ipiipo.v9c
7/22/05

INITIAL PUBLIC OFFERING DISCLOSURE RULES AND INFORMATION PRODUCTION INCENTIVES

James A. Ligon*
University of Alabama

Paul D. Thistle
University of Nevada Las Vegas

The authors wish to thank the editor, an anonymous referee, Daniel Arce, Michael Fishman, Akram Temimi, Brad Wimmer and participants at the Financial Management Association annual meetings for helpful comments on prior versions.

* Ligon (Corresponding Author): Department of Economics, Finance, & Legal Studies, University of Alabama, P.O. Box 870224, Tuscaloosa, AL 35487-0224, Phone: 205-348-6313, FAX: 205-348-0590, E-mail: jligon@cba.ua.edu
Thistle: Department of Finance, University of Nevada Las Vegas, 4505 S. Maryland Parkway, P.O. Box 456008, Las Vegas, NV 98154-6008, Phone: 702-895-3856, FAX: 702-895-4650, E-mail: pthistle@ccmail.nevada.edu

INITIAL PUBLIC OFFERING DISCLOSURE RULES AND INFORMATION PRODUCTION INCENTIVES

Abstract

We show that, in an environment where information regarding firm quality is endogenously produced, mandatory disclosure can reduce the incentives of an issuer contemplating an initial public offering of common stock to produce information regarding the issuer's expected return. We consider the effect of three disclosure regimes (no disclosure, voluntary disclosure, and mandatory disclosure) on information production incentives. We find that the value of information may be positive, zero, or negative, depending on the disclosure regime, the cost of information, and issuer preferences. With endogenous issuer information production, a more rigorous disclosure standard may create a more opaque informational environment. We find that, regardless of the level of information costs, unless the amount of external financing required destroys signaling opportunities or information affects the investment decision, mandatory disclosure Pareto dominates the other disclosure environments.

JEL Codes: G32, D82, G18

Keywords: asymmetric information, disclosure requirements, learning, value of information

INITIAL PUBLIC OFFERING DISCLOSURE RULES AND INFORMATION PRODUCTION INCENTIVES

I. Introduction

As security markets become increasingly globalized and interconnected the question of differential disclosure standards becomes increasingly important. This is particularly true for primary markets since, as Benveniste, Erdal, and Wilhelm (1998) point out "perhaps the most salient characteristic of (IPO) firms is their relative informational opaqueness". U.S. disclosure standards are generally considered among the most rigorous in the world. As a consequence, potential foreign issuers face either the choice of meeting the U.S.'s more rigorous standards or issuing only in those markets whose disclosure standards they can readily satisfy. Cross-country differences in disclosure rules can lead to potentially inefficient segmentation of capital markets.

The literature on primary markets has recognized that issuers, investment bankers and investors have different information, but has generally assumed that the level of information possessed by all parties is exogenously given.[1] However, in reality, information is only partially exogenous. Any information possessed by market participants about a firm must somehow be related to intentional or unintentional actions taken by the firm, which are observed by the informed party. A firm that has been operating for a number of years will, as a by-product of its operations, create data regarding its operations which may be used by itself and third parties in estimating the value of the firm. This type of information may reasonably be considered exogenous.

[1] The models of Grinblatt and Hwang (1989), Welch (1989), and Allen and Faulhaber (1989) suggest an informed issuer tries to communicate project quality to uninformed investors through an underpricing signal. James and Weir (1990) suggest informed issuers signal through establishing borrowing relationships. Studies that assume that the investment banker has an informational advantage over the issuer include Baron (1979, 1982) and Baron and Holmstrom (1980). Rock (1986) presumed that investments differ in quality and some investors have superior information about this while others do not. Benveniste and Spindt (1989) assume investors have an informational advantage over the investment banker and the issuer.

However, firms can influence the extent of publicly available information in a number of ways. Firms that have not used debt or venture capital financing will have produced less publicly available information than those that have. Firms may differ in the extent to which they make use of marketing surveys, engineering reports, and other measures that assess the likelihood of success in introducing new products or production methods. Firms may also choose different points in their corporate life-cycles at which to go public. For example, biotechnology firms must receive regulatory approval for products such as new drugs, so that their type (approved or not) is eventually learned and disclosed. These firms can choose to go public either before or after the regulatory decision is announced, making the decision to learn about its prospects endogenous. Thus, to the extent that firms can control the level of information available to investment bankers and investors, information regarding the firm may reasonably be considered endogenous. We consider the incentive of a firm contemplating an initial public offering to endogenously create information about its prospects in a variety of disclosure environments. The purpose of the current study is to consider the incentive to produce or acquire information in one setting, initial public offerings, where information asymmetry has simply been assumed to exist.

We assume that entrepreneurs, who may be initially uninformed regarding the true probability of success of their firms, can conduct some research that provides information about their true prospects. For a retail firm this might take the form of a market survey, for an oil exploration firm it might take the form of a detailed geological survey, for a biotech firm it might mean delaying an offering until the results of testing are known, for other types of firm an engineering study might be relevant to the prospects of success. The important consideration is that issuers have some control over the information that they possess regarding their chances for success and have some control over the timing of the going public decision. We show that the incentive to produce information in primary markets prior to issuance depends critically on the disclosure environment.

In the "no disclosure" regime, disclosure is not credible and investment bankers cannot directly observe whether the issuer is informed or not, although informed issuers may signal type through equity retention. In the "voluntary disclosure" regime, issuers may credibly choose to reveal their type if they know it, but whether they are informed or not is again not directly observable. Finally, in the "mandatory disclosure" regime, disclosure of whether the issuer is informed or not and of issuer type, if known, is required and credible. We show that the value of information can be positive, zero or negative, depending on the disclosure regime, the cost of information, and issuer preferences. The voluntary disclosure regime has the richest informational environment, where uninformed firms have the appropriate incentives to become informed and to communicate that information to the market. Mandatory disclosure destroys the incentive for uninformed firms to acquire information and may actually create a more opaque informational environment. Nonetheless, the mandatory disclosure regime is preferred by both issuers and investment bankers. We then consider extensions of our base model involving constraints on the minimum amount of external capital required, where informational status affects the investment decision, and where market investors are risk averse in order to determine the robustness of our results.

The idea that more information is better is clearly intuitively appealing and is often the rationale offered for rigorous disclosure standards. However, the academic literature has recognized that more rigorous disclosure standards do not necessarily lead to more information.[2] The central result in the voluntary disclosure literature is the “unraveling” or full disclosure result (Viscusi, 1978, Grossman, 1981, Milgrom, 1981). This result states that if sellers are known to be informed, disclosure is costless, credible and interpreted the same way by all buyers, then sellers will always fully disclose their information. Failure to disclose leads consumers to believe the worst, creating an incentive for voluntary revelation of type by all but the worst sellers (who

[2]The disclosure literature is reviewed in Verrechia (2001) and Dye (2001), who focus on the theoretical literature, and in Healy and Palepu (2001) and Core (2001), who focus on the empirical literature.

are nonetheless exposed).[3] When disclosure is mandatory, then, if possible, sellers will choose to remain uninformed (Matthews and Postlewaite, 1985, Farrell, 1986). The mandatory disclosure rule eliminates the option to suppress bad news, and reduces the incentive for sellers to become informed. At the same time, the mandatory disclosure rule makes claims of ignorance credible. Thus, mandatory disclosure may actually reduce the information available in the market. We find that the intuition of these results on voluntary disclosure and mandatory disclosure continue to be valid in the specific context of IPO disclosure standards and thus contribute to the policy debate regarding international disclosure standards.

Dye (1990) distinguishes between disclosures that have "real externalities" and "financial externalities" depending on whether the disclosures affect other firms' cash flows or affect investors' perceptions of cash flows. When there are financial externalities, mandatory (welfare maximizing) disclosure coincides with voluntary disclosure in many cases. Shavell (1994) makes a similar distinction between information that is "mere foreknowledge" and information that affects value. In his model, expenditures on foreknowledge are socially wasteful; it follows that mandatory disclosure is socially optimal since sellers choose to remain uninformed. In an initial public offering context, Fishman and Hagerty (1990) find that limiting disclosure can be socially valuable, since allowing greater discretion increases the probability of funding negative net present value projects.[4] In our base case model, information affects perceptions of value, however, the perception of value also affects risk sharing arrangements.

We consider the incentives of a risk averse entrepreneur contemplating an initial public offering to endogenously create information about its prospects (probability of success). One of

---

[3] If there is uncertainty whether sellers are informed (e.g., Dye, 1985, Jung and Kwon, 1988) or if information revelation is costly (Verrechia, 1983, Dye 1986, Pae, 1999), then there is partial disclosure where sellers disclose good news and suppress bad news about firm value. Bushman, et. al. (1996), Dye (1998) and Fishman and Hagerty (2003) develop models in which buyers differ in their interpretation of sellers' disclosures, again leading to partial disclosure.

[4] If disclosure has real effects, then whether there is too much or too little expenditure on information and/or disclosure depends on how information affects consumption and/or production decisions. For

the principal roles of capital markets is the reallocation of risk in society. We employ the analytical frameworks of Rothschild and Stiglitz (1976) and Wilson (1977), which involve the allocation of risk under imperfect information. An issuer may wish to learn its own type in order to better tailor its offering (the optimal price and equity retention level) to the true state of the world. Thus, the incentive to acquire information is to increase the expected utility of the issuing entrepreneur. We explore whether the benefit from being able to tailor the offering to the true state of the world offsets the potential costs of becoming informed, including both the direct costs of information and the potential impact upon what offerings the market will accept. We do this for each of the three different disclosure regimes. We show that issuers and investment bankers prefer the mandatory disclosure regime. Mandatory disclosure makes claims of ignorance credible, allowing uninformed issuers to avoid the "classification risk" inherent in the decision to become informed, and yields larger fees for investment bankers. This is the opposite of the traditional investor protection rationale for disclosure requirements.[5] We then consider three extensions of our base model involving cases where there are constraints on the minimum amount of external capital required, where informational status affects the investment decision, and where market investors are risk averse.

The next section describes the market and informational environment. The third section discusses the optimal strategies for investment bankers. The fourth, fifth and sixth sections discuss incentives to produce information and equilibrium offerings under the different disclosure regimes. Section seven discusses the welfare implications of the model. Section eight considers extensions of our base model involving constraints on the minimum amount of external capital required, where informational status affects the investment decision, and where market investors are risk averse. Section nine discusses empirical implications of the model. The final section summarizes and concludes the study.

---

example, in Shavell (1994) there is too little disclosure, while in Pae (1999) there is too much.

[5] Our results, however, reinforce Huddart, Hughes and Brunnermeier's (1999) argument that competition

II. The Market and Informational Environments.

In this section we discuss the market participants (the entrepreneur/issuer and the investment banker), the information possessed and acquirable by issuers, the structure of offerings and issuer utility, and the structure of investment banker utility. We set up a game of incomplete information in which one-time players, issuers, meet repeated players, investment bankers.

