The Winner's Curse: Experiments with Buyers and with Sellers

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This paper presents a replication and extension of experiments with the "winner's curse" which were initiated in John Kagel and Dan Levin (1984, 1986) and Douglas Dyer et al. (1989). The common-value auction involves firms bidding for an item of unknown common value. Since the value of the item is unknown, the winners can bid more than the value and thereby lose money. The winner's curse occurs if the winners of auctions systematically bid above the actual value of the objects and thereby systematically incur losses. The phenomenon is said to occur possibly in the bidding for such natural resources as mineral rights, where the value of the mineral is unknown but each firm has an estimate of the value. Due to the field nature of the data, doubts have existed as to the actual existence of the curse. The Kagel and Levin (1986) paper tested for the existence of the phenomenon in a laboratory setting. The hope is that, by achieving a thorough understanding of the phenomenon as it might exist in simple laboratory environments, economists will become better equipped to identify and study the phenomenon in more-complex field settings.

Kagel and Levin (1986) report the existence of a winner's curse, but as is the case with any seminal experiment, it is impossible to control for everything. After seeing their data and studying their experimental procedures, one finds that there exist alternative explanations for what they saw. The winner's curse involves buyers who pay more than the value of an item and therefore experience a loss. Monetary losses in an experiment pose a problem because the experimenter generally has no means of collecting money from subjects. Subjects, knowing this, have reason to believe that the downside risk on their actions is truncated, and thus they might be prone to more risky actions than would be the case if they were forced to suffer full losses. In order to minimize this effect, subjects are frequently given a cash stake which they can lose. Kagel and Levin (1986) were aware of the problem, and they provided such a stake and used experienced subjects. They also required subjects to leave the experiment if and when the stake was lost. While these procedures provide some control, the possibility that losses could have contributed to the existence of the winner's curse has not been completely eliminated (Robert Hansen and John Lott, 1991). After a loss or two, a subject's reserve could be sufficiently low that prospective losses could exceed the balance. Thus, inflated bids carry no additional risk. Furthermore, one could theorize that experience with the curse facilitates learning and caution even in people who have had experience with bidding on other occasions. According to that theory, the process of removing bankrupt subjects succeeded in removing subjects less prone to the curse (i.e., those who had the experience of losing money and might adjust their behavior accordingly). Thus, subjects more prone to the curse would remain in the experiment and contribute to the existence of the curse. The situation is complicated even further by the possibility that subjects' beliefs about the reaction of other subjects to potential bankruptcy could cause general departures

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from symmetric Nash-equilibrium behavior. Thus, a skeptic could claim that the existence, magnitude, and persistence of the winner's curse in the Kagel and Levin (1986) data were direct consequences of the way that Kagel and Levin's experimental procedures dealt with substantial losses by subjects. The technique used by Dyer et al. is the same as that used in Kagel and Levin (1986), so similar questions might be raised about it as well.

The strategy of the research reported here is to look for the phenomenon using procedures that avoid the bankruptcy problems. Two different sets of procedures are used. First, the "winner's curse" experiment in which subjects might lose money was conducted simultaneously with a second experiment in which subjects were making money. The second set of procedures involved competitors as sellers in a common-value auction. The winner's curse can appear in this setting as the sale of an item for less than it is actually worth to the seller. The seller's loss occurs as an opportunity cost only, so the possibility of bankruptcy does not exist.

The experiments using these different sets of experimental procedures produced several results which are the substance of the paper.

1. The winner's curse was observed in both experimental settings. In essence, the Kagel and Levin results were replicated.
2. The winner's curse observed by Kagel and Levin (1984, 1986) was not a consequence of their experimental procedures.
3. The winner's curse might diminish in size or frequency but does not completely dissipate over time.
4. The winner's curse is a general phenomenon exhibited by most agents.
5. Theories of "suboptimal" behavior advanced as explanations of the phenomenon do not explain the data as well as does the completely rational model in which the phenomenon does not exist at all theoretically.

