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Auditor Bidding and Independence:
A Laboratory Markets Investigation

Jon S. Davis

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January 1988

Auditor Bidding and Independence:
A Laboratory Markets Investigation

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The author wishes to thank the Arizona Economic Science Laboratory and the Accounting Departments at the Universities of Arizona and Illinois for their financial support. In addition, the author would like to express his appreciation for the suggestions and criticisms from his dissertation committee (William Felix, William Waller, S. Mark Young, and R. Mark Isaac), as well as those received from Paul Beck, Tony Cebuhar, Linda DeAngelo, Ira Solomon, and David Wallin. Last, the author would like to thank his wife, Kathleen, for her encouragement and help as a research assistant.

AUDITOR BIDDING AND INDEPENDENCE:
A LABORATORY MARKETS INVESTIGATION

Abstract

Certain economic factors in the auditing environment have been hypothesized to affect both prices selected by auditors and their independence. This paper reports the use of laboratory markets to test the hypotheses that start-up costs and the client's cost of changing auditors results in lowballing in initial engagements and in decreased independence. The results of the experiments support theoretical predictions to a limited extent: initial period lowballing is observed but not always at the predicted level and increased availability of quasi-rents leads to subject behavior consistent with decreased independence.

AUDITOR BIDDING AND INDEPENDENCE:
A LABORATORY MARKETS INVESTIGATION

1. Introduction

There have been numerous reports in the popular press that competition in the audit market has led to the practice of setting initial period audit fees below the total cost of performing the audit (termed lowballing) [Andreder, 1979; Bernstein, 1978; Commission on Auditor's Responsibilities, 1978; Wall Street Journal, 1985a, 1985b]. At the same time, policymakers have expressed concern that competition and lowballing could lead to reduced auditor independence and audit quality [Commission on Auditor's Responsibilities, 1978; Securities and Exchange Commission, 1977; United States Senate, 1977, 1985].

Motivated by the concerns of policymakers, DeAngelo [1980, 1981] develops a model of the auditor-client relationship that links aspects of the auditing environment to lowballing and auditor independence. Under the assumptions presented in Table 1, DeAngelo's analysis predicts that transactions costs provide incumbent auditors with client-specific quasi-rents over the life of the auditor-client relationship. DeAngelo contends that lowballing for initial engagements is an economically rational response to the availability of the quasi-rents in a competitive market. DeAngelo further argues that lowballing does not directly affect auditor independence because initial period losses represent a sunk cost to the auditor. Rather, auditor independence is predicted to be reduced by the availability of future quasi-rents.

Insert Table 1 About Here.

While DeAngelo's model has been criticized (e.g., Simunic [1986]), it should not be discarded until sufficient evidence is gathered to determine its usefulness and another model, more tenable in the light of existing evidence, is developed to replace it. Likewise, additional empirical evidence will aid in the development of a better model. In any case, empirical evidence is needed.

To address this need, several studies have examined the predictions of DeAngelo's model. Researchers have used actual audit fee data to search for evidence of lowballing [e.g., Baber, Brooks and Ricks, 1986; Beck and Barefield, 1986; Francis, 1984; and Palmrose, 1986]. No clear evidence has been gathered to date, principally because of the unavailability of data regarding auditor production functions (however, Schatzberg [1987] describes a study performed contemporaneously with the study reported here and finds lowballing in a laboratory market where subjects' price choices are exogenously constrained by the experimenter). Likewise, attempts to use field data to infer auditor independence (e.g., Raganathan, Lewis and Evans [1986]) have been limited by the inability to directly examine auditor behavior.

An alternative approach to most of the above studies is to gather evidence supporting DeAngelo's model through the use of laboratory markets. Laboratory markets allow direct observation of individual and market behavior and control over all aspects of the environment. The approach thereby avoids the measurement and estimation difficulties inherent in field studies (see Smith, Schatzberg and Waller [1987] for additional discussion of the benefits of laboratory markets in auditing research).

While a laboratory market study cannot provide evidence regarding the reasonableness of the model as an abstraction of the audit market, it can be

used as a direct test of the veracity of the model in the abstract. To the extent that the model is supported by direct tests, then belief in its ability to predict human behavior is enhanced¹. Alternatively, if DeAngelo's predictions are not borne out in a simple laboratory setting (designed to give the model its best shot at success), then it is unreasonable to expect performance to improve in the complexity of the "real world." The similarity (or mundane realism) of laboratory markets to the audit market is less important in this regard. Rather, it is theory and not raw findings that are generalized to the real world [Swieringa and Weick, 1982, p. 81].

Given the dearth of evidence and the importance of independence in determining the demand for auditing in the marketplace [Watts and Zimmerman, 1983], the impact of market variables and auditor pricing behavior on independence remains a significant issue to be addressed. Because DeAngelo's model represents the seminal attempt to link independence with auditor pricing behavior, it is the focus of the research question addressed in this paper. Specifically, are the predictions of economic behavior generated by DeAngelo's model borne out in a simple laboratory characterization of the audit market?

The remainder of this paper begins with a brief review of DeAngelo's model, followed by a description of how the model is operationalized in a laboratory setting. Next, testable hypotheses are developed. The experimental method is then described and results from a series of experiments are presented. Last, conclusions are presented and directions for future research are discussed.

2. Model and Hypotheses

2.1 DeAngelo's Model of the Auditor-Client Relationship

A principal result of DeAngelo's analysis is the prediction that lowballing will occur in initial offers made by auditors for an engagement as a response to the availability of a future stream of quasi-rents accruing to an incumbent. The quasi-rents arise from two sources. First, client-specific start-up costs, K , incurred on the initial audit provide technological advantages to an incumbent auditor on future audits of the client. Second, an incumbent gains an advantage because the client faces transactions costs, CS , when changing auditors. When one or both of these aspects of the auditing environment are in place, an incumbent can prevent entry by other auditors and capture benefits by setting audit fees above the avoidable cost of producing audits, A . These advantages represent a specialized asset in the hands of the auditor.

DeAngelo suggests that this specialized asset creates a bilateral monopoly between the auditor and his client. A bilateral monopoly arises from the ability of each party to impose real costs on the other by termination. The auditor can force the client to incur transactions costs by terminating the relationship. At the same time, by switching auditors the client could impose a cost on the auditor through lost quasi-rents.

DeAngelo argues that the bilateral monopoly and the future quasi-rent stream will be anticipated and reflected in equilibrium prices offered by auditors in the initial engagement. That is, given that auditors bidding on the initial engagement anticipate future quasi-rents upon gaining an incumbency, competition in the market is hypothesized to drive first period offers down to a point where the initial period audit fee, F_1 , will equal

first period costs, $A + K$, less the discounted value of future quasi-rents accruing to the incumbent, or

$$F_1 = (A + K) - (F - A)/r \quad (1)$$

where F is the future period audit fee charged by the incumbent and r is the discount rate which is parametric and available to all auditors and clients in the market. Thus, competition in the initial period is predicted by DeAngelo to result in the use of a multiperiod pricing strategy by auditors, enabling them to earn just a normal rate of return over the life of the relationship. When the future rent stream, $F - A$, is positive², equation 1 predicts that the initial period offer by an incumbent will be below initial period cost.

Since auditors are assumed to maximize utility, incumbents are predicted to select the maximum entry-preventing offer, which is dependent on the client's decision rule for switching auditors. Since clients are also utility-maximizing, they will change auditors only when they believe that the present value of a new auditor's fees plus the transactions cost, CS , is less than the present value of the incumbent auditor's fees. The client's rule is formally stated by DeAngelo [1981, p. 121] as

$$F < A + r(CS + K)/(1 + r). \quad (2)$$

The right hand side of the inequality represents the maximum bound for entry-preventing offers. That is, if a non-incumbent auditor wins an auction after time $t = 1$ when the incumbent has offered a price within the realm specified in equation 2, the non-incumbent would earn less than normal profits over the remainder of the engagement. It follows that, in equilibrium, the incumbent's future period offer is expected to be

$$F^* = A + r(CS + K)/(1 + r) - \epsilon \quad (3)$$

where ϵ is some arbitrarily small positive number and asterisks denote equilibrium values. By inspection of equation 3, one can see that the amount of future rents to be earned by an incumbent is an increasing function of the client's transactions cost of switching auditors, CS , and the auditor's initial period start-up cost, K .

When both CS and K equal zero, future fees will equal future period avoidable costs in every time period implying an extension of the perfectly competitive market at $t = 1$ to all future periods. The competition will drive quasi-rents to zero in future periods and no advantages will accrue to the incumbent. Using equation 1, it is evident that no lowballing will occur because no quasi-rents are available to the incumbent. Conversely, as both CS and K increase, the future quasi-rent stream available to an incumbent increases, resulting in a prediction of larger amounts of lowballing in the initial period³.

