	20	20‡
Mean ASK*	189	186	218	191	197
S.D. ASK*	25	41	25	55	30
Median ASK*	185	200	225	198	200
Mode ASK*	175	225	220	225	225
Max ASK*	228	225	250	300	250
Min ASK*	150	100	150	100	150
Skewness	0·050	−0·86	−1·12	−0·35	−0·13
No. *CAR*†	10	13	11	7	11

* In SEK.
† Number of subjects who said they expected to use a car to get to the university in the next couple of months. A χ-square test was run to test whether the number of subjects who expected to use a car to get to the university in the near future differed across the treatments. The result was that we could not reject the null hypothesis of no difference across treatments at any reasonable level of significance ($\chi^2_{df=4} = 2{\cdot}95$; $p = 0{\cdot}57$).
‡ Plus 23 buyer subjects.

item at a value exceeding the market petrol value, hence disregarding any significant 'endowment effect'). *BDMU* was designed under the hypothesis that not disclosing what the upper bound was, but stating that it was set at a level equal to the maximum price that we believe any real buyer would be willing to pay, would encourage the subjects to reflects on what this maximum price could be. This design could be relevant for certain objects where a precise maximum price is difficult to specify.

After subjects had stated their selling prices, they were asked whether or not they expected to use a car to get to the University in the next couple of months. In a regression, the variable *CAR* was set equal to 1 (0) for those who said yes (no) to this question.

The experiments reported in this paper were performed in two rounds, the second 6 months after the first. In the first round, we ran *BDM*225, *BDM*300, and a version of *BDMU* (and two other tests not reported here; for a full report see Bohm *et al.* 1995). The second round included tests of *BDMU*, the market experiment presented below and – for comparison between the two rounds – a repeated test of *BDM*225.[9] Since the two *BDM*225 tests gave similar results (Table 2, $p = 0{\cdot}73$; Table 3, $p = 0{\cdot}97$) we report, for brevity, all tests as if they were undertaken at the same time.

I.B *Results*

Summary statistics for *BDM*225, *BDM*300, and *BDMU* are reported in Table 1.[10] (The column *BDM*225*F* refers to the repeated test of *BDM*225 mentioned above; disregard the *MARKET* column for the time being.) Table 2 shows nonparameteric pairwise comparisons of the asks under the different

[9] The outside market price of the petrol that prevailed for the first round (SEK 228) was not very different from that at the time of the second round (SEK 225).
[10] All primary data are available on request.

Table 2

Pairwise Wilcoxon–Mann–Whitney Rank Sum Tests

	*BDM*225	*BDM*225*F*	*BDM*300	*BDMU*
*BDM*225*F*	0·73 (0·67)			
*BDM*300	**0·0003** **(0·0006)**	0·0025 (0·029)		
BDMU	0·43 (0·44)	**0·84** **(0·96)**	0·03 (0·048)	
MARKET	0·34 (0·34)	**0·63** **(0·76)**	0·018 (0·039)	**0·93** **(0·86)**

The table gives the *p*-values of the tests. The *p*-values in parentheses refer to tests performed with data truncated at SEK 225, i.e. all asks above SEK 225 are reduced to that level. Figures in bold type refer to tests from the same round. The null hypothesis in these pairwise tests is that the mean ASKs of the observed distributions are equal. The alternative hypothesis is that the means differ, i.e. these are two-sided tests. The Wilcoxon–Mann–Whitney test checks for differences in location. The results of the more general Kolmogorov–Smirnov test, which checks for any difference in the compared distributions, are qualitatively identical to those given above.

treatments. Table 3 presents a regression of asks on treatment dummies and the *CAR* variable.[11] The table also gives the corresponding statistics in parentheses where asks above SEK 225 have been reduced to SEK 225.

The main result is that asks in *BDM*300 are significantly higher than in *BDM*225 (Table 2, $p = 0{\cdot}0003$; Table 3, *p*-value = 0·00004), indicating that selling prices for subjects confronted with the BDM mechanism are quite sensitive to the choice of the upper bound, in spite of the fact that the dominant strategy in all three variants studied is to reveal selling reservation prices truthfully. If *BDM*225 is interpreted as having an upper bound reflecting the maximum price that any real buyer would be willing to pay, *BDM*300 would seem to make subjects overstate their selling reservation prices. It should be noted that this was not simply the effect of allowing subjects in *BDM*300 to state asks above SEK 225. As Table 2 indicates, a significant difference in asks remains if the observed distributions are truncated at SEK 225 (*p*-value = 0·0006). The reason for this difference may be, as suggested initially, that subjects in *BDM*300 may have been misled by the possibility of prices in excess of the prevailing price in the outside market.[12]

