A Theory of Dismantling a Joint Ownership: The role of the Venture Capitalist in an IPO *

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Abstract

When a firm goes public, the joint ownership of the firm is dismantled asynchronously, as venture capitalists are able to sell all of their shares soon after an IPO while the entrepreneur usually stays in the firm for a longer period. This paper captures this empirical fact by introducing a model of the IPO decision that explicitly considers the interaction of different block-holders of the firm at the time of an IPO. We focus on the case of a venture capitalist and a single entrepreneur. We find that in our model the privately optimal size of the IPO depends on the pre-IPO ownership structure. We characterize the nature of this dependence and perform an empirical analysis for the US IPO market for the period 1994-2005. The data confirm that the unsynchronized dismantlement of a joint venture affects the size of an IPO in a way consistent with our model. Our empirical results suggest that the decision of what fraction of the firm to sell is distorted in the direction generally favored by the venture capitalist.

JEL codes: G32 G34 D23 L2
Keywords: Venture Capital, Initial Public Offering, Joint Ownership.

I Introduction

Going public is one of the most important events in the lifetime of a firm. One of the unresolved questions regarding Initial Public Offering (IPO) activity is how control considerations affect the decision of going public and the fraction sold to the outside investors. Ritter and Welch (2002) provide a comprehensive survey of the literature.

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Most theoretical studies in corporate governance assume the IPO firm to be a monolithic structure. The usual assumption is that there is an entrepreneur who owns a firm and decides whether or not to go public. In the case of going public, he chooses the optimal ownership structure (Becht, Bolton, and Roell 2003). However, the empirical evidence shows that the ownership of the firm before going public is not necessarily concentrated in a managing entrepreneur. In fact, it is frequently divided between multiple agents, who may have divergent objectives. One such agent of particular interest to is the venture capitalist.

Venture capitalists typically finance high risk and potentially high reward investment projects, purchasing equity or equity-linked stakes while the firm is privately held (Gompers and Lerner 2001). Since the late eighties venture capital has become an increasingly important source of financing for start-up firms. In the period 1980 to 1990, 29% of the firms that went public had the support of one or more venture capitalists. The figure increased to 44% after 1990 and peaked at 58% during the internet boom.¹ Venture capitalists usually have a sizable portion (around 60%) of the firm’s equity (often in the form of convertible securities), and they also participate actively in management (Kaplan and Stromberg 2003).

While theoretical research has addressed the positive role of venture capital in mitigating information asymmetries, this paper focuses on a different aspect of the venture capitalist-entrepreneur relationship. Specifically, it analyzes the conflict that arises from the fact that the venture capitalist often uses the IPO as an exit strategy. Cumming and MacIntosh (2003), using a sample of venture capital projects, report that about 30% of the projects eventually go through an IPO and that in nearly 70% of the venture-backed IPOs the venture capitalists had sold all of their holdings within a year. This effectively means that IPOs serve as an exit strategy for venture capital. It is a way to realize the return on their investment in a privately-held firm.²

In their potentially conflictive relationship the venture capitalist and entrepreneur may have multiple divergent objectives across many of the firm’s decisions in terms of investment, IPO

¹The percentages in this paragraph were calculated from data used by Lam (2006).
²Selling the firm privately is another way of exiting for the venture capitalist. Our paper focuses on the case where an IPO is the strategy chosen.
timing and the amount of shares sold to the public. In this paper, we restrict attention to the conflict arising from the ownership structure at IPO.

Brau and Fawcett (2006) report the responses by CFOs to the question of which factors are important motivators for conducting an IPO. Over 32% of the CFOs in venture-backed firms responded that allowing the venture capitalists to cash out is an important factor. Moreover, Table 1 shows that the percentage held by a venture capitalist seems to be strongly correlated with the fraction of the company sold at IPO. These two pieces of evidence motivate our study on the dismantling effect arising from the potential misalignment on incentives.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pairwise correlation with size of IPO</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of shares owned by VC</td>
<td>0.49 **</td>
</tr>
<tr>
<td>log(Assets)</td>
<td>0.05 *</td>
</tr>
<tr>
<td>log(Debt)</td>
<td>0.06 *</td>
</tr>
<tr>
<td>log(Equity)</td>
<td>0.03</td>
</tr>
<tr>
<td>Tobin’s Q</td>
<td>0.02</td>
</tr>
</tbody>
</table>

* Significant at 5%. ** Significant at 1%.

In our model the exit of the venture capitalist after the IPO is anticipated by the entrepreneur prior to going public. This exit can have consequences for the future allocation of control inside the firm. Consider an entrepreneur who has private benefits of control and who expects the venture capitalist to exit at some stage after the IPO by selling all its shares. If the shares are bought by a big player, the entrepreneur may lose control of the firm if the buyer buys enough shares to take over the firm. If this possibility looms in the future, then the entrepreneur may be either reluctant to go public in the first place, or will prefer to sell relatively less shares during the IPO, given that this allows to retain control. The venture capitalist, however,

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3Lam (2006) finds that the timing of venture-backed IPOs does not differ significantly from those not venture-backed, after controlling for industries and size.

4Scoring 4 or 5 in a scale from 1 to 5. The response is statistically significant at the 1% level, compared to non-ventured-backed IPO firms.

5The issue gets more complex if the firm offers dual class shares to retain the control rights. In our sample, dual class share structures are relatively few, accounting for only 7% of all the IPOs.
cares only about the price of the shares at the time of exit. Thus, the optimal ownership structure, in particular the fraction offered to the public at the IPO is likely to be different for the entrepreneur and the venture capitalist. The model predicts that entrepreneurs tend to undersell to the public at the IPO relative to the choice a venture capitalist would make (and also relative to the optimal level).  

We compare the predictions of our model with empirical evidence of the US IPO market for the period 1994-2005, using data from SDC (Security Data Corporations) and IPODATA, a commercial vendor. A feature of the model is that the size of the IPO is a non-linear function of the fraction held by the venture capitalist. We find evidence in favor of our model in that in the data the size of the IPO is non-linearly related to the fraction owned by venture capital. We estimate this empirical relationship and conclude that the unsynchronized dismantlement of a joint venture affects the size of an IPO in a very specific way.

The paper is organized as follows: The next section links our work to the related literature. It is followed by a model that illustrates our main arguments. Section IV provides some empirical analysis based on the model predictions. Section V concludes. Lengthy proofs are relegated to an Appendix.