Consider an entrepreneur who is considering issuing shares to sell a proportional interest in a single project of uncertain value.[6] The issuer determines the price at which the shares will be offered and the quantity of shares offered. We assume that the issuer cannot price discriminate and that the offer price is a firm commitment not subject to renegotiation. Thus, when the issuer specifies the price and the total quantity of shares, she is implicitly valuing the project. Henceforth, we will be concerned only with the value or aggregate price of the underlying project and the proportion of the project offered for sale, rather than the price or number of individual shares. Since there is one project per firm, these terms may be used interchangeably.

A. Issuers' Preferences. The issuer is assumed to dictate the price and quantity of the offering and bears the risk of a failed offering. All issuers have identical increasing, concave von Neumann-Morgenstern utility functions, $u(w)$. The issuer will invest the proceeds of any offering in the risk-free asset; we normalize the risk-free return to zero. The issuer is thus going public to provide liquidity for the entrepreneur's holdings rather than to finance investment in the firm. We consider the case where the entrepreneur requires a minimum level of external funding in Section VIII.

---

for trading volume among exchanges leads to higher disclosure standards.

[6]As will be seen, the motivation of the issuer to sell equity in the base model is risk aversion, rather than a need for financing. Thus, there is no need to consider the incentives to issue debt. The model easily generalizes to any number of situations involving risk sharing such as limited partnerships, oil and gas leases, and industry risk pools.

Each issuer's sole source of initial wealth is the project, which has a valuation distribution such that a "success" or good outcome of V_S occurs with probability t_i and a "failure" or bad outcome of V_F occurs with probability $1 - t_i$, where $V_S > V_F$. We assume that V_S, V_F and t_i are all fixed, so that there is no moral hazard problem. Projects may be high quality with a probability of success of t_H or low quality with a probability of success of t_L, where $1 > t_H > t_L > 0$. Project quality is relative, all projects are good investments in the sense that $t_L V_S + (1 - t_L)V_F > 0$. We consider the case where $t_L V_S + (1 - t_L)V_F < 0$ and thus information status affects the desirability of investment in section VIII. We let α_H and α_L denote the population proportion of each type, where $0 < \alpha_H, \alpha_L < 1$ and $\alpha_H + \alpha_L = 1$. These parameters are assumed to be common knowledge. Market participants' experience with the market allows them to know t_H and t_L but they cannot, without more information, discern the quality of any particular project.

P represents the aggregate price of the entire project and q represents the fraction of the project offered for sale. An offering, $C = (P, q)$, consists of a price and the fraction of the project sold by the issuer. Issuers are assumed to choose the offering that maximizes expected utility, given their assessment of the probability of a high return. Expected utility for a issuer with offering C and subjective probability of a high return ω is

$$U(C, \omega) = \omega\, u((1 - q)V_S + qP) + (1 - \omega)\, u((1 - q)V_F + qP) \qquad (1)$$

where $0 \leq q \leq 1$.

B. Issuers' Information. Standard adverse selection models assume that all issuers know their type. In contrast, we assume that some proportion of the population of issuers does not initially know whether they have a high or low value firm. The central concern is whether these uninformed issuers will choose to learn the prospects of their firm given the disclosure environment. Since information may arise exogenously, we assume that a proportion β ($0 < \beta < 1$) of the population is informed about their type. We assume the probability of being exogenously informed is uncorrelated with type so that the population proportion of exogenously informed high quality issuers is $\beta_H = \beta\alpha_H$, the proportion of exogenously informed low quality

issuers is $\beta_L = \beta\alpha_L$, and the proportion of uninformed, $(1 - \beta)$, contains high and low quality issuers in their population proportions. The parameter β is common knowledge.

Uninformed issuers know the probability of success, ω, belongs to a set Ω with elements $\{t_H, t_L\}$. Each issuer has a prior distribution over possible success probabilities $\pi(\omega)$. Then $\pi_j = \int_{\Omega_j} \pi(\omega)d\omega$ is the prior probability that the issuer's project is type $j = H, L$. Given the common knowledge assumptions, these are equal to the population parameters, i.e., $\pi_H = \alpha_H$ and $\pi_L = \alpha_L$. Then uninformed issuers estimate their probability of a high return as the average for the uninformed, that is,

$$t_U = \int_{\Omega} \omega\pi(\omega)d\omega = \pi_H t_H + \pi_L t_L. \qquad (2)$$

Since the probability of being exogenously informed is uncorrelated with type, this is equal to $\bar{t} = \alpha_H t_H + \alpha_L t_L$, the average probability of success for the population as a whole.

The issuer's decision to become informed or remain uninformed is a choice between two information structures. An information structure, Φ, consists of a signal space, X, and a signal function $\phi: \Omega \rightarrow X$. If the signal x is observed, then the probability of success lies in $\Omega(x) = \phi^{-1}(x)$. The prior probability of receiving the signal x is $\Pi(x) = \int_{\Omega(x)} \pi(\omega)d\omega$. The entrepreneur's posterior belief, $\pi(\omega|x)$, is the Bayesian update of the prior, given the signal. We assume that uninformed issuers initially have the uninformative information structure Φ_0, for which $\phi^{-1}(x) = \Omega$ for all signals.

We assume that uninformed issuers can conduct some research (e.g., a market survey or engineering study) that provides noiseless information about the true probability of a high return. In particular, we assume the uninformed issuer can obtain an information structure that reveals the firm's type.[7] An information structure reveals project type if there are signals x_H, x_L such that

[7]In general, an information structure can reveal a project's type without revealing the probability of a good outcome. See Ligon and Thistle (1996) for a discussion. Here, since t_H and t_L are common knowledge, an information structure that reveals the project's type also reveals the probability of success.

$t_H \in \Omega_H = \phi^{-1}(x_H)$, $t_L \in \Omega_L = \phi^{-1}(x_L)$ and $\omega \in \Omega_H$, $\omega' \in \Omega_L$ implies that $\omega > \omega'$. The information structure may have a non-negative utility cost, γ. If the information structure is costly, the cost is assumed to be common knowledge.

The value of an information structure is related to its effect on expected utility, where the offering is chosen optimally given the signal. Define $W(\Phi)$ as the expected utility associated with a given information structure Φ. That is,

$$W(\Phi) = \int_X [\max_C U(C, E\{\omega|x\})]\Pi(x)dx. \quad (3)$$

If Φ_1 is an information structure that reveals the issuer's type, then the gross value or marginal benefit of information is

$$I = W(\Phi_1) - W(\Phi_0). \quad (4)$$

The issuer chooses to becomes informed if the gross value or marginal benefit of information is at least equal to its marginal cost, $I \geq \gamma$, where γ is the cost, in utility terms, of the information structure.[8] A positive net value of information flows from the possibility that the issuer can adapt the offering to the firm's true type.[9] The net value of information is most likely to be positive when the self-selection constraint for the next lowest quality type is binding between the high quality offering and next most favorable feasible alternative offering.

C. Investment Bankers' Preferences. The issues are marketed through a firm commitment offering by an investment bank. Investment banks play an important role in the establishment of stable equilibria for the games we consider. That role is discussed fully in the next section. Investment banks acquire the issue and resell it to investors in the market at the same price at which they acquired the issue. Investment banks and investors in the market are risk neutral and

[8] As the referee has pointed out, an alternative approach to measuring the value of information is the decision-maker's willingness to pay, that is, the reduction in wealth that makes informed expected utility equal to uninformed expected utility. We show in Appendix A that the two approaches are equivalent.

[9] In our base model we do not consider other potential sources of information value such as the ability to adjust investment policy to its optimal level as in Shavell (1994) or that information has externalities in the evaluation of other firms as in Admati and Pfeiderer (2000). We consider the case where information affects investment in section VIII below.

observe the same information.[10] Investors are assumed to purchase, for reasons exogenous to the model, all available issues that are fairly priced given their information set. Investment banks are assumed to derive utility $B = \varepsilon U(C, \omega) - f((P - V^e)q)$ from each offering they accept and resell, where ε is small and non-negative, P is the price at which the offering is accepted, and V^e is the expected value of the firm given the investment banker's beliefs. If $P \leq V^e$, then $f((P - V^e)q) = 0$ and the investment banker's utility is $\varepsilon U(C, \omega)$. If $P > V^e$, then $f((P - V^e)q) > \varepsilon U(C, \omega)$, and the investment banker's utility is negative. If the investment banker rejects the offering, then $B = 0$. It is thus optimal for investment banks to reject offerings believed to be overpriced.

The value $\varepsilon U(C, \omega)$ can be regarded as the investment banker's fee and can be thought of as the "certification value" added by the investment bank (e.g., Booth and Smith, 1986). If the issuer attempts to bypass the investment banker and market the issue directly to investors, the certification value is lost and the price received by the issuer is discounted by this amount. That is, issuers cannot gain by bypassing the investment bank because investors will lower the amount that they are willing to pay for issues.[11] Since we assume that the investment banking market is competitive, the fee charged by the banker equals this certification value. We assume that the issuer's risk aversion is sufficient to offset this cost so that the issuer still prefers to issue equity versus retaining the entire project.[12] Since the issuer bears this cost in any successful offering, and it is a constant percentage of issuer utility in all offerings, it is irrelevant to an issuer's choice between offerings, and is henceforth ignored in calculation of the issuer's utility. Our primary purpose in using this specification is to minimize the role that transaction costs play in

---

[10]Risk neutrality is not necessary but substantially reduces the notation and simplifies the analysis. It is necessary that investment banks and investors in the market assign smaller risk premiums to the asset than does the issuer (e.g. because of better diversification). Risk averse investors are discussed in Section VIII.

[11]One can think of the presence of the investment bank as removing a background risk in parameter values so that even if issuers can convincingly convey type to investors through disclosure or signaling investors discount issues that bypass the investment bank because of the background risk.

[12]Issuers strictly prefer to use an investment banker rather than market shares directly because, in addition to the loss of certification value if bankers are avoided, bankers help to stabilize equilibrium as discussed in

determining equilibrium. We note that, in fact, investment banking fees are a fixed percentage of offering proceeds and since issuer utility from an offering is positively correlated with the proportion of the firm sold that this specification has a basis in actual practice. The evidence of Chen and Ritter (2000) suggests that 90% of deals raising between $20-80 million have investment banker fees of exactly 7%, which is a constant percentage of offering proceeds.

