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Going Public without Governance: Managerial Reputation Effects

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ABSTRACT

This paper addresses the agency problem between controlling shareholders and minority shareholders. This problem is common among public firms in many countries where the legal system does not effectively protect minority shareholders against oppression by controlling shareholders. We show that even without any explicit corporate governance mechanisms protecting minority shareholders, controlling shareholders can implicitly commit not to expropriate them. Stock prices of such companies are significantly higher and firms are more likely go public because of this reputation effect. Moreover, insiders divest shares gradually over time, at a rate that is negatively related to the degree of moral hazard.

RECENT EMPIRICAL RESEARCH INDICATES THAT in many countries the relevant corporate finance issue is not the traditional agency problem between management and shareholders, but rather the agency problem between the controlling shareholders and the minority shareholders. This problem may arise in some countries for two reasons: (1) the corporate governance structure of public companies insulates large shareholders—that is, those with a majority of the votes and often with an involvement in the firm's management—from takeover threats or monitoring;[1] and (2) the legal system does not protect minority shareholders because of either poor laws or poor enforcement of laws.[2]

Despite the lack of protection for minority shareholders, the average ratio of stock market capitalization held by minorities to gross national product is greater than 40 percent in a sample of 49 countries.[3] This raises the question of why people are willing to be minority shareholders when they know

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[1] For example, see La Porta, Lopez-de-Silanes, and Shleifer (1999) for evidence from 27 countries, and Franks and Mayer (1990, 1994) for evidence in Germany and France.

[2] See La Porta et al. (1998). See also Pagano and Roell (1998) for another treatment of the same agency problem considered in this paper.

[3] See La Porta et al. (1997).

that neither corporate governance mechanisms, such as takeovers and monitoring, nor laws protect them from expropriation by large shareholders. This paper provides a simple answer to this puzzle.

In our framework, a risk-averse entrepreneur is initially the sole owner of the firm and is motivated to go public in order to diversify the firm's idiosyncratic risk with investors. The entrepreneur remains as the controlling shareholder and manager of the firm even after it goes public (henceforth the entrepreneur is referred to as the *manager)*. The firms's stock price depends on how much effort the manager exerts or how much he diverts from the firm's cash flow—his private benefits of control. The manager's action depends on his costs of extracting private benefits (his type) which only he knows, although investors know the probability distribution of types. In this framework, countries with weak legal systems are the ones where either managers' expected ability to extract private benefits is high or, alternatively, the degree of moral hazard is high.

Given this framework, the answer to the puzzle about people's willingness to be minority shareholders is: Firms can sell shares to minority shareholders even without any explicit mechanism of governance because managers are able to commit implicitly not to expropriate shareholders. In other words, managers can develop a reputation for treating minority shareholders well. This is credible because investors know that if a manager starts to extract high levels of private benefits just after going public, when he still owns a substantial amount of shares, investors will discount the stock price accordingly, and the insider's remaining shares will sell at a reduced price. In equilibrium, managers hold a concentrated equity ownership to provide a guarantee that they are willing to build a reputation for not expropriating minority shareholders. Moreover, this reputation effect reduces the inefficiencies caused by the agency problems and improves the firm's chances of going public.

Through a series of simulations with several parameter values we show that the reputation effect is economically significant whenever the moral hazard problem is significant. For example, when managers can be expected to divert 50 percent of the cash flow, the stock price with the reputation effect is 30 percent higher than the predicted stock price based only on the actual level of protection of minority shareholders.

This paper contributes to and extends a number of topics in the finance literature. First, the model proposes a new theoretical explanation for the existence of outside equity. Most of the models in the finance literature in which managers are allowed to divert cash flow and in which cash flow is nonverifiable (or costly to verify) are incompatible with outside equity, and only debt financing works (see Harris and Raviv (1992) for a survey of models). Two exceptions are the work by Fluck (1998) and Myers (2000), which develop theories of outside equity that are compatible with the two features mentioned above. Our model has similar results, although the mechanism is quite different. Fluck's theory of outside equity is based on the control rights and the maturity design of equity and depends on the ability of equity holders to dismiss management. In contrast, in this paper, managers are unambiguously in charge and cannot be disciplined by a threat of dismissal. In Myers, equity holders own the firm and have a "primitive right" to withdraw their share of assets at any time, giving investors some control rights that indirectly prevent insiders from capturing the cash flow of the firm. Thus in both Fluck and Myers equity holders have more control over the managers than in this paper. In our model, the motivation for the existence of outside equity is diversification of risk with outside investors, and the reason that sustains equity—despite the lack of any controlling mechanism by investors—is the multiperiod nature of the realization of cash flow and trading of shares, which allows managers to commit implicitly to not expropriate investors.

Second, this paper extends the existing literature on agency problems (e.g., Berle and Means (1932), Jensen and Meckling (1976)) and asymmetric information problems (e.g., Leland and Pyle (1977)) from a static to a dynamic framework. The paper shows that a model in which a firm goes public in the presence of agency problems, asymmetric information, and trading of shares in the stock market over time has several novel properties and empirical implications not found in static models.

For example, the model predicts that the insider ownership time-series and cross-sectional variation is related to the degree of moral hazard. At the initial public offering (IPO), the size of the block of shares divested is negatively related to the degree of moral hazard. Likewise, following the IPO, shares are gradually divested over time at a rate that is negatively related to the degree of moral hazard.

The model also helps our understanding of the relationship between firms' growth opportunities and their ability to develop a reputation with shareholders. Intuition suggests that the reputation effect would be even more intense for a growth company with large financing requirements, because such a company is likely to revisit the primary capital markets more frequently. Contrary to this intuition, our results indicate that as long as the firm can finance growth prospects by borrowing from banks or issuing riskless debt, the firm's ability to build a reputation and its cost of equity financing are unrelated to its growth opportunities. Intuitively, this result holds because the reputation-building mechanism comes from the managers' dependence on a unique feature of the equity markets—namely, the ability to diversify idiosyncratic risks. No reputation can be credibly developed for treating equity holders well based on the firm's future needs for additional funds as long as forms of financing other than equity are available.

Moreover, the model suggests an additional benefit—one that has not been considered before in the literature—for allowing companies to use dual-class shares and pyramidal structures, which are often used by a large shareholder as a mechanism to maintain control. When firms are allowed to use dual-class shares and pyramidal structures, managers are able to divest more equity without losing control. This gives them more room to build a reputation for extracting low levels of private benefits, because reputation is developed based on the prospect of future sales of shares. Therefore, regimes that facilitate the dilution of ownership indirectly benefit from a more intense reputation effect, in addition to directly allowing owners to increase diversification of risks.[4]

The remainder of the paper is organized as follows: Section I presents the model. Section II solves for the multiperiod signaling equilibrium of the game. Section III develops the corporate finance results of the paper, and discusses the related finance literature. Section IV discusses the empirical implications and relevance of the model, and Section V concludes. Proofs are in the Appendix.

I. The Model

The problem is modeled as a stochastic dynamic game with incomplete information and a finite number of periods (T periods). The players in the game are a risk-averse owner-manager and investors in a competitive stock market, and there exists a possibility of gains from trading because the owner-manager can diversify idiosyncratic risks with investors. The manager chooses in every period how many shares to trade and decides how much effort to exert; the expected cash flows increase with managerial effort. The costs of exerting effort are incurred by the manager, and investors do not know how much it costs the manager to exert effort. A manager who can exert effort at low cost (high cost) is referred as a high type (low type) manager. The actual level of effort exerted by the manager during every period is assumed to be observable by investors, although it cannot be verified.[5] An alternative interpretation of effort levels in the model, following Grossman and Hart (1988), is that the manager can divert for himself a fraction of the cash flow or extract private benefits of control. With this interpretation, investors do not know how much cash flow the manager can divert. Formally, the model develops as follows.

Initially, at period $t = 0$, the manager is the sole owner of a firm that produces a risky stream of cash flows for a total of T-periods, $(y_t)_{t=1}^{T}$. In every period, $t = 1, \ldots, T$, the manager chooses simultaneously a multidimensional signal (α_t, e_t) that is observed by investors, where α_t is the percentage of the total number of shares owned by the manager in period t, and e_t is the manager's effort level choice. The firm's cash flow in period $t - 1$ is equal to $y_{t-1} = y_{t-1}(e_t, \eta_t)$ and depends both on independent random shocks,

[4] We will argue later that the costs associated with structures that increase the separation of ownership and control are not so significant for markets with low protection to minority shareholders.

[5] Lack of verifiability implies that it is not possible to write and/or enforce contracts that provide incentives for the manager.

η_t, and on the manager's effort level e_t. We use a lag in the specification of cash flows because the effort level chosen by managers is observed by outside investors only after the publicly observed cash flows and random shock are realized. Therefore, there is a lag from the time the manager chooses effort and investors observe it. Also, for convenience, we normalize the effort variable so that the expected cash flow is equal to the level of effort: $E[y_{t-1}(e_t, \eta_t)] = e_t$.

In the model there are two observationally indistinguishable types of manager: a high type, $\theta = \bar{\theta}$, and a low type, $\theta = \underline{\theta}$, with different costs of exerting effort. The cost of exerting effort is, in monetary equivalent terms, equal to $c_{t-1}(e_t, \eta_t, \theta)$. Although the manager knows his own type, investors know only the prior probability distribution of types, $\mu_0 = P(\theta = \bar{\theta})$. Note that, in general, even though investors observe realized managerial effort, they do not observe the manager's type.

Equivalently, instead of managers having different and unobservable costs of exerting effort, managers could differ with respect to the amount of private benefits they get from diverting cash flows from the firm. A simple *diversion model* that will be used throughout is specified as follows. A manager of type θ can extract up to a fraction b_θ of cash flow at every period: type $\bar{\theta}$ is the high type that is completely honest and never extracts private benefits ($b_{\bar{\theta}} = 0$), and type $\underline{\theta}$ is the low type that can extract up to a fraction b of cash flow ($b_{\underline{\theta}} = b$, $0 < b \leq 1$). So if the cash flow in period t is y_t, the low type could extract private benefits equal to by_t and the minority shareholders receive a verifiable cash flow of only $(1 - b)y_t$.

The extensive form of the game is as follows. At each period t the previous history of the game is known by all players. The manager moves by choosing simultaneously a new fraction of equity ownership and effort level (α_t, e_t), which are the manager's t-period signals. After observing the manager's signals, investors update their prior beliefs about the manager type and price shares in the market accordingly. Investors price shares competitively (Bertrand pricing competition) and trading is realized at the market clearing price P_t (price per share multiplied by the number of shares). The game continues as described above until a final period is reached.[6]

We emphasize that the manager is assumed not to be able to commit to a long-term strategy or to commit today to play a predetermined strategy in the future. The short-term nature of the problem or the lack of commitment is an essential feature of the model.[7]

[6] In the initial period $t = 1$ there is no choice of effort, $e_1 = \emptyset$ (because the firm generates no cash flow in period $t = 0$), and in the last period $T + 1$ there is no trading, $\alpha_{T+1} = \alpha_T$, but the manager chooses an effort level e_{T+1} (which determines the T-period cash flow).

[7] We depart from the principal-agent literature by assuming that no long-term incentive contracts can be written and/or enforced. This can be motivated by the lack of verifiability of variables, the lack of ability of courts to enforce contracts, or the ability of managers with control to manipulate variables or to change contracts during their life.

For any given history of moves, the payoffs for managers and investors are specified as follows. The manager's utility depends on his net worth at the end of the game, equal to

$$w_T = \sum_{t=1}^{T+1} (\alpha_{t-1} - \alpha_t)P_t + \alpha_{t-1} y_{t-1}(e_t, \eta_t) - c_{t-1}(e_t, \eta_t, \theta),$$

where the first term corresponds to revenues from trading shares, the second term to dividends received, and the last term to his costs of exerting effort (define $c_0 \equiv 0$ and $y_0 \equiv 0$).

