Auction Theory and the Market for Audit Services: Evidence that the Winner's Curse may contribute to Low Balling Behavior

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ABSTRACT: We argue that the market for audit services closely resembles a common value seller's auction. In particular, audit firms typically compete to supply an audit service whose cost is uncertain but similar across audit firms for a given audit client. Further, audit firms generate their own estimate of the true cost of the audit service prior to offering a price. Thus, applying auction theory to the market for audit services may yield new insights for audit research. To demonstrate the usefulness of auction theory to auditing research, we study experimental audit markets that take the form of a common value seller's auction. We find that non-incumbent auditors (sellers) fall prey to the winner's curse and low ball their audits on average. This low balling behavior is reduced but not eliminated with experience. Thus, we document the existence of a winner's curse in the market for audit services and identify one factor that might mitigate it. We discuss the potential for this form of low balling to impair auditor independence and raise other research questions that may be addressed by applying auction theory to the market for audit services.

Key Words: Audit pricing, Auction theory, Low balling, Winner's curse

Data Availability: Data available upon request.

I. INTRODUCTION

Researchers have begun to utilize the large literature in auction theory to generate new insights in accounting.[1] For example, Baiman, Fischer, Rajan, and Saouma (2007) use auction markets found in the literature to generate new solutions to the problem of resource allocation in a multi-divisional firm. Bloomfield and Luft (2006) use a seller's auction to show how responsibility for cost management can hinder contractors from learning to avoid the winner's curse. To date, however, researchers have not directly applied auction theory to the market for audit services. In particular, while prior research has discussed whether the cost of performing an audit should be treated as a private and/or a common value item (Kanodia and Mukerhji 1994; Schatzberg and Sevcik 1994; Coate and Loeb 1997), researchers have not identified a theoretical auction that resembles the market for audit services. Further, prior studies have solved for the risk neutral Nash equilibrium bidding strategy applicable to a given audit setting but have largely ignored evidence in the auction literature that bidding behavior displays systematic deviations from such risk neutral Nash equilibrium strategies.

The purpose of this study is to demonstrate the potential usefulness of auction theory in audit research. We argue that the market for audit services closely resembles a common value seller's auction. Thus, applying auction theory to the market for audit services may yield new insights. To demonstrate the potential for new insights, we study experimental audit markets that take the form of a common value seller's auction. In particular, we examine the behavior of experimental audit markets where each auditor (seller) has a private cost estimate drawn randomly from a range around the true cost of the audit. We find that non-incumbent auditors

[1] For extensive reviews of the auction literature, see Kagel (1995), Kagel and Levin (2002), and Klemperer (2004).

(sellers) fall prey to the winner's curse and low ball their audits on average. This behavior is reduced but not eliminated with experience. Our results suggest that the winner's curse may contribute to low balling behavior in the market for audit services. By applying auction theory to the market for audit services, therefore, we generate new insights regarding low balling behavior.

Kanodia and Mukherji (1994, 607) argue that the market for audit services shares characteristics in common with the market for other professional services such as consulting or advertising. These characteristics include the following: (1) Services are specific to each individual client's idiosyncratic needs. (2) Information about a specific client's needs is discovered mainly during the process of servicing the client. (3) Client specific information is useful for repeatedly servicing the client in the future. (4) Long term contingent contracts cannot be written. (5) There are several competing suppliers. The first two characteristics imply that there is ex ante uncertainty regarding the true cost of the service, the third characteristic implies that an incumbent service provider accrues an informational advantage in future engagements, and the last two characteristics imply that there will be competition from other suppliers to provide the service. Kanodia and Mukherji assert that these characteristics can lead service providers to make price offers below the short-term cost of the service to maximize long-term profit.[2] They do not, however, identify a theoretical auction that best matches the market for audit services or identify behavioral factors that may contribute to low balling behavior.

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[2] Regulators who oversee the auditing industry have frequently expressed concerns about the presence of low balling in auditing because of the possible impairment of auditor independence. Regulators who have expressed concern about the presence of low balling in the market for auditing services include the American Institute of Certified Public Accountants (AICPA 1978) and the Securities and Exchange Commission (SEC 1977). In a 2001 speech at the 3rd annual SEC Disclosure and Auditing Conference, Lynn E. Turner, the Chief Accountant for the SEC stated: "Low balling of audit fees is a serious issue that was raised by various people who testified during the public hearings that the Commission held on the topic of auditor's independence…(W)e will be monitoring the fees where there are changes in auditors to assess whether the concerns regarding low balling are valid."

The extant audit pricing literature appears to have reached a consensus that auditors pursue a low balling pricing strategy as a rational response to the presence of future expected quasi-rents (DeAngelo 1981; Schatzberg 1994; Kanodia and Mukherji 1994; Schatzberg and Sevcik 1994; Coate and Loeb 1997). Quasi-rents are excess rents that a firm may earn in the short run because of the competitive advantage of incumbency.[3] Absent from the audit pricing literature, however, is a discussion of other characteristics inherent in the market for audit services that may contribute to low balling behavior. For example, the ex ante uncertainty in the cost of the audit and the presence of competitors may lead auditors to unintentionally low ball their audits. This behavioral source of low balling, which has not been previously demonstrated in the audit literature, has significant implications for both regulation and audit research.

Experimental economists have extensively studied the behavior of buyer's auctions where there is competition to purchase an asset, the prospective buyers are uncertain as to the (ex ante) value for the asset, all prospective buyers are aware that they have the same (ex post) value for the asset, and each bidder develops an independent estimate of the true value of the asset (Kagel and Levin 2002). This form of auction, which characterizes many real-world markets such as the market for oil leases, has been labeled the "common value auction".[4] A key feature of bidding behavior in common value auctions is the "winners curse," whereby bidders systematically fail to condition their expected value for the asset given that they possess the most

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[3] Prior research has advanced various sources for the expectation of quasi-rents in auditing. DeAngelo (1981) proposes that transaction costs, specifically start-up costs and switching costs, produce the opportunity for quasi-rents. Schatzberg (1994) proposes that opinion shopping can produce quasi-rents. Kanodia and Mukherji (1994), Schatzberg and Sevcik (1994), and Coate and Loeb (1997) propose that the informational advantage obtained from incumbency, specifically the incumbent auditor's ability to surreptitiously learn the true cost of the audit, produces quasi-rents.