The results for *BDMU* are of particular interest, since this variant could be used (even) for objects whose realistic maximum buying prices on a market cannot be determined with any great precision by the experimenter (compare,

[11] With small group sizes such as those used here, the composition of the groups might differ in background variables to an extent that could be important for selling price behaviour. However, we could not come up with any interesting theory regarding personal characteristics that could be expected to influence the subjects' valuation of a commodity like the one used here, aside from the CAR variable. But since data on sex, age and past student record were available, we could run, at no significant extra cost, a regression including these background data. None of these variables had any significant effect and their inclusion does not alter the effects of the other variables.

[12] The *CAR* dummy had significant effects in the regression on both the level and the variance of the asks (with *p*-values of 0·01 and 0·001, respectively). This means that car owners valued petrol higher and more uniformly than did others.

Table 3

*Effects of Treatments and Car Access on Asks**

Variable	Estimate	S.E.	t-value	p-value
		Regression, dependent variable: *ASK*		
Constant	180	6·25	28·9	0·0000
	(182)	(5·81)	(31·3)	(0·0000)
BDM225F	−0·35	9·45	−0·04	0·97
	(−2)	(9·55)	(−0·17)	(0·86)
BDM300	29	7·10	4·12	0·00004
	(23)	(6·56)	(3·54)	(0·0004)
BDMU	4	12·5	0·30	0·77
	(−2)	(11·2)	(−0·15)	(0·88)
MARKET	12	7·92	1·53	0·13
	(8)	(7·44)	(1·09)	(0·28)
CAR	13	5·48	2·47	0·01
	(13)	(4·62)	(2·78)	(0·005)
		Regression, dependent variable: σ^2		
Constant	888	283	3·14	0·002
	(750)	(239)	(3·14)	(0·002)
BDM225F	0·94	0·43	2·20	0·03
	(0·93)	(0·43)	(2·17)	(0·03)
BDM300	−0·11	0·43	−0·25	0·80
	(−0·52)	(0·43)	(−1·21)	(0·23)
BDMU	1·39	0·44	3·18	0·001
	(1·15)	(0·44)	(2·64)	(0·008)
MARKET	0·26	0·44	0·59	0·55
	(0·002)	(0·44)	(0·004)	(0·99)
CAR	−0·75	0·23	−3·27	0·001
	(−0·46)	(0·23)	(−2·03)	(0·04)

A Wald test based on the coefficients in the regression†

The following hypotheses are tested:‡	Coefficient	S.E.	t-ratio	p-value
$BDM225F_{\text{MEANASK}} = MARKET_{\text{MEANASK}}$	−12·5	9·91	−1·26	0·21
$BDM225F_{\text{VARIANCEASK}} = MARKET_{\text{VARIANCEASK}}$	0·68	0·44	1·56	0·12

* This maximum likelihood estimation of Green's (1990) model of multiplicative heteroscedasticity takes into account the effects of the treatments on the variance as well as the level of the asks. The figures in parentheses refer to a regression performed with data truncated at SEK 225, i.e. all asks above SEK 225 are reduced to that level. The regression analysis reported here covered all treatments, including the three not discussed in detail in this paper. See Bohm *et al.* (1995).

† A full report of the Wald test is available on request.

‡ The alternative hypotheses in each row are that the compared moments differ.

e.g., the second example taken from Grether and Plott). *BDMU* did not produce mean seller prices that deviated significantly from *BDM225* (p-values $> 0·77$) although the variance was significantly higher (p-value $= 0·001$, as shown in Table 3). It should be noted that (in the first round) we tested another version of the BDM mechanism with an unspecified upper bound, but this time without the information that the upper bound was set 'equal to what we believe is the maximum price any real buyer would be willing to pay'. This version gave rise to asks significantly higher than in *BDM225* (p-value $=$ 0·017).[13] This can be interpreted as saying that if *BDM225* represented the

[13] The mean ask in this BDMU version was SEK 216 and the standard deviation SEK 58. Also in this version the variance was significantly higher than in BDM225 (p-value = 0·0000).

behaviourally incentive-compatible BDM version for the case at hand and if we hence wanted *BDMU* to yield mean asks not different from *BDM*225, it is not enough to leave the upper bound unspecified. The results suggest, at least in certain cases, that it is sufficient to add that the non-disclosed upper bound 'equals what the experimenters believe is the maximum price any real buyer would be willing to pay'. Although this wording cannot be regarded as credible, and therefore should not be used, for objects whose real maximum price can be determined only within a very wide interval (such as rare paintings), there are other objects where the maximum-price uncertainty is more limited (such as pieces of real estate) and therefore the added specification is applicable.