The risk-averse manager has a von Neumann–Morgenstern utility function that is negative exponential in his total wealth.[8] The manager's utility is then $E[-\exp[-w_T]]$ and his objective is to maximize his utility (for simplicity, the coefficient of risk-aversion is made equal to 1). Expected values are taken with respect to the distribution of the exogenous random shocks to the cash flow. Because of the negative exponential utility function, the manager's utility at time t is independent of his current wealth and depends only on the incremental income from the decisions from period t to the future:

$$w_{t,T} = \sum_{s=t}^{T} (\alpha_{s-1} - \alpha_s)P_s + \alpha_{s-1} y_{s-1}(e_s, \eta_s) - c_{s-1}(e_s, \eta_s, \theta).$$

Thus, the problem of the manager of type θ at the start of every period t is to choose strategies $\{\alpha_s, e_s\}_{s=t}^{T+1}$ that maximize the objective function $E[-\exp[-w_{t,T}]]$. Another convenient property of the exponential utility function and the independence of the random shocks allows for a further simplification of the manager's objective function (see Lemma 1 in the Appendix).

The manager's problem can be rewritten in a simplified manner as

$$\max_{\{\alpha_s, e_s\}_{s=t}^{T+1}} \sum_{s=t}^{T+1} (\alpha_{s-1} - \alpha_s)P_s + v_{s-1}(\alpha_{s-1}, e_s, \theta), \tag{1}$$

where the function $v_t(\alpha_t, e_{t+1}, \theta) = -\log E[\exp-[\alpha_t y_t(e_{t+1}, \eta_{t+1}) - c_t(e_{t+1}, \eta_{t+1}, \theta)]]$. Throughout the paper, we will be considering the reformulated utility function $v_t(\alpha_t, e_{t+1}, \theta)$ with the regularity conditions described in the Appendix.

Investors are risk-neutral (investors diversify the idiosyncratic risk of the firm) and maximize expected return, and the required rate of return is equal to zero. A share of stock pays at period t a dividend equal to the expected

[8] To avoid complications associated with savings and consumption decisions in an intertemporal framework, the manager is assumed to consume his total wealth at the end of the game.

cash flow y_t. Investors' returns thus depend not only on the actions of the manager at time t but also on his future actions. Stock prices are then, in a competitive investment market, equal to the sum of future expected cash flows:

$$P_t = E_t[y_t + \cdots + y_T]. \tag{2}$$

Finally, we will use the perfect Bayesian equilibrium (PBE) concept throughout the paper, with the refinement concept introduced in the next section.

II. The Multiperiod Signaling Game

This section characterizes the equilibrium of the multiperiod signaling game. This characterization is then used in the next section to derive the corporate finance implications of the model.

A. The Complete Information Game

The dynamic game proposed in the previous section is particularly simple to solve when there is complete information about the manager type. This is the dynamic version of the Jensen and Meckling (1976) agency problem, where there is a known moral hazard problem and the manager is assumed to be unable to commit not to shirk or divert cash flow from the firm after having reduced his ownership stake.

The complete information game with no commitment has a unique subgame perfect equilibrium that can easily be obtained by backward induction as follows. In the last decision period, $t = T + 1$, there is no trading, so $\alpha_{T+1} = \alpha_T$ and the manager of type θ chooses a level of effort e_{T+1} that solves the problem $\max_{e_{T+1}} v_T(\alpha_T, e_{T+1}, \theta)$. Let $e_{T+1}(\alpha_T, \theta)$ be the effort level and let $V_T(\alpha_T, \theta)$ be the utility of the manager θ. The equilibrium stock price in period $t = T$ is then given by $P_T(\alpha_T, \theta) = e_{T+1}(\alpha_T, \theta)$ because investors anticipate the manager's choice of effort in the next period.

Proceeding backward, we have that the choice of effort and ownership by the manager at any period $t = 1, \ldots, T$ is given by $\{e_t(\alpha_{t-1}, \theta), \alpha_t(\alpha_{t-1}, \theta)\}$, the solution of *the complete information problem*:

$$V_{t-1}(\alpha_{t-1}, \theta) = \max_{\{\alpha_t, e_t\}} (\alpha_{t-1} - \alpha_t) P_t(\alpha_t, \theta) + v_{t-1}(\alpha_{t-1}, e_t, \theta) + V_t(\alpha_t, \theta), \tag{3}$$

where the price of shares at period t is defined recursively as $P_t(\alpha_t, \theta) = e_{t+1}(\alpha_t, \theta) + P_{t+1}(\alpha_{t+1}(\alpha_t, \theta), \theta)$, and $V_{t-1}(\alpha_{t-1}, \theta)$ is the equilibrium utility of the manager who owns α_{t-1} shares in the subgame starting in period t (the value of the period t maximization problem).

We have just established the following result:

Proposition 1: *There is a unique subgame perfect equilibrium of the game with complete information. The unique equilibrium strategies are as follows: In any period t where the manager owns α_{t-1} shares, the equilibrium choices are $e_t(\alpha_{t-1},\theta)$ and $\alpha_t(\alpha_{t-1},\theta)$, and investors trade shares at $P_t(\alpha_t,\theta)$ given by the solution of the complete information problem in equation (3).*

This proposition characterizes the equilibrium of the complete information game, and we will refer to it repeatedly when we look for the equilibrium in the incomplete information game. An interesting feature of the complete information model is that it predicts that insiders divest a large block of their shares soon after the IPO and then essentially keep their ownership constant after the IPO. This is particularly simple to see in the diversion model where the type θ manager can extract a fraction b_θ of the cash flow every period. In the unique equilibrium in this case, the manager divests all his shares at the IPO and extracts a fraction b_θ of the cash flow thereafter.[9] On the contrary, in the incomplete information case, we will show that shares are gradually divested over time.

Also, in the incomplete information game the payoff of the low type (high type) manager is greater than (lower than) the payoff in the complete information game. It can be the case that a high-type manager might be driven out of the public markets and not go public because of a "lemons problem." Nonetheless, when going public, a high type will certainly try to send signals to investors that he is of a high type, through his trading of shares and his choice of effort, in order to fetch a higher stock price. Obviously, investors know that low types might also have incentives to mimic the high types. These issues are the focus of our analysis throughout the remainder of the paper.

B. Equilibrium Refinement

It is well known that the multiperiod game with incomplete information can have a multiplicity of perfect Bayesian equilibria. There are many PBEs for signaling games because this equilibrium concept does not impose any restrictions on the out-of-equilibrium beliefs. In this section, we propose a refinement concept that restricts the set of perfect Bayesian equilibria. This refinement concept is different from the intuitive criterion of Cho and Kreps (1987) that is commonly used in the finance literature and usually selects a separating PBE.[10] We start the analysis in this section by first showing that in our multiperiod model a separating PBE, in general, does not even exist. We then move on to propose the refinement concept that will be used throughout this paper.

[9] In general, if one allows managers to trade shares very frequently, there would be almost instantaneous convergence to a lower level of ownership. This is similar to Coase's (1972) analysis of pricing by a durable-goods monopolist. When offers by the monopolist take place very quickly, the price converges to the competitive prices almost instantaneously.

[10] See John and Williams (1985) and Leland and Pyle (1977) for well-known finance papers that select a separating PBE equilibrium.

For concreteness, consider the diversion model where the high type manager cannot divert the cash flows and the low type can divert up to a fraction b of the cash flow. Also, suppose that there exists a separating PBE. In the separating PBE, the low type reveals himself in the first period, selling all the shares at a discount of b, and thereafter extracts a fraction b of the cash flow. The utility of the low type following this strategy is $V_0(1,\underline{\theta}) = \sum_{t=1}^{T}(1-b)\bar{y}_t + v_t(b)$, where $v_t(\alpha) = -\log E[\exp -\alpha y_t]$ and $\bar{y}_t = E[\tilde{y}_t]$. On the other hand, the high type maintains a high ownership stake α_1 in the first period and, after revealing himself in the first period, divests all shares at a price with no discount equal to $\sum_{t=2}^{T}\bar{y}_t$.

The low type could have imitated the strategy of the high type, however, in which case the low type would be able to sell all remaining α_1 shares at the price with no discount in period 2, get the value of the risky cash flow of period 1 without stealing, which is equal to $v_1(\alpha_1)$, and then from period 2 on, after having sold all shares, divert a fraction b of the cash flows. Therefore by imitating the high type, the low type can get $(1-\alpha_1)P_1(\alpha_1,\bar{\theta}) + V_1(\alpha_1,1,\underline{\theta})$, where the price of a share in the first period is $P_1(\alpha_1,\bar{\theta}) = \sum_{t=1}^{T}\bar{y}_t$, and the low type utility, after the first period when investors believe that the manager is definitely of the high type, is $V_1(\alpha_1,1,\underline{\theta}) = \alpha_1\sum_{t=2}^{T}\bar{y}_t + v_1(\alpha_1) + \sum_{t=2}^{T}v_t(b)$.

The incentive compatibility condition that must be satisfied for the existence of a separating equilibrium is thus that

$$(1-\alpha_1)P_1(\alpha_1,\bar{\theta}) + V_1(\alpha_1,1,\underline{\theta}) \le V_0(1,\underline{\theta}), \tag{4}$$

which is equivalent to $\sum_{t=1}^{T}b\bar{y}_t \le \alpha_1\bar{y}_1 - v_1(\alpha_1) + v_1(b)$ in the diversion case discussed above. A simple inspection of this expression indicates that whenever the moral hazard parameter (b) is large enough there is no separating equilibrium, because the expression on the left-hand side is larger than that on the right-hand side for all values of α_1. The above results are summarized in the following proposition.

PROPOSITION 2: *There exists a separating PBE in the multiperiod signaling game if and only if the incentive compatibility condition (equation (4)) holds for some* $\alpha_1 \in [0,1]$. *Furthermore, if the level of moral hazard is large, then the multiperiod game has no separating equilibrium.*

The ability of a low type manager to imitate the separating strategy of a high type profitably implies that it can well be the case that no separating equilibrium exists in the multiperiod game. If the familiar separating PBE in general does not exist, then which equilibrium refinement concept is appropriate? In this paper we use the lexicographically maximum (*lex max)* refinement concept introduced by Mailath, Okuno-Fujiwara, and Postlewaite (1993), which they argue is an appropriate refinement for signaling games such as the one we are studying. This refinement concept is intuitively very simple. A PBE (σ,μ) satisfies the lex max property if it maximizes the utility for the high type manager among all PBE and if, conditional on maximizing the utility for the high type, it also maximizes the utility for the low type. This basic idea can be naturally extended to a multiperiod signaling game as we propose in the Appendix. From this point on, we will search for a PBE that satisfies the lex max property, and we will show next how to reduce the problem of obtaining the equilibrium to the simpler problem of solving a dynamic program.

C. The Multiperiod Equilibrium

We characterize the equilibrium using the familiar backward induction approach. Assume that we are given equilibrium strategies for all continuation games starting in period $t + 1$ where the manager owns α_t shares and the market believes that the manager is a high type with probability μ_t. We proceed using backward induction until we obtain the equilibrium at the IPO when the manager owns all shares and prior beliefs are μ_0. Suppose that the equilibrium payoff in each such continuation game is equal to $V_t(\alpha_t, \mu_t, \theta)$ for a manager of type θ and the stock price is $P_t(\alpha_t, \mu_t)$. What strategy (σ_t, μ_t) for the t-period game is an equilibrium given any initial ownership stake α_{t-1} and prior beliefs μ_{t-1}?