[4] In a pure common value auction, the actual value of the asset is the same for everyone but bidders have different private information about the actual value. Common value auctions typically take the form of a first-price sealed-bid auction. That is, each bidder chooses a price without knowing the prices of other bidders and the highest bidder wins the asset at their stated price (Klemperer 2004).

optimistic estimate of the item's value (Kagel and Levin 1986). Despite the large number of studies related to the common value *buyer's* auction (see Kagel 1995; Kagel and Levin 2002; and Klemperer 2004), there is little evidence regarding the common value *seller's* auction. Yet, the common value seller's auction is the type of theoretical auction that most closely resembles the characteristics of the audit market identified by Kanodia and Mukherji (1994, 607).

To address this gap in the literature, and demonstrate the usefulness of auction theory to auditing research, we study experimental audit markets that take the form of a common value seller's auction. In particular, we examine the behavior of experimental audit markets in which each auditor (seller) has a private cost estimate drawn randomly from a range around the true cost of the audit. In previous low balling experiments, auditors have been provided the true cost of the audit (Schatzberg 1990; Schatzberg 1994) or identical information from which to estimate the true cost of the audit (Schatzberg and Sevcik 1994). We assert that it is more descriptive of the audit market to assume that audit firms possess private cost estimates of the true cost of an audit. To focus on potential behavioral sources of low balling, we eliminate the possibility of future quasi rents by excluding transaction costs and other features designed to give incumbent auditors a cost advantage. In particular, our experimental audit market operates as a one-period repeated common value seller's auction in which auditors (sellers) are provided with individual cost signals and make price offers to a robot client (buyer) who is programmed to accept the lowest price offer. If the expectation of future quasi-rents is the only source for low balling behavior, therefore, we should not observe low balling in our experimental setting.

We find that audit firms (sellers) make price offers below the true cost of the audit even when there is no opportunity for future quasi-rents. This low balling behavior is reduced but not eliminated with experience. Thus, we document the existence of a winner's curse in the market for audit services and identify one factor that might mitigate it. Previous experimental studies that have tested low balling behavior attributable to future quasi-rents have found that such low balling behavior *increases* with experience (Schatzberg 1990; Schatzberg 1994; Schatzberg and Sevcik 1994). Thus, our result that low balling behavior *decreases* with experience provides further evidence that the source of the low balling we document is a systematic pricing error consistent with the winner's curse. Yet, our behavioral form of low balling behavior does not completely go away even after repeated replication.

By applying auction theory to the market for audit services, this study contributes to both the audit pricing literature in accounting and the auction literature in economics. Regarding the audit pricing literature, assuming that audit markets take the form of a common value seller's auction represents a refinement in the literature that is capable of yielding new and useful insights. Schatzberg and Sevcik (1994), Kanodia and Mukherji (1994), and Coate and Loeb (1997) deviate from the early low balling literature by assuming that non-incumbent auditors are unaware of the true cost of the audit but possess identical information with which to estimate the true cost. We introduce a further innovation by assuming that auditors possess a private signal regarding the true cost of the audit service. Because auditors develop an estimate of the true cost of an audit before submitting their price offer, this assumption is likely to capture an important feature of the market for audit services. Thus, this assumption represents a potential refinement in theoretical and experimental audit research.

By investigating deviations from the risk neutral Nash equilibrium bidding strategy in common value seller's auctions, this study also contributes to the auction literature in economics. Little is known about the behavior of participants in common value seller's auctions. In particular, there is mixed evidence that the winner's curse documented in common value buyer's auctions (e.g. Bazerman and Samuelson 1983; Kagel and Levin 1986; Kagel, Levin, Battalio and Meyer 1989; Goerre and Offerman 2000) is also present in common value seller's auctions. Dyer et al. (1989) provide some evidence consistent with the winner's curse in a seller's market. Hansen and Lott (1991) argue, however, that Dyer et al.'s findings are attributable to participants in the experiment only incurring limited liability for losses. Hansen and Lott point out that as participants' cash balances approached zero, they had little incentive to avoid incurring large losses. Thus, the bidding strategies displayed by the participants may, in fact, have been fully rational. Lind and Plott (1991) further argue that Dyer et al.'s evidence may have been driven by their bankruptcy rules. By removing bankrupt individuals from the experiment, Dyer et al. removed those individuals who most likely would have learned to avoid the winners curse. Contrary evidence provided by Lind and Plott (1991), however, may be questioned because participants in their experimental market could incur opportunity costs but not true financial losses.

We are careful to avoid problems identified with prior experimental studies of common value seller's auctions and thereby provide strong evidence that the winner's curse exists in such markets. In contrast with Lind and Plott (1991), our experimental setting allows participants to incur true financial losses. In contrast with Dyer et al. (1989), our participants simultaneously participate in a separate lottery that has a positive expected value while they participate in the common value seller's market, thereby reducing the possibility that limited liability becomes an issue. Our experimental market setting also requires that participants experience bankruptcy twice before they are declared officially bankrupt and removed from the experiment, thereby enhancing the potential for experience with the curse to facilitate learning. Thus, our evidence of a winner's curse in the market for audit services has significant implications for economic theory as well as audit theory and practice.

The remainder of our paper is organized as follows. In Section 2 we develop the hypotheses that we test in this study by applying auction theory to the market for audit services. Section 3 describes our experimental design and Section 4 presents our analysis of the data. We conclude in Section 5 by summarizing our findings and their implications.

II. HYPOTHESES DEVELOPMENT

The impetus for audit pricing research can be traced to concerns expressed in the Report of the Commission on Auditors' Responsibilities (Cohen Report 1978) that low balling impairs auditor independence. In response to these concerns, DeAngelo (1981) constructed a model to investigate the theoretical support for auditor low balling. DeAngelo made several simplifying assumptions regarding audit-related costs in her model. In particular, start-up costs for the initial audit and recurring audit costs are certain, are common knowledge,[5] and are equivalent for all auditors. Similarly, costs incurred by clients to switch auditors are certain, are common knowledge, and are equivalent for all clients. The model yielded two conditions necessary for low-balling to occur: 1) a competitive market for auditing services such that the auditor's expected profits are zero, and 2) a cost advantage to incumbent auditors due to auditor start up costs, client switching costs, etc. Given the results of her model, DeAngelo (1981, p. 126) concluded that low balling is merely "a competitive response to the expectation of future quasi-rents, and does not itself impair independence" (DeAngelo 1981, p. 126). Schatzberg (1990) tested the intuition behind the model in an experimental laboratory setting and found support for

[5] Information that is common knowledge is known by all parties. In particular, it represents public information that each party knows and that each party knows is known by all.