Before discussing the implications of DeAngelo's analysis for independence, it is necessary to address her operationalization of the concept. DeAngelo treats independence (operationalized as the probability that an error is reported by the auditor, conditional on its discovery) as one of two aspects of audit quality. The second aspect of audit quality, auditor competence, is defined as the probability that the auditor discovers an error in the financial statements of the client. In reality, DeAngelo notes that these two probabilities are not separable and independence or the lack of it may have an effect on either or both of them. That is, an auditor who lacks independence might succumb to management pressure by designing the audit so as not to discover an error or by failing to report an error that has been discovered. To simplify her analysis and eliminate any confounding of

independence and technical capabilities of the auditor, DeAngelo assumes that the probability of discovering a breach by management is both positive and fixed across auditors and time. Thus, only the auditor's report decision can be affected by independence in the model.

In order for the auditor's opinion to have value, the market's assessment of the conditional probability of reporting a breach⁴ in DeAngelo's world must be some number greater than zero. The greater the assessed conditional probability, the greater will be the auditor's value in the market.

To the extent that quasi-rents accrue to an incumbent auditor, DeAngelo's analysis predicts that auditor independence will decrease. The future quasi-rents arising from the bilateral monopoly relationship provide management with power to impose a cost on the auditor by terminating the auditor-client relationship, providing economic incentives to the auditor to conceal discovered breaches. These economic incentives are offset by both the auditor's ability to impose costs on the client by termination (through the cost of switching) and by a possible decrease in the market value of the auditor's opinion and the resulting loss in audit fees from other clients (i.e., collateral bond) if non-independent behavior is discovered by the public.

It follows that the greater the available quasi-rents, the greater the incentive to the auditor to conceal management breaches. Likewise, under a condition of no future quasi-rents, the auditor would have no economic incentive to conceal a breach by management and would strictly prefer disclosure or termination of the client relationship. Without quasi-rents, bilateral monopoly, and their causes (i.e., the transactions cost of switching

auditors and initial period start-up costs), the auditor is posited to be perfectly independent.

Thus, DeAngelo predicts that variables present in the auditing market will result in lowballing and in a decrease in auditor independence. Lowballing itself is not predicted to affect auditor independence because any loss incurred in an initial engagement is sunk, and accordingly, is irrelevant to future behavior.

2.2 Operationalizing the Model

2.2.1 Assumptions

DeAngelo's model provided a theoretical link between auditor independence and the intertemporal fee structure of audit services but was not sufficiently developed for empirical testing in the laboratory. Accordingly, to operationalize the model, additional assumptions were necessary.

First, to create a market in the laboratory, it was necessary to specify an institution that defines the communication and exchange rules in the economy [Smith, 1982]. In practice, no single institution dominates the audit market. Clients, for example, may hire an auditor without consulting competing auditors, and determine price and services (e.g., audit, tax and management consulting) to be provided through negotiation. Alternatively, a sealed offer auction may be used in which clients request that several auditors provide written offers detailing the services to be performed and price. The client then hires the auditor with the most attractive price/service package. Likewise, some combination of negotiation and auction procedure may be used. Consistent with DeAngelo's characterization, which abstracts from the multi-product environment in which auditing exists (see Beck, Frecka and Solomon [1988a, 1988b] for an extension of DeAngelo's model

to a multi-product setting), it was assumed that only one product may be offered by sellers. Since negotiations typically pertain to the provision of multiple products and since some subset of hirings in audit engagements are decided by sealed offer auctions, the assumption of a sealed offer auction was deemed appropriate as a starting point.

Transactions costs arise from disclosure requirements and training of new auditors by client personnel. Since the cost of disclosure and training may be observable (although imperfectly) by auditors, it was assumed that sellers⁵ have complete knowledge of the transactions costs incurred by the buyer when switching sellers. In addition, full knowledge of transaction costs is consistent with the common knowledge assumption in Table 1.

Third, it was assumed that the sellers know the outcome of each auction, insofar as the winning offer and the winning seller. It is clear that the identification of the winning seller is always known following an auction in the audit market. At the very least, the winner will be identified through the audit opinion issued with the client financial statements. The winning offer is not always known by the market, but in instances where the sealed offer auction mechanism is used, disclosure of the winning offer seems relatively frequent (particularly with respect to audits of public entities). Furthermore, as with the assumption of known transaction costs above, the knowledge of the winning seller and contract price is consistent with the common knowledge assumption.

Last, since it is impossible in a laboratory setting to operate a market in perpetuity (due to a requirement for a number of different subject groups and monetary constraints), it was assumed that a buyer exists for a finite

number of auction periods. This assumption raises the issue of end period effects which are dealt with later in this section.

2.2.2 Market Characteristics

Auditor cost function. Consistent with the assumptions listed in Table 1, all sellers had identical cost functions. The cost function consisted of three components. The first component, initial auction start-up cost, was treated as a between-groups experimental variable. The second and third components, which together made up constant future period avoidable costs, were the reservation wage, or opportunity cost incurred when the auction was won (operationalized by compensating subjects for losing each auction), and a constant cost incurred by the winning seller in each auction. Start-up costs were incurred only once by a winning seller in each market sequence, so that all past winners in a market incurred only constant future period avoidable costs upon winning an auction.

Client behavior and parameters. Smith [1987, p. 14] notes that the use of incomplete markets (e.g., a computerized buyer) is justified as an intermediate step in testing models of seller price behavior that assume passive, simple, demand-maximizing behavior by buyers. Because DeAngelo's characterization of buyer behavior satisfies the criteria set forth by Smith and since seller behavior was of primary interest in the market, a computerized buyer was used in the experiments. One limitation of this approach is that the possibility of strategic behavior on behalf of a human buyer is eliminated.

The computerized buyer followed the rule specified by DeAngelo, presented in equation 2. That is, the buyer acted to minimize costs by choosing the lowest offer in the initial period of an engagement and switched sellers when

a new seller's expected future fees plus the transactions cost of changing sellers was less than the incumbent seller's expected future fees. The cost of switching was treated as an experimental variable and was manipulated between-subjects over experimental sessions.

The discount rate and end period effects. The discount rate used in equations 1 through 3, above, was set to zero in the laboratory market. The extent to which auditors consider discount rates in their pricing decisions is not of central importance to the insights provided by DeAngelo's model and therefore was not considered here. However, the necessary assumption of a finite time horizon (each client existed for five auctions) can be construed as an operationalization of the discount rate, to the extent that the present value of future expected quasi-rents is made finite.

The presence of an end period does not materially alter the fundamental predictions made by DeAngelo. Specifically, to the extent that a future quasi-rent stream accrues to the incumbent, there exists an economic incentive for the seller to lowball and not to report a discovered error and hence fail to be perfectly independent. Both the buyer and the sellers know the lifespan of the market.

2.2.3 The Audit Process

To test propositions relating to seller independence in auditing, it was necessary to create a process in the laboratory analogous to the audit opinion formulation process. The essence of this process is judgment in the face of uncertain outcomes and payoffs. The auditor's judgment concerns the choice of a report to issue, given his posterior belief (after gathering evidence) of the probability of material misstatement in the client's financial statements. Due to cost constraints on evidence gathering, the presence of misstatements

is often uncertain. Thus, the "working definition" of auditor independence used by DeAngelo (i.e., the conditional probability that the auditor reports an error given that an error has been discovered) represents a simplification in that it does not take into account the uncertainty that often surrounds the existence of errors in financial statements.

When the existence of an error is uncertain, the auditor's choice of reports is based both on the materiality level chosen and the level of risk that the auditor is willing to accept. Materiality and acceptable risk are, in turn, determined by auditor judgment. Thus, the effects of decreased independence on audit judgment may be manifested either in the definition of materiality chosen by the auditor or in the level of acceptable risk selected. Given the large body of research in auditing dealing with audit risk and risk models, and since DeAngelo's operationalization of audit quality deals more directly with audit risk than with materiality, a simplified model was adopted where materiality considerations are absent (or set exogenously in the definition of "error"). In this abstraction of the audit task, choice of audit report is primarily determined by the maximum level of risk that the auditor is willing to accept. Then, a change acceptable level of risk chosen by an auditor in the face of a change in possible lost future quasi-rents (through client termination) would be suggestive of a decrease in auditor independence.

The operationalization of the audit process required the seller to choose a decision rule, used by the computer to select a report on the presence or absence of error in information produced by the buyer. Consistent with the description of the audit process, above, the decision rule was the *maximum acceptable probability of error* in the buyer information at which the seller

would be willing to issue a "no error" report, given the possible outcomes and payoffs that he faced. Once the decision rule was specified by the seller, the computer performed an examination of the buyer's information. The outcome of the examination was an "actual probability of error," ρ_E (which was constant, consistent with DeAngelo's assumptions). Following the examination, the computer issued a report ("no error" or "error") on the buyer's information consistent with the decision rule specified by the seller. If the actual probability of error was greater than the probability specified by the seller, an "error" report was issued by the computer. Conversely, if the actual probability of error was less than or equal to the probability specified by the seller, the computer chose a "no error" report. The report and the buyer's information were then provided to an imaginary third party (the information user).