The perfect Bayesian equilibrium concept imposes the following restrictions on the strategies that can be equilibria. Suppose that the equilibrium strategy for the high type is to play (α_t^*, e_t^*).[11] The low type manager can either pool with the high type and play (α_t^*, e_t^*) or reveal himself, choosing any other action. Of course, if the low type decides not to pool with the high type, he should then play according to his complete information optimum (see Proposition 1), which corresponds to $(\underline{\alpha}_t, \underline{e}_t) = (\alpha_t(\alpha_{t-1}, \underline{\theta}), e_t(\alpha_{t-1}, \underline{\theta}))$ and yields utility for the low type equal to $V_{t-1}(\alpha_{t-1}, \underline{\theta})$. So we can restrict our attention to strategies for the low type manager where he plays (α_t^*, e_t^*) with probability β_t and $(\underline{\alpha}_t, \underline{e}_t)$ with probability $1 - \beta_t$. We will see that it is necessary to consider mixed strategies for the low type, since there might not exist any equilibrium in which all players use pure strategies. Investors should respond to the signals (α_t^*, e_t^*) and $(\underline{\alpha}_t, \underline{e}_t)$ that are played in equilibrium consistently with Bayes' rule: First, when (α_t^*, e_t^*) is played, they update their beliefs to $\mu_t^* = \mu_{t-1}/(\mu_{t-1} + (1 - \mu_{t-1})\beta_t)$, with $\mu_t^* \in [\mu_{t-1}, 1]$, and price shares consistently at $P_t^* = P_t(\alpha_t^*, \mu_t^*)$, the equilibrium value of shares given by the equilibrium strategies in the continuation game. Second, when $(\underline{\alpha}_t, \underline{e}_t)$ is played they are now sure that the manager is of the low type, so $\mu_t = 0$, and they price shares at $\underline{P}_t = P_t(\underline{\alpha}_t, \underline{\theta})$ given by the equilibrium in the complete information game with type $\underline{\theta}$.

Furthermore, the Nash condition for the low type requires that, given the response of investors, the low type should play (α_t^*, e_t^*) for sure (pool) whenever the utility of the low type from pooling is greater than the utility from

[11] Without any loss of generality, we will restrict our attention to strategies where the high type plays only pure strategies (see Mailath (1992)).

separation, which then implies that $\mu_t^* = \mu_{t-1}$. Additionally, whenever the utility from pooling is lower than the utility from separation, the low type should play $(\underline{\alpha}_t, \underline{e}_t)$ with probability one, which then implies that $\mu_t^* = 1$.

Let us define the utility function for the t-period signaling problem as

$$u_t(\alpha_t, e_t, P_t, \mu_t, \theta) = (\alpha_{t-1} - \alpha_t)P_t + v_{t-1}(\alpha_{t-1}, e_t, \theta) + V_t(\alpha_t, \mu_t, \theta), \tag{5}$$

where $V_t(\alpha_t, \mu_t, \theta)$ and $P_t(\alpha_t, \mu_t)$ are the equilibrium values of the $t+1$ period continuation game for managers and investors. The discussion above suggests that the PBE equilibrium that maximizes the utility of the high type manager can be associated with the solution to the following dynamic programming problem:

$$\begin{aligned} \max_{\{\alpha_t, e_t, \mu_t, P_t\}} \quad & u_t(\alpha_t, e_t, P_t, \mu_t, \bar{\theta}) & \\ \text{s.t.} \quad & 1 \geq \mu_t \geq \mu_{t-1} & \text{(B)} \\ & P_t = P_t(\alpha_t, \mu_t) & \text{(CC)} \\ & (u_t(\alpha_t, e_t, P_t, \mu_t, \underline{\theta}) - V_{t-1}(\alpha_{t-1}, \underline{\theta})).(\mu_t - \mu_{t-1}) \leq 0 & (\text{IC}_1) \\ & (u_t(\alpha_t, e_t, P_t, \mu_t, \underline{\theta}) - V_{t-1}(\alpha_{t-1}, \underline{\theta})).(1 - \mu_t) \geq 0 & (\text{IC}_2) \end{aligned} \tag{6}$$

where α_t^*, e_t^*, μ_t^*, and P_t^* are the solutions to the problem and $V_t(\alpha_t, \mu_t, \bar{\theta})$ is the value of the program.

In order to complete the specification of the dynamic program we need to provide the expression for the terminal period $V_T(\alpha_T, \mu_T, \theta)$ and $P_T(\alpha_T, \mu_T)$, as well as show how to proceed recursively to obtain $V_{t-1}(\alpha_{t-1}, \mu_{t-1}, \underline{\theta})$ and $P_{t-1}(\alpha_{t-1}, \mu_{t-1})$.

First, the terminal period, $t = T + 1$, is exactly like the terminal period of the complete information game analyzed in Section II.A, and thus the expressions for $V_T(\alpha_T, \mu_T, \theta)$ and $P_T(\alpha_T, \mu_T)$ can be similarly obtained. Second, the low type payoff is simply $V_{t-1}(\alpha_{t-1}, \mu_{t-1}, \underline{\theta}) = \max\{(\alpha_{t-1} - \alpha_t^*)P_t^* + v_{t-1}(\alpha_{t-1}, e_t^*, \underline{\theta}) + V_t(\alpha_t^*, \mu_t^*, \underline{\theta}), V_{t-1}(\alpha_{t-1}, \underline{\theta})\}$ because the low type can either pool or separate. Finally, the stock price is given by the competitive equilibrium condition and Bayes' rule as follows[12]:

$$P_{t-1}(\alpha_{t-1}, \mu_{t-1}) = \frac{\mu_{t-1}}{\mu_t^*}[e_t^* + P_t^*] + \left(1 - \frac{\mu_{t-1}}{\mu_t^*}\right)P_{t-1}(\alpha_{t-1}, \underline{\theta}). \tag{7}$$

The next proposition shows that there exists a solution to the dynamic programming problem of equation (6) and it shows how to relate this solution to an equilibrium of the game.

[12] Note that $P_{t-1}(\alpha_{t-1}, \mu_{t-1}) = E[e_t + P_t] = [e_t^* + P_t^*]P(e_t = e_t^*) + [\underline{e}_t + \underline{P}_t]P(e_t = \underline{e}_t)$, and Bayes' rule implies that, $P(e_t = e_t^*) = \mu_{t-1}/\mu_t^*$, which yields the recursion expression for the stock price.

PROPOSITION 3: *The multiperiod game has a unique PBE equilibrium outcome satisfying the lex max refinement. Furthermore, the equilibrium path and the payoffs for managers and investors are associated with the solution to the dynamic programming problem (equation (6)).*

The equilibrium of the multiperiod signaling game has several novel characteristics. For ease of exposition, it is useful to concentrate on the diversion model in which the low type can divert a fraction b of the cash flow.

Note first that the equilibrium path for the high-type manager is deterministic and is given by the ownership stake α_t^* and the stock price P_t^*, solutions of the dynamic programming problem. However, the equilibrium path for the low type manager is stochastic, because with some probability he mimics the high type or otherwise reveals that he is expropriating cash flows from shareholders. The first time the low type manager behaves badly, investors learn that he is a low type and the stock price adjusts to $\underline{P}_t = \sum_{s=t}^{T} \underline{y}_s$, where $\underline{y}_t = (1 - b)\bar{y}_t$, and he divests all his shares.

The rate at which the market learns the information about the manager is given by the variable μ_t^* which is the probability that the manager is of a high type given that he has been behaving well. Naturally, the path of μ_t^* is nondecreasing. Moreover, $\mu_{t+1}^* = \mu_t^*$ means that in equilibrium there is no diversion of the t-period cash flow (pooling); $1 > \mu_{t+1}^* > \mu_t^*$ means that there is some probability of diversion of the t-period cash flow (semi-pooling); and $\mu_{t+1}^* = 1$ means that the low types definitely divert the t-period cash flow (separation). Of course at the last period of the game the low types always divert, and thus $\mu_{T+1}^* = 1$.

Furthermore, the stock price P_t^* and the probability μ_t^* are related in an economically meaningful way by an expression derived from equation (7). For example, the stock price at the time of the IPO is given by

$$P_1^* = \sum_{t=1}^{T} \left[\frac{\mu_1^*}{\mu_{t+1}^*} \bar{y}_t + \left(1 - \frac{\mu_1^*}{\mu_{t+1}^*}\right) \underline{y}_t \right], \tag{8}$$

where the term μ_1^*/μ_{t+1}^* is the unconditional probability of no diversion of the t-period cash flow, $\bar{y}_t$ is the expected cash flow given that there is no diversion, and $\underline{y}_t$ is the expected cash flow with diversion.

We will show that the multiperiod equilibrium is such that there is a positive probability that the low type will behave well in the beginning of the game followed by expropriation toward the end of the game. These and other novel properties of the multiperiod equilibrium are discussed in more detail in the following section.

III. Corporate Finance Results

This section develops the main results of the paper. We show that managers can develop a reputation for not expropriating cash flows from minority shareholders. This reputation effect causes a significant increase in the stock price, reduces the inefficiencies associated with agency problems, and facilitates firms going public. Our results also suggest that a firm's growth rate does not have a significant effect on its reputation-building ability. Furthermore, we show that there is a negative relationship between the degree of moral hazard and both the size of the block that is divested at the IPO and the rate of the divestiture of shares over time after the IPO.

Our goal is to analyze the equilibrium outcome of the multiperiod game and develop the comparative statics analysis of the equilibrium. The variables of interest to us are the path of insider ownership α_t^*, the share price P_t^*, and investors' information about the manager μ_t^*, all given by the results of Proposition 3. Also, we use the equilibrium payoffs of owner-managers to determine how likely the firm is to go public.

Since a closed-form solution for the multiperiod equilibrium is not obtainable, we use numeric simulations to derive our results. The simulations are performed using the diversion model in which there are either high type managers who do not divert cash flows or low type managers who can divert a fraction b of the cash flow. The parameters in the comparative statics analysis are the initial probability $1 - \mu_0$ that a manager is of a low type (the asymmetry of information parameter) and the moral hazard parameter b. As a proxy for the degree of moral hazard we use $b(1 - \mu_0)$, which is equal to the expected fraction of the cash flow that can be diverted by the manager.[13]

In the remainder of this section we formulate and then explain each of the main results.

Result 1: At the IPO, a block of shares is divested; following the IPO, shares are gradually divested. The size of the block sold in the IPO and the rate at which shares are divested over time are negatively related to the degree of moral hazard.

The main trade-off faced by the high type manager in his choice of divestiture is, intuitively, one of selling shares at a low price today in order to be able to sell shares at a higher price in the future. More specifically, when the high type manager diverts more shares in the current period, then the stock price in the current period is lower but there is more diversification of risk and the stock price in future periods is higher. Investors know that the low type manager is more likely to reveal himself diverting cash flows when he owns fewer shares, so they update their beliefs that the manager is of a high type by a larger amount when the manager owns fewer shares and there is no diversion of cash flows. Therefore, the high type trades off more diversification of risk and a higher share price in the future when choosing to divest more shares, against a higher share price in the current period, when choosing to divest fewer shares.

[13] We developed a computer program to obtain the numerical results. The program was written in MATLAB and is available upon request.