DeAngelo's assertion that low-balling occurs in a competitive market for auditing markets as a result of cost advantages to incumbent auditors.

Subsequent models of audit pricing in the literature have supported DeAngelo's (1981) conclusion that low balling is a rational response to the expectation of future quasi-rents. These models differ primarily in how future quasi-rents arise. In Schatzberg's (1994) model, future quasi-rents arise because auditors vary in their opinion of the resolution of the underlying reporting issues and the appropriate audit report to provide. The possibility of litigation losses and differential reporting behavior results in a higher total expected audit-related cost for one type of auditor. Thus, the possibility of future quasi-rents occurs because the client does not know their auditor type and must update their beliefs subsequent to the audit being performed. Schatzberg presents experimental evidence supporting the model's intuition and concludes that low balling behavior can occur because of "opinion shopping" by the client.

An important assumption underlying the models in DeAngelo (1981) and Schatzberg (1994) is that the incumbent auditor can maintain incumbency and earn quasi-rents by making price offers equal to the price at which the client would incur incremental costs from changing auditors. The models in Dye (1991) and Kanodia and Mukherji (1994) assume that the client rather than the auditor possesses all the bargaining power. Dye's (1991) model suggests that if the presence of future quasi-rents is publically observable, in equilibrium no low balling occurs in the first period and no quasi-rents are earned by incumbent auditors.[6] Craswell and Francis (1999) provide evidence in support of Dye's (1991) model by showing that discount rates on initial audit engagements are significantly higher in America than in Australia during a period in

[6] This result is based on the following intuition: 1) given that quasi-rents are publically observable, the presence of quasi-rents indicates the possibility that the auditor's independence is impaired; thus the presence of quasi-rents adversely affects the outsiders' interpretation of the client's financial statements at the client's expense, and 2) with no benefit to be obtained from incumbency, the auditor has no incentive to impair their independence.

which Australian audit fees were publicly available. Kanodia and Mukherji (1994) assume that the client makes a "take it or leave it" pricing offer to the incumbent auditor each period and updates their belief as to the true audit cost based upon the auditor's response to the offer. Kanodia and Mukherji's model suggests that low balling in the first period occurs as a rational response to the informational advantage to be gained from incumbency, even in a setting where the client possesses all the bargaining power.

Schatzberg and Sevcik (1994) generate an expectation for future quasi-rents in their model by assuming there is variation in both audit cost and audit quality. In their model, they treat audit cost and audit quality as variables that take on a value of either high or low with corresponding probabilities. They also assume that these audit costs and quality levels vary across auditor-client pairings and are unknown by the client and non-incumbent auditors; nonetheless, incumbent auditors become aware of their audit cost. Schatzberg and Sevcik conduct an experimental examination of the predictions of their model and find evidence that the informational advantage that accrues to the incumbent auditor leads auditors to low ball in the initial period and subsequently earn quasi-rents in the following period.

Coate and Loeb (1997) introduce a model that, like the Schatzberg and Sevcik (1994) and Kanodia and Mukherji (1994) models, assumes incumbent auditors surreptitiously learn the cost of the audit. This knowledge provides them with an informational advantage over non-incumbent auditors that can generate future quasi-rents. The models differ in their treatment of audit cost as a private value and/or as a common value item. Schatzberg and Sevcik (1994) assume that each auditor has a private cost for conducting the audit that is independent of other auditors' costs, while Kanodia and Mukherji (1994) assume that the cost of conducting the audit is common across all auditors. In contrast, Coate and Loeb (1997) assume that the audit cost contains both private and common value elements. Though differing in their assumptions regarding audit cost type, the three models share the conclusion that low balling in the initial audit period is a rational response to the expectation that the incumbent auditor can use their informational advantage to generate quasi-rents in the future.

It is important to note that the three models in the literature that assume cost uncertainty for non-incumbent auditors (Schatzberg and Sevcik 1994; Kanodia and Mukherji 1994; Coate and Loeb 1997) predict fully rational, symmetric offers by non-incumbent auditors. That is, these models do not incorporate the potential for differential price offers or systematic deviations from risk neutral Nash equilibrium strategies. Schatzberg and Sevcik (1994) assume that non-incumbent auditors know the different possible audit costs and their associated probabilities. Kanodia and Mukherji (1994) assume that non-incumbent auditors know the range in which the true audit cost lies. Coate and Loeb (1997) assume that non-incumbent auditors have the same expected cost of performing the audit. Thus, while researchers have discussed the potential for the winner's curse to arise in the market for audit services and contribute to low balling behavior (Schatzberg 1994; Schatzberg and Sevcik 1994), prior theoretical and experimental studies have used setting that preclude the possibility of the winner's curse arising.

We also assume cost uncertainty for non-incumbent auditors in our study of pricing behavior in the market for audit services. However, in contrast to prior theoretical and experimental studies in the audit pricing literature, we incorporate the realistic assumption that non-incumbent auditors must generate a private estimate of the true underlying cost of the audit. Thus, we model the market for audit services as a common value seller's (procurement) auction where non-incumbent auditors possess individual cost estimates drawn from a range around the true cost. This characterization of the market for audit services suggests the potential for differential price offers and systematic deviations from risk neutral Nash equilibrium strategies.

In experimental studies of common value buyer's auctions, whereby buyers submit bids to purchase a product or service based on private signals of value drawn from a range around the true value, researchers have documented systematic pricing behavior consistent with the winner's curse (e.g. Bazerman and Samuelson 1983; Kagel and Levin 1986; Kagel, Levin, Battalio and Meyer 1989; Goerre and Offerman 2000). The winner's curse occurs when participants fail to properly adjust their price offer for the information that will likely be conveyed to them upon winning the auction, which is that they received the most optimistic signal as to the item's true value. Thus, the winner's curse is a systematic failure to account for an adverse selection problem (Kagel and Levin 1986), and reflects a systematic deviation from the risk neutral Nash equilibrium strategy.

