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Underpricing of New Issues and the Choice of Auditor as a Signal of Investment Banker Reputation

Ronald J. Balvers, Bill McDonald, and Robert E. Miller

ABSTRACT: A theoretical model that explicitly incorporates the relation between investment banker and auditor is developed to provide a framework for testing the effect of auditor selection in the initial market for unseasoned equity issues. The theoretical model generates a number of testable propositions. Consistent with stylized facts, the theory suggests that high reputation investment bankers will more frequently use high reputation auditors, and that both investment banker and auditor reputation help to reduce underpricing. As either reputational variable increases, the model predicts that the impact of the other variable will diminish. The empirical results confirm this more complex relation. The structure of the model documented in this research may explain the difficulties of previous studies in identifying an empirical relation between auditor reputation and underpricing.

A NUMBER of recent studies have addressed various aspects associated with the pricing of new issues (see Smith [1986] for a survey). Underpricing, or a negative difference between a new issue's offering price and the first bid, has also been studied. For example, Miller and Reilly [1987] find an average underpricing of about ten percent.

The current study focuses on the interaction between the investment banker and the selection of an auditor in relation to the underpricing phenomenon. A theoretical model is derived in the context of the asymmetric information environment described by Rock [1986] and Beatty and Ritter [1986]. The model is developed from the perspective of a profit-maximizing investment banker where the reputation of the auditor has divergent effects on uncertainty of information. The model generates unique propositions concerning the interaction of investment banker and auditor repu-

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Ronald J. Balvers is Assistant Professor, Bill McDonald is Associate Professor, and Robert E. Miller is Assistant Professor, all at University of Notre Dame.

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tation. Empirical tests on a sample of 1,182 initial public offerings during the 1981–1985 period support each of the model's propositions.

In Section I a brief review of prior theoretical models and empirical tests is presented. In Section II the theoretical model and its testable implications are derived. Section III describes the data set used for empirical tests. The propositions generated from our theoretical model are tested in Section IV and concluding remarks appear in the final section.

I. Previous Research

Theoretical Models of the Placement Process

A variety of theoretical models have been proposed to characterize the initial public offering phenomenon. Rock [1986] and Beatty and Ritter [1986] focus on the observed phenomenon of underpricing by investment bankers. Rock develops a model of the placement process in which there are two types of market participants: informed and uninformed. To insure sufficient demand for a new security, Rock's model posits that investment bankers must maintain an equilibrium level of underpricing. Equilibrium underpricing maintains demand by assuring uninformed investors that they will not be victims of the "winner's curse"—i.e., the case where their demand is fully satisfied only if the initial return is nonpositive. Beatty and Ritter extend Rock's model and show that underpricing should be related to the level of *ex ante* uncertainty.

In another line of research focusing more on the valuation of the new issue, signaling models are used to examine the asymmetry of information between the owner and the investor. Leland and Pyle [1977] consider the proportion of ownership retained by the original entrepreneurs as an important signal to market participants, with empirical evidence supporting this hypothesis provided by Downes and Heinkel [1982]. Ritter [1984a] subsequently shows that the empirical results are also consistent with an agency relationship or a wealth effect hypothesis. Baron [1982] concentrates on the informational advantage of the investment banker over the firm. Hughes [1986] provides a general characterization of the relation between the firm, investment banker, and investors in a bivariate signaling model.

The current study uses the asymmetry of information between uninformed and informed investors in Rock's model to motivate a signaling model where investment bankers can signal their reputation through the reputation of the auditing firm participating in the underwriting coalition. This signal will, in turn, affect the equilibrium level of underpricing.

Studies Incorporating Auditor Selection

Relatively few studies of initial public offerings have specifically incorporated the impact of auditor selection. Titman and Trueman [1986] develop a model that delineates the owner's incentive to signal through the quality of the investment banker or auditor selected for the issue. Their model shows that an owner with favorable information about the firm can convey this information to the market through the quality of the investment banker or auditor and thereby positively affect value (note that they focus on valuation and not underpricing). The model can be applied separately to either the selection of investment banker or auditor, but does not allow for interaction between the two. As will be discussed later, in practice the selection of auditor is not independent from the choice of investment banker.

Simunic and Stein [1987] examine product differentiation of auditors in the new issue market. They provide empirical support for the proposition that auditor reputation is not homogeneous. Their theory of audit quality predicts a direct relation between auditor reputation and initial value. This hypothesis is not supported in an earnings multiple model; however, it is supported in an equity multiple model. Additionally, their model suggests a linkage between auditor selection and investment banker reputation, although the selection process is couched in terms of the firm's managers.

Beatty [1986] provides an empirical study of the relation between underpricing and auditor selection. He identifies a number of differences between new issues associated with Big Eight versus non-Big Eight firms. For example, Big Eight clients disclose fewer uses of funds, fewer risk factors, and tend to have a shorter registration period. As noted by Beatty, most of his tests are based on conjectures from theoretical models that do not specifically account for the role of the auditor in the placement process. He is unable to consistently document a significant relation between auditor reputation and the underpricing of new issues.

II. A Theoretical Model of Auditor Choice by Investment Bankers

In this paper, we concentrate on the interaction between the investment banker and auditor. In practice, the investment banker frequently determines auditor selection either through tacit approval of the firm's current auditor or by requesting auditor change. Thus, we derive a model from the perspective of the investment banker where the reputation of the auditor affects the signaling environment. The empirical results of Beatty [1986] indicate that auditor reputation is either only marginally related to underpricing or that a simple model based on *ex ante* uncertainty does not sufficiently describe the process. Our theoretical model generates a series of empirically testable propositions. The model suggests, and the empirical results support, a signaling environment where auditor reputation is important but is not related to underpricing in a simple unidimensional fashion.