The paper is organized as follows. In Section I, the experimental design is outlined. In Section II, some competing models are discussed. Section III contains a statement of the measurement system. The results are in Section IV. The concluding section contains a discussion of conjectures that might advance an understanding of the phenomenon.

I. Experimental Design

The experiments were two types of common-value auctions. The first type of experiment was the common-value auction as conducted by Kagel and Levin (1984, 1986) in which buyers bid for an item of unknown value. Subjects agreed that if they suffered losses they would work them off at $10 per hour.[1] In experiment 1, subjects participated in a sealed-bid private-value auction at the same time that they participated in a common-value auction in which the winner's curse might occur. In the second experiment, subjects participated in both a common-value auction in which they were buyers (experiment 2) and also in a common-value auction in which they were sellers (experiment 3). (In other words, experiments 2 and 3 were run simultaneously on the same subjects.) These secondary auctions constituted a source of funds which reduced the likelihood of bankruptcies in case the winner's curse was operative. These procedural changes were implemented so that subjects had full financial liability in the range of financial exposures that were likely to exist in the experiments.

The second type of experiments (experiments 3–5) were common-value auctions with competition among sellers as opposed to buyers. The sellers tendered offers to sell an item of unknown value. Each seller was given one item to sell. Their option was to keep the item and collect its value or sell the item and collect the revenues from the sale. The person with the lowest offer sold his item and received the asking price, while everyone else kept the item and received the value. In this common-value selling auc-

[1]Only one subject suffered sufficient loss to be required to work. He worked about one hour to cover an $8 loss.

tion, all subjects earned positive profits, including the winner, but the winner could suffer opportunity costs by selling the item for less than the amount received by those who did not sell the actual value of the item.

The experiments were conducted at the California Institute of Technology, using undergraduates as subjects. Most of the subjects had participated in other experiments prior to these and were familiar with the experimental environment. The subject pool serves as a partial control for the hypothesis that the curse might be due to confusion about instructions. The instructions read to the subjects are given in the Appendix. Prior to the experiment, the common values of the objects were determined by realization from a random-number table. Given the value of the object, "clues" or "signals" were drawn for each subject independently. Each subject was given a stack of slips of paper which contained the clues to the common value of the items being auctioned. The slips were stapled so that only the clue for the current period could be observed. The subject observed the clue and then submitted a bid. After the auction, all bids, signals, and the common value were posted. The winner was then announced. The subject removed the top slip to expose the clue for the next period.

The clue was called a signal about the true value of the item to be auctioned. The value of the item was randomly chosen from the range $(\underline{x}, \bar{x})$. If v was the item's value, then the signals were randomly chosen over an interval $(v-\varepsilon, v+\varepsilon)$, where ε is a positive value set by the experimenter. In order to avoid the winner's curse, the bidder must recognize that, if he wins and thus buys (sells) the object, then he probably has the highest (lowest) signal, which is probably above (below) the item's value. Therefore, in order for the person not to lose money, (forgo profits) he must bid (ask) significantly less (more) than this signal.