It is important to note that losing money in a common value auction does not equate to suffering the winner's curse. There are circumstances where a bidder may make profits but still experience the winner's curse. It is also not necessary for a given bidder to win the auction to experience the winner's curse. In a common value buyer's auction, the winner's curse arises because there is competition to purchase a product or service and bidders do not know the estimates of value possessed by other bidders. Likewise, the winner's curse arises in a common value seller's auction because there is competition to sell a product or service and bidders do not know the estimates of cost possessed by other bidders. In particular, the bidders in a common value seller's auction do not know their relative cost estimates or whether they possess the lowest estimate of cost. Finally, it is important to note that the winner's curse always results in profits being obtained at levels below those associated with the risk neutral Nash equilibrium bidding strategy.

We assert that the market for audit services closely resembles a common value seller's auction. Thus, given evidence from common value buyer's auctions, we expect to observe systematic deviations from the risk neutral Nash equilibrium strategy consistent with the winner's curse. In particular, we expect auditors to engage in lowball behavior not as a rational response to future expected quasi-rents, but because they fail to account for the potential adverse selection problem inherent to the marketplace. Falling prey to the winner's curse increases the likelihood that the accepted price offer is below cost, and thus, by definition, a low ball offer. These expectations derived from the auction literature lead to our first two hypotheses:

H1: Sellers of audit services fall prey to the winner's curse and under-price their price offers on average.

H2: Sellers of audit services incur financial losses as a result of falling prey to the winner's curse.

Experimental studies of common value buyer's auctions find that behavior consistent with the winner's curse decreases as participants gain experience with the auction. Indicative of learning, participants adjust their bids over time and reduce the frequency and magnitude of losses, although they do not learn to completely avoid such losses (Kagel and Levin 1987; Lund and Plot 1991). Thus, we also expect participants in common value seller's auctions to adjust their offers over time to reduce the frequency and magnitude of losses consistent with the winner's curse. This expectation leads to our third hypothesis:

H3: Sellers of audit services learn over time to reduce financial losses caused by the winner's curse.

III. EXPERIMENTAL DESIGN

The data we analyze to test our hypotheses was gathered using student participants and a computerized laboratory market that takes the form of a common value seller's auction. During each period of a 15-period market, groups of three sellers made a price offer to sell a commodity to a buyer.[7] Participants were not informed how many periods the market would operate to mitigate end-of-market effects. Each period the commodity had a common, uncertain cost and prospective sellers received private signals of that cost prior to submitting their offers. After all price offers had been submitted for a given period, the winning offer was publicly disclosed to the group along with the cost of the commodity for that period. The payoff for a given sale equaled the price of the winning contract less the actual cost of the commodity that period.

We utilize experimental markets with three prospective sellers and one buyer to approach the assumption of competitive audit markets in audit pricing models (DeAngelo 1981; Schatzberg 1994). Mayhew (2001) argues that incorporating multiple buyers may be useful to control for reputation effects and strategic behavior on the part of buyers. While our experimental market used only one buyer, we controlled for reputation effects and strategic behavior by using a robot buyer. The use of a robot buyer also allowed us to focus on the pricing behavior of sellers. The robot buyer was programmed to accept the offer with the lowest price.

One hundred and thirty-five individuals from a large university in the southeastern United States participated in seven computerized experimental sessions resulting in 45 market groups. Each perimental session lasted approximately one hour and fifteen minutes. At the beginning of each session participants were randomly placed into groups of three by the computer program.

[7] We use the labels seller, buyer, and commodity in place of auditor, client, and audit service to describe our experimental method. We used these same labels in our experimental instructions to avoid the potential for role playing and to be consistent with Smith's (1976) induced value theory.

Each participant received a copy of a set of instructions that were read aloud by the experimenter (see the Appendix for a copy of the instructions). The participants retained their copy of the instructions throughout the course of the experiment and were able to refer to them as needed. Subsequent to being read the instructions, the participants participated in five practice periods. Before beginning the practice periods, however, participants were required to correctly complete a quiz about the operation of the market to ensure that they correctly understood the operation of the marketplace. The practice periods were included to familiarized participants with the computer interface and reduce the volatility of decision-making documented in early periods of experimental markets (Forsythe and Lundholm 1990). The experiment was programmed and conducted with z-Tree software (Fischbacher 2007).

The cost of the commodity each period (v) was randomly chosen by the computer from a uniform range (x, y) and prospective sellers received private signals of the cost prior to submitting their offers. The private signals (x_i) were randomly chosen over an interval $(v+ \in, v- \in)$ where $\in$ was a positive parameter set by the experimenter (Lind and Plott 1991). The following parameters were used and were common knowledge among participants: $x = ECU150$, $y = ECU1500$, and $\in = ECU200$ for every trading period. This knowledge provided the sellers with enough information to calculate the potential upper and lower limits for the cost of the commodity, v. To avoid the winner's curse, sellers would be required to accurately assume that the true cost of the product could exceed their private signal and adjust their price offer accordingly.

In addition to participating in the experimental market, sellers simultaneously participated in a lottery each period representing outside forms of income for the auditor. The lottery served several important purposes. In addition to providing "idle compensation" and thereby avoiding excessive risk taking, the lottery generated outside earnings that reduced the likelihood of the participant going bankrupt (Ham, Kagel, and Lehrer 2005). The lottery had an expected value of *ECU10* each period, as it paid *ECU40* with a 50 percent probability and -*ECU20* with a 50 percent probability. Payoffs from the lottery were randomly determined for each seller at the end of period. In summary, each period proceeded as follows:

1. The cost of the commodity (v) is randomly drawn from a uniform distribution over the range (ECU150,ECU1500). Sellers are aware of the range but not the actual cost drawn.
2. Sellers receive private signals regarding the actual cost of the commodity drawn over the interval $(v+\in, v-\in)$. Sellers are aware of their own private signal and the value of $\in$ (ECU200), but are unaware of the private signals of other sellers.
3. Each seller makes an offer to the buyer to provide the commodity at a given price.
4. The robot buyer contracts with the seller who makes the lowest price offer to provide the commodity.
5. The contract price and the true cost of the commodity (v) are publicly announced and the resulting payoff is added to the account of the seller who contracted with the buyer.
6. Each seller participates in a lottery that pays either ECU40 or -ECU20 with equal probability. The outcome of the lottery is randomly determined.
7. The next trading period begins until the fifteenth period is completed.