Auditor Selection and Auditor Reputation

There are two fundamental assumptions we make with respect to the audit firm.[1] Both are consistent with previous theoretical and empirical results.

First, since our model is developed from the perspective of a profit maximizing investment banker, we assume that the investment banker explicitly or implicitly makes a decision about the auditor retained in the initial coalition. This decision can occur implicitly by accepting the existing auditor of the firm or explicitly by requesting an auditor change. Both the issuing firm and the investment banker have a vested interest in the selection decision; however, Simunic and Stein [1984] argue that the optimum choice of audit quality, if managers and underwriters were to select independently, should be consistent between the two groups. The investment banker, wanting to preserve its reputation capital, prefers a high quality auditor to assimilate and verify financial information in the issuance process and, thus, help prevent mispricing of the issue. Accordingly, we view the investment banker as selecting the auditor and indirectly com-

[1] Throughout the paper, we consider only the case in which the underwriting contract is a firm commitment.

pensating the firm in part for the excess cost of hiring a high reputation auditor. The auditor plays a passive role, attesting to the earnings estimate which is in no way influenced by the reputation of the investment banker.[2] Carpenter and Strawser [1971] and Arnett and Danos [1979] provide evidence that auditor change frequently occurs when a firm goes public and that the investment banker in many cases instigates the change. Simunic and Stein [1987] also cite anecdotal support for auditor change as a result of pressure from underwriters (see "Small CPA Concern Sues an Underwriter Over Loss of Client," *Wall Street Journal* [July 18, 1983, p. 1]). Note that we are not suggesting that investment bankers always select an issuing firm's auditor. The firm frequently has already made this choice and obviously has their own agenda for such selection. However, the investment banker subsequently decides whether this auditor is acceptable for taking the firm public.[3]

Second, we differentiate audit services using the usual Big Eight and non-Big Eight classifications. The role of the audit firm in our model is based on the effect of auditor reputation on perceived investment banker reputation, and the ability of the auditor to affect *ex ante* uncertainty. The assumption that a Big Eight auditor will serve to reduce *ex ante* uncertainty about the issuing firm's earnings is consistent with a number of general theories of auditor selection. DeAngelo [1981] argues that in order to maintain their investment in reputation capital, Big Eight firms will provide higher quality services. Alternatively, Healy and Lys [1986] suggest that auditor size and audit quality are not necessarily related. They indicate that the Big Eight firms can be differentiated through specialized services they can provide (e.g., SEC reporting in this case). More notably, the Big Eight firm's larger investment in reputation implies that investors will be able to more readily assess auditor quality and that there will be a more consistent realization of contracted-for quality. In the DeAngelo scenario, Big Eight auditors are assumed to provide higher quality and, thus, should provide a more precise estimate of earnings. In the Healy and Lys theory, investors would be more certain of the contracted quality because of the Big Eight auditor's higher potential of reputation loss. More closely related to the current study, Simunic and Stein [1987] model the problem of auditor choice in the context of product differentiation, where a key characteristic is "the credibility, reputation, or brand name of the auditor [p. 5]." They emphasize that, since credibility is an important attribute, auditor displacement at the time of a new issue does not necessarily occur because a smaller audit firm is technically incapable. Although these three general theories of auditor selection offer different decision scenarios, they each describe an environment consistent with our classification scheme where Big Eight audi-

[2] In principle, the issuance process can be described completely only if the underlying forces that lead to a certain coalition of investment banker, firm, counsel, and auditor are fully characterized in relation to the investor. The complexity of multivariate signaling models and our focus on the interaction between investment banker and auditor in pricing the new issue make an exhaustive characterization impractical. For example, we do not consider the incentives that investment bankers or auditors might have for specializing in a particular type of firm. This issue will not affect our analysis provided that investment bankers or auditors with a specific reputation level do not all specialize in the same type of firm.

[3] As additional anecdotal evidence, we interviewed a managing director at Goldman Sachs who stated that the reputation of a firm's auditor was one of several items critical in deciding whether to accept a firm as a client. He said that in almost all cases, Goldman Sachs will ask a firm to switch to a Big Eight auditor if they do not already employ one.

tors will tend to reduce *ex ante* uncertainty through their assessment of an issuing firm's earnings.

The Model

We begin by assuming an environment similar to that of Rock [1986] and Beatty and Ritter [1986]. We assume an investment community consisting of informed investors and uninformed investors. All agents are taken to know the structure of the investment banker's model, but informed investors have an advantage over uninformed investors by knowing the market value of the shares to be issued and the (actual) reputation of the investment banker. Also, the issuing firm and the investment banker have an informational advantage over uninformed investors in knowing the investment banker's actual reputation. As discussed in the previous section, the differentiating aspects of audit services are assumed to be captured in the Big Eight versus non-Big Eight classification. All market participants are assumed to perceive this distinction without error.[4]

The coexistence of informed and uninformed investors implies, as shown by Rock, that the uninformed investors are subject to a winner's curse so that they will only subscribe to a particular investment banker's offering if that investment banker, on average, underprices its offerings. Beatty and Ritter then obtain two important results. They show that an underpricing equilibrium is maintained since investment bankers will lose potential investors if underpricing is too little, or will lose issuers if underpricing is too much, thus, forfeiting the value of their reputation capital. Second, they show that the equilibrium degree of underpricing is positively related to *ex ante* uncertainty.