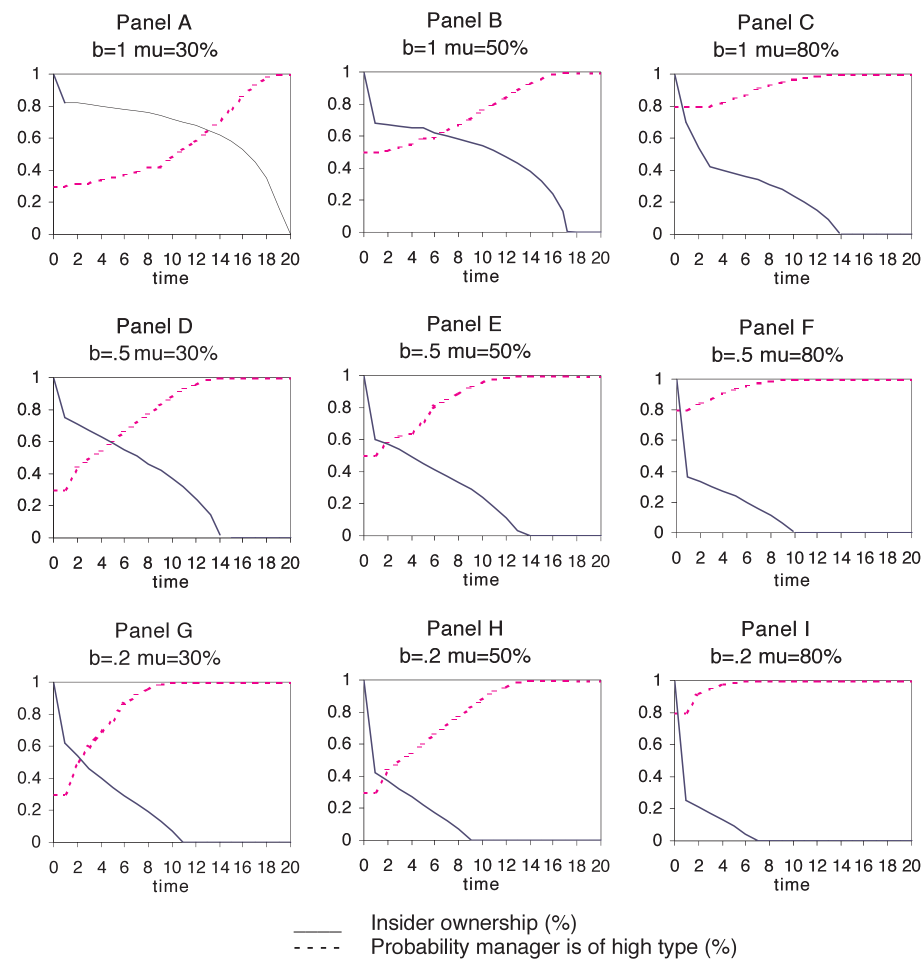

Figure 1. Dynamics of insider ownership and revelation of information. Equilibrium path for the 20-period game for different parameters (b, μ_0). The horizontal axis represents time: $t = 0$ is the period before IPO, $t = 1$ is the moment of the IPO, and $t = 20$ is the last period. The vertical axis represents the percentage of shares owned by the manager and the probability that the manager is of a high type conditional on no diversion of cash flow. Cash flows are independently and identically distributed with a gamma distribution with parameters (1,1).

Figure 1 depicts the equilibrium path of insider ownership, α_t^*, and the path for the probability of being a high type, μ_t^*, for a game with 20 periods. The figure illustrates the content of our first comparative statics result. The horizontal axis in Figure 1 is calendar time starting from the IPO until the firm is liquidated.

The intuition for the relationship between the rate of divestiture of shares and the degree of moral hazard is as follows. Note first that the degree of moral hazard increases with higher values of b and lower values of μ_0. For any given μ_0, a smaller value of b is associated with a smaller gain in the stock price that can be induced by retention of shares, and therefore it is optimal to diversify more risk early through a faster divestiture of shares. This also leads to a quicker revelation of information about the manager. Analogously, as μ_0 increases, there is less room to increase the share price by making investors believe that the manager is more likely to be of the high type, and thus it pays off to diversify more of the risk immediately at the IPO, leading to a bigger block being divested initially.

Result 2: Managers can develop a reputation for behaving well—that is, for extracting low levels of private benefits or exerting high levels of effort. In equilibrium, the stock price at the IPO is significantly higher than it would be without this reputation effect. Furthermore, the increase in the stock price associated with the reputation effect is positively correlated with the degree of moral hazard.

A manager will act strategically, extracting low levels of private benefits in order to sell shares at a high price. A low type manager can credibly commit not to divert the cash flows because if he started to extract high levels of private benefits from the IPO, investors would discount the price of shares accordingly, and the manager's remaining shares would sell at a reduced price.

The stock price at the IPO with the reputation effect is given by expression (8),

$$P_1^* = \sum_{t=1}^{T} \left[\frac{\mu_1^*}{\mu_{t+1}^*} + \left(1 - \frac{\mu_1^*}{\mu_{t+1}^*}\right)(1-b) \right] \bar{y}_t,$$

where μ_1^*/μ_{t+1}^* is the unconditional probability that there is no diversion of the t-period cash flow. If the manager could not establish any reputation, and therefore expropriated as much of the cash flow as possible from shareholders in every period, the stock price would be equal to $P_1 = \sum_{t=1}^{T}[\mu_0 + (1-\mu_0)(1-b)]\bar{y}_t$. Note that $P_1^* \geq P_1$ because $\mu_0 \leq \mu_1^* \leq \mu_t^* \leq \mu_{t+1}^*$. The gain from the reputation effect is $P_1^* - P_1$. At one extreme, when there is separation early on, the gain is not very significant, and at the other extreme, when there is pooling or semi-pooling for several periods, the gain is very significant. The average increase in stock price for the 20-period game with expected cash flow equal to $\sum_{t=1}^{20}\bar{y}_t = \$100$ is shown in Figure 2 for several parameter values. The figure shows that the increase in the stock price associated with the reputation effect is very significant and that this increase is positively related to the degree of moral hazard. For example, when $b = 1$ and $\mu_0 = 30$ percent, the degree of moral hazard is very severe ($b(1-\mu_0) = 0.7$), and the stock price goes from \$30 without any reputation effect to \$57 with the reputation effect, an increase of 90 percent. Also, when $b = 1$ and $\mu_0 = 50$ percent, the degree of moral hazard is 0.5 and the stock price increases from \$50 to \$66, an increase of 32 percent. For moderate

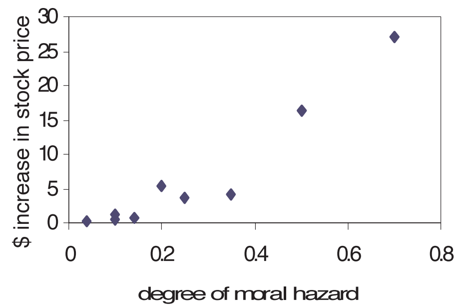

Figure 2. The reputation effect. Increase in stock price at the IPO, $P_1^* - P_1$, for the 20-period game associated with the reputation effect for several moral hazard (0.2, 0.5, and 1) and asymmetric information parameters (0.3, 0.5, and 0.8). The horizontal axis is the proxy for the degree of moral hazard, $b(1 - \mu_0)$. The sum of expected cash flows with no diversion is equal to $100, and cash flows are independent and identically distributed with a gamma distribution.

values of the moral hazard problem, gains greater than five percent can be easily obtained due to the reputation effect. For low values of moral hazard, the gains from reputation are not very significant. There is also a strong correlation (0.95) between the dollar gains in stock price attributed to the reputation effect and the degree of moral hazard.

Another interesting result is that *the firm is more likely to go public in the multiperiod setting*. The idea is that the "lemons problem," which can drive good firms out of the stock market, is ameliorated because owner-managers are able to sell shares gradually and build a reputation for behaving well. For example, if $b = 1$, $\mu_0 = 50$ percent, and the cash flow is realized over 20 periods, then a low type manager gets a total value of $84 when going public and the high type gets $75. In a static game the "lemons problem" is so severe that the firm would not go public and the value of the closely held concern would be only $69. Likewise, the firm is more likely to go public and is worth more for owner-managers the lower the moral hazard problem and the higher the prior probability that the manager is of a high type.

So far this paper has emphasized the role of secondary equity offerings and the need to diversify the idiosyncratic risk of the firm as a mechanism that allows the manager to build a reputation for good behavior. Is this reputation effect even more intense for a growth company with large financing requirements, which is likely to revisit the primary capital markets more frequently? In other words, is a firm with more growth opportunities able to raise equity financing at a lower cost because it can build more reputation for reducing the moral hazard problem?[14] According to the evidence in Singh (1995), firms in developing markets, where there are significant growth

[14] I thank an anonymous referee for suggesting this relationship.

opportunities, rely more heavily on external equity financing than firms in developed markets. Could this finding be related to firms' ability to build more reputation in the presence of more growth opportunities?

Result 3: The reputation effect is not significantly dependent on the firm's growth opportunities as long as the firm can raise debt financing or the owner-manager is not credit constrained.

Contrary to intuition, our results indicate that firms' growth opportunities are largely unrelated to a lower cost of equity financing as long as firms have the ability to finance growth prospects by issuing riskless debt. We believe that, since firms usually have the option of borrowing from banks or issuing debt securities, any claim that managers should behave better with minority shareholders because of the need to revisit the capital markets should be robust to the availability of debt financing. We develop Result 3 by first showing that the reputation effect is not dependent on the financing needs of the firm and then showing that it is unrelated to the rate of growth of cash flows.

First, let us see why the reputation effect is unrelated to the firm's future financing needs. Intuitively, this result holds because the reputation-building mechanism comes from the owner-managers' dependence on a unique feature of the equity markets: the ability to diversify idiosyncratic risks. As long as other forms of financing besides equity are available, no reputation can be developed for treating equity holders well based on the firm's future needs for additional funds. Owner-manager's decisions with respect to ownership, effort, and investments are neutral with respect to the firm's external financing needs if the firm is able to obtain external financing by raising fairly priced and riskless debt. More specifically, let the total cash flows under any investment choice be $\tilde{y}_t$, which is financed issuing riskless debt D_t, where $\sum D_t = 0$ (the interest rate has been set equal to zero).[15] The cash flow to equity holders is equal to $\tilde{y}_t - D_t$ and therefore the manager's choice of divestiture and effort that maximizes the manager's problem (equation (1)) is not dependent on the level of riskless debt in the firm's capital structure. Likewise, we obtain the same neutrality result with respect to the financing needs of the firm if the owner-manager is wealthy or not credit constrained.[16]

We are still left with the possibility that the growth rate of cash flows per se can influence the manager's ability to develop a reputation for treating minority shareholders well. In order to explore the potential for a relation-

[15] The assumption that the firm is able to finance its external capital requirements by issuing riskless debt is less stringent than it might seem. For example, allowing for efficient renegotiations between the firm and creditors, the set of investment opportunities that can be financed with riskless debt can be quite large.

[16] By the same reasoning as above, the owner-manager's choices of effort and divestiture are unaffected as long as the firm can finance investments issuing equity (e.g., using rights offerings) in which the manager has enough funds to maintain the same fractional ownership stake he had before the issuance.

ship between the growth rate of cash flows and the reputation effect, we conducted some numerical analyses. Suppose that the real rate of growth of the cash flow is equal to g, so that $E[\tilde{y}_t] = (1+g)E[\tilde{y}_{t-1}]$ and $\sum_{t=1}^{T} \tilde{y}_t = \tilde{y}$.[17] Is there any relation between g, the stock price, and the value of the firm for entrepreneurs? Our quantitative results suggest that there is no significant relation between the relevant variables and the growth rate.

For example, with the moral hazard and asymmetric information parameters equal to $(b, \mu_0) = (1, 0.5)$ and total cash flow equal to $\sum_{t=1}^{20} \bar{y}_t = \$100$, the stock prices at the IPO are \$67, \$66, and \$63, respectively, for growth rates equal to −0.2, 0, and 0.2. Also, the average value from going public for the owners, which includes their expected extraction of private benefits, is \$80, \$83, and \$82, respectively. Therefore, the growth rate does not significantly influence the reputation effect for values of g in a 20 percent range of zero. In spite of that, the growth rate does have an impact on the insider ownership variable. Insiders in mature firms, with a real growth rate of −0.2, hold only 22 percent of their firm's equity 10 periods after going public, but insiders in firms with real growth rates equal to zero and 0.2 hold, respectively, 60 and 68 percent of their firm's equity 10 periods after going public. Nevertheless, as we allow for extreme values of growth (e.g., growth rates close to +1.0 and −1.0), the outcome converges to the outcome of the static game where managers are not able to develop any reputation because all the cash flow comes, respectively, in the last period and first period of the game. Therefore, extreme values of growth rates can have an adverse effect on the value of the firm.