Participants were provided with an initial cash endowment of 300 ECUs at the beginning of each market. Cash balances accumulated after each period based upon the outcomes of the auction and the lottery. Participants were considered bankrupt if their overall cash balance went below 0 ECUs. The first time this occurred, they were re-initialized with a new positive cash endowment of 300 ECUs. However, if their earnings balance went negative a second time they were paid their $10.00 show-up fee and excused from the laboratory. To maintain groups of three sellers, participants who had gone bankrupt twice were replaced by a computerized seller who was programmed to submit prices randomly between 150 ECUs and 1500 ECUs.[8] At the end of each experimental session, participants were paid in private a show-up fee of $10 in addition to their earnings for the experiment. For purposes of payment, one experimental dollar (ECU) earned during the experiment equaled $0.025 (US).

IV. RESULTS AND ANALYSIS

The 45 market groups in our study participated in 15 market periods each resulting in 2,025 potential price offers (45 market groups × 3 sellers per group × 15 periods). As per Table 1, the participants received an average payment of $18.93 upon completion of the experiment. During the seven sessions, ten individuals were declared officially bankrupt and were paid their $10 show up fee and were excused from the laboratory. For the remainder of the experiment, these individuals were replaced by robot sellers who made random price offerings between 150 ECUs and 1500 ECUs. For purposes of testing the hypotheses in this study, we exclude price offers made by robot sellers and by participants who were in a group that included a robot seller in a given period. This leaves 1,869 price offers in our sample.

[Insert Table 1 about here]

Hypothesis 1 predicts that sellers of audit services fall prey to the winner's curse. Except for cost signals at the extremities of the range, the risk neutral Nash equilibrium (RNNE) prediction for common value seller's auctions is for sellers to make price offers equal to their

[8] Ten participants were dismissed for twice going bankrupt. As discussed later, our results omit all price offerings made by the affected groups after these participants were dismissed.

private cost signal plus the potential noise in the signal[9]. In most cases, therefore, the RNNE prediction for this experiment is for sellers to make price offers equal to their private cost signal plus two hundred ECUs. This predicted price behavior would maximize expected earnings and result in price offers that are perfectly correlated with the private cost signals. The bivariate correlations in Table 2 suggest that, while the correlation between price offers and private cost signals is strong and highly significant ($p < 0.01$), the correlation is less than one (0.92 and 0.94 for the Pearson and Spearman correlation, respectively). This provides some preliminary evidence that sellers fell victim to the winner's curse in making their price offers.

[Insert Table 2 about here]

The graph of price offers in Figure 1 and the regression analysis in Table 3 provide direct evidence regarding Hypothesis 1. If sellers fall prey to the winner's curse, observed price offerings should be lower than the RNNE prediction. Figure 1 reveals that the majority of price offers are less than the RNNE prediction. Thus, sellers exhibited under-pricing behavior consistent with the winner's curse. Table 3 shows the result of a regression model that regresses sellers' price offers on their private cost signals. The RNNE prediction is that the intercept term equals 200 and the coefficient on the private cost signal equals 1. Consistent with the hypothesis that sellers fall prey to the winner's curse, the 95% confidence interval for the intercept term and the coefficient on the seller's cost signal fall below the RNNE predictions. These results provide strong support for hypothesis 1.

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[9]Wilson (1977) was the first to develop a Nash equilibrium solution for a first-price sealed bid common value seller's auction. In the interval $\underline{x}+\in < x_i < \bar{x}+\in$ the symmetric risk neutral Nash equilibrium bid function is $b(x_i) = x_i + \in - Y$, where $Y = [2\in/(n+1)]\exp[-(n/2\in)(-x_i + (\bar{x} - \in))]$. For most values of x_i, the Y term approximates 0. Thus, the risk neutral Nash equilibrium (RNNE) in most cases is for sellers to make price offers equal to their cost signal plus the potential noise in the signal.

[Insert Table 3 and Figure 1 about here]

Hypothesis 2 predicts that sellers of audit services incur financial losses as a result of falling prey to the winner's curse. Table 4 presents descriptive statistics regarding the winner's average profit and the frequency of losses for each of the 45 market groups. Consistent with hypothesis 2, the winner made price offers below cost in 65% of the market periods. This high percentage of losing contracts suggests that sellers fell prey to the winner's curse by failing to properly account for the cost uncertainty and adverse selection inherent in the market. The average auction profits for every group were less than the profits that would have been achieved had participants followed the RNNE pricing strategy. Only 4 of the 45 market groups managed to achieve positive average profits. Interestingly, only 68% of the auctions were won by the seller who possessed the lowest or most optimistic cost signal. These results provide strong support for hypothesis 2.

[Insert Table 4 about here]

Hypothesis 3 predicts that sellers of audit services learn over time to reduce financial losses caused by the winner's curse. Table 5 shows the results of the regression model that regresses sellers' price offers on their private cost signals using data from three time frames: the first five periods, the middle five periods, and the last five periods of each market. A comparison of the intercept term for each of the three time frames provides evidence that sellers are able to learn to adjust their price offerings to account for potential noise in their cost signal and thereby reduce the winner's curse. In particular, the intercept term increases monotonically from 118.61 to 161.46 to 174.47. The coefficient on the cost signal, however, remains fairly constant at around the overall value of 0.92. Both the intercept term and the coefficient on the cost signal, however, fail to reach the RNNE prediction of 200 and 1 respectively. These results indicate that participants learn to reduce the magnitude of the winner's curse but do not learn to completely avoid it.

[Insert Tables 5 and 6 about here]

Table 6 provides direct evidence regarding Hypothesis 3 by comparing profits made from accepted offers across the first five periods, the middle five periods, and the last five periods. While the effect is nonmonotonic, and the losses from accepted offers increase in the middle five periods, the losses in the last five periods are clearly lower in the last five periods. This evidence supports Hypothesis 3. Thus, all three hypotheses we test in this study are supported.[10] We conclude that characteristics inherent in the market for audit services (Kanodia and Mukherji 1994, 607) lead auditors to lowball due to the winner's curse. Thus, we identify a behavioral factor that contributes to lowballing behavior independent of future expected quasi-rents.