The winning seller faced four possible outcomes contingent on the choice of report. The first two outcomes, which obtained if a "no error" report was issued, were discovery or non-discovery of an error by the information user⁶. The third outcome, which could obtain when the seller chose an "error" report, was the termination of the engagement (loss of incumbency by the seller). This outcome occurred with a probability ρ_t , constant across sellers and time when an error report was selected. A fourth outcome could arise when an "error" report was issued: the seller was not terminated and he was paid his offer price. The outcomes and payoffs for a winning seller are displayed in Figure 1.

Insert Figure 1 About Here

The experiment attempts to capture the report contingent outcomes and payoffs that face the auditor when issuing an opinion on client financial statements. If the auditor chooses a clean opinion, he may face one of two outcomes, either a significant error is later discovered by investors or no error is subsequently discovered. Likewise, if the auditor issues an "error" report (either a qualified or adverse opinion), he may risk losing the engagement due to client dissatisfaction with the report.

With regard to payoffs, the winning seller receives his offer price if he chooses 1) a "no error" report and no error is subsequently discovered by the information user or 2) an "error" report. Where the winning seller selects a "no error" report and an error is subsequently discovered by the information user, he is both paid his offer price and fined a fixed dollar amount, X . This penalty is analogous to the financial penalties that auditors face when a "clean" opinion is issued and significant errors are subsequently discovered by users of the financial statements. When an "error" report is selected, there is some probability that the client will terminate the relationship (i.e., not rehire the seller in the subsequent auction, regardless of his offer price). This outcome, analogous to the potential cost imposed by clients when the auditor does not provide desired disclosure concessions, represents a real economic loss in that the seller loses his incumbency and the associated future quasi-rents.

2.3 Hypotheses

DeAngelo's model makes predictions concerning an initial offers for an engagement and future period fees charged by an incumbent. Equation 1

suggests that sellers' initial period offers will approach the initial period cost less the value of the future quasi-rents accruing to an incumbent. As presented by DeAngelo, the value of the future quasi-rent stream is determined by future fees set at a maximum entry-preventing level. This rationale is captured by Hypothesis 1:

H₁: The equilibrium initial audit fee, F_1^* , will be $F_1^* = (A + K) - \sum_{i=1}^n (F_i^* - A)$ where n is the number of periods in the market and F_i^* is the maximum entry-preventing offer by the incumbent in period i .

Equation 3 predicts that the equilibrium value for future period fees charged by incumbent auditors will approach the maximum entry-preventing offer. The maximum entry-preventing offer depends on the future period avoidable cost of the auditor, the buyer's cost of switching auditors, CS , and the start-up costs incurred by the auditor, K . This prediction gives rise to Hypothesis 2:

H₂: When CS and K are positive, the incumbent seller's future period equilibrium offer, F^* , will approach the maximum entry-preventing offer in the market.

Where there are no advantages accruing to the incumbent auditor in the market (i.e., where $CS=K=0$), DeAngelo's model suggests that the equilibrium initial offer and the equilibrium future period offer will be driven to avoidable cost, A . Thus, no lowballing is predicted to occur because no future quasi-rent stream will be available to the winner of the initial period auction. This condition suggests Hypothesis 3.

H₃: When the cost of switching sellers, CS , and the additional costs in the initial period, K , are set to zero, the equilibrium initial period fee, F_1^* , and the equilibrium future period fee, F^* , will equal the sellers' avoidable cost.

DeAngelo's analysis also suggests several hypotheses regarding seller independence. First, in contrast with the view often adopted by policy makers (i.e., that lowballing leads to reduced auditor independence), DeAngelo

suggests that sunk costs incurred in the initial period in the form of losses from lowball offers below initial period costs do not affect the reporting behavior (independence) of auditors. This position gives rise to Hypothesis 4.

H₄: There will be no difference between the independence of sellers in markets where lowballing has occurred and in markets where lowballing is restricted.

DeAngelo's model also predicts that, as the future quasi-rent stream available to the auditor from a client increases, he will be influenced more easily by the client with respect to his reporting decision and thus, less independent. The quasi-rent stream is proposed by DeAngelo to be increased by an increase in the level of start-up costs, K , and by an increase in the level of the clients's cost of switching auditors, CS^7 (see equation 2). Thus the following two hypotheses are suggested:

H₅: Sellers will be less independent in markets when start-up costs are incurred.

H₆: Sellers will be less independent in markets where the buyer incurs a cost of switching when changing auditors.

Where both start-up costs and the cost of switching are equal to zero, it is predicted that no quasi-rents will accrue to the incumbent auditor. In this condition, DeAngelo predicts auditors will be perfectly independent, implying that their report choice will not be influenced by possible termination by the client. This prediction suggests the following hypothesis:

H₇: In markets where start-up costs and the cost of switching sellers are both equal to zero, the incumbent seller will be perfectly independent.

3. Method

3.1 Subjects

The subjects were 120 undergraduate and graduate business and economics students at the University of Arizona. All but two had no prior experience

with auditing⁸ and 26 percent had participated previously in other laboratory market experiments⁹.

Student subjects were chosen as surrogate auditors for a number of reasons. First, given the requirement for dominant rewards¹⁰ and the nature of the appropriate auditor subject group (partners who make offers on engagements and issue opinions), the cost of laboratory markets using auditor subjects was prohibitive. Second, the expected number of audit partners available as subjects was insufficient for even one replication of the experimental design. Third, student subjects in laboratory markets act with only real economic incentives in mind (consistent with DeAngelo's characterization of the auditor). The use of student subjects in lieu of agents operating in the naturally occurring market is well supported in the laboratory markets literature: so long as real people pursue real incentives in a laboratory market, choice of subjects should not be critical [Plott, 1982].

3.2 Experimental Design

The subjects were randomly assigned to one of five experimental cells, displayed in Figure 2. Three independent variables were manipulated: (1) the buyer's cost of switching sellers during the market week, (2) the sellers' initial period start-up costs, and (3) the presence or absence of a minimum price restriction on offers, equal to the seller's direct cost. The experiment was run in two phases. The first phase, consisting of a series of ten markets without the audit task described in the last section, was used to test Hypotheses 1 through 3 related to pricing behavior. The second phase was identical to the first phase, except that subjects were required to perform the audit task, and their payments were conditioned on the resulting

report/outcome pairs. The second phase was used to test hypotheses 4 through 7 relating to independence.

Insert Figure 2 About Here.

There were four replications of each cell (A through E) for a total of 20 experimental sessions. Each replication had six subjects, all sellers, for a total of 24 subjects in each cell and 120 subjects in all.

3.3 Dependent Variable Measures

Subject responses in the first phase of the experiment included the offer prices at which they were willing to sell a service in each of five auctions during a market. The winning contract (offer) price is used to test equilibrium predictions.

In the second phase, subject responses in each auction included both offer prices and the maximum acceptable probability of error at which they would be willing to issue a "no error" report, given the payoff function. The effect of quasi-rents on probability choice (used as a surrogate for independence) was measured in two ways. First, since the theoretical level of quasi-rents available to the initial auction winner varied across experimental cells, the average initial auction probability choice for the auction one winner was used as a measure. A larger mean auction one probability choice (the less the likelihood of being fired) for a cell is indicative of a lower level of independence in the cell. Second, to control for the possibility of individual differences in probability choice, the mean difference between probabilities elicited for each auction one winner at auction one (when theoretical loss from termination is greatest, due to available future quasi-rents) and at auction five (when the theoretical loss is zero) was used as a

measure. A larger difference in auction one and auction five probability choices suggests a lower level of seller independence.

3.4 Parameter Values

A summary of the parameter values used in the operationalization of DeAngelo's model are presented in Table 2. The values for each of the parameters in the cost function, as well as the other market parameter values were arrived at after studying results of pilot studies and after discussions with individuals experienced in laboratory market research¹¹. The values were set so that, based on pilot results, subjects would earn an average of \$20 in the experiment (*ex post*, the actual average subject payment was \$19.40 and total cash payments for the experiments were \$2,328)¹². Given the parameter values selected, Hypotheses 1 through 3 predict the equilibrium offers presented in Table 3.

Insert Tables 2 and 3 About Here

3.5 Validity Checks

A post-experimental questionnaire was used to gather demographic data (as a check for successful random assignment of subjects) and to administer various questions to gather evidence that requirements for creation of a market in the laboratory had been satisfied and that experimental manipulations were successful.