II Literature

The paper connects two branches in the literature of initial public offerings: the study of the relationship of venture capitalists and entrepreneurs in a firm and the analysis of the optimal ownership structure at the time of the IPO. Our paper is one of the first to suggest that

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6One may suspect that the size of the IPO is critical for a reason other than the dismantling effect discussed in the paper. Selling a large portion of the firm in an IPO, or selling insider shares in an IPO may perhaps send a negative signal to market investors as a lack of insider confidence on the firm. When a firm goes public, it may not be willing to sell at the optimal size because of the negative signaling effect, which is abstracted from in our model. However, the survey by Brau and Fawcett (2006 Table VI) suggests that the signaling effect to the firm’s value is of minor importance. Less than 12% and 4% of the CFOs perceive that selling a large portion of the firm in the IPO and selling insider shares at the IPO would send a negative signal. Moreover, they do not report any significant difference between the venture-backed firms and the non venture-backed IPOs when it comes to the signaling issue. Hence, our abstraction from the signaling effect on the IPO size does not seem to miss out a key determinant of IPO size.
the existence of multiple blockholders in a firm prior to going public can play an important role during the IPO process, changing some results in the existing literature, and the first to consider the control implications of the presence of venture capitalists in a firm before an IPO.\footnote{So far, the literature has emphasized the monitoring and certification role of venture capitalists during the going public process. See Megginson and Weiss (1991).}

In Pagano and Roell (1998) the optimal size of an IPO is one that induces optimal monitoring by the outside shareholders. By dispersing the ownership of outside investors (which can be achieved by going public) the entrepreneur limits their involvement in the firm management. However, a certain degree of monitoring from outside investors is required in order to raise external equity (otherwise the degree of extraction of private benefits by the entrepreneur will be such that no outside investor will be willing to participate). The basic framework of Pagano and Roell (1998) is used by Burkart and Panunzi (2001) to analyze the effect of legal investor protection in ownership concentration and, by Shleifer and Wolfezon (2002) to analyze the effect of this variable in the development of stock markets in a general equilibrium context.

In a more recent paper, Boot, Gopalan, and Thakor (2006) model the going public decision as a mechanism that allows firms to obtain cheaper finance but that also introduces the possibility of disagreements between management and investors, which can be costly for the firm.

In public capital markets, the firm is subject to exogenous controls, limiting the autonomy of management. By contrast, private ownership can provide management the desired autonomy due to the possibility of precisely-calibrated private contracting. The disadvantage of private ownership is that it imposes a liquidity cost on those who provide financing.

One important assumption in this line of research is that entrepreneurs are able to maintain control of the firm. This is not an innocuous assumption, Pagano and Zingales (1998) find, using Italian data, that the turnover in control is twice as high in firms that went public compared to similar privately held companies. In a recent survey of CFOs, Braun and Fawcett (2006) find that the possibility of losing control is the main reason for a firm to stay private.

The relationship between transfers of control and optimal ownership structure is analyzed in Bebchuk (1994). The main insight of his model is that the initial ownership structure
and legal rules determine if a transfer of control will be realized or not. In an extension of that model, Bebchuck and Zingales (1996) go one step backward and analyze the ownership structure decisions at the IPO: their main finding is that, when expected control contests are taken into account, the privately optimal ownership structure for the entrepreneur differs from the socially optimal. In particular, there will be excessive incidence of controlling shareholders structures and excessive extraction of private benefits.

Our model is most closely related to Bebchuck and Zingales (1996) in the sense that it also includes the feature that expected transfers of control have an impact on the ownership structure. Our model improves on the analysis by showing that the conflict between different pre-IPO blockholders in a firm has an impact on the fraction of the firm sold at the IPO.

III The Model

In this section we introduce our model of the IPO decision. We assume the existence of an investment opportunity that requires financing that the existing shareholders of the firm cannot provide. However, by going public, the firm introduces the possibility that an external investor can buy enough of the shares placed during the IPO such that it can successfully challenge the incumbent management. Hence, at the IPO stage, the firm decision-makers face a potential trade-off between investing more (by placing a larger share of equity in the IPO process) and increasing the ease of a successful external take-over. The mandated exit of the venture capitalist is the first time at which this takeover can take place. The fact that the venture capitalist exits the firm before the entrepreneur does generates a divergence in their interests, which will influence the optimal size of the IPO desired by these two players.

We aim for the simplest model that highlights the above features. For this reason we abstract from uncertainty in the projects and risk-averse participants, which are certainly conspicuous aspects in the transit of a firm from its start-up to the IPO and beyond.

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8In the survey by Brau and Fawcett (2006), finance needs are frequently mentioned by CFOs as the reason to go public.

9The presence of the venture capitalist hinders a takeover as he controls a sizable fraction of shares.
III.1 The Players

III.1.1 Description of the players

Table 2: Players in the model

<table>
<thead>
<tr>
<th>Player</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrepreneur (E):</td>
<td>Owns $\beta$ of the firm prior to IPO. May manage the firm.</td>
</tr>
<tr>
<td>Venture Capitalist (VC):</td>
<td>Owns $(1 - \beta)$ prior to IPO and has a predetermined time of exit.</td>
</tr>
<tr>
<td></td>
<td>May manage the firm.</td>
</tr>
<tr>
<td>Minority Shareholders:</td>
<td>Buy a fraction $1 - \alpha$ of the firm at IPO. Never manage the firm.</td>
</tr>
<tr>
<td>Corporate Raider (R):</td>
<td>May want to take control of firm after the exit of VC.</td>
</tr>
<tr>
<td></td>
<td>May manage the firm after the IPO.</td>
</tr>
</tbody>
</table>

In accordance with our goal of keeping the model as simple as possible, we consider a single firm which is initially jointly owned by a single entrepreneur and a single venture capitalist. These are the two idealized key players that are central to the model. There are two further players who play a less important role. One of these players, the minority shareholder, encompasses all investors that buy shares at the IPO. The last player, the corporate raider, is a player who may attempt a take-over of the firm after the venture capitalist’s exit. These last two players are not central to our inquiry, and are therefore modeled in a somewhat mechanical way, as will be clear below.\(^{10}\) All players are assumed to be risk-neutral.

Table 2 collects our four players and their relationship to the firm. In our model we take $\beta$ as given and $\alpha$ is determined endogenously in the model.

III.1.2 Who manages the firm?

Three out of four players can potentially manage the firm: the entrepreneur and the venture capitalist (either collectively or individually) before a takeover, and the corporate raider if successful in taking over the firm. All of these configurations are considered in the model.

\(^{10}\)This does not mean that they are incapable of behaving strategically, or that they are irrational. It means that their environment is (modeled to be) such, that their optimization problem is a simple dichotomous choice.
It is common in venture capital arrangements that both the initial entrepreneur and the venture capitalist share the positions on the board. Whose interests management will defend in case of divergence of shareholder’s interests is unclear and possibly differs widely across firms. We will explicitly consider the two extreme cases: when the entrepreneur has full control and when the venture capitalist has full control.

With respect to management after the IPO, we distinguish between a firm run by a corporate raider or the original management team. The case of different entrepreneurial ability of the corporate raider is explicitly considered.

We now proceed as follows: first we describe the environment, the timing of the model and the actions pertaining to each player at every point in time. We then go over the main assumptions. Finally, we present the solution and main results of the model.

III.2 Environment and Timing of the Model

Time transpires discretely. There are four dates $t \in \{-1, 0, 1, 2\}$. Actions only take place at dates 0 (the IPO stage) and date 2 (the takeover).

III.2.1 The Firm

A firm operates at all four dates. It yields payoffs at date 1 and date 2. The payoff at date 1 can be interpreted as the return of an expansion project that requires an investment that exceeds the credit available to the current shareholders. The level of investment $c \in \mathbb{R}_+$ is chosen by the party controlling the firm. The payoff at date 1, $y_1(\alpha, c)$, is a function of the amount invested ($c$) and the shares retained by the original shareholders ($\alpha$). The payoff at date 2 is just a function of the entrepreneurial ability of the player who is in control at date 2.