V. SUMMARY AND CONCLUSION

Accounting researchers have only begun to apply the extant auction literature to accounting research questions. We apply the auction literature to auditing research by asserting that the market for audit services approximates a common value seller's auction and then studying pricing behavior in such experimental auctions. In contrast to the assertion that auditors low ball as a rational response to future expected quasi-rents (DeAngelo 1981; Schatzberg 1994; Kanodia and Mukherji 1994; Schatzberg and Sevcik 1994; Coate and Loeb 1997), we provide

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[10] Untabulated sensitivity analysis shows that our results our unaffected by excluding cost signals outside the range of $\underline{x} + \in < x_i < \overline{x} + \in$. Untabulated sensitivity analysis also shows that our results our unaffected by the inclusion of beginning wealth from the lottery as an explanatory variable.

evidence that auditors low ball because they fall prey to the winner's curse. We also provide evidence that over time auditors learn to reduce the magnitude of the winner's curse but do not learn to completely avoid it. Thus, we demonstrate the potential usefulness of auction theory to auditing research.

To focus on behavioral sources of low balling, we utilize an experimental design that minimizes the possibility that expectations for future quasi-rents will arise. In particular, there is no cost advantage that accrues to incumbent auditors as in previous experimental studies of audit pricing. This and other simplifications we make to focus on behavioral sources of low balling may limit the generalizability of our results. Yet, by incorporating other important aspects of the market for audit services that have previously received little attention, such as the fact that audit firms develop an estimate of audit cost prior to submitting an offer, our experimental design represents an advancement in experimental audit research. Further, our approach supports Dopuch and King's (1996, 67) assertion that "the interaction between markets and behavioral characteristics could be a fruitful area for future research in the auditing area." Again, our evidence suggests that such research could benefit by applying insights from the large auction literature in economics.

Future research could advance audit pricing research by examining the robustness of the winner's curse we document in a single-period common value auction setting. Such research might examine, for example, a setting in which auditors decide upon the extent by which they are willing to pay for a more precise cost signal. Such research may also incorporate idiosyncratic differences among audit firms (e.g., audit industry specialists) by modeling the market for audit services as an almost-common value auction in which the reoccurring cost to audit contains both a common and private value element. Alternatively, future research might examine a multiperiod common value audit setting in which the incumbent auditor learns the reoccurring cost to audit and thereby obtains an informational advantage over non-incumbent auditors and, therefore, the potential for future quasi-rents. Future research may also examine reputational effects in a multi-period auction setting by replacing the robot client with a human client.

Finally, our evidence raises again the concern among audit regulators that low balling behavior is detrimental because it can lead to a lack of independence. The current consensus in the literature that low balling behavior is a rational response to future expected quasi-rents appears to belittle this concern. As per DeAngelo, low balling is merely a "competitive response to the expectation of future quasi-rents, and does not itself impair independence" (DeAngelo 1981, 126). By demonstrating a behavioral source of low balling based on the winner's curse, the question arises whether such low balling may lead to a lack of independence. Given that this form of low balling produces a loss that the incumbent auditor cannot rationally expect to offset with expected future gains, it may cause the auditor to offset the loss with a reduction in audit effort, thereby impairing independence. Thus, future theoretical and experimental research should consider the full implications of this behavioral form of low balling for the market for audit services.

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Table 1
Experimental Participant's Payment

Variable	Mean payments to Participants[a]
Wealth from Auction[b]	221.90 ECUs ($5.55)
Wealth from Lottery[c]	135.36 ECUs ($3.38)
Show-up Fee[d]	400.00 ECUs ($10.00)
Total	757.26 ECUs ($18.93)

[a] Excludes ten participants who were twice declared bankrupt during the experiment and as such left with only their $10.00 show-up fee.

[b] Portion of payment attributable to initial endowment and the auction portion of the experiment.

[c] Portion of payment attributable to lottery portion of the experiment.

[d] In addition to the participant's profits from the experiment they were paid a $10 show-up fee.

Table 2
Bivariate correlations for variables in audit pricing model*
(N = 1869)

Variable	Price Offering	Cost Signal
Price Offer[a]	1.00	0.92 (<0.01)
Cost Signal[b]	0.94 (<0.01)	1.00

* Pearson correlation statistics are reported above the diagonal and nonparametric Spearman correlation statistics are reported below the diagonal. Two-tailed probabilities are in parentheses.

[a] Price Offer: the price offer made by participants during the common value procurement portion of the experiment.
[b] Cost Signal: the cost signal provided to the participants prior to making a price offer.

Table 3
Regression model of audit price offers[a]

Model: Price Offer = $\alpha_0 + \alpha_1$Cost Signal + ε

Variable	RNNE Predictions	For all periods	95% Confidence Interval for β Lower Bound	Upper Bound
Intercept	200	147.95***	132.02	163.88
Cost Signal[b]	1.0	0.92***	0.91	0.94
Adjusted R^2		0.85		
N		1839		

***, **, * Denote two-tailed significance at the 0.01, 0.05, and 0.10 levels, respectively.

[a] Price Offer: the price offer made by participants.

[b] Cost Signal: the cost signal provided to the participants prior to making a price offer.

Table 4
Descriptive statistics
Winner's average profit and the loss frequencies

Group[a]	# of Auctions[b]	Average Auction Profits[c]	Average RNNE predicted profits per period[d]	Auctions in which winner loses money[e]	Auctions with winner having lowest signal[f]
1	15	-$1.86	$2.63	12 (80%)	12 (80%)
2	15	-$0.69	$2.59	7 (47%)	9 (60%)
3	15	$0.90	$1.86	11 (73%)	10 (67%)
4	15	-$0.70	$2.55	10 (67%)	11 (73%)
5	15	$0.28	$1.49	5 (33%)	12 (80%)
6	15	-$1.64	$2.01	10 (67%)	14 (93%)
7	11	-$2.37	$2.76	8 (73%)	6 (55%)
8	15	-$1.84	$1.82	10 (67%)	8 (53%)
9	15	-$0.49	$2.37	10 (67%)	10 (67%)
10	15	-$1.03	$1.61	10 (67%)	10 (67%)
11	11	-$2.71	$3.01	9 (82%)	6 (55%)
12	15	-$1.58	$2.10	14 (93%)	9 (60%)
13	15	-$0.87	$2.59	7 (47%)	9 (60%)
14	15	-$1.23	$1.77	9 (60%)	11 (73%)
15	15	-$0.31	$1.98	9 (60%)	6 (40%)
16	8	-$5.66	$2.38	8 (100%)	2 (25%)
17	15	-$0.82	$2.13	9 (60%)	9 (60%)
18	6	-$9.71	$1.80	6 (100%)	4 (67%)
19	15	-$1.92	$2.99	12 (80%)	9 (60%)
20	15	-$0.62	$2.70	6 (40%)	13 (87%)
21	15	-$0.52	$2.32	11 (73%)	12 (80%)
22	8	-$5.79	$2.67	8 (100%)	5 (63%)
23	15	$0.42	$1.81	6 (40%)	9 (60%)
24	8	-$5.76	$1.00	6 (75%)	6 (75%)
25	15	$0.29	$2.65	6 (40%)	13 (87%)
26	15	-$0.74	$1.49	9 (60%)	8 (53%)
27	15	-$1.77	$1.94	11 (73%)	11 (73%)
28	15	-$0.60	$1.96	10 (67%)	12 (80%)
29	15	-$0.60	$1.90	7 (47%)	14 (93%)
30	13	-$2.89	$2.13	11 (85%)	10 (77%)
31	15	$0.00	$2.07	7 (47%)	13 (87%)
32	15	-$1.09	$2.66	5 (33%)	7 (47%)
33	15	-$2.85	$2.32	12 (80%)	9 (60%)
34	15	-$0.33	$2.61	9 (60%)	9 (60%)
35	15	-$2.50	$2.36	11 (73%)	12 (80%)
36	15	-$1.27	$2.24	10 (67%)	11 (73%)