A. Discussion of the Literature

This paper is related to an extensive finance literature on reputation building. Diamond (1989, 1991) and John and Nachman (1985) present models of development of reputation in debt markets with the same building blocks as our model (moral hazard, asymmetric information, and dynamics), where reputation mitigates the conflicts of interest between borrowers and lenders in taking on projects with excessive risk.[18] In Diamond (1989), if there is initially substantial adverse selection, the reputation effect is weak and does not induce good behavior in borrowers with a short track record. A longer track record reduces the adverse selection problem and eliminates the conflict of interest of borrowers. Alternatively, if there is not substantial initial adverse selection, reputation can begin to work immediately. The equilibrium in our game has similar characteristics, although our model differs in two main ways from those of Diamond (1989, 1991) and John and Nachman (1985). First, their models are applied to explain the properties of debt

[17] In our previous simulations, the real growth rate was set equal to zero.

[18] See also Chemmanur and Fulghieri (1994) for a model where investment banks can develop a reputation for producing information.

markets as opposed to equity markets. Second, their models are based on repeated games similar to the models of Kreps and Wilson (1982) and Milgrom and Roberts (1982), while our equity model is not a repeated game because of its dependence on a state variable (ownership).[19]

This paper is also related to an extensive finance literature on going public and signaling problems. Leland and Pyle (1977) conclude that a manager holds shares of the firm to signal to investors the information that the firm has a high market value (which is independent of the manager's action). Unlike Leland and Pyle, in this paper a manager holds concentrated equity ownership to provide a guarantee to investors that he is willing to build a reputation for consuming low levels of private benefits. Another well-known signaling model is that developed by John and Williams (1985), in which dividend payments are used as a signal. The main difference between these signaling models and our model is that we address a multiperiod signaling problem. Also, the focus in our model is not on questions related to the underpricing of new issues, as in Allen and Faulhaber (1989), Welch (1989), Grinblatt and Hwang (1989), Stoughton and Zechner (1998), and Chemmanur (1993). Importantly, in our model the motivation to go public is to diversify risks, unlike Zingales (1995), where the motivation to go public is to extract more surplus from potential buyers.[20]

IV. Empirical Relevance and Implications

This model provides several new empirical implications for the dynamics of insider ownership. The model predicts that insiders divest shares gradually. There is an initial public offering (IPO) where a block of new shares (primary offering) and/or existing owners' shares (secondary offering) are sold to the public, followed by gradual secondary and/or primary offerings over time. Furthermore, the insider ownership time series is related to the degree of agency problems: The size of the block divested at the IPO and the rate at which shares are divested are negatively related to the degree of agency problems expected by investors. Alternatively, the time it takes to reach a certain insider ownership level is positively related to agency costs. These predictions do not follow from Jensen and Meckling (1976) extended to a multiperiod model, where there would be almost instantaneous convergence to a lower level of ownership (see the multiperiod complete information model of Section II.A). The complete information model would predict that insiders divest a large block of their shares soon after the IPO and then essentially keep their ownership constant after the IPO. Our incomplete

[19] Also, unlike Kreps and Wilson (1982) and Milgrom and Roberts (1982), in this paper, the long-run player (the manager) faces many long-lived opponents (investors), as in Fudenberg and Kreps (1987).

[20] See also Mello and Parsons (1998) for a model of going public that also takes into account the final ownership structure of the firm.

information model, on the other hand, predicts a time series with a gradual divestiture of shares, with a cross-sectional variation that depends on how severe the agency problem is.

Rydqvist and Hogholm (1995) provide evidence that is consistent with the predictions of our model. They show evidence of insider ownership for corporations that went public in Sweden from 1970 to 1991. Two years before going public, the mean ownership concentration is 90 percent. Immediately after the IPO, the average ownership retention is reduced to 57 percent, and five years after the IPO the ownership is reduced to 36 percent. It would be interesting to test the time series and the cross-sectional patterns of insider ownership for other markets; we did not find any evidence on the cross-sectional empirical implications of the model in the literature.

It is important to highlight the point that the model is consistent with the widely documented evidence that equity markets are not a relevant source of financing for corporations. Mayer (1990) has shown that internally generated funds are the major source of financing for industrial countries over the 1970 to 1985 period and that equity financing represents a negligible amount. In our view the main role of the equity markets is not to provide financing to firms, but to provide owners with the ability to diversify idiosyncratic risks and to provide them with liquidity (see Rydqvist and Hogholm (1995) and Pagano, Panetta, and Zingales (1998)). For example, even though the U.S. stock market represented only 0.8 percent of the total financing during 1970 to 1985, it performed a very significant role as a divestiture mechanism. Demsetz and Lehn (1985) show that the largest 500 firms in the United States in 1980 had the five largest shareholders owning, on average, only 25 percent of shares. For this reason our model is based not on primary offerings but on secondary offerings of equity; the motivation to go public is not financing but diversification of risks. Moreover, the implications of the model are not with respect to the dynamics of seasoned equity offerings but for the dynamics of insider ownership.[21]

Our results have special empirical relevance for countries where legal institutions do not offer enough protection to minority shareholders against oppression by majority shareholders. Many empirical studies attempt to estimate the size of private benefits and these studies unanimously conclude that private benefits are, on average, substantial for companies in many countries.[22] Furthermore, the conflicts between controlling and minority share-

[21] See Welch (1996) for evidence on equity offerings following the IPO.

[22] Barclay and Holderness (1989) find that for the United States the premium of block trades over the postannouncement exchange price is, on average, four percent of a firm's market value. Bergstrom and Rydqvist (1992) find a premium of voting relative to nonvoting shares of 6.5 percent in Sweden; Zingales (1994) finds a premium of 81 percent in Italy; Levy (1983) finds a premium of 45.5 percent for Israel; Horner (1988), 20 percent for Switzerland; Megginson (1990), 13.3 percent for the U.K.; Robinson and White (1990), 23.3 percent for Canada; and Lease, McConnell, and Mikkelson (1983), 5.4 percent for the United States. See also Barclay, Holderness, and Pontiff (1993) for private benefits of control in closed-end mutual funds and DeAngelo and DeAngelo (1985) for a study of the concentration of managerial ownership and control in dual-class shares corporations in the United States.

holders can be particularly severe because the legal system in many countries does not effectively protect minority shareholders against oppression by controlling shareholders, either due to poor laws or poor enforcement of laws (see La Porta et al. (1998)). Even in the United States, where shareholders have one of the best and most elaborate legal systems protecting their interests, there is substantial evidence documenting the discretion that managers have over investors' money, giving them the latitude to waste some of it on private benefits.[23]

This paper explains why firms can go public even when investors do not get control rights in exchange for their funds and the legal system does not offer good protection to minority shareholders. Our results show that these firms can go public because of the multiperiod nature of share trading and the generation of cash flows. It is precisely when the agency problem is more severe that managers can implicitly commit to investors that they are not going to divert the cash flows of the firm. The chances of going public and the value that entrepreneurs can gain from going public are increased in the multiperiod setting, and the average value of firms that go public is enhanced by a reputation effect that implicitly protects minority shareholders against expropriation. However, notice that our results do not imply that the quality of the legal system is irrelevant. The better the quality of the legal system, the more insiders are able to divest at a higher stock price. Nevertheless, we show that the market can solve a significant part of the problem related to the lack of protection by being able to develop implicitly a reputation for not expropriating minority shareholders.[24]

For example, our quantitative results show that when managers can divert an expected amount of 50 percent of the cash flows, the stock price is more than 30 percent higher than the stock price based only on the existing level of protection of minority shareholders. In other words, the reputation effect accounts for 30 percent of the value of shares because, in equilibrium, managers are expected to divert much less than what the legal system allows them to divert. Moreover, this increase in stock price is positively correlated with the degree of moral hazard (coefficient of 0.95 in our simulations).

Another empirical implication of the model is that there is no significant relationship between firms' growth opportunities and the size of the reputation effect. This result is derived under the assumption that firms are able to finance growth prospects either borrowing from banks or issuing riskless debt. Demirgüç-Kunt and Maksimovic (1998) show that firms' ability to ob-

[23] For example, oil industry firms in the mid-1980s spent significant resources in negative NPV projects (Jensen (1986)); negative returns to bidders in the announcements of acquisitions are motivated by managers' preferences for diversification and growth instead of shareholder value (Morck, Shleifer, and Vishny (1990)); managers resist takeovers to protect their private benefits rather than to serve shareholders (e.g., Jarrell and Poulsen (1987)).

[24] See also Shleifer and Vishny (1997) for a survey of corporate governance mechanisms.

tain external financing to fund growth is related to a measure of the efficiency of the legal system, consistent with the fact that higher growth firms cannot obtain funding exclusively based on reputation.[25]

An important assumption in our application of the model to equity markets of low-protection countries is that managers are unambiguously in charge and cannot be disciplined by takeovers, or by dismissal by the board of directors or other large blockholders. The empirical evidence that is starting to mount in markets around the world seems to be consistent with this assumption (e.g., Franks and Mayer (1990) and La Porta et al. (1999). In fact, one can argue that in those markets the only equilibrium is for firms to have a controlling shareholder. Any firm widely held without a controlling shareholder, even if well-managed, would likely be the target of a raider who would buy enough shares to form a controlling block. This blockholder would find it more profitable to extract private benefits for himself instead of acting as a monitor who increases the value of the firm for minority shareholders. For the same reason, other large blockholders in these environments, such as banks and institutional investors, are not likely to act as monitors for minority shareholders; it is much more profitable for them to get "side payments" in exchange for their compliance than to spend resources opposing management. In addition, La Porta, et al. (1999) provide evidence that controlling shareholders are often alone and there are no other large blocks in the hands of banks and other financial institutions.[26]

The assumption that managers cannot be disciplined by outsiders seems to be at odds with the documented evidence on large voting premiums (e.g., Zingales (1994) and Levy (1983)); a large voting premium suggests that managers might be ousted by outsiders acting as a disciplinary agent for minority shareholders.[27] Several plausible explanations can reconcile a large voting premium with a lack of outside discipline of managers. First, in many countries where there are dual-class shares, regulation forces a bidder to make the same offer per share to all target shareholders, with the exception that he may differentiate the bid between classes of shares (Rydqvist (1992)). A marginal voting share might trade at a premium, not because of the possibility of a disciplining takeover but because of a negotiated sale of control

[25] On the other hand, Singh (1995) finds that developing countries—where presumably growth opportunities are higher than in developed countries—rely more heavily on external financing than developed countries, and also use equity more intensively than debt financing for their external financing needs. Singh's results are consistent with a story in which firms with high growth rates are more likely to need external financing because internally generated funds are insufficient to finance investment opportunities. Additionally, firms with a more concentrated ownership and more volatile cash flows—more likely to be found in developing than developed markets—find equity financing relatively more desirable than debt financing because risk-averse entrepreneurs' marginal gains from diversification are higher.

[26] In Germany, Japan, and France, banks and other financial institutions often control the major industrial corporations (Franks and Mayer (1994)). In most of the rest of the world, public corporations are often controlled by their founders or the founders' offspring (La Porta et al. (1999) and Zingales (1994)).

[27] I thank an anonymous referee for bringing out this point.