We will assume below that the venture capitalist exits at the beginning of date 2. This means that there are only two parties that may manage the firm at that date: the entrepreneur and the corporate raider. If no takeover has taken place, then the entrepreneur is in control and
the payoff is $y_2^E$. If a takeover has taken place, then the corporate raider is in control and the payoff is $y_2^R$. Note that the payoff at date 2 is assumed to be independent of the level of investment $c$.\textsuperscript{11}

III.2.2 The IPO

The funds for the investment are collected through an IPO. New shares are issued in order to be sold at the IPO, therefore diluting the fraction of the firm held by initial shareholders. We denote the fraction of the company which remains in hands of the initial shareholders with $\alpha \in [0, 1]$. The fraction sold at the IPO is therefore $1 - \alpha$. We allow for the possibility of $\alpha = 1$, meaning that the company stays private. The date 1 payoff function $y_1(\alpha, c)$ is net of IPO costs.

III.2.3 The Take-Over Threat

A take-over threat is triggered by the following fact-based assumption about the venture capitalist.

\textbf{Fact 1}: The venture capitalist must exit at the beginning of $t = 2$.

Fact 1 captures the empirical fact that venture capital organizations usually exit the firms they invest in some time after the IPO. The assumption is key to the model in two aspects. First, it generates a divergence in the entrepreneur’s and venture capitalist’s preferences due to a different time horizon. Second, it allows for a hostile take-over, as one of the big shareholders leaves the firm after the IPO.\textsuperscript{12}

We assume that there are private benefits of control $B > 0$ that accrue to the entrepreneur at the end of date 2. Since the venture capitalist exits at the beginning of date 2, he does not enjoy these benefits. This captures the divergence of preferences due to different time horizons

\textsuperscript{11}Comparable qualitative results are obtained if a more general functional form $y_2^i(c)$ is assumed. However, assuming that $y_2^i$ is independent of $c$ is convenient for the analysis.

\textsuperscript{12}As argued above, takeovers are more difficult before the venture capitalist’s exit.
of the initial joint owners of the firm.\textsuperscript{13} These benefits are lost however if there is a successful takeover. We assume that a corporate raider may try to take over the firm by buying shares from minority shareholders and the exiting venture capitalist and install his own management team. Let $\pi$ be the percentage of shares required to maintain control of the firm.\textsuperscript{14} If the entrepreneur owns at least a fraction $\pi$ of the company, then he may block the take-over and retain control of the firm.

### III.2.4 Timeline

Table 3 describes the player's actions at each stage. This timeline is common knowledge among all players.

### III.3 Assumptions and Equilibrium

Two operational assumptions are convenient for solving the model:

**Assumption 1** *Bargaining power always lies with the seller of the shares.*

This assumption facilitates the tractability of the model. However, similar results are obtained by assuming Nash bargaining with less than full power for some of the parties in each transaction.

**Assumption 2** *Investment returns are given by* $y_1(\alpha, c) = f(\alpha)c$, *with* $f(\alpha)$ *increasing, continuous and twice differentiable over* $\alpha \in [0, 1]$. *Further assume* $f'(\alpha) \geq f(\alpha) > 0$ *and* $f''(\alpha) < 2f'(\alpha)$.

The linearity in $c$ is for convenience. The functional assumptions on the form of $f(\alpha)$ ensure that there will be a unique value of $\alpha \in [0, 1]$ that maximizes $y_1(\alpha, c)$. The assumptions on

\textsuperscript{13} Adding private benefits of control at any other date does not alter the results, hence they are disregarded.

\textsuperscript{14} It is natural to think of $\pi$ as being equal to $\frac{1}{2}$. However, governance rules or laws affect the value of $\pi$. For example, in a firm with staggered boards and large required percentages to change the status quo, a management team is able to retain control with an equity share far less than $\frac{1}{2}$. 

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Table 3: Timeline

- $t = -1$
  - A privately held firm is jointly owned by an entrepreneur and a venture capitalist, with shares $\beta$ and $1 - \beta$ respectively.
- $t = 0$ IPO stage
  - A new project requiring external financing $c$ and yielding $y_1(\alpha, c)$ next period arises.
  - The firm may go public (IPO) by selling $1 - \alpha$ of the firm to minority shareholders.
- $t = 1$
  - Cash flow $y_1(\alpha, c)$ is paid out as dividends.
- $t = 2$ Takeover Stage
  - Venture capitalist exits by selling $\alpha(1 - \beta)$ of the firm.
  - A corporate raider with entrepreneurial productivity $y^R_2$ appears. He may try to take control by buying shares from the VC and minority shareholders. Entrepreneur can (but is not forced to) block if he retains enough shares $\alpha \beta \geq \pi$.
  - The firm generates a cash flow $y^i_2, i = E, R$ depending on who is in control.
  - Entrepreneur obtains private benefits $B$ if in control at $t = 2$.

$f$ are not overly restrictive as they allow for concave, linear or even convex specifications of $f(\alpha)$.

**Definition 1** Throughout the paper we use Subgame Perfect Nash Equilibrium as our equilibrium concept.

### III.4 Solving the Model

We solve the model by backwards induction. At date 2 (the Takeover stage) a corporate raider with level of productivity $y^R_2$ appears and tries to take over the firm. If $y^R_2 > y^E_2$ both the VC and minority shareholders are willing to sell their shares to the corporate raider extracting all the surplus from the transaction by Assumption 1. This means that R will pay $y^R_2$ if the shares are enough for successful take-over and $y^E_2$ otherwise. In this last case, minority shareholders
are indifferent between selling or not. If $y^R_2 < y^E_2$, then the highest price that can be offered by the corporate raider is lower than the lowest price at which minority shareholders are willing to sell their shares. Therefore, the corporate raider does not buy any shares.\(^{15}\)

The fraction $\pi$ is the percentage of shares required to maintain control of the firm. If the entrepreneur retains $\alpha \beta > \pi$, he owns enough equity to block any takeover attempt. It should be noted that even if the entrepreneur has the ability to block a takeover, he may be willing to surrender control if $y^R_2$ is high enough relative to $y^R_2$ and $B$. In fact, the entrepreneur prefers to keep control if and only if

$$\alpha \beta y^E_2 + B > \alpha \beta y^R_2$$

The left hand side is the payoff to the entrepreneur if he is in control. It consists of the dividend and his private benefits of control. The right hand side is the dividend to the entrepreneur if the corporate raider is in control. The condition can also be expressed as $\alpha \beta(y^E_2 - y^R_2) + B > 0$.

Consequently, we can distinguish the following cases:

1. if $y^E_2 > y^R_2$: There is no takeover attempt
2. if $y^E_2 < y^R_2$ and $\alpha \beta < \pi$, there is a successful takeover
3. if $y^E_2 < y^R_2$, $\alpha \beta > \pi$ and $\alpha \beta(y^E_2 - y^R_2) + B > 0$, the entrepreneur blocks the takeover.
4. if $y^E_2 < y^R_2$, $\alpha \beta > \pi$ and $\alpha \beta(y^E_2 - y^R_2) + B < 0$, the entrepreneur doesn’t block the takeover (although he can).