Table 4 - Continued
Descriptive Statistics
Winner's average profit and the loss frequencies

Group[a]	# of Auctions[b]	Avererage Auction Profits[c]	Average RNNE predicted profits per period[d]	Auctions in which winner loses money[e]	Auctions with winner having lowest signal[f]
37	15	-$1.52	$2.12	10 (67%)	8 (53%)
38	15	-$0.18	$2.94	8 (53%)	10 (67%)
39	15	-$4.63	$1.64	13 (87%)	11 (73%)
40	15	-$0.96	$2.19	9 (60%)	9 (60%)
41	12	-$1.00	$2.49	7 (58%)	8 (67%)
42	15	-$1.57	$2.11	10 (67%)	10 (67%)
43	15	-$4.30	$1.79	13 (87%)	11 (73%)
44	15	-$0.49	$2.95	9 (60%)	14 (93%)
45	6	-$5.27	$2.03	6 (100%)	4 (67%)
Total	623	-$1.53	$2.22	406 (65%)	426 (68%)

[a] Group: the 135 participants were randomly assigned to 45 groups of three.

[b] # of Auctions: the number of common value procurement auctions that group participated in.

[c] Average Auction Profits: the average profits from participating in the common value procurement auctions.

[d] Average risk neutral Nash equilibrium (RNNE) predicted profits per period: the average profits that would have been obtained from participation in the auction had the individuals used the risk neutral Nash equilibrium strategy.

[e] Auctions in which the winner lost money: the number of auctions in which the winner of the auction low balled and thus incurred a loss

[f] Auctions with winner having lowest signal: the number of auctions in which the winner had received the lowest cost signal (i.e. received the most optimistic signal as to the actual cost).

Table 5
Regression model of audit price offers[a]

Model: Price Offer = $\alpha_0 + \alpha_1$Cost Signal + ε

Variable	RNNE Predictions	For all periods	First 5 periods	Middle 5 periods	Last 5 periods
Intercept	200	147.95***	118.61***	161.46***	174.47***
Cost Signal[b]	1.0	0.92***	0.93***	0.91***	0.93***
Adjusted R^2		0.85	0.87	0.82	0.87
N		1839	675	633	561

***, **, * Denote two-tailed significance at the 0.01, 0.05, and 0.10 levels, respectively.

[a] Price Offer: the price offer made by participants.

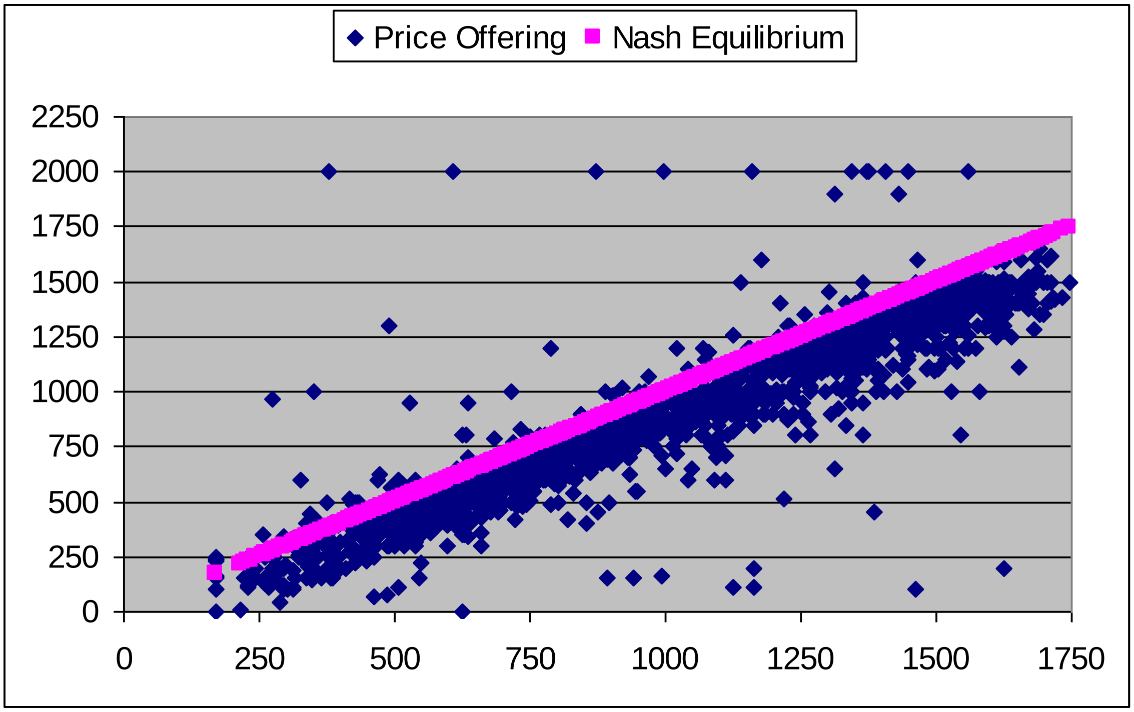
[b] Cost Signal: the cost signal provided to the participants prior to making a price offer.

