Gender Effects in Private Value Auctions[*]

John C. Ham

Department of Economics, University of Southern California and IZA

and

John H. Kagel**

Department of Economics, The Ohio State University, Columbus, OH, USA

Abstract

In a two-stage auction women are significantly more likely to go bankrupt than men, bidding more aggressively than the men in both phases of the auction process.

** Corresponding author at: Department of Economics, 410 Arps Hall, 1945 North High Street, Columbus, OH 43210-1172, USA

E-mail address: Kagel.4@osu.edu (J.H. Kagel)

In an earlier experimental study of bidding in common value auctions, we collected demographic and ability data for subjects in an effort to determine if such things as gender, SAT/ACT scores, and student major had an impact on bidding in these auctions (Casari, Ham and Kagel, 2004; hereafter CHK). One of the most robust results from that study was that after controlling for ability via SAT/ACT scores and major, women start out bidding substantially higher than men, resulting in a much higher frequency of falling prey to the winner's curse (losing money conditional on the event of winning) and going bankrupt as a result. However, women also learn much more rapidly than men, so that by the end of their initial (inexperienced) subject session they have largely caught up with the men, and go on to slightly surpass them when returning as experienced subjects, in terms of their bidding behavior.

This gender effect - women were bidding much more aggressively than men - was a total surprise since it was a result for which we could find no precedent in the experimental literature. If anything, the more aggressive bidding by women in these auctions would seem to contradict received knowledge regarding gender effects as women are known to be more risk averse and less competitive than men (see Croson and Gneezy, 2004, for an up-to-date survey of gender effects as they relate to economic issues), which would dictate less aggressive bidding in this environment, resulting in less of a tendency to fall prey to the winner's curse.[1] However, given that women change their behavior relatively quickly, and learn faster than men, it occurred to us that this behavior could simply reflect women having less experience in strategic decision making.

This paper is designed to provide an initial look at gender effects in another auction environment to see if comparable results - more aggressive initial bidding by women followed by greater learning – would be found there as well.

Here we report on gender effects from an experiment whose primary purpose is to investigate indicative bidding in auctions (Kagel, Pevnitskaya, and Ye, 2004; hereafter KPY).

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[1] Unlike private value auctions, it is not possible to attribute this overly aggressive bidding by women to risk aversion in this case as all subjects start out bidding above the expected value conditional on winning and losing money as a consequence (i.e., they fall prey to the winner's curse).

Indicative bidding is a two-stage auction process commonly employed in field settings for capital intensive assets. In stage one bidders are invited to make non-binding bids to purchase the asset under a sealed-bid auction format. Based on these non-binding first-stage bids, a short list of bidders is selected to make binding bids for the asset in a first-price sealed bid auction. (See Ye, 2005, for further discussion of the motivation for and analysis of the properties of indicative bidding.) We look at data from the Indicative 100 treatment reported in KPY as this treatment resulted in minimal numbers of bankruptcies (and thus minimizes sample selection effects - see CHK). For present purposes, our only interest in these auctions is to look at gender effects in both the first and second-stages of the bid process. Readers should consult KPY for details regarding experimental procedures as well as the analysis of indicative bidding. Although KPY did not collect gender or other demographic/ability information, gender was determined after the fact from names on subject record sheets.

We can summarize our results as follows: First, women are significantly more likely to go bankrupt then men. This higher bankruptcy rate results from two factors: First, women are more likely to bid more aggressively than men with lower stage-one values, values which result in negative average profits conditional on entering into stage two. Second, women tend to bid higher than men in stage two, with a number of very high bids that result in instant bankruptcy conditional on winning the auction.

Experimental procedures: Each experimental session started with two auction markets with six bidders each (N=6) operating simultaneously. A total of 16 subjects were recruited for each session, with 4 of the 16 acting as standbys in any given auction period. In each auction period subjects were randomly assigned to one of the two auction markets, with members of the stand-by group guaranteed to be assigned to active bidding status in the next auction period. In case of bankruptcies, the number of subjects in the stand-by group was decreased. All of the IB100 sessions lasted the full 25 auction periods that were planned with two-auction markets operating simultaneously. Sessions lasted approximately 2 hours.