The following matrix collects all the cases.

<table>
<thead>
<tr>
<th></th>
<th>$y^E_2 &gt; y^R_2$</th>
<th>$y^E_2 &lt; y^R_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\alpha \beta(y^E_2 - y^R_2) + B \geq 0$</td>
<td>$\alpha \beta(y^E_2 - y^R_2) + B &lt; 0$</td>
</tr>
<tr>
<td>$\alpha \beta \geq \pi$</td>
<td>no takeover</td>
<td>no takeover</td>
</tr>
<tr>
<td>$\alpha \beta &lt; \pi$</td>
<td>no takeover</td>
<td>takeover</td>
</tr>
</tbody>
</table>

\(^{15}\)Making this a rather uninteresting case.
It will be useful to use indicator functions to express payoffs in the analysis that follows.

Define $I_1$ as an indicator function that takes on the value 1 when the entrepreneur is able to block any takeover attempt and 0 otherwise.

$$I_1 = \begin{cases} 
1 & \text{if } \alpha \beta \geq \pi, \\
0 & \text{if } \alpha \beta < \pi.
\end{cases} \quad (2)$$

Define $I_2$ as an indicator function that takes on the value 1 when the entrepreneur wants to block any takeover attempt and 0 otherwise.

$$I_2 = \begin{cases} 
1 & \text{if } \alpha \beta (y^E - y^R) + B \geq 0, \\
0 & \text{if } \alpha \beta (y^E - y^R) + B < 0.
\end{cases} \quad (3)$$

As an example, the lower right portion of the preceding matrix can now be expressed in a matrix in which each cell is the product of the two indicator functions.

<table>
<thead>
<tr>
<th>$y^E &lt; y^R$</th>
<th>$I_2 = 1$</th>
<th>$I_2 = 0$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_1 = 1$</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>$I_1 = 0$</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

A number 1 in a cell means that the takeover is blocked since the entrepreneur both wants to and is able to block it. A zero means that at least one of these conditions is not satisfied, and that the takeover is not blocked.

At date 0 (the IPO Stage) the firm sells shares corresponding to a fraction $(1 - \alpha)$ of the equity of the firm. We assume that there is a large number of risk neutral-minority investors willing to buy shares, so a zero-profit condition for them holds.
Using the above defined indicator functions, the zero-profit condition for the minority investors is given by the following equation:

\[ c = (1 - \alpha) \left\{ y_1(\alpha, c) + y_2^R + I_1 I_2 \left[ y_2^E - y_2^R \right] \right\} \]  

(4)

The zero-profit condition states that the amount invested \( c \) equals the return to minority shareholders, which is composed of the fraction of the company they own \((1 - \alpha)\) times the date 1 and date 2 payoffs. Notice that if the entrepreneur is in control at date 2 \((I_1 I_2 = 1)\), then the firm payoff is \( y_1(\alpha, c) + y_2^E \). If, on the other hand, the corporate raider is in control at date 2 \((I_1 I_2 = 0)\), then the payoff is \( y_1(\alpha, c) + y_2^R \).

The zero-profit condition allows to focus on the share kept at the IPO, by expressing \( y_1 \) and \( c \) as function solely of \( \alpha \). The following lemma states the precise expression of these functional relationships.

**Lemma 1** Using equation (4) together with Assumption 2, \( y_1 \) and \( c \) can be expressed as functions of \( \alpha \):

\[
y_1(\alpha) = \frac{(1 - \alpha)f(\alpha)}{1 - (1 - \alpha)f(\alpha)} \left\{ y_2^R + I_1 I_2 \left[ y_2^E - y_2^R \right] \right\}
\]

(5)

and

\[
c(\alpha) = \frac{(1 - \alpha)}{1 - (1 - \alpha)f(\alpha)} \left\{ y_2^R + I_1 I_2 \left[ y_2^E - y_2^R \right] \right\}
\]

(6)

The knowledge of these functional forms allows to solve for the size of the IPO that would be chosen by a constrained planner who has the power to allocate control of the firm to any player and whose only constraint is the zero-profit constraint.\(^{16}\)

**Proposition 1** A social planner whose only constraint is the zero-profit constraint would choose a fraction \( \alpha^* \) (would sell \( 1 - \alpha^* \) of the shares at the IPO), where \( \alpha^* \) solves \( 1 - \alpha^* = \frac{f(\alpha^*)}{f'(\alpha^*)} \).

Moreover, given Assumption 2, \( \alpha^* \) is unique.

\(^{16}\)The planner is also constrained by physical constraints such as the functional form of \( f(\alpha) \), the timing, etc.
It is straightforward to see that the optimal amount of shares being sold to the public will be different for the entrepreneur and the venture capitalist.

If the entrepreneur controls the firm, the optimal $\alpha$ for $E$ is given by:

$$V^E = \max_{\alpha \in [0,1]} U^E = \max_{\alpha \in [0,1]} \alpha \beta y_1(\alpha) + \alpha \beta y^R + I_1 I_2 \left[ \alpha \beta (y_E^2 - y^R) + B \right]$$  \hspace{1cm} (7)

If the venture capitalist is in control, the optimal $\alpha$ for the VC is given by:

$$V^{VC} = \max_{\alpha \in [0,1]} U^{VC} = \max_{\alpha \in [0,1]} \alpha (1-\beta) y_1(\alpha) + \alpha (1-\beta) y^R + I_1 I_2 \left[ \alpha (1-\beta) (y_E^2 - y^R) \right]$$  \hspace{1cm} (8)

Note that the two payoffs differ in that the VC does not receive private benefits in period 2. Absent $B$ in the third term, the utility functions of the entrepreneur and the venture capitalist would lead to the same choice of $\alpha$, since both players agree on the effect on productive efficiency in both periods of their choice of inside versus outside financing.\(^{17}\) The entrepreneur’s utility function can be written as a function of the venture capitalist’s utility function.

$$U^E = \frac{\beta}{1-\beta} U^{VC} + \underbrace{I_1 I_2 B}_{\text{disagreement}}$$  \hspace{1cm} (9)

It is the existence of $I_1 I_2 B$ in the entrepreneur’s utility function that may cause disagreement in the choice of $\alpha$. This term arises from their different preferences over control in the second period, which can be traced back to the forced exit of the VC and his consequent loss of private control benefits in period 2. We therefore call the last term the disagreement effect.

**Proposition 2** Disregarding the disagreement effect, the entrepreneur and the venture capitalist would choose the same size for the IPO.

**Proof** This follows immediately from the proportionality relationship in equation (9). Q.E.D.

\(^{17}\)Absent private benefit controls, i.e. $B = 0$, the two utility functions would be proportional with proportionality factor $\frac{\beta}{1-\beta}$, therefore yielding the same maximizing value of $\alpha$. 

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If the entrepreneur and the venture capitalist do not attempt to influence period 2 control with their choice of $\alpha$, we have the following result.

**Proposition 3** Disregarding control issues, the entrepreneur and the venture capitalist would undersell at the IPO, i.e. choose to keep a higher fraction $\hat{\alpha}$ of the shares than what is efficient, i.e. $\hat{\alpha} > \alpha^*$. 