Table 6
Auction profits[a] for accepted price offers

	For all periods	First 5 periods	Middle 5 periods	Last 5 periods
Mean Auction Profits[a]	-61.27	-65.61	-83.80	-30.71
Standard Deviation	152.68	156.65	182.20	96.84
N	623	225	211	187

[a] Auction Profits: the difference between the participants price offer and the cost of the audit for accepted price offers.

Figure 1
Price offers in relation to the Nash equilibrium price offer



Appendix
Experimental Instructions

Thank you for your participation in today's experiment. I will read through a script to explain to you the nature of the experiment and how to navigate the computer interface with which you will be working. I will be using this script to ensure that all sessions of this experiment receive the same information. Please feel free to ask questions as they arise. I ask that you please refrain from talking with other participants or looking at their monitors during the experiment. If you have a question or problem, please raise your hand and one of us will come and assist you.

This experiment considers the economics of market decision making. All monetary amounts in this experiment are denominated Experimental Currency Units or ECUs. Your earnings for this session will be equivalent to the sum of your earnings from each round converted into US $. At the end of the experiment, you will be paid by check the sum of your earnings plus a $10 show-up fee. Your earnings in ECUs will translate into dollars at the rate of 1 ECU=$0.025 USD. If you earn 250 ECUs, you will earn $6.25; 500 ECUs equals $12.50; 1000 ECUs equals $25.00; and so on.

In this experiment, you will act as sellers of a commodity for a sequence of trading periods. You have been randomly assigned to groups of three. Your task, each trading period, is to make a price offering to a computerized buyer. A price offering is the price at which you are willing to sell one unit of a commodity. The buyer is programmed to accept only the lowest offer from each group for each period.

Each group will thereby sell only one unit of the commodity each trading period. The seller from each group who makes the lowest offer will make a profit that period equal to the difference between their offer and the cost of the unit. That is,

Profit = Offer – Cost of the unit

If this difference is negative, it represents a loss to the seller.

If you do not submit the lowest offer, you will earn zero profits that trading period. In this case, you neither gain nor lose money from submitting an offer.

To further clarify, please see the example in Table 1. This table indicates price offerings made by three fictitious sellers. In this example, Seller 2 would sell one unit at a price of 198 ECUs and receive profits equal to 198 ECUs less the cost of the unit. The other two sellers would earn zero profits for that trading period.

TABLE 1

	Seller 1	Seller 2	Seller 3
Submitted Prices	209	198	212

The cost of the item for each round will be identical for each group; thus, the cost will be the same for each of the three sellers in the group. When submitting their price, none of the sellers will be aware of the exact cost of the item but will have received a private signal regarding the cost of the item.

The cost of the commodity will be determined randomly and will range from 150 ECUs to 1500 ECUs. For each period, any value within this interval has an equal chance of being drawn. The cost of the item can never be less than 150 ECUs or more than 1500 ECUs. The costs are determined randomly and independently from period to period. As such, the cost in one period tells you nothing about the cost in the next period. It also does not preclude drawing the same cost in later periods.

Private Information Signals:
Although you will not know the precise cost prior to making your price offering, you will receive information which will narrow down the range of possible values. This information will consist of a private signal which will be selected randomly from an interval whose lower bound is cost minus 200 ECUs, and whose upper bound is cost plus 200 ECUs. Any value within this interval has an equal chance of being drawn and being assigned to one of you as your private information signal.

For example, suppose that the true cost of the auctioned item is 420 ECUs, each of you will receive a private information signal which will consist of a randomly drawn number that will be between 220 ECUs (420 ECUs – 200 ECUs) and 620 ECUs (420 ECUs + 200 ECUs). Any number in this interval has an equal chance of being drawn.

Table two shows a set of six computer generated signals for a cost of 600 ECUs.

TABLE 2

	Signal 1	Signal 2	Signal 3	Signal 4	Signal 5	Signal 6
Actual Cost is 600 ECUs	720 ECUs	648 ECUs	420 ECUs	612 ECUs	497 ECUs	540 ECUs

You will note that some signal values are above the actual cost of the item and some are below the actual cost of the item; therefore for any given period, your private information signal can be above or below the actual cost of the item.

From this information you will always know that the cost is greater than or equal to your signal value less 200 ECUs and that the cost is less than or equal to your signal plus 200 ECUs.

Finally, you may receive a signal value below or above the cost limits already outlined (signal below 150 ECUs or above 1500 ECUs). There is nothing strange about this; it just indicates that the cost is close to 150 ECUs (or 1500 ECUs).

Your signal values are strictly private information and are not to be revealed to anyone else. For each trading period, cost is the same for all three sellers in a group, but it can vary each period. Further, the cost is only disclosed in a given period after all price offering have been made.

No one may submit a price less than 0 ECUs or higher than 2000 ECUs for an item.

In case of a tie for the lowest price, the winner will be chosen at random.

Are there any questions about how these procedures will work?

You will now play five practice trading periods. For purposes of practice, you will each play against two computerized sellers, who are programmed to submit prices randomly between 150 ECUs and 1500 ECUs. Payoffs from these practice rounds do not count towards your overall winnings. The only purpose of these practice rounds is to familiarize you with navigating the computer interface.

(Five Practice Trading Periods Are Played)

Lottery:
During the course of the experiment you will also be a participant in a lottery. At the end of each trading period, you will automatically be entered into a lottery. The lottery payoff is determined “like the flip of a coin”, you have a 50% chance of earning 40 ECUs and a 50% chance of losing 20 ECUs. Earnings from the lottery are totally unrelated to your sales outcomes.

Are there any questions about how these procedures will work?

Now the experiment will begin. You will be given a starting balance of 300 ECUs. Each round, this balance will rise as you make money and fall if you have rounds with negative earnings. You will be declared bankrupt, if you lose so much money that your overall balance goes below 0 ECUs. The first time this occurs, we will re-initialize you, starting you over with a new positive initial balance of 300 ECUs. However, if your earnings balance goes negative a second time, you will be asked to leave the experiment with only your $10.00 show-up fee. To maintain groups of three sellers you will also be replaced by a computerized seller who is programmed to submit prices randomly between 150 ECUs and 1500 ECUs.

As promised, everyone will receive a show-up fee of $10.00 irrespective of their earnings from participating in the experiment.

You are not to reveal your submitted prices or profits to anyone, nor are you to speak to any other participant while the experiment is in progress.

Are there any questions?