Five experiments were conducted. The first two were buyer markets which replicated one of the experimental settings of Kagel and Levin (1984, 1986). The next three were seller markets. All experiments were conducted with seven subjects. Experiments 1 and 2 had the same set of predrawn signals, and experiments 4 and 5 had the same set of predrawn signals. The value of ε for the buying auctions was \$30, and it was 200 francs in the selling auctions. The range from which v was drawn was $(\underline{x}, \bar{x}) =$ (\$25, \$225) for the buyer auctions and $(\underline{x}, \bar{x})$ = (150 francs, 1,500 francs) for the seller auctions. (The franc values were \$0.0025, \$0.001, and \$0.0007 for experiments 3, 4, and 5, respectively.) The parameter choices reflect an attempt to identify unambiguously the curse, should it exist. The models reviewed below suggest that the curse becomes more severe with larger ε and a larger number of people. The parameters are those of Kagel and Levin (1986) that make the curse severe. Another consideration was cost. In the seller auctions, all subjects (except the seller) were paid the value of the item, which makes the experiments potentially expensive. For example, if the value in the seller auction had been drawn from the same distribution over dollars that it was drawn from in the buyer auction, then the cost of the experiment would have been on the order of \$875 ([expected value of v]$\times 7$) per period. The scaling factor that was chosen to reduce the cost keeps ε equal to the same proportion of the range of v and also permits many periods. This creates an obvious difference in marginal dollar stakes between the two types of experiments, with the potential "losses" due to departures from Nash behavior being very small in the selling experiment. Should otherwise inexplicable differences in behavior be observed, the magnitude of incentive would be an obvious line of research to pursue.

II. Models

Assume that v is drawn from a uniform distribution. Assume that each x_i is drawn independently from a uniform distribution over the interval $[v-\varepsilon, v+\varepsilon]$. If x_i is the signal observed by individual i and the structure is common knowledge, the theoretical problem is to model how i chooses a bid as a function of x_i.

At least four models make sense. The first is the *risk-neutral Nash-equilibrium model* of the associated bidding game.[2] The second model is based on the hypothesis that individuals make a specific type of calculation error but still conform to the general principles of game theory. We call this the *strategic-discounting model*. The third model is based on the hypothesis that people do not behave strategically. They only bid the expected value as if the situation were a simple second-price auction of a lottery and not one in which strategies might be important. This model is called the *naive model*. The fourth model, called the *private-value model*, postulates that individuals bid as if x_i were a private value of the object for each i. That is, individuals fail to understand the basic statistical relationship between value and signals.

The optimal bidding strategy according to the risk-neutral Nash-equilibrium model (RNNE) is to bid as a function of the signal (x_i). Under the buying auction, the optimal strategy is

$$(1)\quad b(x_i) = x_i - \varepsilon + Y$$

$$Y = [2\varepsilon/(n+1)]$$

$$\exp[-(n/2\varepsilon)(x_i - (\underline{x} + \varepsilon))]$$

where n is the number of subjects. Under the selling auction, the RNNE optimal strategy is

$$(2)\quad b(x_i) = x_i + \varepsilon - Y$$

$$Y = [2\varepsilon/(n+1)]$$

$$\exp[-(n/2\varepsilon)(-x_i + (\bar{x} - \varepsilon))].$$

A strategic-discounting model (SD) is postulated by Kagel and Levin (1986) for buyer auctions. The model is based on the hypothesis that individuals fail to recognize that the auction winner will be the subject with the highest signal. Kagel and Levin's strategic-discounting model can be generalized to the seller auction. The equations for the optimal bidding strategy under the assumption that the bidder fails to recognize that the winner has the highest (lowest) signal are

(3) buying auction:

$$b(x_i) = x_i - (2\varepsilon/n) + (Y/n)$$

(4) selling auction:

$$b(x_i) = x_i + (2\varepsilon/n) - (Y/n).$$

The above equations for the RNNE and SD models are only valid on the interval $\underline{x} + \varepsilon \le x_i \le \bar{x} - \varepsilon$.

The naive model (N) for both the buying auction and the selling auction simply has the bid equal to the signal. The bidding strategy for both types of auctions is

$$(5)\qquad b(x_i) = x_i.$$

The final model, the private-value model (PV), holds that individual i makes the mistake of placing a private value x_i on the object and that the private value of each of the j others is independently drawn from the internal $x_j \varepsilon [x_i - \varepsilon, x_i + \varepsilon]$. By applying risk-neutral Nash theory to this situation, bidding functions can be derived. For buyers, the bidding function is

$$(6)\qquad b(x_i) = x_i - \frac{\varepsilon}{n}$$

and for sellers it is

$$(7)\qquad b(x_i) = x_i + \frac{\varepsilon}{n}.$$

III. Measurement Methodology

The four theoretical models lend themselves naturally to a single measurement system. The single regression for each individual,

$$(8)\quad b_{it} = \alpha_i + \beta x_{it} + \gamma Y_{it} + e_{it} \sim N(0, \sigma_i^2)$$

can be used as a measure of the accuracy of all four theoretical models. The equation

[2]Obviously, risk aversion is a natural extension. We have been unable to find a closed-form solution for the bidding functions.