A basic model can now be developed for the investment banker's actions that incorporates the Beatty and Ritter results and focuses on the issues at hand—pricing and the investment banker's auditor preference. Since the investment banker can spread risk over a syndicate, we assume risk neutrality. In the context of the problem, we specify a profit function where the investment banker's proceeds are a result of three general components: (1) the uninformed investors' perception of the investment banker's reputation, (2) a basic fee that is tied to actual reputation minus a penalty, also related to actual reputation, that is a result of any deviation from the equilibrium level of underpricing, and (3) a cost of acquiring auditor reputation. The motivation for this specification is elaborated in the subsequent derivation of the complete model.

An investment banker is to select the offer value of an issue (offer price times the number of shares issued, denoted as p) and auditor reputation (A) so as to maximize expected profits (Π) given by:

$$\max_{p,A} \Pi(p,A) = \max_{p,A} [bR(A) + R' \cdot \{f - gE[u-(v-p)]^2\} - cA], \quad (1)$$

[4] We subsequently test the sensitivity of our empirical results to this classification scheme by excluding the "middle group" of auditing firms from the sample (the second seven of the largest 15) [Simunic and Stein, 1987, p. 27], and separately, testing auditor fees as an alternative measure of auditor reputation. The assumption that all market participants perceive auditor reputation without error is for simplification, implying that investment banker reputation is less easily observable to uninformed investors than is auditor reputation. To motivate this assumption, we argue that mistakes by auditors are directly observable and attributable to the auditor, whereas the investment banker may not be judged as easily. However, our results are theoretically robust in the sense that even if auditor reputation is observed with error (including when the error is greater than that associated with observing investment banker reputation), then the auditor selection will still provide a signal—although noisy—about the investment banker's reputation.

where

$R(A)$ = the investment banker's reputation (a function of the auditor's reputation (A)) as perceived by uninformed investors,

R' = the actual reputation of the investment banker,

u = the equilibrium level of underpricing, as in Beatty and Ritter,

v = market determined value of the offering, with $E(v)=\mu$,

and b, c, f, and g are constants. The first term in the right-hand-side of equation (1) represents the ability of the investment banker to benefit the firm by signaling its reputation through auditor selection. This works through the effect of perceived reputation on *ex ante* uncertainty which in turn affects underpricing. The second term reflects a basic fee, f, tied to the investment banker's actual reputation, R', minus the loss in goodwill, also proportional to R', due to mispricing of the new issue. Consistent with Beatty and Ritter, investment bankers who miss the underpricing equilibrium will lose either potential investors if they do not underprice enough, or issuers if underpricing is too large. Accordingly, we represent the goodwill costs by a quadratic loss function that penalizes the investment banker for any deviation from the optimal level of underpricing. Clearly, an investment banker with higher reputation has more goodwill to lose so that the loss in goodwill can be considered proportional to reputation. For $u-(v-p)<0$ the investment banker loses goodwill with potential issuers who know R'. Likewise, for $u-(v-p)>0$, there is a goodwill loss to currently informed investors who also are assumed to know R'.

The third term in equation (1) represents the investment banker's cost of assuring himself or herself of a high reputation auditor. The investment banker is assumed to pressure the firm to hire a reputable auditor, which is in the banker's own interest since better information about earnings makes it easier for the investment banker to price correctly and maintain reputation capital. To the extent that investment bankers benefit, they should implicitly or explicitly pay for part of the reputable auditor's incremental cost.[5]

Uncertainty in the information environment is structured relative to underpricing so that the percentage underpricing is proportional to *ex ante* uncertainty, i.e.,

$$u/p = h(\sigma_v^2 + \sigma_m^2), \qquad (2)$$

where

h = the increase in the optimal percentage underpricing per unit increase in *ex ante* uncertainty,

$\sigma_v^2 = a(\bullet) - \ell n A$,

$\sigma_m^2 = r(\bullet) - \ell n \mathbf{R}$,

a = the exogenous part of the uncertainty attributable to the firm,

r = the exogenous part of uncertainty attributable to the market environment,

with $\mathbf{R}=R(A)$ when uninformed investors are evaluating the model, and $\mathbf{R}=R'$ for the informed investors, investment banker, and issuing firm. We

[5] Simunic and Stein [1984, p. 20] provide evidence that underwriters make side payments to issuing firms to "induce the purchase of higher audit quality level." As subsequently detailed, audit reputation is measured with a binary variable for Big Eight auditors. Francis and Stokes [1986] and Palmrose [1986] find that Big Eight fees are higher than non-Big Eight fees for "small" clients (Palmrose defines small as total assets of less than $150 million). The majority of firms in our sample, being new issues, are relatively small. To test the sensitivity of our results, the empirical tests were repeated excluding all firms whose offer size was greater than $50 million. This had no effect on the sign or significance of any of the variables tested.

adopt the Beatty and Ritter result that the equilibrium percentage underpricing is positively related (we assume proportional) to the level of *ex ante* uncertainty. The *ex ante* uncertainty, as specified in equation (2), is attributed to two independent sources. The first source of uncertainty, σ_v^2, is solely due to firm-specific factors—$a(\bullet)$, which is determined by factors exogenous to this model, and a term that reduces σ_v^2 based on the reputation of the auditor chosen. The logarithmic form of the latter relation accounts for diminishing returns to information acquisition. The second source of uncertainty, σ_m^2, captures uncertainty due to the market environment. Similar explanations can be provided for the composition of market uncertainty, σ_m^2, which consists of the exogenous part $r(\bullet)$ and a part that depends on the investment banker's reputation as perceived by uninformed investors. The uninformed investors' perception of investment banker reputation will be shown to depend on the choice of auditor. The auditor reputation variable, therefore, plays two important roles in the model: (1) the reduction of uncertainty concerning the measure of firm-specific value, and (2) the reduction of perceived uncertainty that results from the signal generated by the reputation of the auditor selected.