The experimental treatment involved a two-stage auction. Each bidder demanded a single unit, with first-stage values x_i drawn i.i.d. from a uniform distribution with support [500,1500] (with integer values only being drawn). Subjects then made non-binding (sealed) bids for the right to bid in the second stage. The two highest first-stage bids were given the right to bid in

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stage two. First-stage bids were restricted to be within [0, 10,000]. All bidders entering stage-two also paid a fixed entry fee of 100 (whether they won the auction or not).

Subjects entering stage two received updated information regarding their private value for the item, a random draw (y_i) of either 500 or 1500 with equal probability. The stage-two auction was a first-price sealed bid auction between the two bidders entering stage two. The total value of the item (v_i) for those bidding in stage-two is the sum of their stage-one and stage-two values ($v_i = x_i + y_i$) with the high bidder in stage-two earning the difference between v_i and their stage-two bid. Stage-two bids were restricted to be within [1000, 3000], the lowest and highest possible values of v_i.

A total of three sessions were conducted. Of the 48 subjects participating in these sessions, we could clearly identify gender for 45 subjects. For those whose gender could be identified 38% were women (17/45).[2] We look for differences between men and women in bankruptcy rates, first-stage bids, and in second-stage bids.

Bankruptcies: There were a total of 10 bankruptcies from the 45 individuals whose gender we could clearly identify. Women went bankrupt more often than men with 11% (3 out of 28) of the men and 35% (6 out of 17) of the women going bankrupt. The Z-statistic for the difference in these two frequencies is 1.99, which is significant at the .05 level using a two-tailed test.

Probits based on first-stage bids: First-stage bids determined the right to bid in stage two. Analysis of average profits in relationship to stage-one values shows that average profits were negative for those bidders entering stage-two with relatively low stage-one values; e.g., bidders whose stage-one values were 1000 or less (the lower half of the support for stage-one values) earned average profits of -25.0. These negative average profits resulted from two factors: First, other things equal, relatively low stage-one values resulted in relatively low profits conditional on winning in stage-two (103.7 versus 226.5 for those with stage-one values greater than 1000).[3]

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[2] Subjects whose gender was not identifiable from their name are dropped from the sample here.

[3] All values are denominated in experimental currency units which were converted into US dollars at the rate of 1 experimental dollar equaling $0.03. These calculations exclude five stage-two bids that were well above the bidder's stage-two value. Subjects were given starting cash balances of 600 to which profits were added, with final balances paid in cash along with a $6 participation fee.

Second, entering stage two with a low stage-one value significantly reduced a bidder's chance of winning in stage-two (37.0% versus 54.7% for those with stage-one values greater than 1000), while still having to pay the 100 stage-two entry fee.[4]

We provide two probits for stage-one bids. In the first probit the dependent variable is 1 if the first-stage bid was 10,000, and 0 otherwise. Recall that 10,000 was the maximum stage-one bid which many bidders made (39.8% of all bids were at 10,000) so that such a bid was indicative of a definite desire to get into stage-two. We use random effect models throughout, with subject as the random component, pooling the data for all sessions. We divide the data into two periods – early auctions (periods 1-12) and later auctions (periods 13-25) – specifying a dummy variable Per = 1 if periods 13-25, 0 otherwise. We employ a dummy variable to distinguish between stage-one values associated with positive expected profits conditional on entering into stage two versus those associated with negative expected profits (DS = 1if x > 1000; 0 otherwise). We employ a gender dummy F equal to 1 if female (0 otherwise). We include a number of interaction terms as well: Per*DS accounting for increased recognition that high stage-one values tend to produce positive profits conditional on entering stage two; F*DS permitting women to bid differently than men with high stage-one values, and F*Per and F*Per*DS which permits differential learning on the part of men and women. Thus, we assume that an individual bids 10,000 if the following index function is positive

$$I_{it}^* = \gamma_0 + \gamma_1 DS_{it} + \gamma_2 Per_{it} + \gamma_3 PerDS_{it} + \gamma_4 F_i + \gamma_5 FDS_{it} + \gamma_6 FPer_{it} + \gamma_7 FPerDS_{it} + \alpha_i + e_{it} \quad (1)$$

where the error terms α_i and e_{it} are each independently and identically normally distributed.