The value $f(P - V^e)q)$ can be thought of as the cost of providing price support in an overpriced offering (e.g., Ruud, 1993; Hanley, Kumar, and Seguin, 1993). The banker avoids this cost by rejecting offerings where the price exceeds the expected value. We assume purchasing an underpriced offering does not add to investment banker utility, since the underpricing benefit is passed on to investors and reputational effects of underpriced offerings for the investment banker (positive to investors and negative to issuers) cancel out (e.g. Beatty and Ritter, 1986). This specification of investment banker utility insures that bankers have an incentive to accept offers maximizing the utility of issuers, subject to the issues being fairly priced. This specification also insures that, although risk neutral, bankers have a strict preference for accepting fairly priced offerings versus investment in the risk free asset. The particular acceptance strategies of investment banks are discussed in the next section.

D. The Offering Market. An offering may be viewed as a game in which the participants are the issuer, the investment banker, and nature. The extensive forms of the games we consider have the following common elements. Nature moves first and chooses the issuer's type as H or L, or equivalently, chooses the probability of success as t_H or t_L. The usual assumption is that issuers, but not investment bankers, observe this move, so that issuers have an informational advantage. In contrast, we assume that investment bankers and at least some issuers do not observe this move. The next move is the uninformed issuer's decision whether or not to become informed and learn her type. As pointed out, we analyze games where investment bankers observe this move

---

the next section.

and games where they do not.[13] The issuer will then choose an offering. The investment banker then either accepts or rejects the offering. Finally, the uncertainty regarding the project's success or failure is resolved and the players receive their payoffs. The stage game then repeats *ad infinitum* with new issuers arriving, sequentially and probabilistically, at each repetition.

III. Investment Banker Strategies.

In order to evaluate the strategies played by investment bankers in the stage games, it is necessary to consider the long run equilibrium of the repeated game being implicitly played among investment bankers. Indeed, the principal role played by investment bankers in the model is that their repeated presence throughout the stage games creates a more stable incentive structure than one that pairs one-time issuers with one-time atomistic market participants. That is, out-of-equilibrium moves may lead an atomistic market to respond in ways that destabilize equilibria. This is particularly important in connection with potential pooling equilibria. Specifically, for any proposed pooling equilibrium, there exists an offering that involves a greater retention and a higher price that would be preferred by the high quality issuers but not by low quality issuers. Thus, the first such offering made could rationally come only from a high quality issuer. However, if such an offering is accepted at the high quality price, then any firm who declines to make it is revealed as low quality. If the deviant offering yields low quality firms higher utility than simply selling the entire firm at the low quality price, there will be no equilibrium in the market.[14] An investment banker playing repeatedly can reject these equilibrium destabilizing responses. One-time atomistic market participants' incentives would

[13] In each of these games, the issuer knows what the investment banker can observe regarding his move to obtain information. That is, we make the standard assumption that players' information partitions are common knowledge.

[14] It was this line of argument that led Rothschild and Stiglitz (1976) to conclude that pooling equilibria could not exist in their economic environment. Wilson (1977) shows that if the players observing the signal act in a non-myopic manner pooling equilibria can be sustained. Both separating and pooling are perfect Bayesian equilibria, but pooling equilibria do not satisfy the intuitive criterion (Cho and Kreps, 1987).

lead them to accept such offerings. Even if atomistic participants played repeatedly, it is unlikely that they could act with sufficient foresight and coordination to refuse such an offering. However, investment bankers, playing repeatedly, would be more likely to coordinate to refuse such offerings and maintain stable pooling equilibria because of the ability to develop effective punishment strategies for potentially deviant banks. If disclosure does not reveal type and pooling equilibria are the preferred solution to any remaining adverse selection problems in IPO markets, the foregoing argument provides an explanation for the presence of investment bankers in the offering process. If issuers attempted to market directly, market equilibrium may fail to exist just as Rothschild and Stiglitz (1976) suggested.

Since investment bankers play the game repeatedly, while issuers play a one shot game, it is necessary to place some structure on the problem in order to determine investment banker behavior.[15] If issuer type is observable, we assume that all investment banks will acquire any fraction, q, for the fair price for the issuer type. We assume that, if issuer type is unobservable, an investment banker will play the strategy that maximizes long run utility, assuming issuers play best responses, subject to the informational constraints, and subject to the condition that no competing strategy which causes the original strategy to produce negative utility produces positive utility in the long run. It turns out that this strategy is equivalent to the anticipatory equilibrium of Wilson (1977) and leads bankers to accept the largest possible offering fraction at prices that are consistent with the informational incentives and issuer utility maximization.[16]

To evaluate investment banker strategies we define certain potential contract offerings. The definition of particular offerings and investment banker strategies in connection with them

[15]See, for example, Fudenberg, Kreps, and Maskin (1990). Under the folk theorem for infinitely repeated games any payoff profile that strictly Pareto dominates the minimax payoff profiles in the mixed extension of an n person one shot game with finite action sets is the average payoff in some perfect equilibrium of the infinitely repeated game. The practical implication is that a plethora of equilibrium candidates become sustainable.

[16] Separating equilibria with partial subsidies, such as those suggested by Miyazaki (1977), are not possible. Since the investment banker must resell the issue to the public and the separating-subsidizing contracts reveal type, the market would not purchase the overpriced offerings by low quality issuers.

are discussed in Appendix B. The offerings are illustrated in Figure 1 and summarized in Table 1 for reference. We denote the fair prices (expected values) of the high and low quality projects by $P_H = t_H V_S + (1 - t_H)V_F$ and $P_L = t_L V_S + (1 - t_L)V_F$. For the uninformed, who estimate their probability of success as t_U, the fair price is $P_U = t_U V_S + (1 - t_U)V_F$. Observe that $P_U = \pi_H P_H + \pi_L P_L$. The axes in Figure 1 show final wealth, $W_j = (1 - q)V_j + qP$, when the outcomes of the project are success and failure. The point E is the issuer's endowment where the project constitutes all of the issuer's wealth and where $q = 0$. The lines EH, EU and EL represent the fair price lines for types *H*, *U* and *L*. They represent final wealth combinations with varying levels of q for the three types, with point E representing $q = 0$ and the intersections of EH, EU, and EL with the 45% line through the origin representing $q = 1$ for each of the three types. The slopes of the fair price lines are $t_j/(1 - t_j)$, $j = H, U, L$.

In general, investment bankers will reject any offering that they believe is overpriced. If the parameters of the stage game lead to a separating equilibrium, then bankers know that each type will make the fairly priced offering that maximizes its expected utility and will not be imitated by other types. If an offering C_j meets these criteria, then bankers believe the issuer is type j with probability one. If disclosure on type is credible, then bankers will accept contracts offering the entire firm at a price fair for that type. Claims to be uninformed are credible only if informational status is observable.

Suppose disclosure of type is not credible and it is a rational expectations equilibrium for issuers to become informed. Then bankers will accept offers priced at P_H only if the quantity offered is sufficiently limited so that type *L* issuers prefer not to mimic, that is if $q \leq q_H'$. If a higher quantity is offered, i.e., $q > q_H'$, investment bankers will only accept offers priced at P_L.

Suppose disclosure on type is not credible and it is a rational expectations equilibrium for uninformed issuers to remain uninformed. Alternatively, suppose that contract offerings would create informational incentives inconsistent with equilibrium. Then bankers will accept offerings priced at P_H only if the quantity offered is sufficiently limited so that neither type *L* or

uninformed issuers mimic, i.e. $q \leq q_H$". Investment bankers accept offerings priced at P_U only if the quantity is sufficiently limited so that type L issuers do not mimic, i.e. q_H" $< q \leq q_U$". If $q > q_U$", then the offering must be priced at P_L.

IV. Equilibrium Offerings with No Disclosure.

We first consider the incentive of firms to acquire information in an IPO market where the issuer's decision to obtain information is completely unobservable by the market and no credible statements as to type are possible. Since any information acquired by the firm cannot be credibly communicated directly, it must be communicated indirectly through a credible signal. Here the signal is equity retention. This environment is closest in spirit to the original models of Rothschild and Stiglitz (1976), Leland and Pyle (1977) and Wilson (1977) with the exception that, for at least some issuers, information status is endogenous.

First, we point out that for any given offering C, we have

$$\pi_H U(C, t_H) + \pi_L U(C, t_L) - U(C, t_U) = 0. \tag{5}$$

This follows from the definition of t_U and the linearity of expected utility in the probabilities. We make extensive use of this fact. This leads to the following proposition. All proofs are in Appendix C.

> *Proposition 1*: Assume that issuers can learn their type at zero cost, that issuers informed/uniformed status is unobservable, that type H issuers prefer separation, and that project type is not observable by investment bankers. Then, in equilibrium, (*a*) the gross value of information is zero, $I = 0$, and (*b*) the equilibrium offerings are $\{C_H', C_L^*\}$.

That is, type H contracts are offers to sell a limited quantity of the firm ($q \leq q_H'$) at the price P_H, and type L contracts are offers to sell the entire firm at the price P_L.

The characterization of equilibrium depends on the assumption of zero information costs. If information is costly, then it need not be an equilibrium for uninformed issuers to become informed. The characterization of equilibrium also depends on the assumption that issuers become informed if the net value of doing so is zero. If we instead assume that issuers remain

uninformed when the net value of information is zero, then the equilibrium offerings are the same as those suggested in the following corollary.

> *Corollary to Proposition 1*: Assume that issuers can learn their type at positive utility cost γ, that issuers' informed/uniformed status is unobservable, that better type issuers prefer separation from lesser type issuers, and that project type is not observable by investment bankers. Then, whether or not the uninformed become informed, in equilibrium, (*a*) the gross value of information is positive, $I > 0$, but the net value of information may be positive or negative, and (*b*) the equilibrium offerings are $\{C_H", C_U", C_L^*\}$.

The net value of information obviously depends upon the level of information costs, γ. If information is too costly, the uninformed will remain uninformed. But, irrespective of whether or not they choose to become informed, the equilibrium offerings are the same. Type *H* issuers choose a contract that is priced at P_H and that limits quantity sufficiently that neither type *L* issuers nor uninformed issuers choose to mimic (i.e. $q \leq q_H"$). The contract chosen by uninformed issuers (if there are any) is priced at P_U and that limits quantity sufficiently so that type *L* issuers do not mimic (i.e. $q \leq q_U"$). The contract chosen by type *L* issuers priced at P_L sells the entire firm.

Proposition 1 and its Corollary apply when the parameters of the model imply that a separating equilibrium holds in the stage games. It is easy to see that the equilibrium value of information is zero if there is a pooling equilibrium. In a pooling equilibrium, both high and low quality issuers offer the contract $\overline{C}_H$ which maximizes type *H* utility at the pooling price. Bankers accept $\overline{C}_H$ if they expect uninformed issuers to learn their type. Then, from eq. (5), the gross value of information is $I = \pi_H U(\overline{C}_H, t_H) + \pi_H U(\overline{C}_H, t_L) - U(\overline{C}_H, t_U) = 0$. Even if bankers expect uninformed issuers to remain uninformed, the definition of the optimal pooling contract, $\overline{C}_H$, implies a higher offering fraction than the equilibrium signaling contract for the uninformed, $C_U"$. Since the uninformed pool price is equal to the overall population pool price, all issuers

offer the optimal pooling contract, $\overline{C}_H$.[17] Since all issuers are pooled at the same offering, equilibrium exists and again the gross value of information is zero.