The intuition for this result is that the entrepreneur and the venture capitalist do not fully appropriate the marginal gains from investing, since this investment comes at the cost of diluting the fraction of the project that remains in their hands. Mathematically, it can be seen that $\alpha$ and $y_1(\alpha)$ show up interacted multiplicatively in their payoffs. The effect of $\alpha$ on the payoffs is therefore reinforced, leading to a higher choice $\hat{\alpha} > \alpha^*$. 

The entrepreneur and the venture capitalist will try to manipulate second period control to their advantage though. This will be especially important if the disagreement effect is large. It therefore remains to study influence of the disagreement effect on the choice of $\alpha$. The next section resolves this issue by tackling this question through the use of a geometric demonstration.

**III.5 When the entrepreneur and the venture capitalist disagree on the size of the IPO**

In this section we analyze the interactions between the optimal decisions for the entrepreneur and the venture capitalist, especially with regards to the disagreement effect defined in the previous section. We do so with the help of a graphical representation of the entrepreneur’s and the venture capitalist’s optimal choices of the size of the IPO. All figures are drawn in the $(\beta, \alpha)$ plane and present the optimal $\alpha$ for both the entrepreneur and the venture capitalist as a function of $\beta$ for different sets of parameters. The indifference conditions for blocking (indicator functions $I_1$ and $I_2$) are key to to the analysis and are also represented in each figure.
III.5.1 A necessary condition for disagreement

It is convenient to revisit the indicator functions, and think of their representation in the \((\beta, \alpha)\) plane. The first indicator function is equal to 1 whenever the entrepreneur is able to block a takeover. Rearranging equation (2) we obtain

\[ I_1 = 1 \iff \alpha \geq \pi \frac{1}{\beta} \quad (10) \]

The region in the \((\beta, \alpha)\) plane where the entrepreneur is able to block a takeover is the region above the hyperbolic equation \(\alpha = \pi \frac{1}{\beta}\). This equation is represented as a black dashed line in all figures.

The question of whether the entrepreneur actually wants to block the takeover depends on whether his managerial ability exceeds that of the raider or not. In the case where the raider is more productive, the decision depends on the magnitude of \(B\) versus the productivity differential.

\[ I_2 = 1 \iff \begin{cases} 
\text{always} & \text{if } y^R_2 \leq y^E_2 \\
\alpha \leq \frac{B}{(y^R_2 - y^E_2)} \frac{1}{\beta} & \text{if } y^R_2 > y^E_2 
\end{cases} \quad (11) \]

The first case is the case in which the corporate raider is unable to buy the shares, and can therefore be disregarded. The second of these cases depicts an area below the hyperbolic function \(\alpha = \frac{B}{(y^R_2 - y^E_2)} \frac{1}{\beta}\), which is represented as a green dashed line whenever relevant.

Finally, for both indicator functions to be equal to 1 simultaneously,

\[ I_1 I_2 = 1 \iff \pi \frac{1}{\beta} \leq \alpha \leq \frac{B}{(y^R_2 - y^E_2)} \frac{1}{\beta} \quad (12) \]

For the disagreement effect to be relevant, it has to be that \(I_1 I_2 = 1\) for at least some \((\beta, \alpha) \in (0, 1) \times [0, 1]\), which will happen if and only if \(B \geq \pi(y^R_2 - y^E_2)\), i.e. if the private control benefits \(B\) are sufficiently large versus the productivity differential scaled by the difficulty of blocking, \(\pi\). This can be thought of as a necessary condition for disagreement. We now present
three graphical examples. In the first one, we present the case in which this condition fails, $B \in [0, \pi(y_2^R - y_2^E)]$. The other two are examples of cases in which the condition holds.

III.5.2 No disagreement

![Image: Optimal Ownership Structure Prior and After IPO](image)

Figure 1: No Disagreement. There is no region where the entrepreneur simultaneously wants to and can block. This implies that $\alpha$ does not depend on $\beta$.

The case where the condition for disagreement fails is exemplified in Figure 1. This is the case in which the magnitude of $B$ is small versus the productivity differential scaled by the difficulty of blocking ($\pi$). Here, the optimal $\alpha$ is $\hat{\alpha}$, the same for both the entrepreneur and venture capitalist. Manipulation of the size of the IPO is ineffective and Proposition 3 holds. There is no region where the entrepreneur simultaneously wants to and can block. The line depicting the ability to block control ($I_1$) is always above that the willingness to block control ($I_2$), that is, even in cases where the entrepreneur retained enough ownership to block the raider, he still prefers to give up control to him. This implies that the investment level does not depend on $\beta$. 

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III.5.3 Disagreement

In Figure 2 we have the case where the entrepreneur is less efficient than the raider but private benefits of control are sufficiently large so that he always wants to block. As can be seen from the figure, the willingness to block is such that for any combination of $\alpha$ and $\beta$, the entrepreneur will want to retain control if it is possible. He distorts $\alpha$ upward to be able to block when his own share of the company ($\beta$) is low, therefore underselling at the IPO and generating under-investment. Note that, however, when $\beta$ is low enough, the entrepreneur will not have enough power to block a control transfer even by distorting $\alpha$ to its maximum ($\alpha = 1$). In that case, he prefers to chose the investment-first-best $\alpha$ even if that implies surrendering control later. Underselling is not the only inefficiency that may arise in this case.

If it is the venture capitalist who controls the firm, then the result is the opposite. Since the VC anticipates that the entrepreneur will want to block a control transfer, he sometimes prefers to decrease $\alpha$ below $\hat{\alpha}$, increasing the amount of shares distributed to the public and
thereby over-investing.

III.5.4 The Size of the IPO as a Commitment Device

Figure 3 presents the case in which the entrepreneur chooses to over-sell at the IPO. This may happen if the reduction in funds made available by minority investors, who anticipate a productivity drop if the entrepreneur stays in control, is large when compared to \( B \). In the sense that the share of profits that goes to the entrepreneur is reduced by an amount bigger than the increase in utility by the gain in private control benefits. The entrepreneur then wishes to commit not to block a transfer in the future. The mechanism to solve this commitment problem is for him to distort \( \alpha \) downwards, generating over-selling at the time of the IPO in order to prevent his future self from blocking. Note that the value of beta up to which the entrepreneur over-sells is less than for the venture capitalist. This difference arises because the entrepreneur receives private benefits of control. He is less interested in the funds of the minority shareholders as they are a smaller part of his payoff. The maximum inefficiency cost that the entrepreneur is willing to pay is therefore lower.

For the IPO to be used as a commitment device, parameters have to satisfy a pair of conditions

1. The amount of funds that minority shareholders are willing to put into the firm is very sensitive to the productivity differential. This high sensitivity results in that the value foregone by the entrepreneur if he blocks a takeover is large when compared to the private benefits \( B \) gained.

2. The productivity differential \( y^R_2 - y^E_2 \) is small relative to \( B \) so that the necessary condition for disagreement is satisfied \( (B \geq \pi(y^R_2 - y^E_2)) \).