(Bebchuk (1994)) in which marginal voting shares will receive the higher price paid for the controlling block—Italy, Canada, Sweden, and Brazil are some countries with this type of regulation.[28] Furthermore, a premium can exist when there is more than one shareholder fighting for control, and the marginal voting share can be pivotal. None of the potential controllers are expected to monitor and increase value for minority shareholders after gaining control, but rather they are expected to extract private benefits for themselves (see Gomes and Novaes (1999) for a model with multiple controlling shareholders).

The existing literature suggests many disadvantages to using structures that increase the separation between ownership and control (e.g., Grossman and Hart (1988)). The widespread use of these structures (e.g., La Porta et al. (1999) and Rydqvist (1992)), is puzzling because the initial owners bear ex ante the costs of ex post inefficiencies, and it seems reasonable that owners could commit ex ante not to use pyramidal and dual-class shares structures. This suggests that, in many cases, the benefits of using those structures are lower than the costs.

Finally, the model provides a new explanation for the benefits of using pyramidal and dual-class shares structures. The main idea is that when managers can issue restricted voting shares or build pyramids, they are able to increase their reputation for not expropriating minority shareholders, which can increase the value of the firm. As we have seen in the previous sections, the mechanism that allows the reputation effect to work is the prospect of selling additional shares in the future for a higher price; therefore, when managers are allowed to issue shares with restricted voting rights or to develop a pyramidal structure, the effect can work better since there are more shares for managers to sell while still keeping majority control of the firm. Additionally, the costs of using those structures that increase the separation of ownership and control are not as significant because managers in environments with low protection will want to keep control whether dual-class shares and pyramids are allowed or not. As we argued above, keeping control seems to be the only possible equilibrium in many countries where, for example, negotiated transfer of control replaces disciplining mechanisms such as takeovers, which is consistent with the empirical evidence. Furthermore, the ability to divest more shares without losing control can increase the free float (the percentage that the owners sell to the public) and thus increase the amount of risk that owners can diversify.

V. Concluding Remarks

In this article, we develop a model of a firm that is going public in the presence of moral hazard, asymmetric information, and multiple trading periods. The agency problem emphasized in the paper is not the standard agency

[28] See Zingales (1994) for Italy, Smith and Amoaku-Adu (1995) for Canada, and Rydqvist (1992) for Sweden.

problem between managers and shareholders, but the conflicts between a large shareholder, who exerts control over management, and minority shareholders. The motivation for the owner-manager to take the firm public is to diversify the idiosyncratic risk of the firm with investors; however, all participants in the market recognize that there is room for the manager to act opportunistically and expropriate minority investors after going public.

In the multiperiod game, the manager strategically chooses extraction of private benefits and can develop a reputation for not expropriating minority shareholders. Even though managers can expropriate investors, managers are still able to sell shares at a high price because investors know that in equilibrium managers will not expropriate them as much. This model predicts that a significant component of the valuation of stocks in emerging markets (or developed capital markets) with very weak legal protections for minority shareholders can be attributed to the reputation effect. Moreover, we argue that the use of dual-class voting structures and pyramidal structures—mechanisms that increase the separation of ownership and control which are often found in these capital markets—can be efficient. Allowing for an increase in the separation of ownership and control increases the efficiency of stock markets because the reputation effect is stronger when managers can divest more without losing control.

Likewise, the model predicts that the insider ownership time-series and cross-section variation is related to the degree of moral hazard. At the IPO, the size of the block of shares divested is negatively related to the degree of moral hazard, and, following the IPO, shares are gradually divested at a rate that is also negatively related to the degree of moral hazard.

Finally, the multiperiod signaling framework developed in the paper can have promising applications in other areas of finance. For example, the model can be extended to allow the manager to use additional signals, such as capital structure or dividend policy. Most other studies of asymmetric information problems in corporate finance have been conducted in a static setting; however, our results suggest that multiperiod signaling games have several economic properties that do not exist in static games. It remains for future research to determine what new insights will arise from the extension of static models to a more realistic multiperiod signaling framework.

Appendix

A. Assumptions

ASSUMPTION 1: *For all t, the function $v(\alpha,e,\theta)$ is twice differentiable and satisfies the following conditions for all α,e*, and θ:

(A1) *Regularity conditions:* $v_\alpha(\cdot) \geq 0$, *$v(\alpha,e,\theta)$ is concave in (α,e)*, $v_{\alpha e}(\alpha,e,\theta) \geq 0$, *and* $v_\alpha(\alpha,e,\theta) \leq e$.

(A2) *Single-crossing property (SC-P):* $v_\alpha(\alpha,e,\bar{\theta}) \geq v_\alpha(\alpha,e,\underline{\theta})$ *and* $v_e(\alpha,e,\bar{\theta}) \geq v_e(\alpha,e,\underline{\theta})$.

The regularity conditions imposed essentially state that the marginal value of shares decreases with ownership, the marginal value of effort decreases with effort, and diversification of risk is efficient. The second condition is the familiar single-crossing property of the static multidimensional signaling game.

The Lex Max Refinement: Define a continuation game $G(h^t, \mu)$ as any subgame starting from a history of past moves h^t with prior distribution μ. A PBE (σ, μ) is a lex max equilibrium of the multiperiod game if it satisfies the following two conditions for all continuation games. First, the restriction of (σ, μ) to any history h^t, $(\sigma, \mu)_{|h^t}$, satisfies the lex max property—it maximizes the utility for the high type, and conditional on maximizing the utility for the high type it maximizes the utility for the low type—for the continuation game $G(h^t, \mu(.|h^t))$. Second, the maximization in the lex max property is not over the set of all PBE of the continuation game, but is restricted to a subset that is consistent with the lex max concept in all continuation games starting at $t+1$. This is stated formally in Assumption 2.

ASSUMPTION 2: *(σ, μ) is a lex max PBE, if it is a PBE and for any history h^t the restriction to the continuation game $(\sigma, \mu)_{|h^t}$ satisfies the lex max property. The set of equilibria that satisfies the lex max property for any continuation game is defined recursively as follows*: $(\sigma, \mu)_{|h^t} \in LM(h^t, \mu(.|h^t))$ *if and only if $(\sigma, \mu)_{|h^t}$ is a PBE of the continuation game $G(h^t, \mu(.|h^t))$ and there exists no $(\sigma', \mu')_{|h^t}$, PBE of $G(h^t, \mu(.|h^t))$, such that:*

(A1) $\exists \theta$ *such that* $u(\sigma'|h^t, \theta) > u(\sigma|h^t, \theta)$ *and for* $\theta' > \theta$, $u(\sigma'|h^t, \theta') \geq u(\sigma|h^t, \theta')$; *and*

(A2) $\forall h^{t+1}$ *consistent with* h^t *with* $t+1 \leq T$: $(\sigma', \mu')_{|h^{t+1}} \in LM(h^{t+1}, \mu'(.|h^{t+1}))$

B. Proofs

LEMMA 1: *The independence of the random shocks implies that*

$$-\log E[\exp[-w_{t,T}]] = \sum_{s=t}^{T+1} (\alpha_{s-1} - \alpha_s) P_s + v_{s-1}(\alpha_{s-1}, e_s, \theta), \tag{B1}$$

where $v_s(\alpha_s, e_{s+1}, \theta) = -\log E[\exp -[\alpha_s y_s(e_{s+1}, \eta_{s+1}) - c_s(e_{s+1}, \eta_{s+1}, \theta)]]$.

Proof of Lemma 1: Expected values are taken with respect to the distribution of random shocks to the cash flows (conditional and unconditional expectations are identical because of the independence of random shocks). The proof uses the fact that the choices of signals in any period s, α_s, and e_s only depend on the previous history of actions h^{s-1} until period $s-1$, but do not depend on realizations of random shocks to the cash flows. We will later see that this is true because past realizations of random shocks are irrelevant for future payoffs.

First we have that $E[\exp[-w_{t,T}]]$ is equal to

$$E\left[\prod_{s=t}^{T}[\exp-[(\alpha_{s-1}-\alpha_s)P_s+\alpha_{s-1}y_{s-1}(e_s,\eta_s)-c_{s-1}(e_s,\eta_s,\theta)]]\right], \tag{B2}$$

which is equal to

$$\prod_{s=t}^{T}E[\exp-[(\alpha_{s-1}-\alpha_s)P_s+\alpha_{s-1}y_{s-1}(e_s,\eta_s)-c_{s-1}(e_s,\eta_s,\theta)]], \tag{B3}$$

because of the independence of the η_t's. The terms $(\alpha_{s-1}-\alpha_s)P_s$ can be taken out of the expectation operator because they do not depend on the random shock. This implies that

$$-\log E[\exp[-w_{t,T}]] = \sum_{s=t}^{T+1}(\alpha_{s-1}-\alpha_s)P_s + v_{s-1}(\alpha_{s-1},e_s,\theta),$$

where $v_t(\alpha_t,e_{t+1},\theta) = -\log E[\exp-[\alpha_t y_t(e_{t+1},\eta_{t+1})-c_t(e_{t+1},\eta_{t+1},\theta)]]$. Q.E.D.

Proof of Proposition 2: In a separating equilibrium there must be a level of ownership α_1 in the first period such that the incentive compatibility condition $(1-\alpha_1)P_1(\alpha_1,\bar{\theta}) + V_1(\alpha_1,1,\underline{\theta}) \leq V_0(1,\underline{\theta})$ is satisfied. We first show how to obtain, in general, the expression for $V_1(\alpha_1,1,\underline{\theta})$ that appears in the IC condition.

We start by determining the value of $V_{t-1}(\alpha_{t-1},1,\underline{\theta})$. The concept of PBE and its refinements impose very weak restrictions on the equilibrium outcome for games with incomplete information with degenerate priors, where the uninformed player puts all the weight on one of the types. Although the concept of PBE does not provide a unique solution to the problem it seems natural to consider that the equilibrium outcome is similar to the case where there is no incomplete information and the concept of subgame perfection pins down a unique equilibrium outcome. The complete information case where the manager is of type $\bar{\theta}$ was solved in Section II.A; the manager strategy is to play $\alpha_t(\alpha_{t-1},\bar{\theta})$ and $e_t(\alpha_{t-1},\bar{\theta})$ and the investor response is $P_t(\alpha_t,\bar{\theta})$. Playing $(\alpha_t,e_t) \neq (\alpha_t(\alpha_{t-1},\bar{\theta}),e_t(\alpha_{t-1},\bar{\theta}))$ in period t is a dominated strategy of the high-type manager and thus it is reasonable that investors' should believe that such a play must come from a low-type manager. Thus by equilibrium dominance, investors' out-of-equilibrium belief must be given by $\mu(\bar{\theta}|\alpha_t,e_t) = 1$ if $(\alpha_t,e_t) = (\alpha_t(\alpha_{t-1},\bar{\theta}),e_t(\alpha_{t-1},\bar{\theta}))$ and $\mu(\bar{\theta}|\alpha_t,e_t) = 0$ otherwise.

Given the above considerations restricting the out-of-equilibrium beliefs, we can obtain the expression for $V_{t-1}(\alpha_{t-1},1,\underline{\theta})$ recursively as equal to:

$$\max_{\alpha_t,e_t} \quad (\alpha_{t-1}-\alpha_t)P_t(\alpha_t,\mu(\alpha_t,e_t)) + v_{t-1}(\alpha_{t-1},e_t,\theta) + V_t(\alpha_t,\mu(\alpha_t,e_t),\underline{\theta})$$

$$\text{s.t.} \quad \mu(\alpha_t,e_t) = \begin{cases} 1 & \text{if } (\alpha_t,e_t) = (\alpha_t(\alpha_{t-1},\bar{\theta}),e_t(\alpha_{t-1},\bar{\theta})) \\ 0 & \text{otherwise,} \end{cases} \tag{B4}$$

where $V_T(\alpha_T,1,\underline{\theta}) = \max_{e_{T+1}} v_T(\alpha_T,e_{T+1},\underline{\theta})$ and $V_t(\alpha_t,0,\underline{\theta})$ is the value for the low type in the complete information case. Let the solution to the above problem be $e_t(\alpha_{t-1},1,\underline{\theta})$ and $\alpha_t(\alpha_{t-1},1,\underline{\theta})$.