Additionally, we assume that the measures for investment banker and auditor reputation are strictly positive. For consistency, since *ex ante* uncertainty approaches infinity as lim $\mathbf{R}\to 0$, A is chosen such that lim $A\to 0$ as $\mathbf{R}\to 0$. That is, as $\mathbf{R}$ approaches zero, the investment banker will optimally choose A at its lowest possible level since it is impossible to reduce uncertainty below infinity (a further motivation for an initial condition such as this appears in Riley [1975]). There must also be an upper bound to auditor and investment banker reputation to insure that σ_v^2 and σ_m^2 remain positive.

Optimization

Consider the optimal pricing of the issue (p^*) to be determined by the investment banker. The first order condition for equation (1) with respect to p is:

$$\partial\Pi/\partial p = -2gR'[1+h(\sigma_v^2+\sigma_m^2)]\bullet E[u-(v-p)]=0, \qquad (3)$$

which implies that:

$$p^*=\mu-u. \qquad (4)$$

Some additional results are revealed by equations (3) and (4). First, note that the investment banker cannot signal with the value of the offering (p) since $\partial^2\Pi(p^*,A)/\partial p\partial R'=0$. That is, a necessary condition for a signaling equilibrium, as identified by Spence [1973], fails with respect to price, since a higher reputation for the investment banker is not related to the investment banker's optimal pricing decision. Second, since uninformed investors know the structure of the model they know from equation (4) that $\mu=p^*[1+h(\sigma_v^2+\sigma_m^2)]$. Once σ_v^2 and σ_m^2 are revealed—as subsequently will be demonstrated—μ can be correctly inferred from observation of p^*.

Next consider the effect of auditor reputation at p^*. Equation (1) at p^* reduces to:

$$\Pi(p^*,A)=bR(A) +R'[f-g(a-\ell nA)] -cA, \qquad (5)$$

as follows from equation (4) and the fact that $E(v-\mu)^2=\sigma_v^2$. In order for a reputational equilibrium to exist that prevents agents from "selling out" and drawing their reputation capital to its lowest possible value, it must be that $\partial\Pi/\partial R'>0$. To guarantee this condition we assume that $f-g(a-\ell nA)>0$

for all A, i.e., reputation is a desirable characteristic (for a discussion of the incentives to maintain reputation see Klein and Leffler [1981]).

The net benefits of auditor selection, including the gains to signaling, are:

$$\partial\Pi(p^*,A)/\partial A = b \bullet dR(A)/dA + g \bullet R'/A - c = 0, \quad (6)$$

which implies:

$$dR(A)/dA + [g/(bA)]R' = c/b. \quad (7)$$

Keeping in mind that the uninformed investors solve the same equation in which R' is replaced by the unknown $R(A)$, this equation can be solved as a first-order linear differential equation with variable coefficients [Hildebrand, 1976] producing:

$$R(A) = [c/(b+g)]A + k[A]^{-(g/b)}, \quad (8)$$

where k is the constant of integration which under the previous assumptions will be equal to zero (since $A \rightarrow 0$ when $\mathbf{R} \rightarrow 0$).

Before developing the testable implications of this model we first examine the equilibrium conditions of the model for consistency. Note that $dR(A)/dA$ equals $c/(b+g)$ from equation (8), thus equation (7) yields:

$$A^* = [(b+g)/c]R'. \quad (9)$$

By combining equations (9) and (8) for $k=0$, the equilibrium condition that $R' = R(A)$ is verified, i.e., actual reputation equals perceived reputation.[6] Investors still have an incentive to become informed, even though expected market value and investment banker reputation are perfectly signaled, because the informed investors know actual market value. Also, since $\partial^2\Pi/\partial A\,\partial\mu = 0$, auditor reputation cannot signal the expected value of the issue, i.e., $\partial\mu/\partial A = 0$ which is consistent with our earlier observation that μ is perfectly revealed by p^* once the auditor is selected.

From Theory to Measurement

In this subsection we make the transition from the theoretical determinants of underpricing to an equation for underpricing that can be empirically tested. In the process, four testable implications will be derived. The first two propositions are not unique and their predictions have been documented in previous studies. However, they provide a measure of consistency for the theoretical model. The final two propositions delineate the relation between underpricing and auditor reputation, revealing that the relation is not a simple one, yet is empirically verifiable.

Define UP as the relative level of underpricing given by $(v-p^*)/p^*$. From equation (4) for p^* we then find that $UP = (u/p^*) + \epsilon$ where $\epsilon = (v-\mu)/p^*$ and $E(\epsilon) = (1/p^*)E(v-\mu) = 0$. The following equations summarize the model for empirical purposes. First, from equations (8) and (9):

$$R(A) = R' = [c/(b+g)]A. \quad (10)$$

Second, from the definition for UP, since $u/p^* = h(\sigma_v^2 + \sigma_m^2)$, and using equation (10):

$$UP = h[a(\bullet) + r(\bullet)] - h \bullet \ell n[(b+g)/c]R' - h \bullet \ell n R' + \epsilon. \quad (11)$$

The terms $a(\bullet)$ and $r(\bullet)$, the exogenous part of *ex ante* firm-related and market-related uncertainty, respectively, are not directly observable (the empirical proxies

[6] Second-order conditions for a maximum hold since at the optimum:

$$\partial^2\Pi/\partial p^2 = -2gR'[1 + h(\sigma_v^2 + \sigma_m^2)] < 0, \text{ and}$$
$$\partial^2\Pi/\partial A^2 = -R'/A^2 < 0.$$

Furthermore,

$$\partial^2\Pi/\partial p\,\partial A = \partial^2\Pi/\partial A\,\partial p = 0.$$

used will be discussed in Section III). Similarly, no exact measures for A and R' are available to us, in part because we are not informed investors. Instead we use observable A'' and R'' as our measures with:

$$A''=A+\epsilon_A=[(b+g)/c]R'+\epsilon_A \quad (12.A)$$

$$R''=R'+\epsilon_R, \quad (12.B)$$

where ϵ_A and ϵ_R have a mean of zero and variance of $\sigma^2_{\epsilon(A)}$ and $\sigma^2_{\epsilon(R)}$, respectively.