There is clearly a tension between these two requirements, as the first one calls for a small value and the second for a large value of \( B \). The question of whether the two conditions can be satisfied simultaneously depends on the zero-profit condition, and in particular on the exact
Figure 3: Commitment Device. The raider is so much more productive than the entrepreneur, that the entrepreneur wants to commit himself at date 0 to not block a control transfer in the future. The mechanism to solve this commitment problem is to distort $\alpha$ downwards, generating an overselling with respect to his optimal choice.

Functional form of $f(\alpha)$.\(^{18}\)

III.6 Summary of Results

It has been established through Propositions 1-3 that absent the disagreement arising from the forced early exit of the venture capitalist, both the entrepreneur and the venture capitalist would choose to undersell at the IPO and under-invest in the project. The intuition for this result is that the entrepreneur and the venture capitalist do not fully appropriate the marginal gains from investing, since this investment comes at the cost of diluting the fraction of the project that remains in their hands.

Once the disagreement between both players is taken into account, we find that it is possible that both the entrepreneur and the venture capitalist choose to manipulate the fraction of shares sold at the IPO by deviating from the optimal choice in order to influence the blocking

\(^{18}\)Providing a complete characterization is beyond the scope of this paper and would come at the cost of assuming either a certain functional form or more restrictive assumptions on $f(\alpha)$. 

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power of the entrepreneur. These deviations may sometimes have the entrepreneur and the venture capitalist pulling into opposite directions because they fundamentally disagree on who would be the best manager for the firm. Interestingly, the entrepreneur would sometimes choose to distort into the direction of over-selling (normally favored by the venture capitalist) in order to prevent his second period self from blocking a takeover. This arises as a solution to a commitment problem of the entrepreneur.

IV Empirical Evidence

In this section we turn to data of the US IPO market for the period 1994-2005. The objective of the section is to establish whether the model captures the features of the relationship of entrepreneurs and venture capitalists in an IPO.

IV.1 Data Description

We construct a data set for the US-IPO market (NYSE/AMEX/Nasdaq) for the period 1994-2005. We attempt to cover the whole universe of IPOs in that period. We obtain the identities of the firms that go through an IPO from from the Security Data Corporations - Global New Issues database (SDC) and IPODATA, a commercial vendor. The universe for the period 1994-2005 consists of a total of 4618 Initial Public Offerings, largely concentrated in the high-tech and health care industries. The information on ownership of venture capitalists are available from IPODATA. For each venture-backed IPO firm, our data contains the name of the venture capitalist, and the ownership share in the firm. Insider ownership prior and after IPO and financial variables are obtained from the SDC data set.

The data set merges the venture capitalist holdings prior to the IPO with the data on the insider ownership structure. In the sample, 42% of the IPO firms have a venture capitalist as one of its pre-IPO main shareholders. During 1994-2005 the percentage of venture-backed

\[^{19}\text{The commercial vendor’s web page is available at http://www.ipodata.com.}\]
issues fluctuated between 35% in 1999 and 48% in 2004 and peaked at 62% in 2000. The average pre-IPO ownership share of venture capitalists is 54%.

Table 4 presents the main indicators by industry using the Fama-French classification (Fama and French 2004). It includes six main categories: (1) consumer goods, (2) industrials, (3) high-tech, (4) health care, (5) other non-financial and (6) financial. As in their study, we will exclude financial institutions from our analysis. Consumer goods includes durables and non-durables and services. Industrials includes manufacturing (other than computer-related and pharmaceutical industries), utilities, and transportation. High-tech refers to the computer-related industries, telecommunication, and internet firms. Health care includes biotechnology and pharmaceutical firms.

Table 4: VC participation per industries

<table>
<thead>
<tr>
<th>Sector</th>
<th>Total IPO</th>
<th>VC backed IPO</th>
<th>VC Ownership share</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - Consumer goods</td>
<td>490</td>
<td>36.1%</td>
<td>55.5%</td>
</tr>
<tr>
<td>2 - Industrial</td>
<td>327</td>
<td>44.9%</td>
<td>63.7%</td>
</tr>
<tr>
<td>3 - High-tech</td>
<td>1283</td>
<td>46.2%</td>
<td>51.2%</td>
</tr>
<tr>
<td>4 - Health care</td>
<td>412</td>
<td>64.8%</td>
<td>53.2%</td>
</tr>
<tr>
<td>5 - Other non-financial</td>
<td>1348</td>
<td>34.7%</td>
<td>32.9%</td>
</tr>
<tr>
<td>6 - Financial</td>
<td>282</td>
<td>32.6%</td>
<td>34.8%</td>
</tr>
</tbody>
</table>

The venture-backed IPO is more common in high-tech and health care industries, especially at the peak of the previous boom in 1999-2000. The pre-IPO ownership of venture capitalist is higher in those industries.

The model links the fraction of shares sold at an IPO (1 − \(\alpha\) in the model) to the initial insider ownership structure (\(\beta\) in the model). The two pieces of information are available in our constructed data set. We measure \(\alpha\) as the insider ownership after the IPO in the SDC database. We calculate \(\beta\) as the percentage of insider shares before the IPO (from the SDC database) minus the percentage owned by venture capital (from IPODATA).

We exclude financial firms (SIC codes 6000-6999) from the analysis. IPOs of financial firms
const primarily of spin-offs of existing publicly-held companies, and fall outside the scope of our model. Further, as our model implicitly assumes a one to one relationship between ownership share and decision power within the firm, we exclude all firms with dual-class shares or differentiated voting schemes from the sample.

We use several financial firm-level and industry variables as controls.

- \( \log(\text{assets}) \): Log of total assets of the firm pre-IPO (SDC).
- \( \log(\text{debt}) \): Log of total debt of the firm pre-IPO (SDC).
- \( \log(\text{equity}) \): Log of total equity of the firm pre-IPO (SDC).
- \( Q \): Tobin’s Q of the firm pre-IPO (SDC).
- \( \text{AmenityDummy} \): Dummy variable that takes value 1 for media industries and professional sports (industries where the private benefits of control can be expected to be abnormally high). The hypothesis is that in industries with amenity potential, entrepreneur should be less willing to give up control, increasing \( \alpha \) (Demsetz and Lehn 1985).
- \( \text{Industry Dummies} \): Industry categories as defined by Fama and French (2004).

Table 5 details how many observations are available for our purposes out of the universe of 4618 IPOs.

<table>
<thead>
<tr>
<th>Observations</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial observations</td>
<td>4618</td>
</tr>
<tr>
<td>of those, with data for ( \alpha ) and ( \beta )</td>
<td>2040</td>
</tr>
<tr>
<td>of those, non-financial</td>
<td>1815</td>
</tr>
<tr>
<td>of those, with common class shares</td>
<td>1643</td>
</tr>
<tr>
<td>of those, with complete firm-level data</td>
<td>904</td>
</tr>
</tbody>
</table>

Table 5: Loss of observations
IV.2 The Evidence on the Relationship between $\alpha$ and $\beta$

We now turn to study the linear association between our measure of $\alpha$ and the firm-level variables. To do that, a version of Table 1 translated into $\alpha$ and $\beta$ is presented in Table 6. There seems to be a strong correlation between $\alpha$ and $\beta$, especially when compared to the correlation between $\alpha$ and the other variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pairwise correlation with $\alpha$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>0.49 **</td>
</tr>
<tr>
<td>log(Assets)</td>
<td>-0.05 *</td>
</tr>
<tr>
<td>log(Debt)</td>
<td>-0.06 *</td>
</tr>
<tr>
<td>log(Equity)</td>
<td>-0.03</td>
</tr>
<tr>
<td>Tobin’s Q</td>
<td>-0.02</td>
</tr>
<tr>
<td>Amenity Dummy</td>
<td>0.04</td>
</tr>
</tbody>
</table>

* Significant at 5%. ** Significant at 1%.