TABLE 1—PARAMETER RESTRICTIONS IMPOSED BY COMPETING THEORETICAL MODELS

	Buying			Selling		
Model	α	β	γ	α	β	γ
Risk-neutral Nash equilibrium	−30	1	1	200	1	−1
Strategic discounting	−8.6	1	0.14	57.1	1	−0.14
Naive	0	1	0	0	1	0
Private value	−433	1	0	28.6	1	0

can be used for both buying auctions and selling auctions. A summary of the restrictions on the regression equation imposed by the competing theories is included as Table 1. As can be seen, all theoretical models predict $\beta = 1$. The intercept term can be interpreted as $\delta\varepsilon$, where ε is the value of the range of the signal $\{x_i \in [v - \varepsilon, v + \varepsilon]\}$, so $\alpha = \pm 1\varepsilon$ in the RNNE model, $\alpha = (2/n)\varepsilon$ in the SD model, $\alpha = 0$ in the N model, and $\alpha = \pm(1/n)\varepsilon$ in the PV model. For the RNNE model, γ is ± 1; it is $\pm 1/n$ for the SD model, and it is 0 for both the N and the PV models.

The measurement strategy is first to apply the unrestricted regression model. The coefficients can be compared to the theoretical values of the competing models. Then models with parameters as restricted by theory will be applied. The SSE of the unrestricted model can be used with the SSE of the restricted model to compute an F statistic (Chow test) for the hypothesis that the restrictions are not significantly different from the unrestricted measurements. The F statistic will also be used as a measure of the relative closeness of the competing models.

IV. Results

The results of primary interest bear on the existence of the winner's curse. Of secondary interest are results that might uncover the principles that govern individual decision behavior. The findings are summarized by five conclusions.

Conclusion 1: The winner's curse exists.

Evidence. The per-period profit from all auctions is used as a measure. In buying auctions, the profit is the actual value of the object minus the purchase price of the auction winner. In selling auctions, the profit is the sale price of the object minus the actual price received by the winner. Thus, in selling auctions, a negative profit is an opportunity cost incurred because the item was sold for less than it was worth to the seller.

Table 2 lists the average per-period profits from all experiments. As can be seen, the winner suffers a loss in four of the five experiments on average. The table also reports the ratio of the number of auctions in which a loss occurred to the total number of auctions. In all cases, a large proportion of the auctions resulted in a loss. The only possible exception to the general tendency is experiment 4, which was characterized by a large number of attempts at collusion. In total, more than half of all auctions resulted in a loss.

Conclusion 2: The winner's curse persists with experience, but the magnitude and frequency of losses decline with experience.

Evidence. The frequencies of losses of the auction winners are divided into ten-period quartiles for every experiment in Table 3. The size of the average loss is also included in the table. As can be seen, the proportion of auctions in which losses occur is significantly greater than zero in all quartiles. Even after 20 or 30 auctions, the winners lose money more than 25 percent of the time. The frequency of losses decreases after the first 10 trials in all experiments except experiment 5.

The complete time-series of profits for experiment 5 is included as Figure 1. The figure also shows the profit that would have occurred if the agent had used the RNNE strategy. As can be seen, the winners' losses continue to occur even after 30 auctions.