The second part of the proposition follows from analysis of the example proposed before the statement of the proposition. The IC condition for the example is $\sum_{t=1}^{T} b\bar{y}_t \leq \alpha_1\bar{y}_1 - v_1(\alpha_1) + v_1(b)$ and it is straightforward that the condition is not satisfied for any α_1 for large values of b. Q.E.D.

Proof of Proposition 3: We first state and prove a lemma that guarantees that there exists a well-behaved solution to the dynamic programming problem. We apply the Theorem of the Maximum in order to prove the result (see Stokey and Lucas (1989)).

LEMMA 2: *The dynamic programming problem equation (6) has a value $V_{t-1}(\alpha_{t-1},\mu_{t-1},\bar{\theta})$ that is continuous in the state variables (α_{t-1},μ_{t-1}), and also a nonempty solution correspondence $(\alpha_t,e_t,\mu_t,P_t) \in G_t(\alpha_{t-1},\mu_{t-1})$ that is upper-hemicontinuous in the state variables.*

Proof of Lemma 2: We first restate the problem in formal terms and then prove that the conditions of the Theorem of the Maximum apply to the problem.

The maximization problem at any period $t = 1,\ldots,T$ is equivalent to:

$$V_{t-1}(x,\bar{\theta}) = \max_{y \in \Gamma_t(x)} F_t(x,y), \tag{B5}$$

where the beginning-of-period state variable is $x = (\alpha_{t-1},\mu_{t-1}) \in X$, $X = A \times [0,1]$, and the maximization is over $y = (\alpha_t,e_t,\mu_t,P_t,V_t) \in Y$, $Y = A \times E \times [0,1] \times \Re_+^2$. The value of the maximum of the t-period problem is denoted as $V_{t-1}(x,\bar{\theta})$, and the solution correspondence by $H_{t-1}(x){:}X \rightarrow Y$.

The maximand of the t-period problem, $F_t(x,y)$, is defined as a function of the value for the future periods $V_t(x,\bar{\theta})$ as $F_t(x,y) = (\alpha_{t-1} - \alpha_t)P_t + v_{t-1}(\alpha_{t-1},e_t,\bar{\theta}) + V_t(\alpha_t,\mu_t,\bar{\theta})$.

The set of feasible values is given by the correspondence $\Gamma_t{:}X \rightarrow Y$ defined based on the solution correspondence H_t as follows: for any $x = (\alpha_{t-1},\mu_{t-1}) \in X$ and $y = (\alpha_t,e_t,\mu_t,P_t,V_t) \in Y$, $y \in \Gamma_t(x)$ if and only if

$$\exists z = (\alpha_{t+1},e_{t+1},\mu_{t+1},P_{t+1},V_{t+1}) \in H_t(\alpha_t,\mu_t)$$

such that

(1) $P_t = (\mu_t/\mu_{t+1})[e_{t+1} + P_{t+1}] + (1 - (\mu_t/\mu_{t+1}))[P_t(\alpha_t, \underline{\theta})]$
(2) $V_t = \max\{(\alpha_t - \alpha_{t+1})P_{t+1} + v_t(\alpha_t, e_{t+1}, \underline{\theta}) + V_{t+1}, V_t(\alpha_t, \underline{\theta})\}$
(3) $\mu_t \in [\mu_{t-1}, 1]$
(4) $((\alpha_{t-1} - \alpha_t)P_t + v_{t-1}(\alpha_{t-1}, e_t, \underline{\theta}) + V_t - V_{t-1}(\alpha_{t-1}, \underline{\theta})).\ (1 - \mu_t) \geq 0$
(5) $((\alpha_{t-1} - \alpha_t)P_t + v_{t-1}(\alpha_{t-1}, e_t, \underline{\theta}) + V_t - V_{t-1}(\alpha_{t-1}, \underline{\theta})).\ (\mu_t - \mu_{t-1}) \leq 0.$

At the terminal period the initial conditions are defined for any $x = (\alpha_T, \mu_T)$ as $V_T(x,\theta) = \max_{e_{T+1}} v_T(\alpha_T, e_{T+1}, \theta)$ and $H_T(x) = \{(\alpha_T, e_{T+1}(\alpha_T, \bar{\theta}), 1, 0, 0)\}$, a set with a unique element, $(\alpha_{T+1}, e_{T+1}, \mu_{T+1}, P_{T+1}, V_{T+1}) = (\alpha_T, e_{T+1}(\alpha_T, \bar{\theta}), 1, 0, 0)$. Note that both $V_T(x,\theta)$ and $H_T(x)$ are continuous in X and are compact-valued.

Note that the correspondence $G_t(x) = \pi(H_t(x))$, where $\pi(y) = (\alpha_t, e_t, \mu_t, P_t)$ for any $y = (\alpha_t, e_t, \mu_t, P_t, V_t) \in Y$, is a projection. Furthermore, $G_t(x)$ is upper-hemicontinuous (u.h.c.) if $H_t(x)$ is u.h.c.

The Theorem of the Maximum states that the value function $V_{t-1}(x, \bar{\theta})$ is continuous and the solution correspondence $H_{t-1}(x)$ is u.h.c. and compact-valued as long as the maximand $F_t(x,y)$ is continuous and the correspondence $\Gamma_t : X \to Y$ is continuous (u.h.c and lower-hemicontinuous (l.h.c)) and compact-valued. By recursion, the function $F_t(x,y)$ is continuous. We next show that the correspondence $\Gamma_t : X \to Y$ is compact-valued and continuous if $H_t(x)$ is u.h.c. We will use several results about u.h.c and l.h.c correspondences (see Stokey and Lucas (1989)).

Define $\Psi_1(y,z) = (\mu_t/\mu_{t+1})[e_{t+1} + P_{t+1}] + (1 - (\mu_t/\mu_{t+1}))[P_t(\alpha_t, \underline{\theta})] - P_t$ for any $y = (\alpha_t, e_t, \mu_t, P_t, V_t) \in Y$ and $z = (\alpha_{t+1}, e_{t+1}, \mu_{t+1}, P_{t+1}, V_{t+1})$ and $\Psi_2(y,z)$ analogously using restriction (2). Both $\Psi_1(y,z)$ and $\Psi_2(y,z)$ are continuous functions. Let $\Phi_1 : Y \to \Re$ be the correspondence $\Phi_1(y) = \Psi_1(y, H_t(\pi_1(y)))$, where $\pi_1(y) = (\alpha_t, \mu_t)$ is a projection of y. Φ_1 is u.h.c. because $H_t(.)$ is u.h.c. and $\Psi_1(y,z)$ is continuous. Let $\Phi_2 : Y \to \Re$ be defined analogously. Restrictions (1) and (2) are equivalent to $\Phi_1^{-1}(0)$ and $\Phi_2^{-1}(0)$, respectively. Both $\Phi_1^{-1}(0)$ and $\Phi_2^{-1}(0)$ are closed sets. This is true because any u.h.c. correspondence is such that the inverse of a closed set is also a closed set.

Also, let $\Psi_4(x,y) = ((\alpha_{t-1} - \alpha_t)P_t + v_{t-1}(\alpha_{t-1}, e_t, \underline{\theta}) + V_t - V_{t-1}(\alpha_{t-1}, \underline{\theta})).(1 - \mu_t)$, for any $y = (\alpha_t, e_t, \mu_t, P_t, V_t) \in Y$ and $x = (\alpha_{t-1}, \mu_{t-1}) \in X$. Similarly, define $\Psi_5(x,y)$ using restriction (5). Of course, both $\Psi_4(x,y)$ and $\Psi_5(x,y)$ are continuous functions. Restrictions (4) and (5) are equivalent to $\Phi_4(x) = \{y \in Y : (x,y) \in \Psi_4^{-1}([0,+\infty])\}$ and $\Phi_5(x) = \{y \in Y : (x,y) \in \Psi_5^{-1}([0,+\infty])\}$, which are both closed sets. Let also $\Phi_3(x) = \{y \in Y : \mu_t \in [\mu_{t-1}, 1]\}$ for any $x = (\alpha_{t-1}, \mu_{t-1})$. We have just shown that $\Gamma_t(x) = \Phi_1^{-1}(0) \cap \Phi_2^{-1}(0) \cap \Phi_3(x) \cap \Phi_4(x) \cap \Phi_5(x)$, where $\Phi_3(x)$, $\Phi_4(x)$, and $\Phi_5(x)$ all continuous functions of x. This implies that $\Gamma_t(x)$ is compact-valued (closed and bounded): $\Gamma_t(x)$ is obviously bounded, and is an intersection of closed sets, thus also a closed set. We have also shown that $\Gamma_t(x)$ is continuous in x. This completes the proof of Lemma 2. Q.E.D.

We continue the proof of Proposition 3 showing how to associate solutions of the dynamic programming problem to equilibrium of the multiperiod game.

We first construct the PBE (σ, μ) that is a candidate for lex max. For any $(\alpha_{t-1}, \mu_{t-1})$, let $(\alpha_t^*, e_t^*, \mu_t^*, P_t^*, V_t^*) \in G(\alpha_{t-1}, \mu_{t-1})$ be a solution of the dynamic program that maximizes $V_{t-1}(\alpha_{t-1}, \mu_{t-1}, \underline{\theta}) = \max\{(\alpha_{t-1} - \alpha_t^*)P_t^* + v_{t-1}(\alpha_{t-1}, e_t^*, \underline{\theta}) + V_t(\alpha_t^*, \mu_t^*, \underline{\theta})\}$. For any history h^{t-1} and prior μ_{t-1} define a strategy and system of beliefs (σ, μ) as follows: proceed forward to define the strategies for the high type as $\alpha(h^{t-1}, \bar{\theta}) = \alpha_t^*$ and equivalently for effort. Define the rule to update beliefs as $\mu_t(\bar{\theta}|h^{t-1}, \alpha_t, e_t) = \mu_t^*$ if $(\alpha_t, e_t) = (\alpha_t^*, e_t^*)$ and equal to 0 otherwise, and a consistent response $P_t(h^{t-1}, \alpha_t, e_t) = P_t^*$ if $(\alpha_t, e_t) = (\alpha_t^*, e_t^*)$ and equal to $P_t(\alpha_t, \underline{\theta})$ otherwise. Define the strategy for the low type as $\alpha(h^{t-1}, \underline{\theta})$ and $e(h^{t-1}, \underline{\theta})$ where he plays (α_t^*, e_t^*) with probability $\beta_t = [\mu_{t-1}/(1 - \mu_{t-1})][(1 - \mu_t^*)/\mu_t^*]$ and $(\underline{\alpha}_t, \underline{e}_t) = (\alpha_t(\alpha_{t-1}, \underline{\theta}), e_t(\alpha_{t-1}, \underline{\theta}))$ with probability $1 - \beta_t$. The strategy profile and system of beliefs (σ, μ) are well defined and the players' payoff in any continuation game starting with state variables (α_t, μ_t) is given by $V_t(\alpha_t, \mu_t, \theta)$ and $P_t(\alpha_t, \mu_t)$, the solution to the dynamic programming problem.

Note that the strategy profile and system of beliefs (σ, μ) are Markovian with respect to the state variables (α_t, μ_t). A strategy profile σ and system of beliefs are Markovian with respect to the state variables (α_t, μ_t) if and only if for any two histories h^t and $\bar{h}^t$ such that the posterior beliefs are the same, $\mu_t = \mu(.|h^t) = \mu(.|\bar{h}^t)$, and also the equity ownerships are the same, $\alpha_t = \alpha_t(h^t) = \alpha_t(\bar{h}^t)$, then the strategies and beliefs in the continuation game are equal, $\sigma_{|h^t} \equiv \sigma_{|\bar{h}^t}$ and $\mu_{|h^t} \equiv \mu_{|\bar{h}^t}$.