Demographic questions included inquiries regarding past experience in competitive bidding situations, prior audit experience (to ensure that screening of subjects was successful), past experience with laboratory markets, age, sex, educational background, etc. Additional questions were included to ensure that a laboratory market had been successfully created.

These questions addressed Smith's [1982] precepts of salience (recognition that rewards are tied to behavior), dominance (belief on the subject's part that the payment received is adequate to compensate for subjective transaction costs), and privacy (no knowledge of other subjects' earnings). It was assumed that all subjects in the markets satisfied the nonsatiation precept (that subjects prefer more money to less). Other questions attempted to determine the importance of possible termination by the client when selecting the probability decision rule, the extent to which subjects believed the random audit task outcomes were drawn from the described population, etc. A final group of questions served as manipulation checks.

3.6 Experimental Procedures

The site of the experiment was a classroom containing six networked personal computers. Upon arriving at the site, subjects were paid a three dollar appearance fee. Subjects selected from introductory management accounting classes (64 percent of the group) also were given full credit on a quiz (two percent of their grade) as an additional incentive to attend. The sessions were monitored by the researcher and an assistant to minimize interaction between subjects. A separate room contained a seventh personal computer which acted as the buyer in the markets.

Following an initial sealed bid auction sequence, used to measure risk preferences, subjects read a set of computerized interactive instructions describing the first experimental market, designed to test Hypotheses 1 through 3, regarding price behavior. The instructions described the cost function faced by the subject, the operation of the market, the behavior and cost function of the buyer and how profits and losses were computed in the market.

After completing the instructions, subjects began the first market sequence which consisted of a computerized sealed offer institution using the market parameters described in Table 2, with no audit task and certain payoffs. During each of ten, five-auction markets, offers were entered by the subjects on the computer keyboard and displayed on the computer screen. Upon receiving offers from all subjects, the buyer selected a winner, whose identification number and offer was sent to all subjects in message form. Ties were always settled in favor of the incumbent subject, or randomly if there was no incumbent. After receipt of the message, the profit for each subject was automatically computed and displayed on the viewing screen. The winning subject's profit/loss was equal to his offer less cost for the auction and all losers had daily profit equal to \$1.25.

At the end of each five-auction market, cumulative profits were displayed on each subject's personal computer. Then, a new market began in which subjects offered to sell the commodity to a new buyer. Subjects knew that several markets would be run, but were not told the actual number.

After completing phase 1 of the experiment, subjects were paid their profits in cash and were given a 45 minute break for either lunch or dinner. The meal was provided to the subjects by the experimenter, in the laboratory. During the break, subjects were continuously monitored to ensure that the experiment was not discussed. As a validity check, in the post-experimental questionnaire, subjects unanimously reported that they were not aware of any discussions regarding the experiment during the break.

After the break, subjects completed a second set of computerized interactive instructions describing the reporting task that they would perform in the second phase of the experiment. Upon completion of the reporting task

instructions, subjects were permitted to ask questions to clarify any portion of the instructions that they had difficulty in understanding. Next, subjects practiced providing reports in a nonmarket setting for five simulated auctions. Subjects then began phase 2, which consisted of eight, five-auction weeks where the subjects offered to sell the reporting task as a service to a different buyer each week. The second phase was identical to phase one, with the addition of the audit task and uncertain payoffs described in Table 2. Likewise, the independent variable values were identical to those used in the first half of the experiment for each group of subjects. After having made offers and received the outcome of each auction, the computer prompted subjects to enter a cutoff probability, from which a report was determined.¹³

Following selection of a probability, the outcome of the audit process for each auction was determined by the computer based on a representative sample of outcomes selected in advance of the experiment¹⁴. The outcome and resulting payoff were communicated to the winning seller by his computer and his profits were appropriately updated to reflect the payoff. When the winning seller was fired by the buyer or fined for "error" discovery (when a "no error" report was issued), the outcome (that the incumbent was fired or fined) was announced to all sellers in the form of a message on the computer.

4. Results

4.1 Validity Checks

The major demographic variables collected in the post-experimental questionnaire were analyzed to ensure randomization of these characteristics across subjects. There were no significant differences ($p < .05$) across conditions, indicating random assignment of subjects to each cell. In addition, results suggest that the experimental precepts required for creation

of a market in the laboratory were satisfied. Mean responses for measures of salience, dominance, and privacy were all above 5 on 7-point Likert scales, with standard errors of .10 to .11. In addition, the scales had relatively high levels of reliability (Chronbach's alpha or correlation coefficients of .72 to .93). Finally, results of two sets of manipulation checks indicate that the experimental manipulations of start-up costs and cost of switching were successful ($p < .05$).

Responses to additional questions administered to subjects at the end of the experiment indicate that subjects 1) obtained no pertinent information regarding the experiment prior to participation, 2) believed that the outcomes observed in the audit task (being fired or fined) were randomly drawn from the described populations, 3) understood both the operation of the markets and the probability selection task, and 4) agreed that they were not coaxed or led to a particular strategy by the experimenter or by the instructions.

4.2 Hypothesis Tests

The contract price data for the last five markets (with five auctions in each market) in phase one are presented in Figures 4 through 8. Each figure displays the observed contract prices in each cell, plotted over 25 cent intervals. The numbers on the graphs represent the frequency of contract prices observed in each interval. For example, in Figure 3, the number "21" plotted at auction one represents 21 contracts observed in the interval \$37.25 to \$37.49. Theoretical predictions (generated from Hypotheses 1 through 3), presented in Table 3, are displayed as horizontal lines in the figures.

Insert Figures 3 to 6 About Here

Two descriptive measures of the predictive ability of price hypotheses are presented in the figures. The first measure is the nearness of the predicted price to the modal 75 cent interval of prices (i.e., the 75 cent interval containing the largest frequency of observed contract prices), represented by vertical lines to the right of the contract price frequencies. The second measure is the nearness of predicted prices to the median contract price, represented in the figures by circles plotted to the left of the contract price frequencies. In addition to the median and modal 75 cent interval, the mean and the results of *t*-tests are reported in Table 4.

Insert Table 4 About Here

Several caveats accompany the use of descriptive and parametric statistics (e.g., *t*-statistics) in laboratory markets studies. The use of a modal interval and a median admittedly lacks objectivity and is somewhat arbitrary. However, there exist equal limitations in the application of conventional statistical analysis to the data. Specifically, much of the data fails to satisfy distributional assumptions and the requirement for independence of observations. Given these limitations, both qualitative evaluation (e.g., descriptive statistics) and conventional statistical analysis are presented so that the reader may draw his own conclusions regarding the hypotheses, recognizing the trade-off between the two approaches.

Results and discussion of Hypotheses 1 through 3. Hypothesis 1 predicts that initial auction offers in phase one are a function of the expected future quasi-rents available to the incumbent. Specifically, sellers are predicted to lowball in an amount equal to the future rents available to the incumbent.

The initial auction prices in cells B, C, and D (Figures 4 through 6) provide strong support for Hypothesis 1. That is, the modal 75 cent interval of contract prices either contained or was very near the predicted equilibrium price. Likewise, median prices are also very near the predicted level. The results of *t*-tests in Table 4 provide mixed support for the hypothesis. A difference between the mean of observed contracts and the predicted value cannot be rejected for cell B. However, there is a statistically significant difference observed for cells C and D, reflecting the tendency of the contract prices to be skewed in the direction above the predicted level.

The second hypothesis addresses seller pricing behavior in auctions two through five. Specifically, it predicts that the future contract prices will equal the theoretical maximum entry-preventing price. Figures 4 through 6 provide mixed results with respect to Hypothesis 2. For auctions two through four (where no quasi-rents were available) in cells B and C (Figures 4 and 5), the modal 75 cent interval again either contains or is very near the predicted equilibrium level. Likewise, median prices are relatively near the predicted levels. However, in cell D, for auctions two through four (where no quasi-rents were available), the modal intervals and medians are higher than the predicted prices and seem to move progressively farther from predicted levels as the final auction approaches. This tendency is also reflected to a limited extent in auction four of cell B as can be observed in Figure 5. Table 4 also presents mixed results with respect to Hypothesis 2. The trend toward higher mean contract prices can be observed in cells B and D, reaching statistical significance in auction 4 in both cells. In contrast, cell C shows a significant tendency for observed mean contracts prices to fall below predicted levels.

In contrast, in auctions where quasi-rents are available (auction five for cells B, C and D), the medians and observed 75 cent modal intervals are less than the predicted equilibrium in every case. Likewise, mean observed contract prices are observed to be significantly less than the predicted level in all three cells at $p < .01$.