TABLE 2—WINNER'S AVERAGE PROFIT AND THE LOSS FREQUENCIES FOR ALL EXPERIMENTS (PROFITS GIVEN IN DOLLARS, WITH FRANCS IN PARENTHESES)

Experiment	Average profit per period	Average RNNE predicted profit per period[a]	Number of periods with winner's loss) (total number of periods)
1 (buyer)	−1.67 (−1.67)	11.13 (11.13)	12/20
2 (buyer)	−3.60 (−3.60)	8.85 (8.85)	10/17
3 (seller)	−0.022 (−8.88)	0.196 (78.44)	8/17
4 (seller)	0.021 (20.91)	0.069 (69.28)	13/35
5 (seller)	−0.013 (−18.55)	0.050 (70.85)	25/40

[a]The given RNNE equation is valid only for: $\underline{x} + \varepsilon \leq x_i \leq \bar{x} - \varepsilon$. Some of the winners' signals were not in this range, so no predicted RNNE profit is possible. Therefore, this average includes only periods for which the RNNE predicted profit can be calculated.

TABLE 3—FREQUENCY OF LOSSES FOR WINNERS IN ALL EXPERIMENTS (PROFITS GIVEN IN DOLLARS, WITH FRANCS IN PARENTHESES)

	Experiment				
Quartile	1 (buyer)	2 (buyer)	3 (seller)	4 (seller)	5 (seller)
Periods 1–10					
Number of periods of loss	8/10	8/10	5/10	6/10	5/10
Average profit per period	−7.90 (−7.90)	−8.31 (−8.31)	−0.075 (−29.80)	−0.048 (−48.20)	0.001 (1.10)
Average RNNE profit per period[a]	4.53 (4.53)	5.70 (5.70)	0.177 (70.96)	0.060 (60.44)	0.048 (68.71)
Periods 11–20					
Number of periods of loss	4/10	2/7	3/7	2/10	7/10
Average profit per period	4.57 (4.57)	3.12 (3.12)	0.053 (21.00)	0.032 (31.60)	−0.016 (−22.40)
Average RNNE profit per period[a]	18.47 (18.47)	13.58 (13.58)	0.212 (84.85)	0.048 (48.15)	0.037 (52.68)
Periods 21–30					
Number of periods of loss				3/10	5/10
Average profit per period				0.058 (58.40)	−0.004 (−6.10)
Average RNNE profit per period[a]				0.104 (104.02)	0.090 (128.91)
Periods 31–40					
Number of periods of loss				2/5	8/10
Average profit per period				0.063 (62.80)	−0.033 (−46.80)
Average RNNE profit per period[a]				0.065 (65.34)	0.024 (33.72)

[a]The given RNNE equation is valid only for: $\underline{x} + \varepsilon \leq x_i \leq \bar{x} - \varepsilon$. Some of the winners' signals were not in this range, so no predicted RNNE profit is possible. Therefore, this average includes only periods for which the RNNE predicted profit can be calculated.

This experiment has a more severe curse than the other experiments. Unlike the other experiments, the frequency does not decline with experience.

The first two conclusions offer answers to the questions initially posed for experimental examination. The next series of conclusions reflect questions posed in an attempt to understand why the phenomenon occurs. As was reviewed in the section above, only four theoretical models have been advanced. The first question posed was whether or not any of these four models represents the data in a statistical sense. Since the answer turns out to be negative, the next series of questions is an attempt to