V. Equilibrium Offerings with Voluntary Disclosure.

We now consider the case where informed/uniformed status and project type are unobservable, but where informed issuers may choose to disclose this information on a voluntary basis and such disclosure is credible. Thus, it is not necessary to signal type through retention. Clearly, informed high quality issuers have an incentive to reveal their type because investment bankers are willing to accept offerings of full ownership of high quality projects (i.e., accept C_H*), which dominates any other feasible contract offering. However, informed low quality issuers have an incentive to feign ignorance. The statement that the issuer is informed can be made credible by the revelation of the information, but the statement that the issuer is uninformed cannot. This has an effect on the value of information. Specifically, claims to be uninformed are not credible because type *L*s have an incentive to mimic this claim. The result is that becoming informed is valuable because there is a probability of learning one is type *H* and upon disclosure of this information being able to offer C_H*. Others will be regarded as type *L*.

> *Proposition* 2: Assume that issuers can learn their type at zero cost, that issuers informed/uniformed status is unobservable, and that project type is not observable by investment bankers. Assume further that issuers can choose to credibly report their project type and that this is the only information on type available to investment bankers. Then in equilibrium (*a*) the gross value of information is positive, $I > 0$, and (*b*) the equilibrium offerings are $\{C_H^*, C_L^*\}$.

If information is costless, then both type *H* and type *L* issuers offer the entire firm at the prices P_H and P_L, respectively.

With zero information costs, pooling equilibrium is not an issue since informed high

[17] Note, C_H" is defined by the type U indifference curve through C_U" and that the type H indifference curve through C_H" has a steeper slope than the type U indifference curve. Thus, if type H issuers prefer $\overline{C}_H$ to C_H" it necessarily entails a larger offering fraction than C_U". Hence, all issuers would prefer $\overline{C}_H$.

quality issuers would necessarily prefer C_H* to $\overline{C}_H$, since it offers the opportunity to sell a larger fraction of the firm at a higher price. With voluntary disclosure and zero information costs, the equilibrium value of information is strictly positive and larger than in the case of no disclosure (the possibility of being able to offer C_H* is more valuable than the possibility of being able to offer the optimal type *H* separating contract when the uninformed acquire information, C_H').

If the cost of information is too high, the equilibrium is once again for uninformed issuers to remain uninformed. In this case, the gain from offering C_H* is not sufficiently high to offset the information cost and the uninformed choose to stay uninformed. This constrains informed type *H*'s to issue C_H" if separation is preferred and $\overline{C}_H$ if pooling is preferred. The investment banker then accepts the equilibrium contract set {C_H", C_U", C_L*} if higher quality issuers prefer separation and accepts $\overline{C}_H$ if type *H* issuers prefer pooling.

The positive value of information is entirely due to the ability of informed high quality issuers to credibly reveal their type. Since uninformed and informed low quality issuers can offer the entire firm at P_L, there is no risk to the uninformed if they learn they have low quality projects. If they learn they have high quality projects, then they gain by being able to offer the entire firm at P_H instead of P_L, and this occurs with probability π_H. If information costs are sufficiently small and the net value of information is positive, investment bankers and issuers are better off, implying a Pareto improvement over the no disclosure environment. The results are similar to those of Grossman (1981) and Milgrom (1981) in that voluntary disclosure leads to full disclosure, suggesting these results are robust across economic environments.

VI. Equilibrium Offerings with Mandatory Disclosure.

We now assume that firms are legally required to disclose all information that they have in their possession regarding the probability of success in an offering prospectus. The failure to disclose is either observable or that there is a penalty against firms that fail to truthfully disclose

that is sufficiently severe, and levied with sufficient frequency, that all firms have the incentive to disclose. Thus, the investment banker can now observe the issuer's move with respect to the research decision (whether the issuer is informed or uninformed) and, if research is undertaken, can observe the results of that research (knows the issuer's type). Failure to disclose becomes a credible signal that the firm is type U. The result is that information has negative value.

The investment banker no longer needs to infer the informational status of the issuer. If the research is conducted, the issuer's type is disclosed; failure to disclose implies that the issuer is uninformed. Since issuer type is observable, investment banks will acquire any fraction, q, at the fair price for the issuer type.

> *Proposition* 3: Assume that issuers can learn their type at zero cost, that issuers informed/uniformed status is observable, and that project type of informed issuers is observable by investment bankers. Then in equilibrium (*a*) the gross value of information is negative, $I < 0$, and (*b*) the equilibrium offerings are $\{C_H^*, C_U^*, C_L^*\}$.

Under mandatory disclosure, each type of issuer offers the entire firm at the fair price for that type.

In this case the investment banker can condition the offerings it will accept on the information status and type of the issuer. The consequence is that if uninformed issuers decide to become informed, then they effectively face a lottery over the proceeds of the offering, receiving either P_H with probability π_H or P_L with probability π_L. Alternatively, they can receive the expected value of the lottery with certainty by remaining uninformed which, being risk averse, they prefer. The mandatory disclosure requirement actually creates a disincentive to the production of information. This makes uninformed issuers better off because they do not face a lottery over type. The ultimate investors in the securities now bear this risk. Since investors are risk neutral, this risk transfer is Pareto efficient. Pooling is not an issue since informed high quality issuers necessarily prefer the full information type H contract, C_H^*, to the optimal pooling

contract, $\overline{C}_H$. The result is similar to that of Matthews and Postlewaite (1985), suggesting their result is also robust across economic environments.[18]

VII. Welfare Implications.

We have shown that, where some firms in the market have the choice of whether to endogenously create information about their prospect of success, mandatory disclosure leads to a more opaque informational environment than either no disclosure or voluntary disclosure, provided information costs are sufficiently small. If information costs are sufficiently high, firms do not produce information irrespective of the disclosure environment. We have also shown that voluntary disclosure with low information costs leads to information acquisition and eliminates the signaling cost associated with equity retention. However, this does not imply that voluntary disclosure represents a Pareto improvement over mandatory disclosure.

> *Proposition 4*: Assume the type H issuers prefer the separating equilibrium under the no disclosure regime. (*a*) If uninformed issuers can learn their type at zero cost, then from the viewpoint of issuers and investment bankers the mandatory disclosure regime is Pareto superior to the voluntary disclosure regime which in turn is Pareto superior to the no disclosure regime, and (*b*) if uninformed issuers can learn their type at cost $\gamma > 0$, then the mandatory disclosure regime is Pareto superior to the voluntary disclosure and no disclosure regimes.

When separating equilibria hold, the disclosure regimes can be Pareto ranked. Although there is less information available to the market, uninformed issuers are better off in the mandatory disclosure environment than in voluntary disclosure environment because they are not forced to face the lottery over type and can credibly claim to be uninformed, while informed issuers are no worse off. Informed high quality issuers and uninformed issuers are better off in the mandatory disclosure environment than the no disclosure environment because they do not

[18] In the somewhat unusual case where the investment banker can observe the informational status of the issuer but not the type of informed issuers, the value of information is negative and if separation is preferred by type *H* issuers, the equilibrium offerings are $\{C_H', C_U^*, C_L^*\}$. If pooling is preferred by type *H* issuers, the equilibrium offerings are $\{C_U^*, \overline{C}_H\}$. The proof for this case is available on request from the authors.

have to bear the costs of signaling their type, while informed low quality issuers are no worse off. Investment bankers prefer environments in which the equity retention signal is eliminated because this leads to larger fees. They thus prefer low information cost environments and either voluntary or mandatory disclosure. Investors are risk neutral and always purchase shares at their expected value under any disclosure regime and thus indifferent between them. Thus, welfare analysis favors mandatory disclosure even though it is more informationally opaque. The implication for competition between markets is that a "race to the top" in disclosure standards would be expected. As discussed in the next section, this result depends on the economic environment assumed.

VIII. Generalizations and Extensions.

Our base model is driven primarily by insurance considerations. That is, the entrepreneur seeks to sell her firm in order to insure her wealth against the variations in the ultimate project outcomes. Mandatory disclosure preserves the insurance opportunities of uninformed issuers because it allows them to remain ignorant of type and still sell their entire firm at its expected value. As is well recognized in insurance markets, too much information can destroy insurance opportunities (Doherty and Thistle, 1996; Hoy and Lambert, 2000; Hoy and Polborn, 2000). We now consider other possible motivations for external finance and their impact on potential equilibria. We first consider the case where the entrepreneur lacks sufficient funds to finance the entire project, that is a minimum amount of external capital must be raised for the project to be undertaken. We then consider the case where the low quality project is not desirable, that is $t_L V_S + (1 - t_L)V_F < 0$. In this case information affects societal welfare, since informed issuers can avoid a negative net present value project. Finally, we consider the case where investors are risk averse.

A. Some Project Financing Required. We maintain all of the assumptions from the original model with the exception that the entrepreneur must obtain at least some external equity financing

in order to undertake the project. That is, the IPO must raise a minimum level of external equity capital, $K \leq P_L$, for the project to be viable. Assume that the value of the firm is zero if the minimum external capital is not raised. Offerings must then satisfy the constraint $Pq \geq K$. This requirement has no effect on equilibrium in the voluntary or mandatory disclosure environments. In these environments the entrepreneur is able to and prefers to sell the entire firm and the fact that a minimum amount of capital is necessary for project viability is irrelevant to equilibrium.

The minimum capital requirement does, however, potentially affect equilibrium in the no disclosure environment. In this disclosure regime, type must be signaled by restricting the fraction of the project sold. Consider, for example, the case where the cost of information is zero and where high quality issuers sell the fraction q_H' to signal their type. If the constraint is binding ($P_H q_H' < K$), then the self-selection constraint is violated and no viable signal is possible.[19] In this situation the only viable equilibrium solution is a pooling equilibrium. The pooling equilibrium will not necessarily be at $\overline{C}_H$. If the minimum capital requirement involves selling a larger fraction than that implied by $\overline{C}_H$, then the equilibrium is a pooling equilibrium at the quantity that satisfies the constraint, otherwise it is at $\overline{C}_H$.