We obtain the following results based on 857 observations from 45 individuals (standard errors are in parentheses)

$$I_{it}^* = -1.281 +1.278DS_{it} - 0.019Per_{it} + 0.782PerDS_{it} + 0.334F_i - 0.449\ FDS_{it} - 0.038FPer_{it} + 0.112FPerDS_{it}$$
$$\quad\ (0.194)\ (0.204)\quad (0.202)\qquad (0.273)\qquad\qquad (0.319)\ (0.322)\qquad\quad (0.325)\qquad\quad (0.445)$$

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[4] An equilibrium for the game with risk neutral bidders is to have everyone bid the maximum in stage-one (a pooling equilibrium) and then for the two randomly selected stage-two bidders to bid the risk neutral Nash equilibrium (RNNE) in stage two as if in an independent private value auction. However, since in practice stage-two bids are substantially higher than the RNNE, it is no longer an equilibrium for everyone to try and get into stage two, only those with higher stage-one values can turn a profit by entering stage two. See KPY for details.

Both the DS and PerDS variables are positive and statistically significant at better than the 1% level, indicating that bidders were much more likely to bid the maximum with the higher, more profitable stage-one values, and that this tendency was more pronounced in the second half of an experimental session than in the first half. Both the Per and FPer variables are *not* statistically significant at anything approaching conventional levels, indicating that the tendency to bid the maximum for lower stage-one values is the same between the first and second half of the experimental sessions for both men and women for lower stage-one values. The gender dummy is positive but not significantly different from zero at conventional levels (p = 0.296), so that women tend to bid the maximum more often than men for lower stage-one values in the initial auction periods, but do not do so significantly more often. The same conclusion holds for later auction periods as well as the sum of the F and FPer coefficient values is positive, but not significant at conventional levels (p = 0.32). Summing the F and FDS terms, women are a little less likely than men to bid the maximum with higher stage-one values (summed coefficient value of -0.115), but this is nowhere near significant at conventional levels (p = 0.672). The same conclusion holds for later periods as well.

The second probit specification is the same as the first, except that the dependent variable in this case is actual entry into stage two. Note that in case of more than two stage-one bids of 10,000, the software randomly determined who the actual stage-two bidders would be. Further, there were a number of instances where subjects got into stage two when bidding less than10,000. The results from this specification are

$$I_{it}^* = -1.239 + 1.024\text{DS}_{it} - 0.137\text{Per}_{it} + 0.342\text{PerDS}_{it} + 0.730\text{F}_i - 0.391\text{FDS}_{it} + 0.072\text{FPer}_{it} - 0.219\text{FPerDS}_{it}$$
$$(0.219) \quad (0.201) \quad (0.207) \quad (0.270) \quad (0.306) \quad (0.299) \quad (0.311) \quad (0.415)$$

As one might expect the results here are quite similar to the previous probit since bidding the maximum in stage-one (10,000) was quite common, and determining who got into stage two was determined randomly from among those bidding the maximum. However, there is one important difference. Namely, the coefficient value for the gender dummy (F) has doubled in value and is statistically significant at better than the 2% level, indicating that women were more likely to enter into stage-two with lower stage-one values than men in the early auctions periods. Further, the summed coefficient values for F and FPer are positive and significant at the 2% level,