To the empirical observer two signals, equations (12.A) and (12.B), are available that predict R'. Using the least squares criterion it can be determined that:

$$E(R'|A'',R'')=[\lambda c/(b+g)]A'' +(1-\lambda)R''$$

where

$$\lambda=\sigma^2_{\epsilon(R)}/\{\sigma^2_{\epsilon(R)}+[c/(b+g)]^2\sigma^2_{\epsilon(A)}\}.$$

Hence,

$$R'=[\lambda c/(b+g)]A''+(1-\lambda)R''+\eta \quad (13)$$

with $\eta=-[\lambda c/(b+g)]\epsilon_A-(1-\lambda)\epsilon_R$ and, thus, has an expected value of zero.

The following testable implications are derived from the above equations.

Proposition 1: Investment bankers with higher reputation tend to be associated with higher reputation auditors.

PROOF:

From equations (12.A) and (12.B) we have:

$$A''=[(b+g)/c]R'' +\{\epsilon_A-[(b+g)/c]\epsilon_R\}. \quad (14)$$

A'' and R'' must be positively correlated. Intuitively, investment bankers with higher reputation have more to lose from mispricing, hence they have a higher marginal benefit of hiring a high reputation auditor. In the theoretical signaling context this implies a perfect correlation between investment banker and auditor reputation as represented by equation (10). Due to randomness introduced by the imperfect measure of reputation, the correlation between the measure for auditor reputation, A'', and the measure for investment banker reputation, R'', would be imperfect but positive.

Proposition 2: Investment bankers with higher reputations underprice less.

PROOF:

From equations (11) and (13)—which together form the empirically relevant equation for underpricing—we find:

$$\partial UP/\partial R''=(1-\lambda)(\partial UP/\partial R') =-2h(1-\lambda)/R'<0. \quad (15)$$

This result arises because a higher reputation investment banker chooses a higher reputation auditor in accordance with proposition 1. The higher reputation auditor reduces uncertainty concerning earnings and sends a positive signal of investment banker reputation to uninformed investors. For both these reasons, *ex ante* uncertainty is reduced so that less underpricing is required.

Proposition 3: The observed measure of auditor reputation helps reduce underpricing.

PROOF:

From equation (11), with use of equation (13),

$$\partial UP/\partial A''=[\lambda c/(b+g)]\partial UP/\partial R' =-[2h\lambda c/(b+g)]/R'<0. \quad (16)$$

Auditor reputation is an important signal in the informational environment of the new issue. A higher reputation auditor not only lowers the variance of the earnings estimate but, also, indicates an investment banker who has a lot to lose by misjudging earnings (and conse-

quently mispricing the new issue). To the empirical observer, A'' helps to predict R' (or A, being perfectly correlated with R') and should, therefore, be related to lower levels of underpricing.

Proposition 4: As both investment banker and auditor reputation increase, their impact on underpricing is reduced.

PROOF:

From equation (16):

$$\partial^2 UP/\partial A''\partial R'' = \partial^2 UP/\partial R''\partial A'' = [2h\lambda(1-\lambda)c/(b+g)]R'^{-2} > 0. \quad (17)$$

As implied by equation (17), for a higher reputation investment banker the effect of a higher reputation auditor on underpricing is positive (i.e., the collective effect is less negative). Similarly, the tendency for high reputation investment bankers to underprice is less when a high reputation auditor is employed. These results are due, basically, to the diminishing returns on information acquisition. Proposition 4 is essentially a qualification on the relations implied by propositions 2 and 3. Empirically, proposition 4 highlights that there is an interactive effect between investment banker and auditor reputation, with the collective impact being lower when both variables are relatively high.[7] In Section III we describe the sample and variables that are used to test these propositions.

III. The Sample and Variables

The sample is from the five-year period of 1981–1985. Only initial public equity offerings in the over-the-counter market with a price greater than or equal to one dollar and contracted as a firm offering were included in the sample.[8] Data on the offering price, number of shares, auditor, and investment banker were taken from *Going Public: The IPO Reporter*. The first market bid was obtained from the *OTC Daily Stock Price Record*. The first bid must be reported in the first five trading days for the issue to be included in the sample. These selection criteria provided a sample of 1,182 securities with complete data.

From equation (11) and the subsequent discussion, propositions 2, 3, and 4 are tested using the model:

$$UP_i = \alpha_0 + \alpha_1 BETA_i + \alpha_2 RSKPRE_i + \alpha_3 IPOIDX_i + \alpha_4 \Delta_{IB(i)} + \alpha_5 \Delta_{A(i)} + \alpha_6 \Delta_{IB*A(i)} + \epsilon_i. \quad (18)$$

The dependent variable, UP_i, is the level of underpricing given by the proportional change in price from the issue to the first bid, i.e., $(v-p)/p$. The term $a(\bullet)$ in equation (11) representing uncertainty associated with the firm, is measured by the variable labeled *BETA* or systematic risk in equation (18). Estimation of the traditional market model *BETA* requires a trading history. Such a history doesn't exist for the sample. We use securities on the CRSP NASDAQ file to generate industry betas at the three-digit SIC level for each of the five sample years. Then for an observation whose issue date is, for example, in 1981, we assign that observation a value of *BETA* based on the market model beta

[7] Formally, a second-order Taylor expansion around A and R of equation (11) using equation (13), yields as one of its terms

$$[\partial^2 UP/\partial A''\partial R''](A''-A_0)(R''-R_0) = [2h\lambda(1-\lambda)c/(b+g)](A''-A_0)(R''-R_0)/R'^2,$$

where (A_0, R_0) indicates the pair of particular values for A and R around which the approximation is taken. Essentially the use of an indicator variable for A'' and R'' results in an interaction term between the two variables.