The consequence is that the disclosure regimes can no longer be Pareto ranked. High quality issuers prefer mandatory or voluntary disclosure (more strongly than in the base case). Uninformed issuers prefer mandatory disclosure. But now low quality issuers will prefer no disclosure. The no disclosure environment in this case results in a pooling equilibrium that such issuers prefer to issuing C_L*. However, with competing capital markets, low quality issuers preferences can not prevail. Uninformed issuers would gravitate to mandatory disclosure environments and high quality issuers to mandatory or voluntary disclosure environments leaving low quality issuers alone and exposed in the no disclosure market. It is only if capital markets are segmented in a manner that does not allow free flow of capital (perhaps due to inadequate

[19] Similarly, if information costs are positive and the constraint is binding, a fully separating equilibrium

accounting or legal standards or government regulation on capital flows) and low quality issuers predominate sufficiently to shape the disclosure environment that the no disclosure environment could prevail. Such a result would effectively trap high quality and uninformed issuers in a sub-optimal equilibrium. To the extent alternative sources of finance are available, we would expect equity markets to be stunted as a result. Casual empiricism suggests that at some points in time some third world markets might have been in such an equilibrium.

B. Low Quality Investment Undesirable. We maintain all of the assumptions of the original model except that we now assume that low quality project have negative value, $t_L V_S + (1 - t_L)V_F < 0$. Note, this implies that at least $V_F < 0$. In this case, an informed issuer can avoid adopting a negative net present value project if they learn that they are low quality. We assume that the proportion of high quality firms is such that $t_U V_S + (1 - t_U)V_F > 0$, or uninformed issuers projects are funded. In this environment, in equilibrium, informed low quality issuers do not participate in the market.

In the no disclosure case, the offering C_L* is not feasible (it would have a negative price and the entrepreneur is ahead not adopting the project). However, without disclosure, entrepreneurs with low quality projects must be prevented from mimicking the behavior of other types. As a consequence, in the no disclosure environment, offerings for the uninformed and high quality issuers would be defined by the low quality indifference curve through the origin. The analysis then proceeds as in the base case. That is, even though low quality projects are undesirable, project type cannot be verified and uninformed and high quality issuers must signal their type by restricting the fraction of the firm offered to prevent low quality issuers from mimicking the behavior of uninformed and high quality types. In the voluntary disclosure case only high quality firms come public. Unless the firm discloses that it is high quality, the market will assume the firm is low quality and not purchase the issue.

---

cannot exist.

In the mandatory disclosure case, the results of Proposition 3 may be reversed. In the case of our original model, becoming informed involved accepting a fair gamble over type, which being risk averse, the entrepreneur would refuse. However, in the current case, the gamble is actually a favorable gamble. The reason is that, if entrepreneurs learn that their project has negative expected value, they have the real option to decline the project and receive a payoff of zero. The pooled value for uniformed types must include the negative expected value of low quality firms. Thus, here entrepreneurs would trade off the higher expected value associated with being informed versus the disutility of the gamble. Whether they would choose to become informed would depend upon the difference in expected values, the degree of risk aversion, and the cost of information. If parameter values are such that the uninformed choose to become informed, uninformed issuers would be indifferent between the mandatory and voluntary disclosure cases. If parameter values are such that the uninformed prefer to remain uninformed, then uninformed issuers continue to prefer the mandatory disclosure to the voluntary disclosure environment. Since they do not participate in the market, low quality issuers are indifferent between disclosure regimes. Informed high quality issuers are indifferent between mandatory and voluntary disclosure but prefer both to no disclosure. Note also that a social planner concerned with societal welfare would want the uniformed to become informed in order to avoid negative net present value projects. Thus, if parameter values are such that the uninformed prefer to remain uninformed, the interests of uninformed issuers and society will be at odds and it is society that would prefer voluntary disclosure and uninformed issuers that would prefer mandatory disclosure. In this situation the implications for competition among markets are that mandatory and voluntary markets could coexist. Uninformed issuers prefer the mandatory disclosure markets and high quality issuers are indifferent. Even though suboptimal from a societal perspective mandatory disclosure markets would still find willing investors since issues are priced at expected value.

C. Investor Risk Aversion. Now assume that investors, although less risk averse than entrepreneurs, are risk averse instead of risk neutral. All of the other assumptions of the original model are retained. Investors in the securities are presumed to buy the issues from investment bankers at the price paid by the bankers, which will reflect the required risk discount.

For each type of firm, outcomes are binomially distributed with mean P_j and variance $t_j(1 - t_j)(V_S - V_F)^2$. This variance is maximized at $t = .5$. Thus, if $t_L < .5 < t_H$, t_U will be closer to .5 than t_L and t_H and offerings by informed type *H*'s and informed type *L*'s will have lower aftermarket variance than offerings by uninformed types. The uninformed choose to remain uninformed in environments with mandatory disclosure and with high information costs. These environments would thus be expected to have higher aftermarket variance. If investors are risk neutral, this does not impose any costs on issuers. With risk averse but rational investors this is this potentially costly to issuers. Note that with risk neutral investors and the assumption that the $r_f = 0$, expected values are not discounted; however with rational risk averse investors a risk adjusted discount rate greater than zero is required. Assume that risk averse investors use the capital asset pricing model as their risk adjustment model. Then the measure of systematic risk is $\beta_A = \rho_{AM}\sigma_A/\sigma_M$, where ρ_{AM} is the correlation of asset A's return with the market, σ_i is the standard deviation of the asset (A) and the market (M), respectively. Thus, so long as the correlations of issuing firms' returns with the returns on the market portfolio are positive and unaffected by informational status, the higher variance of uninformed firms implies they have greater systematic risk (i.e. higher β) than if they were informed. This implies that investors will discount uninformed firms at a higher discount rate than informed firms. It is possible that this risk discount will offset the utility value of remaining uninformed. Again, the result will be parameter dependent. If the incentives are strong enough to induce all firms to become informed, then all parties (issuers, investment bankers, and investors) would be indifferent between mandatory and voluntary disclosure.

IX. Empirical Implications

The model has a number of empirical implications. The Securities Act of 1933 provides penalties for failure to disclose all relevant information as well as for material misstatements in the registration statement. Enforcement of the former is much more difficult than the latter. Proving failure to disclose requires proving the firm actually was in possession of the information at the time of the offering and that it was material to valuation. This would effectively require the presence of a "smoking gun" somewhere in the firm's records. Proving material misstatements on the other hand simply requires the revelation of the inaccuracy of the statement in the registration statement. Thus, one way to interpret U.S. disclosure standards is that they make disclosures credible without making claims to ignorance credible. This is effectively the voluntary disclosure environment. The results of Simon (1989) indicate that aftermarket variance declined following the imposition of disclosure standards by the Securities Act of 1933. These results are consistent with the model if one interpreted the Securities Act as moving from an environment where disclosure is not credible (no disclosure) to one where it is credible (voluntary disclosure).

Mandatory disclosure and voluntary disclosure with sufficiently low information costs also eliminate the need to signal quality through equity retention. Quality must be signaled through retention in the no disclosure environment, irrespective of the level of information costs, and in the voluntary disclosure environment with sufficiently high information costs. Since the investment required is identical across firms in our model, all firms in our model have equivalent book values. Since price and retention are increasing in quality, equity retention and market-to-book ratios should be positively correlated if retention serves as a signal. Pooling equilibria, which may occur in the no disclosure and voluntary disclosure with high information costs environments, also involve retention although it does not serve as a signal in this case.

To test whether there is a link between retention and market to book ratios we collected data from Thomson's SDC New Issues data base on new issues from 1988-1997 and from Jay Ritter's 1975-1984 data base available at http://www.iporesources.org/ipo/ipodata/ritter.html.

We deliberately excluded the Internet bubble years, 1998-2000, as market to book valuations during these years may be unrepresentative. For the Ritter data set, retention is one minus the number of shares offered as a fraction of the total number of post-IPO shares outstanding. For comparability, retention was measured in the same way for the SDC data set. The market to book ratio was computed by first calculating the overall market value of the firm, offer price times number of shares outstanding post-offering, then dividing by the pre-offering book value plus the offering proceeds. Data on means, standard deviations, and correlations of these variables are reported in Table 2. The mean and standard deviation of retention are similar in both periods. The mean market-to-book ratios are also similar, but the standard deviation of market-to-book is much larger in the later period. The high correlation between retention and market-to-book in the earlier period suggests that equity retention could have been a signal of issuer quality (as measured by market-to-book ratios) during this period. However, the relationship between retention and market-to-book, while still significant, is much weaker in the later SDC data period (1988-1997) as the correlation falls from 62% to 11%.[20]

Mandatory disclosure and voluntary disclosure with sufficiently low information costs would eliminate the need to signal quality through equity retention. A switch from a separating to a pooling equilibrium would also eliminate the need to signal quality through retention, reducing or eliminating the correlation between retention and market-to-book, but should also reduce variation in market to book ratios. Since we observe increased variation in market to book ratios coupled with a lower correlation between retentions and market to book, the results are most consistent with either a decline in information costs or increasing rigor of disclosure standards between the Ritter (1975-1984) period and the SDC (1988-1997) periods. Information costs include the cost of disseminating as well as acquiring information. Thus, it is possible that the results reflect the relative explosion of cheap sources of information distribution, including

[20]We also calculated retention as the insiders' share of post-offering ownership for the SDC data (this information is not available for the Ritter data). Mean retention is 44% with a standard deviation of 21%.

the Internet, that developed during the 1990's, making information regarding offering firms more readily accessible, particularly to individual investors.

The model also has potential underpricing implications. Suppose investors receiving IPO allocations are relatively sophisticated and discount the price paid for uninformed IPO issuers to reflect their relatively greater risk. That is, they recognize the implications of uninformed firms on systematic risk and use t_U in calculating σ_U and β_U. Further, suppose that individual investors in the secondary market are not as sophisticated and value the firms at a lower discount rate. Suppose, for example, that $t_H = .6$ and $t_L = .4$, there is an equal proportion of high quality and low quality firms, and the correlation of the returns of all types with the market is the same and positive, then the observed after-market variance of both high and low quality types will be equal and lower than that implied by t_U. The consequence of secondary investors estimating beta from secondary market data will be initial public offering underpricing as the offer price reflects the informational discount while the secondary market price does not. Recent papers by Derrien (2005) and Ljungqvist, Nanda, and Singh (2004) suggest less than fully rational secondary market investors cause IPO prices to rise temporarily above fundamental value. These explanations rely on "investor sentiment" while ours relies on underestimation of the appropriate information related discount.

If the proportion of uninformed firms varies over time, the model provides an explanation for variation in initial returns over time. If investors underestimate the informational discount, then average initial returns will be higher during periods when the proportion of uninformed firms is higher. If, when the proportion of uniformed firms is high, firm type will ultimately be revealed exogenously, then our model explains IPO clustering (i.e. time variation in IPO volume) as well. Hot IPO markets, where number of issues and initial returns are high, arise as issuers strive to go public before type is revealed and initial returns are higher reflecting the information discount demanded by those receiving initial allocations. Hoffmann-Burchardi (2001) presents

---

The correlation between retention and the market-to-book ratio is 0.03722, with a *p*-value of 0.097.

another model of IPO clustering based on information revelation.