It is straightforward to verify that (σ, μ) as defined above is a PBE equilibrium. This is the case because $(\alpha_t^*, e_t^*, \mu_t^*, P_t^*, V_t^*) \in G_t(\alpha_{t-1}, \mu_{t-1})$ is a solution of the dynamic programming problem with restrictions that guarantee that the Nash equilibrium condition (Proposition 1), the competitive condition (Proposition 2), and Bayes' rule for updating beliefs (Proposition 3) as in the definition of PBE are satisfied.

It remains to show that $(\sigma, \mu) \in LM(h^0, \mu_0)$ and that there is a unique equilibrium outcome in $LM(h^0, \mu_0)$. We now proceed inductively to establish that $(\sigma, \mu)_{|h^t} \in LM(h^t, \mu_t)$ and all elements in $LM(h^t, \mu_t)$ produce the same equilibrium outcome, for any period t and history h^t and $\mu_t = \mu(.|h^t)$. First note that at the terminal period $T + 1$ there is a unique $(\sigma, \mu)_{|h^T} \in LM(h^T, \mu_T)$. Assume as the induction hypothesis that $(\sigma, \mu)_{|h^{t+1}} \in LM(h^{t+1}, \mu_{t+1})$ and all elements in $LM(h^{t+1}, \mu_{t+1})$ produce the same equilibrium outcome, for any period $t + 1$. We want to prove that the induction hypothesis also holds for period t. Assume by contradiction that there exists a $(\sigma', \mu')_{|h^t} \in PBE(h^t, \mu_t)$ with $(\sigma', \mu')_{|h^t} \neq (\sigma, \mu)_{|h^t}$ that lexicographically dominates $(\sigma, \mu)_{|h^t}$. It then must be the case that $\exists\theta$ such that $u(\sigma'|h^t, \theta) > u(\sigma|h^t, \theta)$ and for $\theta' > \theta$, $u(\sigma'|h^t, \theta') \geq u(\sigma|h^t, \theta')$; and $(\sigma', \mu')_{|h^{t+1}} \in LM(h^{t+1}, \mu'(.|h^{t+1}))$. By the induction hypothesis then $u(\sigma'|h^{t+1}, \theta) = V_t(\alpha_t, \mu_t', \theta)$ and $P_t(\alpha_t, \mu_t')$. But the existence of θ such that $u(\sigma'|h^t, \theta) > u(\sigma|h^t, \theta)$ and for $\theta' > \theta$, $u(\sigma'|h^t, \theta') \geq u(\sigma|h^t, \theta')$ is a contradiction of the fact that $u(\sigma|h^t, \theta) = V_t(\alpha_t, \mu_t, \theta)$ is the value of dynamic program at period t. Q.E.D.

REFERENCES

Allen, Franklin, and Gerald Faulhaber, 1989, Signalling by underpricing in the IPO market, *Journal of Financial Economics* 23, 303–323.

Barclay, Michael, and Clifford Holderness, 1989, Private benefits from control of public corporations, *Journal of Financial Economics* 25, 371–395.

Barclay, Michael, Clifford Holderness, and Jeffrey Pontiff, 1993, Private benefits from block ownership and discount on closed-end funds, *Journal of Financial Economics* 33, 263–291.

Bebchuk, Lucian, 1994, Efficient and inefficient sales of corporate control, *Quarterly Journal of Economics* 109, 957–993.

Bergstrom, Clas, and Kristian Rydqvist, 1992, Differentiated bids for voting and restricted voting shares in public tender offers, *Journal of Banking and Finance* 16, 97–114.

Berle Adolf, and Gardiner Means, 1932. *The Modern Corporation and Private Property* (MacMillan, New York).

Chemmanur, Thomas, 1993, The pricing of initial public offerings: A dynamic model with information production, *Journal of Finance* 48, 285–304.

Chemmanur, Thomas, and Paolo Fulghieri, 1994, Investment bank reputation, information production, and financial intermediation, *Journal of Finance* 49, 57–79.

Cho, In-Koo, and David Kreps, 1987, Signalling games and stable equilibria, *Quarterly Journal of Economics* 102, 179–221.

Coase, Ronald, 1972, Durability and monopoly, *Journal of Law and Economics* 15, 143–149.

DeAngelo, Harry, and Linda DeAngelo, 1985, Managerial ownership of voting rights—A study of public corporations with dual-classes of common stock, *Journal of Financial Economics* 14, 33–69.

Demirgüç-Kunt, Asli, and Vojislav Maksimovic, 1998, Law, finance and firm growth, *Journal of Finance* 53, 2107–2137.

Demsetz, Harold, and Kenneth Lehn, 1985, The structure of corporate ownership: Causes and consequences, *Journal of Political Economy* 93, 1155–1177.

Diamond, Douglas, 1989, Reputation acquisition in debt markets, *Journal of Political Economy* 97, 828–862.

Diamond, Douglas, 1991, Monitoring and reputation: The choice between bank loans and directly placed debt, *Journal of Political Economy* 99, 689–721.

Fluck, Zsuzsanna, 1998, Optimal financial contracting: Debt versus outside equity, *Review of Financial Studies* 11, 383–418.

Franks, Julian, and Colin Mayer, 1990, Takeovers: Capital markets and corporate control: A study of France, Germany and the UK, *Economic Policy* 10, 189–231.

Franks, Julian, and Colin Mayer, 1994, Capital markets, corporate governance and the market for corporate control, Working paper, London Business School and University of Oxford.

Fudenberg, Drew, and David Kreps, 1987, Reputation in the simultaneous play of multiple opponents, *Review of Economic Studies* 54, 541–568.

Fudenberg, Drew, and Jean Tirole, 1991, *Game Theory* (MIT Press, Cambridge, Mass.).

Gomes, Armando, and Walter Novaes, 1999, Multiple large shareholders in corporate governance, Working paper, Rodney L. White Center for Financial Research, The Wharton School.

Grinblatt, Mark, and Chuan Hwang, 1989, Signalling and the pricing of new issues, *Journal of Finance* 44, 393–420.

Grossman, Sanford, and Oliver Hart, 1988, One share, one vote, and the market for corporate control, *Journal of Financial Economics* 20, 175–202.

Harris, Milton, and Arthur Raviv, 1992, Financial contracting theory; in Jean-Jacques Laffont, ed.: *Advances in Economic Theory: Sixth World Congress*, Vol. II (Cambridge University Press, Cambridge, England).

Horner, Melchior, 1988, The value of the corporate voting right: Evidence from Switzerland, *Journal of Banking and Finance* 12, 69–83.

Jarrell, Gregg, and Annette Poulsen, 1987, Shark repellents and stock price: The effects of anti-takeover amendments since 1980, *Journal of Financial Economics* 19, 127–168.

Jensen, Michael, 1986, Agency costs of free cash flow, corporate finance, and takeovers, *American Economic Review* 76, 323–329

Jensen, Michael, and William Meckling, 1976, Theory of the firm: Managerial behavior, agency costs and ownership structure, *Journal of Financial Economics* 3, 305–360.

John, Kose, and David Nachman, 1985, Risky debt, investment incentives, and reputation in a sequential equilibrium, *Journal of Finance* 40, 863–878.

John, Kose, and Joseph Williams, 1985, Dividends, dilution, and taxes: A signalling equilibrium, *Journal of Finance* 40, 1053–1070.

Kreps, David, and Robert Wilson, 1982, Reputation and imperfect information, *Journal of Economic Theory* 27, 253–279.

La Porta, Rafael, Florencio Lopez-de-Silanes, and Andrei Shleifer, 1999, Corporate ownership around the world, *Journal of Finance* 54, 471–517.

La Porta, Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer, and Robert Vishny, 1997, Legal determinants of external finance, *Journal of Finance* 52, 1131–1150.

La Porta, Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer, and Robert Vishny, 1998, Law and finance, *Journal of Political Economy* 106, 1113–1155.

Lease, Ronald, John McConnell, and Wayne Mikkelson, 1983, The market value of control in publicly-traded corporations, *Journal of Financial Economics* 11, 439–471.

Leland, Hayne, and David Pyle, 1977, Informational asymmetries, financial structure, and financial intermediation, *Journal of Finance* 32, 371–387.

Levy, Haim, 1983, Economic valuation of voting power of common stock, *Journal of Finance* 38, 79–93.

Mailath, George, 1992, Signalling games; in John Creedy, ed.: *Recent Developments of Game Theory* (Edward Elgar Publishing Limited, Hants, England).

Mailath, George, Masahiro Okuno-Fujiwara, and Andrew Postlewaite, 1993, Belief-based refinements in signalling games, *Journal of Economic Theory* 60, 241–276.

Mayer, Colin, 1990, Financial systems, corporate finance, and economic development; in Glen Hubbard, ed.: *Asymmetric Information, Corporate Finance, and Investment* (University of Chicago Press, Chicago).

Megginson, William, 1990, Restricted voting stock, acquisition premiums, and the market for corporate control, *Financial Review* 25, 175–198.

Mello, Antonio, and John Parsons, 1998, Going public and the ownership structure of the firm, *Journal of Financial Economics* 49, 79–109.

Milgrom, Paul, and John Roberts, 1982, Predation, reputation, and entry deterrence, *Journal of Economic Theory* 27, 280–312.

Morck, Randall, Andrei Shleifer, and Robert Vishny, 1990, Do managerial objectives drive bad acquisitions?, *Journal of Finance* 45, 31–48.

Myers, Stewart, 2000, Outside equity, *Journal of Finance*, forthcoming.

Pagano, Marco, Fabio Panetta, and Luigi Zingales, 1998, Why do companies go public? *Journal of Finance* 53, 27–64.

Pagano, Marco, and Ailsa Roell, 1998, The choice of ownership structure: Agency costs, monitoring, and the decision to go public, *Quarterly Journal of Economics* 113, 187–225.

Robinson, Michael, and Robert White, 1990, The value of a vote in the market for corporate control, Working paper, York University.

Rydqvist, Kristian, 1992, Dual-class shares: A review, *Oxford Review of Economic Policy* 8, 45–57.

Rydqvist, Kristian, and Kenneth Hogholm, 1995, Going public in the 1980s: Evidence from Sweden, *European Financial Management* 1, 287–315.

Shleifer, Andrei, and Robert Vishny, 1997, A survey of corporate governance, *Journal of Finance* 52, 737–783.

Singh, Ajit, 1995, Corporate financial patterns in industrializing economies: A comparative international study, World Bank and IFC, Technical paper 2.

Smith, Brian, and Ben Amoaku-Adu, 1995, Relative price of dual-class shares, *Journal of Financial and Quantitative Analysis* 30, 223–239.

Stokey, Nancy, and Robert Lucas, 1989, *Recursive Methods in Economic Dynamics* (Harvard University Press, Cambridge, Mass.).

Stoughton, Neal, and Josef Zechner, 1998, IPO-mechanisms, monitoring and ownership structure, *Journal of Financial Economics* 49, 45–77.

Welch, Ivo, 1989, Seasoned offerings, imitation costs, and the underpricing of initial public offerings, *Journal of Finance* 44, 421–449.

Welch, Ivo, 1996, Equity offerings following the IPO: Theory and evidence, *Journal of Corporate Finance* 2, 227–259.

Zingales, Luigi, 1994, The value of voting right: A study of the Milan stock exchange experience, *Review of Financial Studies* 7, 125–148.

Zingales, Luigi, 1995, Insider ownership and the decision to go public, *Review of Economic Studies* 62, 425–448.