One explanation for the tendency of offers to be substantially less than the predicted level in auctions where quasi-rents are theoretically available relates to occasional non-maximizing strategies adopted by incumbents and non-incumbents. That is, non-incumbents were sometimes observed to undercut incumbent prices and/or incumbents were observed to overprice in auctions where quasi-rents were available. Given the deviations from maximizing behavior on behalf of both incumbents and non-incumbents, subjects were apparently unable to infer (from price data) where the boundary for entry-preventing offers occurred. The resulting uncertainty, combined with observed risk aversion on behalf of all subjects in sealed bid auctions¹⁵, would suggest that incumbents would behave conservatively, selecting offers well below theoretical maximum levels. These results are consistent with other studies involving sealed bid and offer auctions (e.g., see Cox, Smith and Walker [1985] and Fisher [1988]).

The above analysis has further implications for initial auction offers. That is, since the future rents earned by winners of the initial auction were generally less than the predicted maximum, it is expected that initial auction offers would be somewhat higher than that predicted by Hypothesis 1. This tendency was observed in cells C and D. Likewise, in cell B, the distribution of auction one offers tends to be skewed in the direction above the predicted price.

It is apparent from these results that the conclusions derived from DeAngelo's model are not very robust with respect to small deviations from rationality. It is difficult to believe, even in the audit market, that agents literally maximize all the time. As noted by Akerlof and Yellen [1985]:

People may suffer from inertia. They may also rely on rules of thumb which produce acceptable results on the average. So most economic theory based on strict maximization is useful when accompanied with the folk theorem that the results of this theory are approximately correct if the deviations from optimality are small.

Thus, where slight deviations from rational behavior produces outcomes significantly different from theoretical predictions, the assumption of strict maximization is unjustified. Such a result points to the need for theory revision.

The last hypothesis related to seller pricing behavior under conditions of certain payoffs predicts that, where no advantages accrue to the incumbent, a competitive equilibrium will be achieved with offers approaching the sellers' avoidable cost of providing the service. The frequency plot of contract prices in cell A (Figure 3) provide strong support for Hypothesis 3. All but five observed contracts occurred within the 25 cent interval in which sellers' avoidable cost was located. In addition Table 4 provides support for the hypothesis. With the exception of auction 3, the null hypothesis of no difference cannot be rejected in any auction in cell A. The significant result in auction 3 arises from the presence of a very small standard error (the mean observed contract price, \$37.24, is only one cent away from the predicted price of \$37.25).

Descriptive statistics for Hypotheses 4 to 7. The means, standard deviations, and standard errors for the initial auction probability choices

made by winning sellers in auction one are displayed on the left half of Table 5. The initial auction probability is presented both for all phase two markets and for the last four market sequences in phase two (in an attempt to control for learning effects). It is apparent from the mean values that the probabilities selected in cell A (where $CS=K=0$) is less than the probabilities selected in the other four cells (where some cost advantage accrues to the incumbent). The smaller probability in cell A suggests that sellers tend to be more independent (i.e., less willing to accept a chance of improperly issuing a clean opinion).

Descriptive statistics for the probability difference for each market sequence (defined as the initial auction winner's probability choice minus his final probability choice) are displayed on the right hand side of Table 4, for all phase two markets and the last four market sequences in phase two. A smaller the difference between the initial and final probability choice suggests that sellers are more independent. For example, using probability differences subjects behave as if they were more independent in cell A than in other cells because the probability difference is substantially smaller.

Insert Table 5 About Here

Results and discussion for Hypothesis 4. In DeAngelo's characterization of the auditor-client contractual relationship, it is assumed that sunk costs do not play a role in auditor behavior. This assumption is key to her predictions regarding auditor behavior in the light of recent policy issues addressed by governmental bodies such as the Securities and Exchange Commission (e.g., the prediction that any attempts to restrict lowballing in the marketplace will have no effect on auditor independence).

To test Hypothesis 4, four one-tailed t -tests for the difference between means for initial auction probabilities and for probability differences in cells D (where lowballing is allowed and $CS=K=4$) and E (where lowballing was restricted and $CS=K=4$) were run. In addition, to avoid the distributional assumptions of traditional t -tests, approximate randomization analogs of the tests [Noreen, 1986] were also computed. Assuming that the future rents available in the two cells are equal, lack of a significant difference between the two cells would provide support for the hypothesis. The results of the statistical tests for auction probabilities for all of phase two and for the last half of phase two are presented in Table 6. The results of cell mean comparisons for probability differences are presented in Table 7, also for both the entirety of phase two and for the last half of phase two.

Insert Tables 6 and 7 About Here

None of the mean differences for cells D and E are significantly different from zero. The p -values range from .30 to .44. Thus, it cannot be concluded that the independence of sellers is affected by restrictions against lowballing. Hence, in accord with DeAngelo's prediction, sunk costs appear irrelevant. However, for this explanation to hold given the results reported, subjects' expectations regarding the availability of future rents must be presumed equivalent between the two cells, despite the large actual differences observed (a mean of \$1.25 in cell D versus a mean of \$19.59 in cell E).

Some support for equivalent expectations regarding quasi-rents is provided by evidence gathered in the post-experimental questionnaire. Subjects were required to respond to the following statement: "By gaining an

incumbency (i.e., winning before the last day in a market week) during the second half of the experiment, I increased my chance of making profit." Responses were scored on a 7-point Likert scale with a "1" as "strongly disagree" and a "7" as "strongly agree." The mean (standard error) for cells D and E were 5.1 (.30) and 5.8 (.40) respectively, supporting the contention that subjects' expectations of quasi-rents were equivalent in the two groups.

Results and discussion of Hypotheses 5 and 6. Hypotheses 5 and 6 deal individually with the effect of start-up costs and the cost of switching on seller independence. DeAngelo's model predicts that the existence of start-up costs incurred by the seller and a cost of switching incurred by the buyer when changing sellers give rise to an expectation of a future rent stream accruing to an incumbent seller. The expectation of this future rent stream is then predicted to decrease seller independence. Thus, the greater the start-up costs or cost of switching in a market, the less independent the sellers will be.

To test Hypotheses 5 and 6, a series of cell mean comparisons were made, using traditional t -tests and approximate randomization methods. The results of the tests, using auction 1 probabilities, are presented in Table 6. The comparison of mean probability differences (auction one minus auction five) are presented in Table 7. Both tables show results for all markets in phase two and for the last four markets in phase two (to control for learning effects).

Hypotheses 5 and 6 predict that seller independence should be greatest in the cell where no advantages accrue to the incumbent (cell A) because cost of switching and start-up costs are both equal to zero. Next, because the markets in cells B and C have a positive start-up cost or cost of switching,

respectively, the sellers in those markets should be less independent than those in cell A. Likewise, since the future rents available to sellers in cells B and C are theoretically equal, there should be no difference between the independence of sellers in the two cells. Last, the sellers in cell D should be the least independent, since the markets have a positive start-up cost and a positive cost of switching and therefore, the largest level of available future rents. Thus, Hypotheses 5 and 6 predict subjects' independence in the experimental cells will be ranked as follows: $A > B = C > D$.

The cell mean differences for auction one probability choices are in the direction hypothesized (lower mean probabilities suggest greater independence on behalf of sellers). However, only the mean difference between cell A (where $CS=K=0$) and cell D ($CS=K=4$) is weakly statistically significant. Eliminating the first four markets (to control for learning effects) improves the significance of the D-A comparison to $p = .04$ and produces a significant difference in the mean auction one probability choice for cells A and B ($p = .037$), still providing only weak support for the hypotheses. However, substantially more support is provided by the probability difference measures presented in Table 7. Specifically, for the market five to eight comparisons, all differences are in the appropriate direction, and except for the mean difference between cells C ($CS=4$ and $K=0$) and D, all differences are significant. Lastly, in all four approaches, the comparison of cells where either start-up cost or cost of switching is positive (cells B and C) is never significantly different from zero, consistent with the ordering predicted by theory.

The conclusion regarding independence is further buttressed by the results of two questions presented to subjects in the post-experimental questionnaire. The first (second) question asked, when the subject was an incumbent, "On the last (first) day of each week in the second half of the experiment, how important was the possibility of termination by the client in your choice of probability?" Subjects responded to the questions on a 7-point Likert scale anchored with "very important" (scored as a 1) and "not important at all" (scored as a 7). Across all cells, mean subject responses for the first question varied between 5.7 and 6.6, indicating that subjects generally regarded termination as unimportant when selecting their probability decision rules in the final auction of a market. This result is consistent with theory, in that no quasi-rents are available during the last auction. For the initial auction probability choices, subject responses varied across cells; a mean response of 5.0 for cell A, 3.0 for cell B, 2.8 for cell C, 2.7 for cell D and 1.5 for cell E. This ordering suggests that subjects were least concerned with termination in the initial period in cell A (where theoretical future quasi-rents are zero) and became increasingly concerned as quasi-rents increased (in cells B, C ^{and C} and D).