[8] We specifically exclude NYSE and AMEX securities since they account for a very small number of issues (less than 50 during the entire sample period) and, more importantly, in a signaling environment there is a confounding effect of exchange certification that is not considered in the context of our model.

for the portfolio of all securities with the same three-digit SIC, measured using daily observations from 1980 (where the portfolio returns are regressed against the CRSP equal-weighted NASDAQ index).[9]

The variables *RSKPRE* (risk premium) and *IPOIDX* (initial public offering index) are used to measure market uncertainty as indicated in the term $r(\bullet)$ from equation (11). *RSKPRE* is a measure of the market risk premium based on the spread between the returns from a portfolio of corporate bonds and Treasury Bond returns. Bond returns are taken from the CRSP Indices file. Each observation is assigned a value for *RSKPRE* based on the bond return differential in the month the issue went public. The variable *IPOIDX* is a market index generated by creating a daily return index that, for a specific day, only includes securities that have been listed on the CRSP NASDAQ file for less than the prior 20 days. Thus, we have a pseudo market index that captures returns specifically for less seasoned securities. The daily index is then aggregated into a monthly index, and each observation is assigned a value of *IPOIDX* based on the month of the offering. In addition to measuring market uncertainty this variable also serves to capture other market effects such as the "hot issue" phenomenon [Ritter, 1984b].

To measure investment banker and auditor reputation we use dichotomies frequently used in previous studies. Auditor reputation is measured with an indicator variable set equal to one for Big Eight firms and zero otherwise (Δ_A). The classification scheme for investment banker reputation is similar to that of Downes and Heinkel [1982] and Neuberger and La Chapelle [1983]. Investment banking firms that, during the sample period, consistently appeared in the "Top 25" reported annually by *Institutional Investor* are included in the top reputation category. These firms also appear as "bulge" and "major" firms in Hayes [1971]. The indicator variable for investment banker prestige is assigned a value of one if the investment banker is in this top category and zero otherwise (Δ_{IB}). The 18 investment bankers that were consistently in this "Top 25" group during the five-year sample period and, thus, classified as prestigious are listed in the Appendix.[10]

From the theoretical results, the alternative hypotheses for the coefficients in equation (18) are $\alpha_1>0$, $\alpha_2>0$, and $\alpha_3>0$ (i.e., underpricing is a positive function of firm and market uncertainty), $\alpha_4<0$, $\alpha_5<0$ (i.e., high reputation investment bankers and high reputation auditors are associated with lower underpricing), and $\alpha_6>0$. The alternative for α_6 is from proposition 4: the joint impact of having both a high reputation underwriter and auditor is less negative.

IV. Results

Descriptive Statistics

The sample of 1,182 initial public offerings represents 181 different investment banking firms. A cross-tabulation of the investment banker and auditor reputation classifications is presented in

[9] For approximately ten percent of the securities, no SIC code match was available at the three-digit level. In this case we used a two-digit match, where the beta was the average of all three-digit level betas in that two-digit group.

[10] An obvious concern in using these binary classification schemes is whether the ninth largest auditor is much different from the eighth and whether the 19th largest investment banker is much different from the 18th. We consider the sensitivity of our results to this classification scheme in a subsequent section by excluding a "middle tier" of both auditors and investment bankers.

TABLE 1
INVESTMENT BANKER AND AUDITOR CLASSIFICATIONS[a]

Investment Banker	Auditor: Non-Big Eight	Auditor: Big Eight	
Non-Prestigious	199 (16.8%)[b]	484 (41.0%)	683 (57.8%)
Prestigious	53 (4.5%)	446 (37.7%)	499 (42.2%)
	252 (21.3%)	930 (78.7%)	1,182

[a] This table provides a cross-tabulation of the binary variables used to classify auditor and investment banker reputation. The sample of 1,182 initial public offerings is from 1981-1985. Investment bankers classified as "prestigious" are reported in the Appendix.
[b] Tabular percentages do not sum consistently due to rounding error.

Table 1. Although the allocation of new issues to the different classifications of investment banker is roughly equal, clearly the Big Eight firms dominate the market for auditors, with more than 78 percent of the issues. When broken down by year, this allocational pattern did not exhibit any trends and appeared relatively stable.

Table 2 reports the mean and standard deviation for the sample variables by reputation categories and year. The average underpricing, 7.84 percent, is well within the range reported in previous studies (see Miller and Reilly [1987]). Since this study excludes best efforts offerings (typically smaller issuers), the average is lower than studies including such issues. The price-related variables reported for the four distinct reputation combinations suggest distinctive differences between the classifications; however, many of the univariate comparisons between groups are not statistically significant. Not surprisingly, underpricing was notably lower in 1984 when the "new-listing" market index was significantly negative.

Correlations for the sample variables are reported in Table 3. The direction of correlations between underpricing and the other continuous variables in the model is in all cases consistent with the theoretical model. The sign of the interaction is negative for the bivariate context. As expected from the tabular results in Table 1, the correlation between the interaction term and the investment banker measure is relatively high.