The relationship between $\alpha$ and $\beta$ is not necessarily linear. Our model predicts that the relationship may have a non-linear form if the necessary condition for disagreement is satisfied. In Table 7 we investigate the empirical nature of this relationship by partitioning the values of $\beta$ into five intervals and calculating the correlation between $\alpha$ and $\beta$ in each one of them.

<table>
<thead>
<tr>
<th>Interval for $\beta$</th>
<th>Correlation between $\alpha$ and $\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 – 0.2</td>
<td>-0.21 **</td>
</tr>
<tr>
<td>0.2 – 0.4</td>
<td>0.09</td>
</tr>
<tr>
<td>0.4 – 0.6</td>
<td>0.37 **</td>
</tr>
<tr>
<td>0.6 – 0.8</td>
<td>0.31 **</td>
</tr>
<tr>
<td>0.8 – 1.0</td>
<td>0.32 **</td>
</tr>
</tbody>
</table>

** Significant at 1%.

These are of course just pairwise correlations, and do not control for other variables. We take
the results in Table 7 as an indication that a quadratic specification for the right hand side of our regression is warranted.

IV.2.1 Econometric Estimation

Consequently, we proceed to estimate the coefficients $b_j$ in following reduced-form equation:

$$\alpha_{i,t} = b_0 + b_1 \beta_{i,t} + b_2 \beta_{i,t}^2 + b_3 X_i + b_4 X_t + b_5 D_t + \epsilon_{i,t}$$

Where $\alpha_{i,t}$ is fraction of firm kept by the initial owners of firm $i$ that goes public at date $t$, $\beta_{i,t}$ the pre-IPO ownership share of the entrepreneur, $X_i$ are firm characteristics, $X_t$ industry variables and $D_t$ time dummies. We include the quadratic term as explanatory variable to capture the potential non-linear effect on $\alpha$ as indicated in the model.

$X_i$ includes a set of firm characteristics as control variables. They include the Q-value, capital structure and the Amenity Dummy. The capital structure includes the portion of equity and debt as they may influence the size of an IPO.

Regression results are presented in Table 8. The specification in Column 1 of Table 8 presents a regression of $\alpha$ on firm-level variables (excluding beta) and time and industry dummies. Column 2 regresses alpha on beta, both linearly and quadratically, and the industry and time dummies. Columns 3-5 present estimations adding firm-level variables to the estimation in Column 2. Column 3 excludes both time and industry dummies. Column 4 includes time dummies but excludes industry dummies. Finally, Column 5 includes all variables and dummies.

The estimated coefficients on $\beta$ and $\beta^2$ are significant in all specifications, suggesting that the quadratic relationship is robust to the inclusion of different explanatory variables. The point estimate of the coefficient on $\beta$ ranges between -0.23 and -0.32 in all specifications. The estimates of the coefficient of $\beta^2$ are uniformly positive and range between 0.55 and 0.61. Of the firm level variables, Log(Assets) and Log(Debt) are significant with a positive estimated coefficient for Log(Assets) and a negative coefficient for Log(Debt). The Amenity Dummy is
not significant in any of the specifications.

Table 8: Regression Results

<table>
<thead>
<tr>
<th>Dep. var.: alpha</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>beta</td>
<td></td>
<td>-0.23</td>
<td>-0.32</td>
<td>-0.26</td>
<td>-0.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-3.77)**</td>
<td>(-4.03)**</td>
<td>(-3.09)**</td>
<td>(-3.11)**</td>
</tr>
<tr>
<td>beta^2</td>
<td></td>
<td>0.55</td>
<td>0.61</td>
<td>0.57</td>
<td>0.58</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(11.19)**</td>
<td>(9.29)**</td>
<td>(8.48)**</td>
<td>(8.76)**</td>
</tr>
<tr>
<td>Q</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>(1.95)</td>
<td>(1.96)</td>
<td>(1.85)</td>
<td>(1.47)</td>
<td></td>
</tr>
<tr>
<td>log(Assets)</td>
<td>-0.00</td>
<td>-0.01</td>
<td>0.03</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td>(-0.08)</td>
<td></td>
<td>(2.44)*</td>
<td>(2.63)**</td>
<td>(2.80)**</td>
</tr>
<tr>
<td>log(Debt)</td>
<td>0.00</td>
<td></td>
<td>-0.01</td>
<td>-0.01</td>
<td>-0.01</td>
</tr>
<tr>
<td></td>
<td>(0.84)</td>
<td></td>
<td>(-3.42)**</td>
<td>(-3.38)**</td>
<td>(-2.66)**</td>
</tr>
<tr>
<td>log(Equity)</td>
<td>0.00</td>
<td></td>
<td>-0.04</td>
<td>-0.04</td>
<td>-0.04</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td></td>
<td>(-0.70)</td>
<td>(-1.08)</td>
<td>(-1.58)</td>
</tr>
<tr>
<td>Amenity</td>
<td>0.11</td>
<td></td>
<td>-0.04</td>
<td>-0.04</td>
<td>-0.03</td>
</tr>
<tr>
<td></td>
<td>(0.94)</td>
<td></td>
<td>(-0.72)</td>
<td>(-0.44)</td>
<td>(-0.27)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.47</td>
<td></td>
<td>0.31</td>
<td>0.33</td>
<td>0.31</td>
</tr>
<tr>
<td></td>
<td>(6.63)**</td>
<td>(5.24)**</td>
<td>(10.47)**</td>
<td>(5.45)**</td>
<td>(5.22)**</td>
</tr>
<tr>
<td>Industry Dummies</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Time Dummies</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Observations</td>
<td>1075</td>
<td>1643</td>
<td>904</td>
<td>904</td>
<td>904</td>
</tr>
<tr>
<td>R-Squared</td>
<td>0.03</td>
<td>0.40</td>
<td>0.39</td>
<td>0.41</td>
<td>0.42</td>
</tr>
</tbody>
</table>

Robust t-statistics in parentheses. * Significant at 5%. ** Significant at 1%.

IV.3 Lessons for the Model

By fitting $\alpha$ to a quadratic expression of $\beta$ and finding a significative positive coefficient for the quadratic term we conclude that the fraction of shares held by the venture capitalist affects the size of the IPO, just as our model predicted. We are also able to tentatively discard some of the cases of the model.
A look at Figure 4 suggests that the case depicted in Figure 1 and the choice of the entrepreneur in Figure 2 are not warranted by the data. Based on these results, we therefore conclude that it is either the venture capitalist that chooses the fraction of shares sold at the IPO or that it is an entrepreneur who is choosing the amount of shares in order to solve a commitment problem. Within the framework of our model, it appears that the threat of a future takeover affects the size of an IPO.