Results and discussion for Hypothesis 7. Hypothesis 7 predicts that, lacking economic incentives (e.g., future quasi-rents) resulting from advantages accruing to the incumbent (e.g., start-up costs and cost of switching), sellers will be perfectly independent. To test this hypothesis, probability choices of initial auction winners for auction one and five are compared in cell A. Since there is no start-up cost or cost of switching in cell A, no quasi-rents are predicted to arise and, according to the hypothesis, sellers should be perfectly independent in the initial auction.

The auction five probability choice is used as a baseline (perfect independence) since the incumbent will lose the engagement no matter what opinion is issued (the client expires) and therefore has an incentive to be perfectly independent. If the auction one probability choices are not significantly different than the auction five probability choices in cell A, then Hypothesis 7 is supported.

The statistical tests consisted of a conventional one-tailed t -test for difference between means and an approximate randomization equivalent. The resulting t -statistic for all markets is 2.917 ($p < .007$). For the last four markets in each experimental session, the resulting t -statistic is 1.769 ($p < .097$). Using approximate randomization tests for difference between means with 25,000 randomizations, the resulting p -value for the mean difference of auction one and auction five probability choices is .008. For the last four markets in each experimental session, the p -value is .093. Since the results point to less independence on behalf of sellers in the initial auction (the difference in probability choices was positive at a statistically significant level), Hypothesis 7 is rejected.

One possible explanation for the observed behavior might arise from the tie rule that was used in the market. That is, even in cell A, any ties in an auction were always resolved in favor of the incumbent. Thus, since the competitive equilibrium was achieved in cell A, the incumbent could successfully prevent entry by other sellers and retain the incumbency by offering the equilibrium price. While there was no monetary incentive for retaining the incumbency, sellers might still be less independent in initial auctions if there was some utility for winning auctions (and retaining the

incumbency). Hypothesis 7 might have been better tested with a tie rule that randomly decides the winning seller.

5. Conclusion

This study is an initial attempt to directly test predictions generated by DeAngelo's model of the auditor-client relationship in a laboratory market (see also Schatzberg's [1987] laboratory market study of lowballing which was performed contemporaneously with the study reported here). As predicted by DeAngelo, lowballing was observed in all markets where it was permitted and was observed to increase as the availability of future quasi-rents increased. However, exact predictions regarding initial auction price were only weakly supported. In addition, experimental evidence regarding entry-preventing pricing by incumbents (Hypothesis 2) suggests that the theoretical predictions are sensitive to small deviations from strict maximizing behavior on behalf of subjects.

Experimental results were also mixed with respect to predictions of market effects on independence. In accord with theoretical predictions, subjects accepted significantly larger risks of misstatement (implying decreased independence) with increased availability of future quasi-rents. However, contrary to predictions, in a market without quasi-rents, the evidence suggests that independence is less than perfect, possibly because of the presence of a tie-rule which always settled in favor of the incumbent seller.

In future research, tests of DeAngelo's model with other operationalizations (e.g., see Duke's [1987] research in progress which examines DeAngelo's predictions in a negotiated price market) to determine the model's robustness are appropriate. Additional research might include an

extension of the theory to include uncertain costs for non-incumbents and a focus on the demand side of the market for audit services (e.g., the introduction of human buyers). Evidence from the study reported above and from additional studies can contribute to the creation of better theories regarding the relationship between variables in the audit market and auditor independence and audit quality.

Notes

1. Isaac [1983] describes how operationalizations of logically consistent theories or models can lead to poor predictions of behavior. Likewise, while arguing for the necessity of empirical tests of theories of human behavior Kaplan [1964, p. 35] notes: "An inner coherence, even strict self-consistency, may mark a delusional system as well as a scientific one."
2. Under the assumption that auditors are profit maximizing, they will refuse an engagement unless they can earn at least a normal return, such that the discounted value of the sum of future rents is greater than or equal to zero for all future periods.
3. The term "lowballing" in this context refers to the decrease in initial fees (below $A + K$) charged as a response to an increase in expected future quasi-rents generated by increased start-up costs and/or increased transactions costs of switching auditors.
4. The market assessed conditional probability of reporting a discovered error is assumed to be some imperfect function of the actual conditional probability that an auditor will report an error. The market's ability to assess the probability is limited to its ability to observe a portion of actual failures to report after a time lag, and to use other noisy signals such as brand name of the auditor (reputation).
5. For purposes of the experiment, subjects who adopt the role of an auditor will be termed "sellers." Likewise, the client is described as a "buyer."
6. To avoid additional and unnecessary complexity in the experimental task, it is assumed that, when an error exists, it will be discovered with certainty by the information user. Thus, the joint probability of error occurrence and discovery by the information user is equal to the probability of occurrence. While the assumption is not characteristic of the audit market, it has no critical effect on the predictions of DeAngelo's model.
7. While not addressed in the experiment, in the audit market the cost of switching incurred by the client may also work to make the auditor more independent. That is, since it is more costly for clients to switch, the auditor may be able to more easily convince them to "repair" any discovered breach and therefore may be deemed more independent.
8. The two subjects' experience was limited to one auditing course. However, in a post-experimental debriefing, it was clear that neither of the subjects recognized the experiment as a representation of the audit market.
9. Prior empirical results in experimental economics suggest that the presence of experienced subjects act to accelerate the move to an equilibrium with no effect on the equilibrium reached [Ketcham, Smith and Williams, 1984]. The inclusion of experienced subjects (i.e., subjects who had participated in

previous laboratory market experiments) in the subject pool was deemed desirable because equilibrium behavior was the principal focus of the hypotheses and would presumably be reached more quickly when experienced subjects were used in the markets.

10. Smith [1982, p. 934] lists among the necessary conditions for creating a market in the laboratory the precept of dominant rewards. That is, a laboratory market must be constructed such that "(t)he reward structure dominates any subjective costs (or values) associated with participation in the activities of the experiment."

11. The penalty amount, X, of \$10 was selected such that the approximate expected value of choosing all "no error" reports during a market week was approximately equal to the expected value of choosing all "error" reports during a market week when the theoretical equilibrium is satisfied. The actual penalty required for equal expected values was \$9.91, which was rounded up to \$10 for ease of computation.

12. The actual dollar amount received by subjects in the laboratory market was 10% of the dollar profit earned in the experiment, so that expected average cash earnings per subject was approximately \$20.

13. To encourage subjects to report the maximum acceptable probability of error rather than a probability resulting in a specific report (greater or less than the 15% actual chance of error fixed in the markets), a simulated auction with randomly selected actual error probabilities was run for each seller at the end of the experiment. The report choice in the simulated auction was determined by the seller's probability choice in a randomly selected market in which they were the incumbent. The actual error probability was selected randomly from the interval [0,1]. The seller's offer price and cost in the simulated market was equal to the price and cost in the auction selected and the available payoffs were identical to those earned by the subject in the actual market.

14. Prior research [Forsythe, 1986] suggests that subjects are more likely to perceive a preselected sample as randomly selected from a population when it is representative of the population described. That is, the proportion of each outcome in the sample should be the same as the proportion of each outcome in the population described to subjects.

15. Prior to beginning the experiment, subjects participated in a sealed bid auction to gather data that was later used to estimate subject risk preferences using the general constant relative risk aversion model of bidding behavior [Cox, Smith and Walker, 1985]. Estimates of the Arrow-Pratt measure of relative risk aversion indicate that all subjects in the experiment were risk averse.

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Table 1: Relevant Assumptions in DeAngelo's Model

A. THE AUDIT MARKET

1. All auditors are known to have identical cost functions.
2. Contracting between auditors and clients is costly. The costs include initial period start-up costs, K , incurred by the auditor and transactions costs, CS , incurred by the client when changing auditors.
3. Future period costs for providing an audit service, A , are constant.
4. There exists a constant reservation wage available to all auditors to be earned by auditing the next best client, and the reservation wage is identical for all auditors.
5. The discount rate, r , is constant and identical for all auditors and clients in the market.
6. The market is modeled with an infinite time horizon.
7. There is perfect competition among auditors in the initial period of an engagement.
8. Auditors and clients are rational expected utility maximizers.
9. All information is common knowledge.

B. THE AUDIT PROCESS

1. The auditor's probability of discovering a management breach is positive and fixed and identical across auditors and time.
 2. There exists an incentive in the market (i.e., collateral bond) for the auditor to report a discovered breach.
 3. There exists an incentive (in the form of an expected future quasi-rent stream) in the market for the auditor not to report a discovered breach.
-

Table 2: Summary of Parameter Values Chosen for Operationalization of DeAngelo's Model.