Table 4 examines the within and across group variation in more detail for the auditing firms. Peat, Marwick, Mitchell audited the greatest number of new issues in our sample (177). The average market capitalization of firms with Big Eight auditors was almost twice as large as non-Big Eight clients. The range of underpricing within the Big Eight was only 5.4 percent to 8.3 percent. If $v_i\{i=1,2,\ldots,8\}$ is the average underpricing for each Big Eight auditor, the null hypothesis that the v_i's are equal for

TABLE 2

DESCRIPTIVE STATISTICS FOR SAMPLE BY REPUTATION CATEGORIES AND YEAR[a]

	N	*Offer Price* (p)	UP	BETA	RSKPRE	IPOIDX
By Classification[b]						
$\Delta_{IB}=0$, $\Delta_A=0$	199	\$6.75	13.06%	1.24	−0.03%	0.82%
		(0.29)[c]	(1.71)	(0.03)	(0.07)	(0.51)
$\Delta_{IB}=0$, $\Delta_A=1$	484	8.55	8.79	1.21	−0.09	1.09
		(0.18)	(0.80)	(0.02)	(0.05)	(0.33)
$\Delta_{IB}=1$, $\Delta_A=0$	53	13.10	2.96	1.20	0.09	0.27
		(0.51)	(0.98)	(0.08)	(0.16)	(0.81)
$\Delta_{IB}=1$, $\Delta_A=1$	446	13.67	5.06	1.15	0.01	1.45
		(0.22)	(0.56)	(0.02)	(0.05)	(0.35)
By Year						
1981	231	10.14	7.97	1.37	−0.33	−1.16
		(0.37)	(1.11)	(0.04)	(0.10)	(0.47)
1982	87	10.42	10.02	1.22	−0.18	5.88
		(0.55)	(1.85)	(0.04)	(0.15)	(1.08)
1983	513	11.55	9.51	1.15	0.10	2.02
		(0.23)	(0.84)	(0.02)	(0.04)	(0.31)
1984	175	8.21	2.27	1.10	0.02	−2.91
		(0.25)	(0.88)	(0.04)	(0.06)	(0.39)
1985	176	9.45	7.27	1.14	−0.04	3.32
		(0.34)	(1.12)	(0.03)	(0.05)	(0.35)
All	1,182	10.38	7.84	1.19	−0.04	1.15
		(0.15)	(0.49)	(0.01)	(0.03)	(0.21)

[a] *UP*=(first bid-offer price)/offer price; *BETA* is the market model beta assigned to the new issue based on the beta of a portfolio of firms with the same three-digit SIC from the previous year; *RSKPRE* (risk premium) is the return on corporate bonds minus the return on Treasury Bonds during the month of the new issue; and *IPOIDX* (initial public offering index) is the return on a market index during the month of the new issue, where the market index consists of all securities on the CRSP NASDAQ files that have been listed less than 20 days.

[b] Δ_{IB} is equal to one for prestigious underwriters and zero otherwise. Δ_A is equal to one for Big Eight auditors and zero otherwise.

[c] Standard errors are in parentheses.

all i cannot be rejected (F-statistic $=0.34$). The average level of underpricing for all Big Eight firms was seven percent, versus approximately 11 percent for non-Big Eight firms. This univariate comparison indicates a significant difference at a p-level of less than 0.001.

Empirical Tests of the Theoretical Implications

In this section each of the four propositions evolving from the theoretical model are empirically tested. The results in each case support the hypotheses generated from the theory.

TABLE 3
CORRELATIONS FOR THE MODEL VARIABLES[a]

	BETA	RSKPRE	IPOIDX	Δ_{IB}	Δ_A	Δ_{IB*A}
UP	0.056	0.042	0.232	−0.152	−0.095	−0.128
BETA		−0.034	0.025	−0.064	−0.043	−0.067
RSKPRE			−0.243	0.042	−0.016	0.031
Δ_{IB}					0.223	0.911
Δ_A						0.405

[a] Correlations are Pearson product-moment correlations. Variables are defined in Table 2 (N=1,182).

Proposition 1 posits that higher reputation investment bankers will be associated with higher reputation auditors. Table 1 shows that for non-prestigious investment bankers, 70.86 percent of the issues are audited by Big Eight firms. For prestigious investment bankers the proportion is 89.38 percent. Using a simple test of proportions, the null hypothesis that the proportion of Big Eight firms employed by prestigious versus non-prestigious investment bankers is equal can be rejected at a p-level of less than 0.0001. For the top five investment bankers (defined in the Appendix), the proportion of issues using a Big Eight auditor is an even higher 92.62 percent (113 of 122). With the exception of Merrill Lynch, none of the top five investment bankers used a non-Big Eight auditor more than once. These results provide strong empirical support for the tendency of high reputation investment bankers to select high reputation auditors.

Proposition 2 asserts that investment bankers with higher reputations will underprice less. As already noted, this particular conclusion does not distinguish this theory from others with similar conclusions, and has been previously documented. Evidence of this phenomenon is provided in Neuberger and La Chapelle [1983], who divide investment bankers into tiers and find significant differences in initial returns between investment bankers with different levels of prestige. A test of this proposition using the current sample is provided by the coefficient associated with Δ_{IB} in Table 5 which reports the estimate of equation (18). After adjusting for other effects, the use of a prestigious investment banker reduces underpricing by roughly ten percent and the effect is significant at a p-level of less than 0.001. Thus, consistent with previous studies, the current sample empirically supports the proposition that higher reputation investment bankers underprice less.

Proposition 3 indicates that a higher auditor reputation should reduce underpricing. The coefficient associated with Δ_A in the estimate of equation (18) provides a test of this assertion. Consistent with proposition 3, auditor reputation has a signifcantly negative effect, reducing the level of underpricing by approximately 4.2 percent.