Finally, the model provides an explanation of why the primary market for equity remains predominantly an intermediated market. In our model the investment banker is important for establishing appropriate informational incentives and stable equilibria. The investment banker's presence generally benefits better quality firms by making pooling equilibria possible where firm type is not directly observable and pooling is preferred by high quality firms. Investment bankers also benefit higher quality firms by observing and validating firm type when firm type is observable (e.g., Carter and Manaster, 1990). Thus, intermediation would be expected unless informational issues are unimportant. Interestingly, direct auctions of securities generally occur only for government securities when informational issues would be minimized.

X. Conclusions.

We examine the incentives of an issuer of an initial public offering to acquire information about the firm's prospects for success prior to the offering. We examine the informational incentives in three different disclosure environments: where credible disclosure is not possible, where disclosure is voluntary and credible but informational status is not observable, and where disclosure is mandatory and reveals informational status and, if informed, type.

We find that in the environment with no disclosure that uninformed types choose to become informed only if the cost of information is zero and indifferent issuers choose to become informed. Informed high quality issuers who prefer separation, whether exogenously or endogenously informed, reveal type through a signaling mechanism (here, the percentage of equity retained). In the environment where disclosure is voluntary but credible, the value of information is strictly positive and, if information costs are low enough, uninformed issuers become informed and high quality issuers are revealed through disclosure. Low quality issuers are revealed through a failure to disclose. Claims to be uninformed are not credible. In an environment where disclosure is mandatory and credible, claims to be uninformed are credible.

Issuer risk aversion leads the value of information to be negative and uninformed issuers to remain uninformed. Exogenously informed types are revealed through disclosure. In environments where external funding is required for project viability, lower quality issuers may prefer no disclosure. In environments where information status affects investment, society may prefer voluntary disclosure while issuers prefer mandatory disclosure. In environments where investors are also risk averse, there are additional incentives for uninformed issuers to acquire information.

Our results are consistent with prior research suggesting that, in environments where production of information is endogenous, mandatory disclosure standards can result in a reduction of the information available in the economy. Although issuers and investment bankers find mandatory disclosure a Pareto improvement over no disclosure or voluntary disclosure, the presence of uniformed firms potentially imposes costs on unsophisticated investors. The difference between mandatory and voluntary disclosure is that in the former claims to ignorance become credible. The results suggest that it may be more important to assure the credibility of the information presented, thus avoiding the no disclosure environment, and to lower the cost of information production and dissemination rather than mandating what information must be presented.

In our model IPO investors are assumed to be rational, price issues appropriately, and are generally indifferent between disclosure environments. Mandatory disclosure would serve investors' interests only if investors mistakenly believed claims to ignorance to be credible in the absence of regulation. That is, if informational status is not verifiable but investors naively believe that "no news is no news", then they will overpay on average as low quality types claim to be uninformed. On the other hand, if informational status is not verifiable but investors believe "no news is bad news", then positive informational incentives are established and mandatory disclosure becomes unnecessary. Clearly, to the extent real world disclosure standards are intended to be mandatory, either regulators are captured by issuers and investment bankers and

are delivering the environment preferred by these market participants or regulators believe that investors would naively misinterpret the lack of disclosure.

Appendix A
Equivalence of Two Concepts of the Value of Information.

In the text, we measure the value of information as the change in expected utility and the cost of information as a reduction in expected utility. A reasonable objection to this approach is that, if a decision maker must buy the information structure, they must pay for it with real resources and not units of expected utility. This suggests using the decision maker's willingness to pay for the information as the value of information.

Modifying eq. (1) in the text, define

$$U(C, \omega, \kappa) = \omega u((1-q)V_S + qP - \kappa) + (1 - \mathrm{w})u((1-q)V_F + qP - \kappa) \tag{A.1}$$

Then the expected utility associated with the information structure Φ with financial cost κ is

$$W(\Phi, \kappa) = \int_X [\max_C U(C, E\{\omega|x\}, \kappa)]\Pi(x)\mathrm{d}x \tag{A.2}$$

With this notation, the definition of the value of information given in the text is

$$I(\Phi_1) = W(\Phi_1, 0) - W(\Phi_0, 0), \tag{A.3}$$

where Φ_0 is the uninformative information structure. As shown in the text, $I(\Phi_1)$ may be either positive or negative.

An alternative concept of the value of information is the decision-maker's willingness to pay for the information structure, that is, the certain reduction in wealth that makes the informed expected utility equal to the uniformed expected utility. The willingness to pay for the information structure Φ_1, denoted $\kappa(\Phi_1)$, is implicitly defined by

$$W(\Phi_1, \kappa(\Phi_1) - W(\Phi_0, 0) = 0. \tag{A.4}$$

The willingness to pay measure $\kappa(\Phi_1)$ may also be either positive or negative.

Now consider two distinct two information structures, Φ_2 and Φ_1.

Proposition A1: $I(\Phi_2) > I(\Phi_1)$ if, and only if, $\kappa(\Phi_2) > \kappa(\Phi_1)$.

Proof: Suppose that $I(\Phi_2) > I(\Phi_1)$, which is equivalent to $W(\Phi_2, 0) > W(\Phi_1, 0)$. Then the definition of $\kappa(\Phi)$ and the fact that $W(\Phi, \kappa)$ is strictly decreasing in κ imply that $\kappa(\Phi_2) > \kappa(\Phi_1)$.

Conversely, suppose $\kappa(\Phi_2) > \kappa(\Phi_1)$. The definition of $\kappa(\Phi)$ implies that $W(\Phi_2, \kappa(\Phi_2)) = W(\Phi_1, \kappa(\Phi_1))$. The fact that $W(\Phi, \kappa)$ is strictly decreasing in κ implies that $W(\Phi_2, 0) > W(\Phi_1, 0)$. ||

That is, both the value of information measure, $I(\Phi)$, and the willingness to pay measure, $\kappa(\Phi)$, lead to the same ranking of information structures.

Now suppose that the information structure Φ_1 has the financial cost κ, so that the net expected utility of the information structure is $W(\Phi_1, \kappa)$. The equivalent utility cost of the information structure, γ_κ, is defined by $W(\Phi_1, \kappa) = W(\Phi_1, 0) - \gamma_\kappa$. The fact that $W(\Phi_1, \kappa)$ is strictly decreasing in κ implies that γ_κ is a strictly increasing function of κ. Similarly, if the utility cost of the information structure is γ, the equivalent financial cost of the information structure, κ_γ, is defined by $W(\Phi_1, \kappa_\gamma) = W(\Phi_1, 0) - \gamma$. Since there is a one-to-one relationship between κ and γ_κ, the equivalent financial cost, κ_γ, is the inverse function of the equivalent utility cost, γ_κ. That is, a financial cost of an information structure can always be converted into a utility cost of an information structure and vice versa. An important consequence of this equivalence between the utility and financial costs of information structures is the following:

Proposition A2: (*a*) $I(\Phi) > \gamma$ if, and only if, $\kappa(\Phi) > \kappa_\gamma$.
(*b*) $\kappa(\Phi) > \kappa$ if, and only if, $I(\Phi) > \gamma_\kappa$.

Proof: (*a*) $I(\Phi) > \gamma$ holds if, and only if, $W(\Phi, 0) - W(\Phi_0, 0) > \gamma$, or $W(\Phi, 0) - \gamma > W(\Phi_0, 0)$. By the definition of κ_γ, this is equivalent to $W(\Phi, \kappa_\gamma) > W(\Phi_0, 0)$. By the definition of $\kappa(\Phi)$, this inequality is equivalent to $W(\Phi, \kappa_\gamma) > W(\Phi, \kappa(\Phi))$. Since $W(\Phi, \kappa)$ is strictly decreasing in κ, the inequality holds if, and only if, $\kappa(\Phi) > \kappa_\gamma$. (*b*) This follows from (*a*) and the fact that γ_κ is the inverse of κ_γ. ||

That is, both the value of information measure, $I(\Phi)$, and the willingness to pay measure, $\kappa(\Phi)$, lead to the same decision to become informed or to remain uninformed.

Appendix B
Definition of Contract Offerings and Investment Banker Strategy Regarding Them

We let * denote offerings to sell the entire project at the fair price, so that $C_H^* = (P_H, 1)$, $C_U^* = (P_U, 1)$ and $C_L^* = (P_L, 1)$. If P_j is the fair price for type j, then $q = 1$ is optimal for risk averse issuers of type j. Along the 45-degree line in Figure 1, the issuer has sold full ownership of the project, $q = 1$. The offerings C_H^*, C_U^* and C_L^* are located at the intersections of the 45-degree line and the respective fair price lines. The offering C_H^* is feasible only if disclosure regarding type is credible. The offering C_U^* is feasible only if the issuer's informational status (i.e. whether the issuer is informed or not) is verifiable. When these offerings are not feasible, it still may be possible to signal type through the portion of the firm offered, q. The following paragraphs discuss investment banker strategies in these cases.

We let $C_H' = (P_H, q_H')$ denote the fairly priced offering that maximizes expected utility of type H issuers and will not be imitated by type L issuers otherwise choosing C_L^*. That is, C_H' solves the problem: $\max_C U(C, t_H)$ s.t. $P = P_H$ and $U(C_H, t_L) \leq U(C_L^*, t_L)$. As suggested by Leland and Pyle (1977), better types signal by equity retention. The curve U_L in Figure 1 is the type L indifference curve through C_L^*. The offering C_H', which separates type Hs from type Ls, is at the intersection of this indifference curve and the type H fair price line, EH. The pair of offerings $\{C_H', C_L^*\}$ is the two-type separating equilibrium suggested by Rothschild and Stiglitz (1976). It holds when disclosure regarding type is not credible, the uninformed become informed, and type Hs prefer separation. Similarly, we let C_U" solve: $\max_C U(C, t_H)$ s.t. $P = P_U$ and $U(C_U, t_L) \leq U(C_L^*, t_L)$ and let C_H" solve the problem: $\max_C U(C, t_H)$ s.t. $P = P_H$ and $U(C_H, t_U) \leq U(C_U", t_U)$. The offering C_U" is at the intersection of the indifference curve U_L and the type U fair price line EU. The structure of C_U" insures that type Ls just prefer C_L^* to C_U". The curve U_U" is the type U indifference curve through C_U" and the offering C_H" is at the intersection of this indifference curve and the fair price line EH. The structure of C_H" insures that type Us just prefer C_U" to C_H". Thus, the triple of offerings $\{C_H", C_U", C_L^*\}$ is the separating equilibrium when

disclosure regarding type and information status is not credible, there are informed high and low quality issuers and uninformed issuers in the market, and better types prefer to separate from lesser types. [21]

The fair price for the population average project is $\overline{P} = P_U = \bar{t}\ V_S + (1 - \bar{t}\ )V_F = \alpha_H P_H + \alpha_L P_L$. We let $\overline{C}_H = (\overline{P}, \overline{q}_H)$ denote the offering at the average price $\overline{P}$ that maximizes expected utility for informed type *H* issuers, that is, $\overline{C}_H$ solves the problem: $\max_C U(C, t_H)$ s.t. $P = \overline{P}$. The offering $\overline{C}_H$ is equivalent to the pooling equilibrium suggested by Wilson (1977). To avoid clutter $\overline{C}_H$ has not been drawn on Figure 1. It would lie on the line EU somewhere between contracts C_U" and C_U*. If the disclosure environment is such that C_H* is feasible, then pooling equilibria are not an issue since C_H* is preferred to $\overline{C}_H$ by type *Hs*. If C_H* is not feasible and the parameters of the game are such that informed type *H*s prefer C_H' and C_H" to $\overline{C}_H$, then the equilibrium will be separating, while if informed type *H*s prefer $\overline{C}_H$ to C_H', the equilibrium will be a pooling equilibrium at $\overline{C}_H$. If informed type *H*s prefer $\overline{C}_H$ to C_H" but not to C_H', then equilibrium will depend upon the level of information costs. If information costs are zero and indifferent issuers become informed, then type *H*s offer C_H' and a separating equilibrium with the uninformed becoming informed holds. If information costs are positive or indifferent issuers do not become informed, a pooling equilibrium at $\overline{C}_H$ holds. In this case bankers cannot accept C_H' because uninformed issuers would mimic type *H*s.