II. THE MARKET EXPERIMENT

II.A *Experimental Design*

To gain further insight into behaviour under *BDM*225, sellers were confronted with real buyers on a competitive market. This was done in a market design which rules out market power even in the case of a small number of traders. Forty-three subjects were invited to participate in the following experiment.

(1) A random sample of 20 of the subjects were taken to a separate room (for administrative reasons). There they were each given a card and assigned the task of being sellers of their cards on a market to be organised some minutes later.

(2) The remaining 23 subjects were given an SEK 40 participation fee. They were told that they could place bids on a petrol card in a market setting with the 20 sellers who in turn would be asked to state their selling prices for these cards. The 23 buyers were told that if they bought a card in the market, they did not need to pay for it until the following week.

(3) Once the 43 subjects were reassembled, they were given the same information *in plenum* as that given separately to the two groups. Sellers and buyers were now also told how to place asks and bids, respectively, on the basis of which trade would take place at a market price, established as follows.

Potential sellers (buyers) would be ranked from the lowest ask (highest bid) upwards (downwards); then,

(a) if there was a coinciding bid and ask, this would be the market price, and (i) if the number of buyers willing to pay the price coincided with the number of sellers willing to accept the price, this would be the number of cards traded (see Fig. 1 *a*);[14] (ii) if there were more sellers (buyers) than buyers (sellers) at this price, the experimenter would buy (supply) the overshooting number of cards supplied (demanded); hence, the number of cards traded would equal the maximum number of cards supplied or demanded at the 'equilibrium' price (see Fig. 1 *b*, *c*)

(b) if there was no coinciding bid and ask, the volume traded would be given by the number of cards for which there were buyers willing to pay more than

[14] Fig. 1 *a–d* are the diagrams used when these rules were presented and explained to the subjects. Subjects were told that they only needed to understand these rules when presented to them (orally and later in print), but that a full command of them was not needed when stating their buying or selling prices.

the sellers requested; then, the ask of the last actual seller would be the price buyers would have to pay and the bid of the last actual buyer would be the price sellers would get. The excess of selling prices over buying prices would be paid by the experimenter (see Fig. 1 *d*).

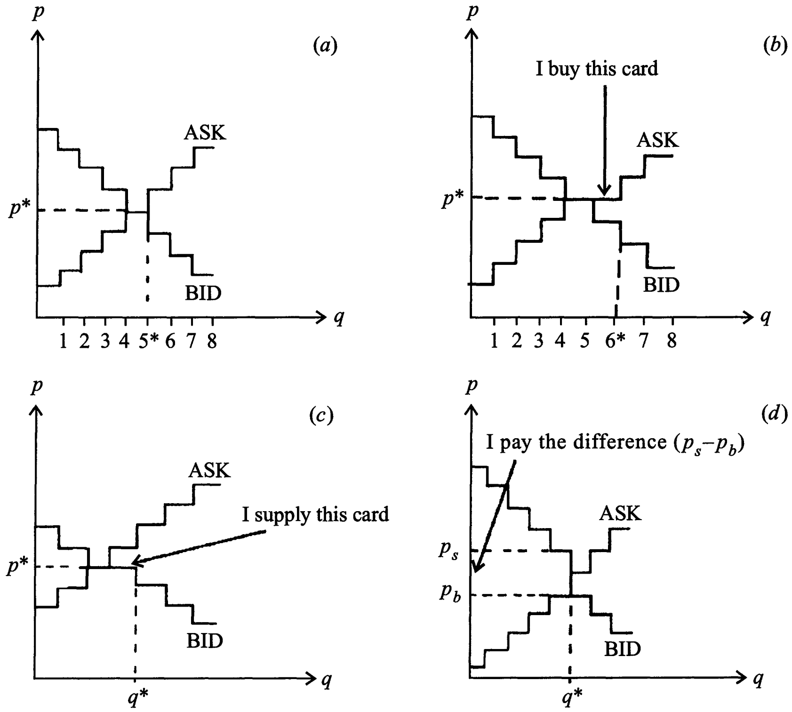

Fig. 1. (*a*) Case I. (*b*) Case II. (*c*) Case III. (*d*) Case IV.