Parameter	Value
A. THE SELLER COST FUNCTION	
1. future period audit cost, A	\$36.00
2. reservation wage for auditing the next best buyer	\$1.25
3. seller start-up costs (variable)	\$4.00 or \$0.00
B. THE SELLER PAYOFF FUNCTION (for phase 2 only)	
1. probability of error discovery, ρ_E	15%
2. penalty if "no error" report chosen and error is discovered, X	\$10.00
3. probability of termination if "error" report chosen, ρ_t	30%
C. BUYER PARAMETERS	
1. buyer's cost of switching sellers, CS (variable)	\$4.00 or \$0.00
2. buyer's decision rule	
a. initial auction	accept lowest offer
b. future auctions	retain incumbent unless his offer + future fees is CS greater than lowest non-incumbent offer + future fees
D. MARKET PARAMETERS	
1. time horizon	5 auctions
2. discount rate	0
3. market institution	sealed offer auction
4. allowable offer range (variable)	all offers allowed <u>or</u> offers > direct cost of audit

Table 3: Price Predictions for the Operationalized Market (phase 1).

Cell	VARIABLE		AUCTION				
	CS	K	1	2	3	4	5
A	\$0.00	\$0.00	\$37.25	\$37.25	\$37.25	\$37.25	\$37.25
B	\$0.00	\$4.00	\$37.25	\$37.25	\$37.25	\$37.25	\$41.25
C	\$4.00	\$0.00	\$33.25	\$37.25	\$37.25	\$37.25	\$41.25
D	\$4.00	\$4.00	\$33.25	\$37.25	\$37.25	\$37.25	\$45.25

Table 4: Means of Contract Prices in Last Half of Phase 1 (and T-Statistics for Hypothesized Prices)

Cell	AUCTION				
	1	2	3	4	5
A	\$37.10 (1.83)	\$37.25 (0.00)	\$37.24 (5.00)**	\$36.73 (1.04)	\$36.73 (1.83)
B	\$37.56 (1.68)	\$37.28 (0.19)	\$37.40 (0.91)	\$37.68 (2.38)*	\$36.11 (3.02)**
C	\$33.67 (2.50)*	\$35.90 (3.27)**	\$36.36 (2.64)*	\$36.44 (2.05)	\$38.35 (7.51)**
D	\$34.45 (4.33)**	\$37.34 (0.23)	\$38.12 (2.01)	\$38.63 (3.32)**	\$39.63 (11.81)**

* = $p < .05$ for 2-tailed test

** = $p < .01$ for 2-tailed test

Table 5: Descriptive Statistics on Independence Measures by Cell.

Cell	<u>Auction 1 Probability</u>			<u>Probability Difference</u>		
	Mean	Standard Deviation	Standard Error	Mean	Standard Deviation	Standard Error
A. All phase 2 markets.						
A	.2894	.2741	.0485	.1444	.2800	.0495
B	.3672	.2484	.0439	.2213	.1898	.0336
C	.3597	.2941	.0520	.2391	.3342	.0591
D	.3794	.2468	.0436	.3291	.3068	.0512
E	.3931	.2571	.0454	.3291	.3068	.0542
B. Markets 5 to 8 in phase 2.						
A	.2331	.2779	.0695	.1063	.2406	.0601
B	.4100	.2640	.0660	.2206	.2037	.0509
C	.3669	.3262	.0816	.3038	.3774	.0913
D	.3863	.2051	.0513	.3375	.2512	.0628
E	.4313	.2777	.0694	.3638	.3333	.0833

Table 6: Cell Mean Comparisons of Auction 1 Probabilities Chosen by the Initial Auction Winner.

	Critical	One-tailed		Approximate
	statistic	<i>t</i> -statistic	<i>p</i> -value	Randomization ¹
				<i>p</i> -value
A. All phase 2 markets.				
D - A	.0900	1.3800	.0888 ⁺	.0892 ⁺
D - B	.0122	0.1972	.4225	.4239
D - C	.0197	0.2903	.3868	.3849
C - A	.0703	0.9886	.1653	.1614
B - A	.0778	1.1890	.1218	.1192
E - D	.0137	0.2176	.4146	.4113
C - B	-.0075	0.1102	.4565	.5499
B. Markets 5 to 8 in phase 2				
D - A	.1531	1.7735	.0430 [*]	.0457 [*]
D - B	-.0237	0.2835	.3894	.6108
D - C	.0194	0.2013	.4209	.4191
C - A	.1337	1.2483	.1106	.1126
B - A	.1769	1.8457	.0373 [*]	.0375 [*]
E - D	.0450	0.5214	.3029	.3038
C - B	-.0431	0.4107	.3421	.6607

* = $p \leq .05$

+ = $p \leq .10$

¹with 25,000 shuffles

Table 7: Cell Mean Comparisons of Differences Between Auction 1 and Auction 5 Probabilities Chosen by the Initial Auction Winner.

	Critical	One-tailed		Approximate
	statistic	<i>t</i> -statistic	<i>p</i> -value	Randomization ¹
				<i>p</i> -value
A. All phase 2 markets.				
D - A	.1728	2.3660	.0122*	.0088**
D - B	.0959	1.5139	.0701 ⁺	.0725 ⁺
D - C	.0781	0.9780	.1678	.1601
C - A	.0947	1.2234	.1143	.1212
B - A	.0769	1.2854	.1041	.1129
E - D	.0119	0.1560	.4381	.4345
C - B	.0178	0.2618	.3976	.3991
B. Markets 5 to 8 in phase 2				
D - A	.2312	2.6598	.0061** ⁺	.0059** ⁺
D - B	.1169	1.4161	.0791 ⁺	.0786 ⁺
D - C	.0338	0.2974	.3851	.3817
C - A	.1975	1.7662	.0436*	.0412*
B - A	.1144	1.4513	.0784 ⁺	.0798 ⁺
E - D	.0262	0.2521	.4013	.4015
C - B	.0831	1.0956	.1409	.2258

* = $p \leq .05$ + = $p \leq .10$

** = $p \leq .01$ ¹with 25,000 shuffles

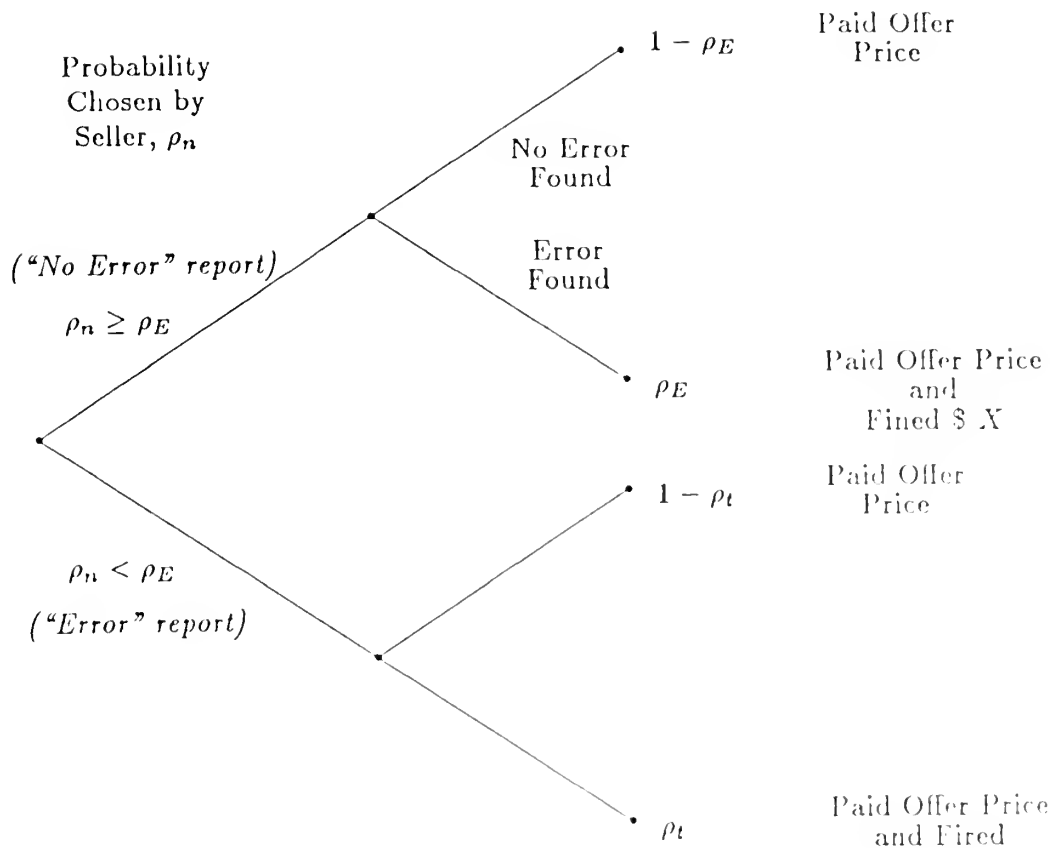


Figure 1: The Seller's Decision Tree and Payoffs in the Laboratory Reporting Task.