indicating that this behavior persists in later auctions as well. The key factor behind this difference from the previous probit is that entry into stage-two can occur with bids below 10,000, and did so at relatively high rates with low stage-one values; e.g., in periods 1-12 men and women entered stage two an equal number of times (23) with stage-one values at or below 1000, but women got in more often with stage-one bids less than 10,000 (9 times versus 3 times for the men). As such the probit with the dependent variable 10,000 only captures part of the more aggressive bidding by women with low stage-one values.[5] As a result, women entered stage two with low stage-one values relatively more often than the men as they comprise 37.8% of the subject population. Finally, for stage-one values greater than 1000, women also entered stage-two relatively more often than men with bids below 10,000, particularly in auction periods 1-12. But these differences are not enough to produce significantly higher entry rates as the sum of the F and FDS coefficient values are positive (0.339) but not significantly different from zero at conventional levels (p = 0.243).[6]

Regressions based on second-stage bids: We conducted random effects regressions based on second-stage bids. Explanatory variables consisted of the sum of the first and second stage valuations (*v*, a bidders' resale values in stage two), a gender dummy (F = 1 if a woman, 0 otherwise), a time dummy (Per = 1 if auction periods 13-25, 0 otherwise), and relevant interaction terms (*v*Per, *v*F, FPer, FPer*v*). We normalize the data by subtracting 1000 from all bids and all values. Our interest here is to see if there are statistically significant gender effects in the second-stage bids and, if so, what they are.

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[5] The number of stage-one bids equal to the maximum in periods 1-12 for stage-one values of 1000 or less differ a little from these: 18 for women versus 23 for men. For auctions 13-25 women entered stage-two with low stage-one values 19 times versus 20 times for the men, with 8 entries occurring with bids below 10,000 for the women versus 6 times for the men. The number of stage-one bids equal to the maximum in periods 13-25 for stage-one values of 1000 or less were 18 for women versus 25 for men.

[6] In periods 1-12 women got into stage-two with a slightly higher frequency than men (after adjusting for differences in the sample populations) with stage-one values greater than 1000 (44.3% of the entries versus 37.8% of the population), with a disproportionate number of these entries resulting from stage-one bids less than 10,000 (13 out of the 39 entries for women versus 8 out of 49 for men).

First, note that there are a number of outliers in the data consisting of bids that would have resulted in losses of 900 or more. In four cases these were winning bids, which resulted in immediate bankruptcy for the winning bidder. Further, four out of five of these bids were from women. Of course we do not know if these bids represent a gross misunderstanding of the auction process, typing errors, a deliberate effort to go home early, or something else? At any rate, given the sensitivity of least squares estimates to such outlier bids we drop them in the analysis that follows.

The estimated bid function for stage-two bids is:

$$B_{it} = 16.7 + 0.763\,v_{it} - 4.6\text{Per}_{it} - 0.012\text{Per}v_{it} - 19.0\,F_i - 0.034\,v_{it}F_i - 32.7\text{FPer}_{it} + 0.136\text{FPer}v_{it}$$
$$\quad\ (54.5)\quad (0.039)\quad (67.5)\qquad (0.052)\qquad\ (80.8)\quad\ (0.058)\qquad\ (102.7)\qquad (0.080)$$

The risk neutral Nash equilibrium (RNNE) bid function for stage-two bids here is $B_{it} = .50v_{it}$ ignoring the selection effects associated with the substantially higher entry rates associated with higher stage-one values noted earlier. Both the Per and Per$v$ variables are not significantly different from zero, implying that there is no significant change in the way men bid between early and later auction periods (joint test for significance yields p = 0.82). Women are bidding no differently from the men in the early auction periods as the F and vF variables are not (jointly) significantly different form zero (p = .40). However, in later auction periods women are bidding significantly differently form the men as the variables F, FPer, vF and FPer$v$ are jointly significant at better than the 5% level (p = .034). Summing these coefficient values, women are bidding more than men for all stage-two values greater than 1517, and bidding less than men prior to this. That is, women were bidding greater than men over the upper three quarters of the support for stage-two values in later auction periods. While such higher bidding can be rationalized in terms of greater risk aversion on the part of women compared to men, its does not explain why (i) women were bidding less than men with lower stage-two values and (ii) why this behavior did not manifest itself in earlier auction periods.