Even with as many as 20 sellers and 23 buyers, subjects could still speculate that most asks would exceed the highest bids and hence that perhaps only a couple of cards would be traded. (The actual number of cards traded turned out to be six, with two cards supplied by the experimenter in line with what was explained under (*a*)(ii) above.) The reason for the choice of pricing formula for case (*b*) is that, in such a small market, where the chance of the type of disequilibrium implied by this case may be conspicuous and where the disequilibrium may represent a significant difference between the ask and the bid for the marginal unit traded, the alternative and perhaps simpler approach of setting a uniform market price equal to the marginal ask (or the marginal bid or the mean of the two) would provide incentives for misrepresentation of asks, bids, or both. For example, assume that the price would be determined by the marginal seller's ask (see Fig. 1 *d*). If so, a potential seller who observed the contingency shown in Fig. 1 *d* and who assigns a non-trivial probability to that contingency as well as to himself being the marginal seller, would have some incentive to state an ask above his true reservation price; if this contingency materialises, he might make a gain large enough to compensate him for the risk of losing the possibility of selling a card at a price he would be willing to accept. The case of a market price determined by the marginal actual buyer's bid should now be straightforward, in that case, a buyer could have an incentive to lower his bid below his true reservation price.

To stay clear of such distorting incentives for disequilibrium case (*b*), we chose the pricing formula mentioned, where neither buyer nor seller could influence the price relevant to him. Buyers could only influence the price for the sellers and *vice versa*. Subjects were told that this small market would work like a large one in the sense that the individual agent could influence his/her outcome only with respect to the volume of his/her trade (zero or one unit) at a price given by the behaviour of others. Hence, the incentives for individual behaviour would be the same here as in a large competitive sealed-bid double auction market. This information was given to the subjects.

II.B. *Results*

Summary statistics of the market experiment are reported in Table 1. Tables 2 and 3 show the results of the statistical analysis, which indicates that asks in the market experiment did not differ from asks in *BDM*225. The *p*-value is 0·63 (see Table 2) in the non-parametric test and 0·21 in the parametric test (see the Wald test reported in Table 3).[15]

III. CONCLUSIONS

In the literature, the BDM mechanism has been used for eliciting seller prices with the range of possible buyout prices significantly extending beyond what a real buyer could be expected to pay. The findings of this study show that this approach (implemented in *BDM*300) clearly inflates elicited seller prices relative to those obtained when the upper bound is closer to an expected real maximum buyer price (*BDM*225), even though the BDM mechanism is theoretically incentive compatible in both instances.

For many commodities (unlike petrol), where it is difficult to provide a narrow estimate of the maximum price a real buyer would be willing to pay, it could make sense to let the upper bound of the buyout-price range remain unspecified. We tested a BDM version, where the upper bound was not disclosed but where it was explicitly stated that the upper bound would be determined by the experimenter's estimate of the maximum price that any real buyer would be willing to pay (*BDMU*). Therefore, the subjects would have to make the same estimates if they regarded the upper bound as relevant to their decision. *BDMU* did not produce mean asks significantly different from those in the BDM version where the upper bound was to set close to a realistic maximum willingness to pay, readily available for the commodity traded here

[15] We tested, in addition, a more cost-saving design of the market experiment (although not theoretically incentive compatible) where 20 sellers were also asked to state buying prices for an additional card, thus reinforcing the demand side of 16 separate buyers and reducing the risk that the student subjects would be exposed to a collapse of a market we were obviously trying to establish. Mean seller prices did not differ significantly between the two designs ($p = 0{\cdot}96$ in the non-parametric test).

(*BDM*225). Thus, the evidence is consistent with the hypothesis behind *BDMU* where the upper bound is specified only to the extent that it is said not to exceed what any real buyer is believed to be willing to pay.

Furthermore, selling prices in *BDM*225 did not differ from selling prices under the incentive-compatible market institution presented here. The institution used does not allow the individual trader to influence prices to his/her own advantage, even when the number of traders is small.[16] Strictly speaking, we cannot be sure that a theoretically incentive-compatible market institution, used for any particular commodity such as that traded here, is behaviourally incentive compatible. Still, it is noteworthy that selling prices generated by this market institution did not differ from those elicited by a BDM version that disallowed any clearly unrealistic buyout prices (*BDM*225).

Stockholm University

Uppsala University

Stockholm University

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[16] This means that when one wants to implement a perfectly competitive experimental market, the institution designed here can be used to replace the more costly market institution where the absence of market power is created by a large number of traders.