[21] We do not consider the case where type *Hs* prefer to separate but type *Us* prefer to pool with type *Ls*.

Appendix C
Proofs

Proof of Proposition 1:

First, we show that issuers will become informed in equilibrium. Suppose that investment bankers expect uninformed issuers to become informed. They will then accept offerings C_H' and C_L*. The uninformed prefer C_H' to C_L*. Then the gross value of information is

$$I = W(\Phi_1) - W(\Phi_0) = \pi_H U(C_H', t_H) + \pi_L U(C_L^*, t_L) - U(C_H', t_U). \quad \text{(C.1)}$$

The selectivity constraint that defines C_H' implies that

$$I = \pi_H U(C_H', t_H) + \pi_L U(C_H', t_L) - U(C_H', t_U). \quad \text{(C.2)}$$

Therefore, $I = 0$. Thus, the uninformed choose to learn the quality of their projects and the equilibrium offerings are $\{C_H', C_L^*\}$.

Now we need to show that it cannot be part of equilibrium to have issuers remain uninformed. Suppose that investment bankers expect issuers to remain uninformed. Then they will accept offerings C_H", C_U" and C_L*. Then the gross value of information is

$$I = \pi_H U(C_H'', t_H) + \pi_H U(C_L^*, t_L) - U(C_U'', t_U) \quad \text{(C.3)}$$

Adding and subtracting $\pi_H U(C_U'', t_H)$ and using the binding self-selection constraints yields

$$I = \pi_H [U(C_H'', t_H) - U(C_U'', t_H)] + \{\pi_H U(C_U'', t_H) + \pi_L U(C_U'', t_L) - U(C_U'', t_U)\}. \quad \text{(C.4)}$$

The term in braces vanishes so that the gross value of information is

$$I = \pi_H [U(C_H'', t_H) - U(C_U'', t_H)] > 0. \quad \text{(C.5)}$$

Thus, issuers choose to become informed and $\{C_H''$, C_U'' and $C_L^*\}$ does not maximize banker profits among the feasible set of offerings. Since issuers become informed, the equilibrium offerings are $\{C_H', C_L^*\}$. ||

Proof of Corollary to Proposition 1:

If information costs are sufficiently small, the uninformed become informed and offer C_H" or C_L* depending on what the signal reveals. If information costs are sufficiently large, the uninformed remain uninformed and offer C_U". Bankers accepting C_H' would lead information to

have negative net value and the uninformed would offer C_H'. Consequently, bankers maximize long run utility by accepting $\{C_H", C_U", C_L^*\}$ because the banker never purchases an overpriced offering whether or not issuers become informed. Thus, irrespective of whether the uninformed choose to acquire information, if information is costly, the equilibrium offerings are $\{C_H", C_U", C_L^*\}$. ||

Proof of Proposition 2:

We first show that, in equilibrium, issuers become informed. Suppose that investment bankers expect issuers to become informed. High quality issuers will reveal their project type and bankers will accept C_H^*. In the absence of disclosure, bankers accept C_L^*. Then the gross value of information is

$$I = \pi_H U(C_H^*, t_H) + \pi_L U(C_L^*, t_L) - U(C_L^*, t_U) \tag{C.6}$$

Adding and subtracting $\pi_H U(C_L^*, t_H)$ and rearranging yields

$$I = \pi_H[U(C_H^*, t_H) - U(C_L^*, t_H)] + \{\pi_H U(C_L^*, t_H) + \pi_L U(C_L^*, t_L) - U(C_L^*, t_U)\}. \tag{C.7}$$

$$= \pi_H[U(C_H^*, t_H) - U(C_L^*, t_H)] > 0, \tag{C.8}$$

since the term is braces vanishes.

We now show that it cannot be part of equilibrium for issuers to remain uninformed. Suppose that investment bankers expect uninformed issuers to remain so. Bankers will accept C_H^* from high quality issuers who reveal their type. Otherwise, they accept either C_L^* or $C_U"$. Then the gross value of information is

$$I = \pi_H U(C_H^*, t_H) + \pi_L U(C_L^*, t_L) - U(C_U", t_U) \tag{C.9}$$

Adding and subtracting $\pi_H U(C_U", t_H)$ and rearranging yields

$$I_V = \pi_H[U(C_H^*, t_H) - U(C_U", t_H)] > 0. \tag{C.10}$$

Thus, issuers choose to become informed. High quality issuers disclose their project type and low quality issuers are revealed, and the equilibrium offerings are $\{C_H^*, C_L^*\}$. ||

Proof of Proposition 3:

Since investment bankers can observe the issuer's type, they accept C_H*, C_L* and C_U* from type H, L and U issuers, respectively. Then the gross value of information is

$$I_1 = \pi_H U(C_H^*, t_H) + \pi_L U(C_L^*, t_L) - U(C_U^*, t_U) \quad \text{(C.11)}$$

$$= \pi_H u(P_H) + \pi_L u(P_L) - u(\pi_H P_H + \pi_L P_L). \quad \text{(C.12)}$$

The concavity of u implies that $I_1 < 0$. Hence, no uniformed issuer desires to become informed. ||

Proof of Proposition 4:

(*a*) If information costs are zero, then informed type Ls offer C_L* under all three regimes and are indifferent among the regimes. Informed type Hs offer C_H' under the no disclosure regime and C_H* under the voluntary and no disclosure regimes. Informed type H's are indifferent between the voluntary and mandatory disclosure regimes and, since $U(C_H^*, t_H) > U(C_H', t_H)$, both are preferred to the no disclosure regime. Uninformed issuers become informed and offer either C_H' or C_L* under no disclosure and either C_H* or C_L* under voluntary disclosure. They remain uninformed and offer C_U* under mandatory disclosure. Uninformed issuers prefer mandatory disclosure to voluntary disclosure by equation (C.12). The comparison of mandatory disclosure to no disclosure is given by

$$I = I_1 + \pi_H[U(C_H', t_H) - U(C_H^*, t_H)] < I_1 < 0, \quad \text{(C.13)}$$

Since the term in braces in relation (C.13) is negative, the uninformed prefer voluntary to no disclosure. Hence uninformed issuers prefer mandatory to voluntary disclosure and voluntary to no disclosure. Investment bankers' utility is proportional to issuers utility as long as offerings are not overpriced. Investors are risk neutral and always purchase shares at their expected value under any disclosure regime and thus indifferent between them. Then mandatory disclosure is Pareto superior to voluntary disclosure which is in turn Pareto superior to no disclosure.

(*b*) Classify information costs as low if $\gamma < I_V$ and high if $\gamma \geq I_V$, where I_V is given by relation (C.10). Observe that informed type L issuers offer C_L* in all three regimes for both high and low information costs, and thus are indifferent among the regimes. Consider the case of low information costs first. Informed type H issuers offer C_H" under no disclosure and C_H* under voluntary disclosure and mandatory disclosure. Informed type H's are indifferent between the voluntary and mandatory disclosure regimes and both are preferred to the no disclosure regime. Uninformed issuers offer C_U" under no disclosure, either C_H* or C_L* under voluntary disclosure and C_U* under mandatory disclosure. Uninformed issuers prefer mandatory disclosure to voluntary disclosure by equation (C.12) and prefer mandatory disclosure to no disclosure since $U(C_U^*, t_U) > U(C_U'', t_U)$. Now consider the case of high information costs. Informed type Hs offer C_H" under both no disclosure and voluntary disclosure and C_H* under mandatory disclosure. Informed type Hs prefer mandatory disclosure to both voluntary disclosure and no disclosure. Uninformed issuers offer C_U" under both no disclosure and voluntary disclosure and C_U* under mandatory disclosure. Uninformed issuers prefer mandatory disclosure to both voluntary disclosure and no disclosure. Investment bankers' utility is proportional to issuers' utility as long as offerings are not overpriced. Investors are risk neutral and always purchase shares at their expected value under any disclosure regime and thus indifferent between them. Then mandatory disclosure is Pareto superior to both voluntary disclosure and no disclosure. ||

Figure 1

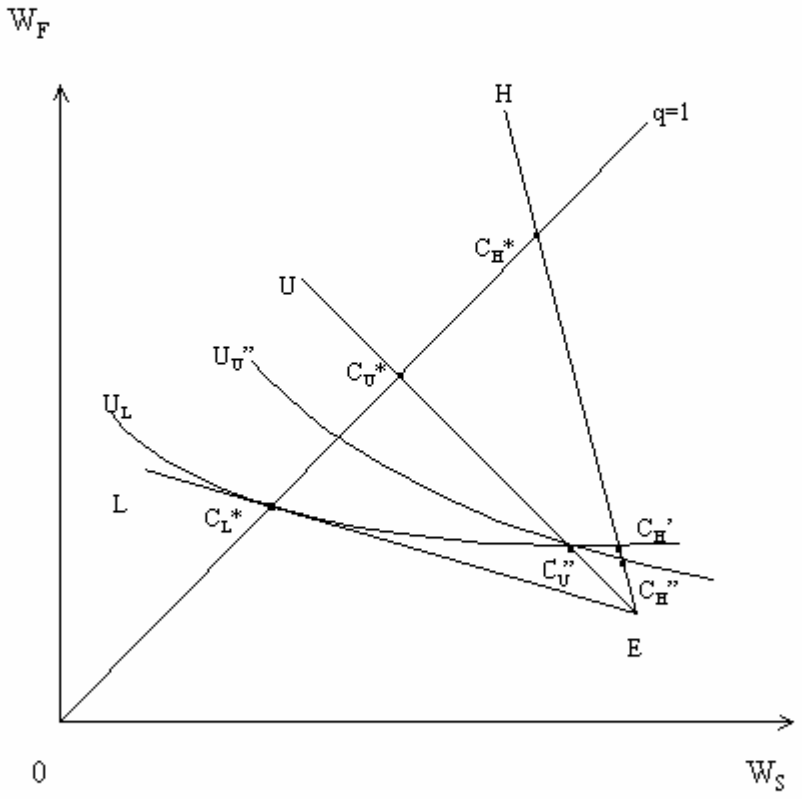

Table 1
Definitions of Contract Offerings

C_i* denotes offerings to sell the entire project at the fair price for type i, $i \in \{L, U, H\}$

C_H' denotes the fairly priced offering that maximizes expected utility of type H issuers and will not be imitated by type L issuers otherwise choosing C_L*

C_U″ denotes the offering fairly priced to uninformed issuers that maximizes the utility of such issuers and will not be imitated by type L issuers otherwise choosing C_L*

C_H″ denotes the offering fairly priced to type H issuers that maximizes the utility of such issuers and will not be imitated by type U (or L) issuers otherwise choosing C_U″(or C_L*).