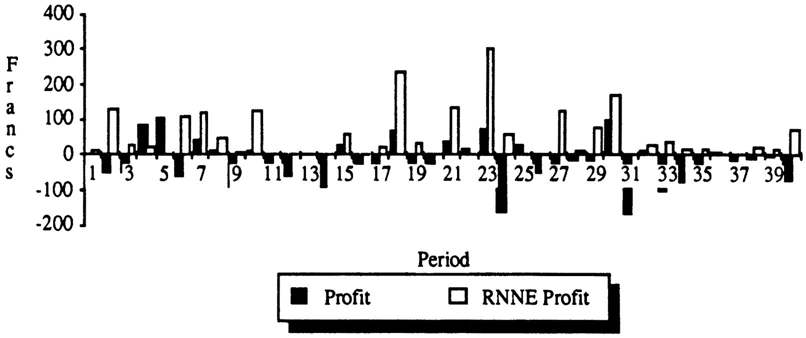

FIGURE 1. PER-PERIOD PROFIT AND RNNE PREDICTED PROFITS FOR EXPERIMENT 5

Note: In periods 5, 11, 13, 20, 22, 25, 26, 31, 36, and 37, the signal is not in the interval $[\underline{x}+\varepsilon \leq x_i \leq \bar{x}+\varepsilon]$, which is the valid range for the given RNNE function. Therefore, no RNNE predicted profits are shown

identify the "best" model and to ask why it fails.

Conclusion 3: All four models (RNNE, SD, N, and PV) can be rejected as statistical representations of the data.

Evidence. Table 4 contains the results of the Chow test described in the section above. In all cases, the statistical model with parameters as restricted by the competing theoretical models can be rejected as being significantly different from the unrestricted estimates. For example, the F statistic for rejecting the model at a 5-percent confidence is 2.64, while the statistic for the RNNE model for buying auctions is 30.53, and for selling auctions it is 5.93.

Conclusion 4: The RNNE model is the best model of the three considered, and the N model is the worst.

Evidence. The pooled data in Figure 2 show the relationship between individual signals and bids. The visual impression favors the RNNE model. The scattered data in the upper left of the figure for the seller auctions are the bids of a small number of subjects who were (evidently) signaling for collusion.

Table 5 contains the estimated coefficients from pooled data, which can be compared with the predictions in Table 1. With the exception of the x_i coefficient, β, the standard errors tell the same stories as do the Chow tests discussed below. The param-

TABLE 4—F STATISTICS FOR THE HYPOTHESIS THAT PREDICTIONS OF RESTRICTED REGRESSION AND UNRESTRICTED REGRESSIONS ARE THE SAME (DEGREES OF FREEDOM; 5-PERCENT F VALUES)

Model	Buying auctions	Selling auctions
RNNE	30.53	5.93
	(3,226; 2.64)	(3,465; 2.61)
Strategic discounting	133.84	91.22
	(3,226; 2.64)	(3,465; 2.61)
Naive	341.12	160.13
	(3,226; 2.64)	(3,465; 2.61)
Private value	224.87	122.99
	(3,226; 2.64)	(3,465; 2.61)

FIGURE 2. PAIRS OF SIGNALS AND BIDS FOR ALL INDIVIDUALS AND ALL EXPERIMENTS

Key: Longer-dashed line shows the prediction of the N model; shorter-dashed line shows the prediction of the SD model; dotted line shows the prediction of the PV model; solid line shows prediction of the RNNE model.

TABLE 5—ESTIMATED COEFFICIENTS FOR POOLED INDIVIDUALS (STANDARD ERRORS IN PARENTHESES)

Experiments	α	β	γ
1–2	−22.694	0.998	0.514
	(3.156)	(0.024)	(0.674)
3–5	341.658	0.863	0.255
	(38.335)	(0.046)	(1.585)

eter values estimated by the regression can be rejected as being equal to those of any of the four models. The β term is close to 1, but this is predicted by all models. The intercept term, α, is closest to that predicted by the RNNE model. The γ term has such a large standard error that little can be said other than that the sign is in agreement with both the RNNE and the SD models.

The major support for the conclusion is simply a restatement of the F statistics in Table 4. If the F statistic is taken as a measure of accuracy, then the RNNE model is always more accurate than its closest competitor, the SD model. The PV model ranks third, and the N model is the worst. The F statistics for all models were also computed for each individual. For the 35 individual data sets, the RNNE model was the best fit (lowest F statistic) for 25, and 10 of these did not differ significantly from RNNE predictions. The SD model was best for all of the remaining 10 individuals, but in all cases, the data were significantly different from the predictions of the SD model.