The indicator variable Δ_{IB*A} is equal to one only for the case where investment banker and auditor reputation are both high. Proposition 4 states that the negative effects of investment banker and auditor reputation on underpricing will be reduced (i.e., become less negative) if both variables are high. This implies that the coefficient associated with Δ_{IB*A}

TABLE 4

A COMPARISON OF UNDERPRICING AND OFFER SIZE BY AUDITOR[a]

Auditor	N	*Underpricing*	*Offer Size (000's)*
Big Eight			
1. Arthur Andersen	145	7.21% (1.24)	$16,805. (1,667.)
2. Coopers & Lybrand	87	8.25 (1.87)	13,606. (1,570.)
3. Deloitte, Haskins & Sells	86	7.56 (1.66)	17,029. (2,805.)
4. Ernst & Whinney	110	7.87 (1.57)	14,600. (1,340.)
5. Peat, Marwick, Mitchell	177	6.68 (1.13)	17,969. (2,547.)
6. Price Waterhouse	102	5.44 (1.17)	18,080. (2,143.)
7. Touche Ross	109	6.85 (1.21)	13,358. (1,485.)
8. Arthur Young	114	6.54 (1.63)	19,389. (2,036.)
All Big Eight	930	7.00 (0.50)	16,540. (752.)
Non-Big Eight	252	10.94 (1.39)	8709. (757.)

[a] Standard errors are reported in parentheses.

should be positive. Consistent with this proposition, α_3 is positive and significant at a p-level of 0.014. The offsetting effect of the interaction term is nontrivial and could explain why previous studies have had difficulties in identifying a relation between auditor selection and underpricing (e.g., Beatty [1986]).

The use of indicator variables for both reputation measures is clearly a coarse approximation. To determine the robustness of our results to this classification scheme we reestimated equation (18) using two alternative classification schemes. In the first test, we excluded from the sample the following "middle tier" groups. For auditors we excluded the seven middle tier firms identified in Simunic and Stein [1987, p. 66]. For investment bankers we excluded all firms listed in Hayes' "Major" and "Submajor" brackets that were not included in the top-18 classification used. This reduced the sample by 274 observations. As a second alternative, we replace the Big Eight binary variable with the values of auditor fees reported in Beatty [1986] (providing an interaction term where the fee is multiplied times the investment banker dummy variable), thus, using the auditor fee as a surrogate for reputation. The results from the regressions, in both

TABLE 5
TESTS OF PROPOSITIONS 2, 3, AND 4[a]
(BASED ON ESTIMATE OF EQUATION (18))

UP =	α_0 +	$\alpha_1 BETA$ +	$\alpha_2 RSKPRE$ +	$\alpha_3 IPOIDX$ +	$\alpha_4 \Delta_{IB}$ +	$\alpha_5 \Delta_A$ +	$\alpha_6 \Delta_{IB*A}$	R^{2b}
	0.107	0.015	1.823	0.612	−0.099	−0.043	0.058	0.090
	(0.017)[c]	(0.010)	(0.465)	(0.067)	(0.025)	(0.013)	(0.027)	

[a] Parameter estimates for the empirical model of equation (18) applied to the 1981–1985 sample of 1,182 initial public offerings.
[b] R^2 is adjusted for degrees of freedom.
[c] Standard errors are reported in parentheses.

cases, were identical to those reported in Table 5 with respect to the sign and significance of the variables. That is, all variables were significant at the 0.05 level except *BETA*, which was significant at the 0.10 level.

V. CONCLUSIONS

A theoretical model that explicitly incorporates the relation between investment banker and auditor is developed to provide a more rigorous framework for testing the effect of auditor selection in the issuance process. The model can be seen as a subset of more general theories modeling the new issue market. The theoretical model generates a number of testable propositions. Two of the propositions, that high reputation investment bankers more frequently use high reputation auditors and that they underprice less, are results that have been previously documented. The sample in this study confirms these results.

The theory suggests that both investment banker and auditor reputation have a negative effect on underpricing. More interestingly, as either one of these variables increases, the impact of the other variable diminishes. The empirical results confirm this more complex relation.

There is a diversity of research attempting to explain the intricate informational environment present in an initial public offering. The complexity of signaling models makes it difficult to resolve these issues in a singular exhaustive theory. Using a simple theory based on an investment banker's profit function, we attempt to model the effects associated with auditor selection. The reputation of the auditor in this model serves to provide two important effects on the information environment—a straightforward reduction of uncertainty associated with earnings and, more subtly, a signal to the marketplace about the reputation of the underwriting coalition. The implications of our theoretical model are consistent with the sample tested in this study. The structure of the model could explain the difficulties of previous studies in identifying an empirical relation between auditor reputation and underpricing.

Appendix
Prestigious Investment Bankers

Investment bankers included in the prestigious category, ($\Delta_{IB}=1$), are:

1. Salomon Brothers*
2. First Boston*
3. Merrill Lynch*[a]
4. Goldman Sachs*
5. Morgan Stanley*
6. Drexel Burnham Lambert
7. Shearson Lehman Brothers
8. Kidder, Peabody
9. Paine Webber
10. Smith Barney, Harris Upham
11. Prudential-Bache Securities
12. E. F. Hutton
13. Bear Stearns
14. Dean Witter Reynolds
15. Dillon Read
16. Lazard Freres
17. Rothschild, Unterberg, Towbin
18. Donaldson, Lufkin & Jenrette

* Indicates that the investment banker is included in the "bulge" group as defined in Hayes [1971].
[a] Becker Paribus was consistently ranked in the "Top 25" until 1984 when it was acquired by Merrill Lynch and is thus classified as "prestigious" for the 1981-1984 period.

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