Summary and conclusions: The present analysis was motivated by finding gender effects in a series of common value auction experiments, for which there was no precedent in the literature. Namely, inexperienced women bid substantially more than men do to begin with, resulting in sharply higher bankruptcy rates. However, women also learned faster than men and closed the gap by the second experimental session. Using a readily available data set, we check if similar effects are present in a private value auction context. We examine data from the two-stage auctions for indicative bidding reported in KPY (2004). We find similar gender effects in this experiment as well as:

1. Women are more likely to go bankrupt than men, other things equal.

2. Women entered stage two with low stage one values significantly more often than men compared to their share of the sample population, and these were stage-one values that resulted in earning negative average profits in stage two. This occurred in both the early and later auction periods.

3. There are a handful of very high, outlier bids in stage-two with a disproportionate number of these bids placed by women compared to men. Dropping these outlier bids, there are no significant differences between how men and women bid in stage-two in early auction periods. However, in later auction periods women are bidding more than men over the upper three-quarters of the support for stage-two values.

Other studies that have looked at gender effects in auctions include Rutstrom (1998) and Chen, Katusack, and Ozdenoren (2004). Rutstrom looks for gender and racial effects in second-price and English private value auctions with subjects bidding for a box of high quality chocolates. She finds no gender effect, but that non-whites bid significantly higher than whites. Since this auction is probably best modeled as an independent private value (IPV) auction in which sincere bidding is a dominant strategy, this could simply represent taste differences. Chen, Katusack, and Ozdenoren check for gender effects in first- and second-price IPV auctions. They find that women bid significantly more than men in the first-price auctions, but find no differences in the frequency of sincere bidding in the second-price auctions. They argue that the latter indicates no differences in intelligence between that men and women in their sample, while the fact that women are known to be more risk averse than men explains women bidding more than men in the first-price auctions. The risk aversion hypothesis does not, however, hold for either the CHK results or the present results. CHK show that women are bidding significantly more than men in a common value auction environment where all bidders start out bidding above the expected value of the item conditional on winning; i.e., the overbidding results in larger average losses for the women than for the men to begin with. The results reported here also cannot be explained by risk aversion since (i) we find women significantly more likely than men to get into stage-two with stage-one values that were so low that they resulted in losing money on average and (ii) women were significantly more likely to go bankrupt than men.

While we do not know precisely what accounts for the more aggressive bidding reported

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for women than men here and in CHK, we can rule out risk aversion and intelligence as measured by the SAT/ACT scores, as these are used as control variables in CHK. At present we conjecture that the overbidding reflects a relative lack of experience with strategic interactions on the part of women compared to men. Support for this conjecture will require identifying similar effects in other experimental environments, which is part of an ongoing research project. What is the possible basis for this relative lack of experience with strategic interaction on the part of women compared to men? Recent research suggests that women tend to shy away from competitive situations more than men, even when they clearly have equal abilities for the task at hand (Niederle and Vesterlund, 2004). And it is in these competitive situations that strategic interactions would come into play.

References

Casari, M., Ham, J. and Kagel, J., 2004, Selection bias, demographic effects and ability effects in common value auction experiments, Ohio State University working paper.

Chen, Y., Katusack, P. and Ozdenoren, E., 2004, Impact of demographic, menstrual cycle, and educational background in private value auctions, University of Michigan working paper.

Croson, R. and Gneezy, U., 2004, Gender differences in preferences, mimeographed, University of Chicago.

Kagel, J., Pevnitskaya, S., and Ye, L., 2004, Indicative bidding: An experimental analysis, Ohio State University working paper.

Niederle, M. and Vesterlund, E., 2004, Do women shy away from competition? paper presented at the SITE Conference on Experimental Economics.

Rutstrom, E., 1998, Homegrown values and incentive compatible auction design, International Journal of Game Theory, 27, 427-41.

Ye, L., 2005, Indicative bidding and a theory of two-stage auctions, Games and Economic Behavior (in press).