TABLE 6—NUMBER OF TIMES WINNER HAD HIGHEST AND SECOND-HIGHEST SIGNAL

Experiment	Highest	Second-highest	Number of periods
1 (buyer)	14	3	20
2 (buyer)	9	8	17
3 (seller)	11	3	17
4 (seller)	21	8	35
5 (seller)	25	7	40

Conclusion 5: Failure of the RNNE model is not due to a few "irrational" people. Almost all agents experienced the "curse" and bid in a manner that was consistent with "curse" behavior.

Evidence. Table 6 gives the number of times that the winning bidder had the highest signal or the second-highest signal. The game-theoretic model predicts that the individual with the highest signal will win the auction. In each experiment, more than half of the auctions were won by the subject with the highest signal. As can be seen, decisions that resulted in winning the auction were not the result of some type of impulsive move by some agent with a lower signal; nor was it the case that bids differed so much across subjects that the fundamental game-theoretic proposition that a positive relationship exists between bids and signals is destroyed. In fact, the empirical result in Table 5 that $\beta = 1$ is strong support for that part of the theory.

Table 7 gives the number of times each agent won the auction and the number of times each agent lost money as a result of winning the auction with a bid that was too high. As can be seen, the experience happens to most individuals. Of the 28 people who won two or more auctions, 20 of them lost money 50 percent of the time or more. Of the 35 subjects, only eight never lost money.

TABLE 7—NUMBER OF WINNING BIDS SUBMITTED AND NUMBER OF TIMES LOSSES OCCURRED, BY SUBJECT AND EXPERIMENT

	Experiment				
Subject	1 (20 periods)	2 (17 periods)	3 (17 periods)	4 (35 periods)	5 (40 periods)
1					
Number of winning bids	4	5	6	3	7
Number of times lost money	3	4	2	2	4
2					
Number of winning bids	3	1	1	6	7
Number of times lost money	2	0	0	3	4
3					
Number of winning bids	0	1	4	0	5
Number of times lost money	0	1	2	0	4
4					
Number of winning bids	5	2	1	5	4
Number of times lost money	3	2	0	2	2
5					
Number of winning bids	4	3	2	6	4
Number of times lost money	3	1	2	2	2
6					
Number of winning bids	2	2	2	12	7
Number of times lost money	0	0	2	3	4
7					
Number of winning bids	2	3	1	3	6
Number of times lost money	1	2	0	1	5

V. Closing Remarks

One question appears to be answered clearly: a winner's curse can be observed. A presumption exists about an answer to a second question: it appears that the curse can persist over many experiences. A major puzzle remains: of the models studied, the best is the risk-neutral Nash-equilibrium model, but that model predicts that the curse will not exist.

Part of the difficulty with further study stems from the lack of theory about the behavior of common-value auctions with risk aversion. Closed-form solutions which permit researchers to estimate models of "subrational" behavior have not been worked out. If the effect of risk aversion is to raise the bidding function as it does in private auctions, then risk aversion together with the strategic-discounting model might resolve the puzzle; but, of course, this is only a conjecture.

Appendix—Instructions

Instructions for buyer auctions are those that were used by Kagel and Levine (1986) and can be found in the appendix to their paper. Instructions were handed out to subjects, and all examples were also on the chalkboard. After the instructions were given to the subjects, they were read aloud by the experimenter, and then the following "test" was administered.

1. Buyer A gets a signal value of $105.00. He bids $100.00 but he is not the high bidder. His ______ (profit/loss) is $______.
2. Buyer B gets a signal value of $75.00. She bids $60.00 and she is the high bidder. The value of the item is $65.00. Her ______ (profit/loss) is $______.
3. Buyer C gets a signal value of $161.00. He bids $132.00 and he is the high bidder. The value of the item is $131.00. His ______ (profit/loss) is $______.
4. Buyer D gets a signal value of $120.00. The value of epsilon is $30.00. Therefore, Buyer D knows that the value of the item is between $______ and $______.