		Start-Up Costs (K)		
		\$0	\$1.00	
Cost of Switching (CS)	\$0	A	B	\$1.00
	\$4.00	C	D	
		No Restriction on Offers	Offer > Cost	

Figure 2: Experimental Design.

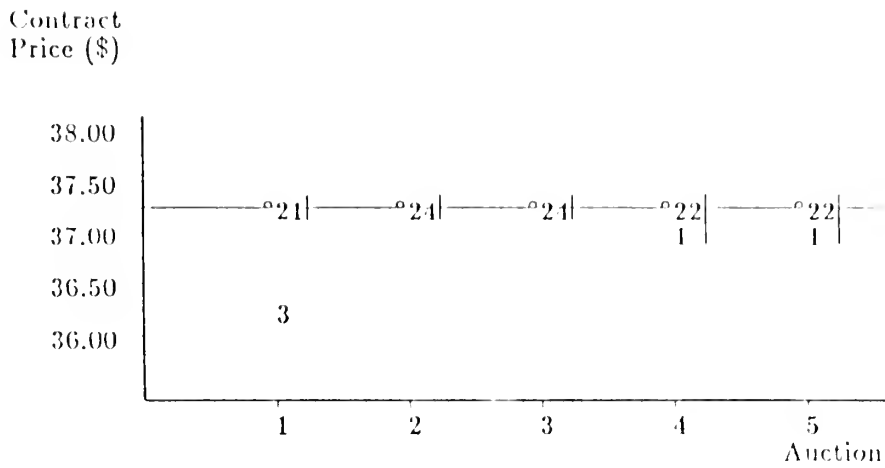


Figure 3: Cell A ($CS=K=0$), Contract Prices Under Certain Payoff Conditions (Phase 1) -- Market 6 to Market 10.

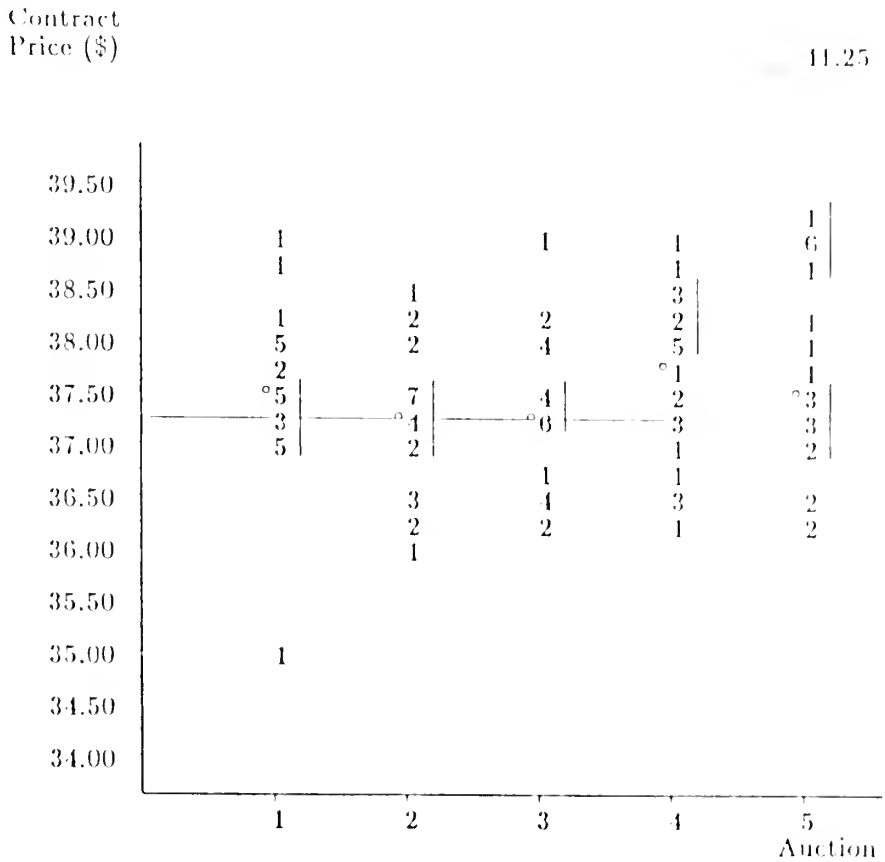


Figure 4: Cell B ($CS=0, K=4$), Contract Prices Under Certain Payoff Conditions (Phase 1) -- Market 6 to Market 10.

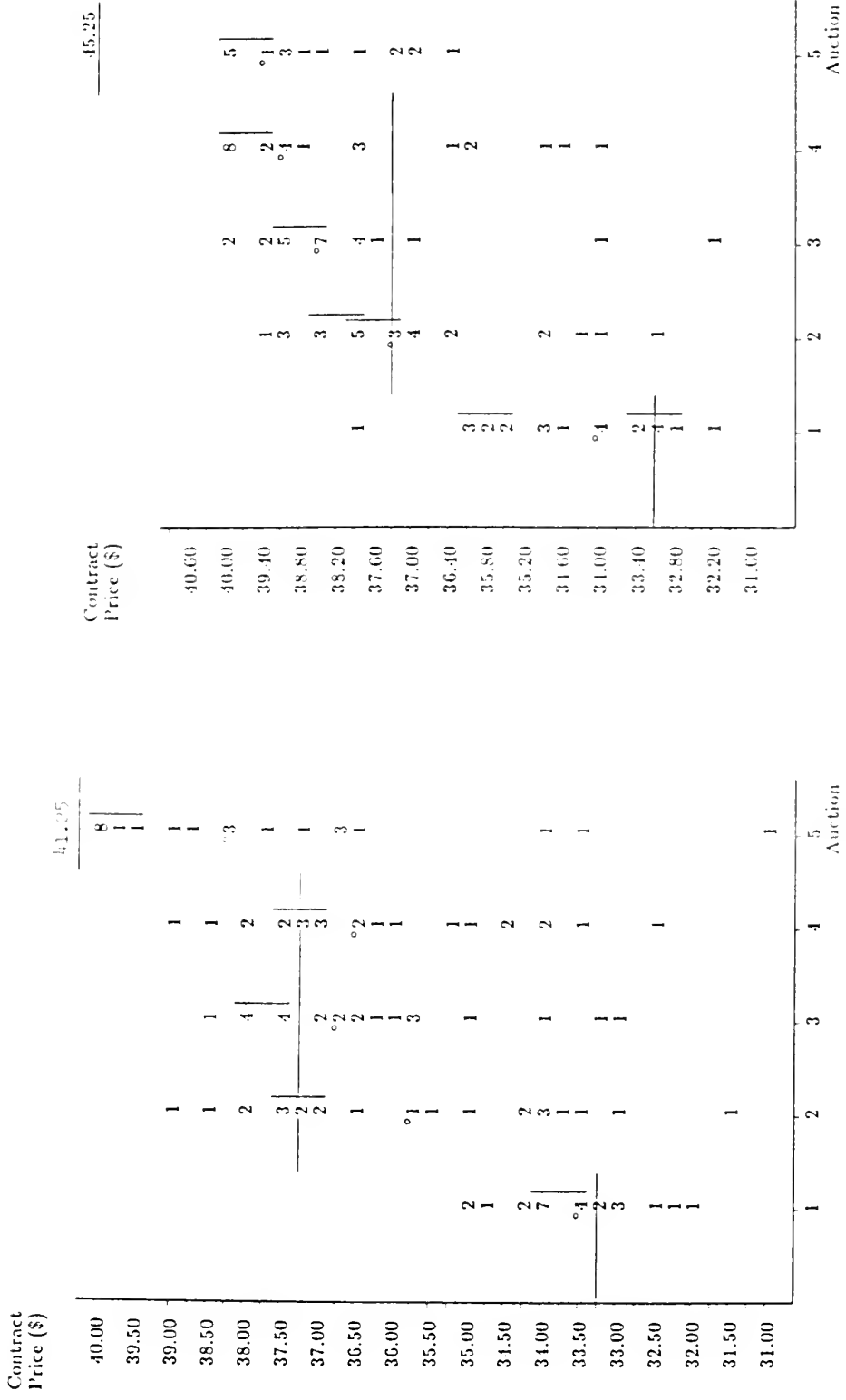


Figure 5: Cell C (CS=4, K=0), Contract Prices Under Certain Payoff Conditions (Phase 1) -- Market 6 to Market 10.

Figure 6: Cell D (CS=K=4), Contract Prices Under Certain Payoff Conditions (Phase 1) -- Market 6 to Market 10.

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