V Conclusions

We set out to study the conflict between different pre-IPO blockholders in a firm and its impact on the fraction of the firm sold at the IPO.
We depart from previous studies of IPOs by abandoning the view of the firm as a monolithic structure. We explicitly take into account the existence of more than one deciding agent at the time of the IPO by focusing on a firm jointly owned by an entrepreneur and a venture capitalist. These two players differ in their objectives for the IPO as they do not share a common time horizon: the venture capitalist plans to exit the firm shortly after going public, using the IPO as an exit strategy. In our model, the disagreement between the two parties inside the firm yields the consequence that both the entrepreneur and the venture capitalist choose to manipulate the fraction of shares sold at the IPO by deviating from their productively efficient choice in order to influence the possibility of blocking future takeovers. We characterize how these deviations depend on environmental and preference parameters.

We then confront our model to the real world, using US data from the SDC - Global New Issues database for the period 1994-2005. We perform an empirical analysis to study how the composition of initial ownership of the firm by the entrepreneur and the venture capitalist affect the size of the IPO. The empirical evidence shows a non-linear relationship between these two variables. We estimate a regression controlling for firm-level and industry variables. Within the framework of our model the data tells that the size of the IPO is distorted into the direction of overselling at the IPO. This is the direction generally favored by the venture capitalist, as it precludes the entrepreneur from inefficiently blocking future takeovers.

As a more general point, the empirical findings suggest that the threat of a future takeover coupled with the disagreement of shareholders within the firm are important in shaping the decision of an IPO. We conclude that the unsynchronized dismantlement of a joint venture has an effect on the size of an IPO.
References


Lam, Raphael. 2006. “Should I stay (private) or should I go (public)? Cross Sectional IPO Activity in the U.S.”


APPENDIX: Proofs

Lemma 1

Proof Equation (4) and Assumption 2 together yield the following system of two simultaneous equations.

\[
\begin{align*}
    c &= (1 - \alpha) \left\{ y_1(\alpha, c) + \bar{y}_2^R + I_1 I_2 \left[ y^E - \bar{y}^R \right] \right\} \\
y_1(\alpha, c) &= f(\alpha) c
\end{align*}
\]

Solving this system with \( \alpha \) as a parameter and \( c \) and \( y_1(\alpha, c) \) as the two variables delivers the desired result. Q.E.D.

Proposition 1

Proof The Planner would give the management to the most efficient agent in the second period. She is able to transfer the control without having to care about whether the entrepreneur wishes or can block the takeover. Therefore, \( \alpha \) is chosen to simply maximize \( y_1(\alpha) \). This amounts to the following problem:

\[
\max_{\alpha \in [0,1]} \frac{(1 - \alpha)f(\alpha)}{1 - (1 - \alpha)f(\alpha)}
\]

The first order condition yields

\[
-\frac{f(\alpha) + (1 - \alpha)f'(\alpha)}{(1 - (1 - \alpha)f(\alpha))^2} = 0
\]

which implies

\[
1 - \alpha = \frac{f(\alpha)}{f'(\alpha)}
\]

the desired result. To make sure that this is a maximum, the second order condition must be checked. Before doing that consider the question of uniqueness. We prove uniqueness of \( \alpha^* \) by studying the properties of the left hand side (LHS) and right hand side (RHS) of equation \( 1 - \alpha = \frac{f(\alpha)}{f'(\alpha)} \). The LHS is monotonically decreasing with slope \(-1\) and takes on all values in the range \([0,1]\). Given Assumption 2, the RHS is also contained in the range \([0,1]\), and for there to be a unique crossing point, it is necessary that the slope be larger than \(-1\). For this to hold,

\[
\frac{\partial RHS}{\partial \alpha} = \frac{[f'(\alpha)]^2 - f(\alpha)f''(\alpha)}{[f'(\alpha)]^2} > -1
\]

which implies

\[
\frac{f(\alpha)f''(\alpha)}{[f'(\alpha)]^2} < 2
\]

The condition is satisfied since \( 0 < \frac{f(\alpha)}{f'(\alpha)} \leq 1 \) and \( \frac{f''(\alpha)}{f'(\alpha)} < 2 \) from Assumption 2. Turning back to the second order condition, after some simplification, the second order condition for a maximum turns out to be

\[
\frac{(1 - \alpha)f''(\alpha) - 2f(\alpha)}{(1 - (1 - \alpha)f(\alpha))^2} < 0
\]
Canceling the quadratic term, using the first order condition to substitute for $1 - \alpha$ and rearranging, we are left with

$$\frac{f(\alpha)f''(\alpha)}{[f'(\alpha)]^2} < 2$$

This condition is clearly satisfied since it is equivalent to the condition which was shown to hold for uniqueness. Q.E.D.

**Proposition 3**

**Proof**

Substituting the expression for $y_1(\alpha)$ from Lemma 1 into the maximization problems of the entrepreneur and the venture capitalist,

$$V^E = \max_{\alpha \in [0,1]} U^E = \max_{\alpha \in [0,1]} \frac{\alpha \beta}{1 - (1 - \alpha)f(\alpha)} \left[ y^R_2 + I_1 I_2 \left( y^E_2 - y^R_2 \right) \right] + I_1 I_2 B$$

$$V^{VC} = \max_{\alpha \in [0,1]} U^{VC} = \max_{\alpha \in [0,1]} \frac{\alpha (1 - \beta)}{1 - (1 - \alpha)f(\alpha)} \left[ y^R_2 + I_1 I_2 \left( y^E_2 - y^R_2 \right) \right]$$

Absent control issues, the indicator functions can be disregarded (they will either be 1 or 0), but the decisionmaker will not try to manipulate them. The maximization problem to be solved by either the entrepreneur or the venture capitalist have the form:

$$V^i = \max_{\alpha \in [0,1]} \frac{\alpha}{1 - (1 - \alpha)f(\alpha)} K_1^i + K_2^i, \quad i \in \{E, VC\}$$

where $K_1^i > 0$ and $K_2^i \geq 0$ are constants. The first derivative of the above expression yields

$$D(\alpha) \equiv \frac{\partial}{\partial \alpha} \left[ \frac{\alpha}{1 - (1 - \alpha)f(\alpha)} K_1^i + K_2^i \right] = \left[ \frac{1}{1 - (1 - \alpha)f(\alpha)} - \frac{\alpha (f(\alpha) - (1 - \alpha)f'(\alpha))}{(1 - (1 - \alpha)f(\alpha))^2} \right] K_1^i$$

We will only be interested in the sign of this derivative,

$$\text{sign}[D(\alpha)] = \text{sign} \left[ 1 - (1 - \alpha)f(\alpha) - \alpha (f(\alpha) - (1 - \alpha)f'(\alpha)) \right]$$

Evaluate this expression at $\alpha^*$

$$\text{sign}[D(\alpha^*)] = \text{sign} \left[ 1 - (1 - \alpha^*)f(\alpha^*) + \alpha^* (f(\alpha^*) - (1 - \alpha^*)f'(\alpha^*)) \right] > 0$$

This, because of the concavity of the objective function at the maximum, then implies that $\hat{\alpha} > \alpha^*$ has to be chosen to satisfy the first order condition for a maximum $D(\hat{\alpha}) = 0$. Q.E.D.