Instructions for the Seller Auctions [Exact Transcript]

GENERAL

This is an experiment in the economics of market decision making. The instructions are simple and if you follow them carefully and make good decisions you might earn money which will be paid to you in cash.

In this experiment we will create a market in which you will act as sellers of a commodity in a sequence of trading periods. One unit of the commodity will be auctioned off in each trading period. There will be several trading periods.

Your task is to submit written asks for the commodity. The precise value of the commodity at the time you make your ask will be unknown to you. Instead, each of you will receive some information regarding the value of the commodity which you may find useful in determining your ask. The process of determining the value of the commodity and the information you receive will be described below.

The currency in these markets is francs. Each franc is worth $______ to you.

The low ask gets the item and makes a profit equal to the ask. If you do not make the lowest ask on the item, you will earn the value of the commodity.

During each trading period, you will be selling in a market in which all of the other participants are also selling. After all asks have been handed in, all signals and asks will be posed on the blackboard. We will circle the low ask and post the value of the item.

The value of the auctioned commodity (V) will be assigned randomly and will lie between 150 and 1500 inclusively. For each auction, any value within this interval has an equally likely chance of being drawn. The value of the item can never be less than 150 nor more than 1500. The values V are determined randomly and independently from auction to auction. A high value of V in one period tells you nothing about the likely value in the next period. It does not even preclude the same value of V appearing in later periods.

Although you do not know the precise value of the item in any particular trading period, you will receive information which will narrow down the range of possible values. This will consist of a private information signal which is selected randomly from an interval whose lower bound is V minus epsilon, and whose upper bound is V plus epsilon. Any value within this interval has an equally likely chance of being drawn and being assigned to one of you as your private information signal.

Throughout this experiment, the value of epsilon is 200.

PRIVATE INFORMATION SIGNALS

Although you do not know the precise value of the item in any particular trading period, you will receive information which will narrow down the range of possible values. This will consist of a private information signal which is selected randomly from an interval whose lower bound is V minus epsilon, and whose upper bound is V plus epsilon. **ANY VALUE** within this interval has an **EQUALLY LIKELY** chance of being drawn and being assigned to one of you as your private information signal. You will always know what the value of epsilon is.

For example, suppose that the value of the auctioned item is 762 and that epsilon is 200. Then each of you will receive a private information signal which will consist of a randomly drawn number that will be between 562 (V − epsilon = 762 − 200) and 962 (V + epsilon = 762 + 100). Any number in this interval has an equally likely chance to be drawn as your signal value.

The line diagram below shows what is going on in this example.

V − epsilon V + epsilon
[V]
150 { signal } 1500
values may be
anywhere in this
interval

EXAMPLE

The value of the auctioned item is 762. This is the information each seller received, and the asks each seller made:

SELLER #	SIGNAL VALUE	ASK
1	590	703
2	756	900
3	838	947
4	634	778
5	716	775
6	847	920
7	642	825

In this example Seller #1 submitted the lowest bid, so he sells the item. His profit is the sale price 703. Seller #1 received 703 while the other sellers receive the value 762.

You will note that the value V of the auctioned item must always be between your signal value minus epsilon, and your signal value plus epsilon.

Finally, you may receive a signal value below 150 or above 1500. This merely indicates that the value V of the auctioned item is close to 150 or 1500.

Your signal values are strictly private information. **DO NOT REVEAL THEM TO ANYONE ELSE**. You are **NOT** to reveal your asks or profits, nor are you to speak to any other subject while the experiment is in progress.

You will not be told the value of V until after all the asks have been collected and posted.

No one may ask less than 0 for the item, nor may anyone ask more than 1700 (which is the maximum value of V plus epsilon). In case of ties for the low ask, we will flip a coin to decide who gets the item.

Are there any questions?

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