$\overline{C}_H$ denotes the offering at the average price $\overline{P}$ that maximizes expected utility for informed type H issuers

Table 2
Relation between Retention and Market to Book Ratios

	Ritter Data 1975-1984		*SDC Data 1988-1997*	
	Mean	*Std. Dev.*	*Mean*	*Std. Dev.*
Retention	68.56%	13.18%	69.76%	14.82%
Market-to-book	4.256	2.839	4.623	8.810
Correlation	0.62243		0.11303	
P-values	<.0001		<.0001	

References

Admati, A.R., Pfleiderer, P., 2000, Forcing Firms to Talk: Financial Disclosure Regulation and Externalities. *Review of Financial Studies* 13, 479-519.

Allen, F., Faulhaber, G.R., 1989, Signalling by Underpricing in the IPO Market. *Journal of Financial Economics* 23, 303-323.

Baron, D.P., 1979, The Incentive Problem and the Design of Investment Banking Contracts. *Journal of Banking and Finance* 3, 157-175.

Baron, D.P., 1982, A Model of the Demand for Investment Banking Advising and Distribution Services for New Issues. *The Journal of Finance* 37, 955-976.

Baron, D.P., Holmstrom, B., 1980, The Investment Banking Contract for New Issues under Asymmetric Information: Delegation and the Incentive Problem. *Journal of Finance* 35, 1115-1138.

Beatty, R.P., Ritter, J.R., 1986, Investment Banking, Reputation, and the Underpricing of Initial Public Offerings. *Journal of Financial Economics* 15, 213-232.

Benveniste, L.M., Erdal, S.M., Wilhelm, W.J. Jr., 1998, Who Benefits from Secondary Market Price Stabilization of IPOs?. *Journal of Banking and Finance* 22, 741-767.

Benveniste, L.M., Spindt, P.A., 1989, How Investment Bankers Determine the Offer Price and Allocation of New Issues. *Journal of Financial Economics* 24, 343-361.

Boot, A.W.A., Thakor, A.V., 2001, The Many Faces of Information Disclosure. *Review of Financial Studies* 14, 1021-1057.

Booth, J.R., Smith, R.L. III, 1986, Capital Raising, Underwriting, and the Certification Hypothesis. *Journal of Financial Economics* 15, 261-281.

Bushman, R.M., Gigler, F., Indjejikian, R.J., 1996, A Model of Two-Tiered Financial Reporting, *Journal of Accounting Research* (*Studies on Recognition, Measurement, and Disclosure Issues in Accounting*) 34, 51-74.

Carter, R., Manaster, S., 1990, Initial Public Offerings and Underwriter Reputation, *Journal of Finance* 45, 1045-1067.

Core, J.E., 2001, A Review of the Empirical Disclosure Literature: Discussion, *Journal of Accounting and Economics* 31: 441-456.

Chemmanur, T.J., Fulghieri, P., 1994, Investment Bank Reputation, Information Production, and Financial Intermediation, *Journal of Finance* 49, 57-79.

Chemmanur, T.J., Fulghieri, P., 1999, A Theory of the Going Public Decision, *Review of Financial Studies* 12, 249-279.

Chen, H.-C., Ritter, J.R., 2000, The Seven Percent Solution. *Journal of Finance* 55, 1105-1131.

Cho, I.K., Kreps D., 1987, Signaling Games and Stable Equilibria. *Quarterly Journal of Economics* 102, 179-221.

Derrien, F., 2005, IPO Pricing in "Hot" Market Conditions: Who Leaves Money on the Table?, *Journal of Finance* 60, 487-521.

Doherty, N.A., Thistle, P.D., 1996, Adverse Selection with Endogenous Information in Insurance Markets, *Journal of Public Economics* 63, 83-102.

Dye, R., 1985, Disclosure of Nonproprietary Information. *Journal of Accounting Research* 23, 123-145.

_____, 1986, Proprietary and Nonproprietary Disclosures, *Journal of Business* 59, 331-366.

_____, 1990, Mandatory versus Voluntary Disclosure: The Cases of Financial and Real Externalities, *Accounting Review* 65, 1-24.

____, 1998, Investor Sophistication and Voluntary Disclosures, *Review of Accounting Studies* 3, 261-287.

_____, 2001, An Evaluation of "Essays on Disclosure" and the Disclosure Literature in Accounting, *Journal of Accounting and Economics* 32, 181-235.

Farrell, J., 1986, Voluntary Disclosure: Robustness of the Unraveling Result and Comment on its Importance, in R. Grieson (ed.), *Antitrust and Regulation*, Lexington Books, Lexington, MA.

Fishman, M.J., Hagerty, K.M., 1990, The Optimal Amount of Discretion to Allow in Disclosure, *Quarterly Journal of Economics* 105, 427-444.

Fishman, M.J., Hagerty, K.M., 2003, Mandatory Versus Voluntary Disclosure in Markets with Informed and Uninformed Consumers, *Journal of Law Economics, and Organization* 19, 45-63.

Fudenberg, D., Kreps, D.M., Maskin, E.S., 1990, Repeated Games with Long-run and Short-run Players. *Review of Economic Studies* 57, 555-573.

Grinblatt, M., Hwang, C.Y., 1989,. Signalling and the Pricing of New Issues. *Journal of Finance* 44, 393-420.

Grossman, S.J., 1981, The Informational Role of Warranties and Private Disclosure About Product Quality. *Journal of Law and Economics* 24, 461-483.

Hanley, K.W., Kumar, A.A., Seguin, P.J., 1993, Price Stabilization in the Market for New Issues. *Journal of Financial Economics* 34, 177-197.

Healy, P.M., Palepu, K.G., 2001, Information Asymmetry, Corporate Disclosure and the Capital Markets: A Review of the Empirical Evidence, *Journal of Accounting and Economics* 31, 405-440.

Hirao, Y., 1993, Learning and Incentive Problems in Repeated Partnerships. *International Ecnomic Review* 34, 101-119.

Hoffmann-Burchardi, U., 2001, Clustering of Initial Public Offerings, Information Revelation, and Underpricing, *European Economic Review* 45, 353-383.

Hoy, M., Lambert, P., 2000, Genetic Screening and Price Discrimination in Insurance Markets, *Geneva Papers on Risk and Insurance Theory* 25, 103-130.

Hoy, M., Polborn, M., 2000, The Value of Genetic Information in the Life Insurance Market, *Journal of Public Economics* 78, 235-252.

Huddart, S.,Hughes, J.S., and Brunnermeier, M., 1999, Disclosure Requirements and Stock Exchange Listing in an International Context, *Journal of Accounting and Economics* 26, 237-269.

James, C., Weir, P., 1990, Borrowing Relationships, Intermediation, and the Cost of Issuing Public Securities. *Journal of Financial Economics* 28, 149-172.

Jung, W.-O., Kwon, Y.K., 1988, Disclosure When the Market is Unsure of Informational Endowment of Managers, *Journal of Accounting Research*, 26, 146-153.

Leland, H.E., Pyle, D.H., 1977, Informational Asymmetries, Financial Structure, and Financial Intermediation. *Journal of Finance* 32, 371-387.

Ligon, J.A., Thistle, P.D., 1996, Consumer Risk Perceptions and Information in Insurance Markets with Adverse Selection. *Geneva Papers on Risk and Insurance Theory* 21, 191-210.

Ljungqvist, A.P., V. Nanda, and R. Singh, 2004, Hot Markets, Sentiment, and IPO Pricing, forthcoming, *Journal of Business*.

Matthews, S., Postlewaite, A., 1985, Quality Testing and Disclosure. *Rand Journal of Economics* 16, 328-340.

Milgrom, P.R., 1981, Good News and Bad News: Representation Theorems and Applications. *Bell Journal of Economics* 12, 380-391.

Miyazaki, H., 1977, The Rat Race and Internal Labor Markets. *Bell Journal of Economics* 8, 394-418.

Pae, S., 1999, Acquisition and Discretionary Disclosure of Private Information and Its Implications for Firms' Productive Activities, *Journal of Accounting Research* 37, 465-474.

Rock, K., 1986, Why New Issues Are Underpriced. *Journal of Financial Economics* 15, 187-212.

Rothschild, M., Stiglitz, J.E., 1976, Equilibrium in Competitive Insurance Markets: An Essay on the Economics of Imperfect Information. *Quarterly Journal of Economics* 90, 629-649.

Ruud, J.S., 1993, Underwriter Price Support and the IPO Underpricing Puzzle. *Journal of Financial Economics* 34, 135-151.

Shavell, S., 1994, Acquisition and Disclosure of Information Prior to Sale. *Rand Journal of Economics* 25, 20-36.

Simon, C.J., 1989, The Effect of the 1933 Securities Act on Investor Information and the Performance of New Issues. *American Economic Review* 79, 295-318.

Verrechia, R., 1983, Discretionary Disclosures. *Journal of Accounting and Economics* 5, 179-194.

Verrechia, R., 2001, Essays on Disclosure, *Journal of Accounting and Economics* 32: 97-180.

Viscusi, W.K., 1978, A Note on "Lemons" Markets with Quality Certification, *Bell Journal of Economics* 9, 7-279.

Welch, I., 1989, Seasoned Offerings, Imitation Costs, and the Underpricing of Initial Public Offerings. *Journal of Finance* 44, 421-449.

Wilson, C., 1977, A Model of Insurance Markets with Incomplete Information. *Journal of Economic Theory* 16, 167-207.