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ABSTRACT

In this dissertation we collate a unique hand-collected dataset of 417 IPO firms for the 2001 to 2004 period, and study the effectiveness of governance and signaling mechanisms at an IPO. In chapter 1 our main contention is that current management research on IPOs has primarily looked at how corporate governance variables like board composition and ownership structure affect IPO underpricing, while largely overlooking the implications of these governance structures for long-term liquidity. This is a significant oversight, given the many benefits to IPO issuers from having a liquid stock (e.g., reduced cost of capital, increased external monitoring etc.). We find that both pre-IPO ownership structures and the degree of underpricing affect aftermarket liquidity. More specifically, the information advantages of large ownership reduce stock liquidity, while increased liquidity following greater underpricing underlines a key benefit of underpricing that has been previously ignored. We are therefore able to present a fuller picture of pre-IPO ownership and underpricing and their long term performance implications. In chapter 2 we look at how signaling at the time of IPO certifies firm quality and helps address the adverse selection problem for uninformed investors. We contend that classifying signals according to common characteristics (like cost) has significant managerial implications in terms of whether, when and how much firms need to invest in developing signals, and how these decisions are likely to influence subsequent firm performance. We then contribute to the literature by proposing a typology of signals based on whether signaling costs are incurred upfront (default-independent) or whether they depend on future profitability (default-contingent). We

argue that this definitional distinction highlights more fundamental differences in the underlying characteristics of the two signal types in terms of cost, clarity, consistency, commitment and visibility. Only default-independent signals usually possess these desirable characteristics, making them more powerful determinants of firm value than default-contingent signals.

SYRACUSE UNIVERSITY

TWO ESSAYS ON GOVERNANCE IN IPO FIRMS

A dissertation submitted in partial fulfillment of the requirements for the degree of

Doctor of Philosophy in Management

Palash Deb

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I am a hopeless bankrupt when it comes to indebtedness. I am deeply indebted to my advisor Prof. Ravi Dharwadkar, who introduced me to the very idea of corporate governance that is the basis of much of my current and future research agenda. The personal time and effort he has invested to mentor me throughout the PhD program have been much beyond the formal requirements of his role as advisor. I therefore want to thank him for all his support. I am also grateful to Prof. Pamela Brandes for her generous time and attention to the ongoing projects I am working with her. I have learnt a lot from Prof. Natarajan Balasubramanian, and my second dissertation paper would not be possible without his constructive comments about the idea and his help in obtaining the patents data. Prof. Don Harter helped me develop my skills in research methods, and I have tried to apply a few of the things I learnt in his class to the present dissertation. I am also indebted to Prof. Dennis Gillen, who, as the chair of the management department, always lent me an attentive ear and had a solution for every conceivable issue I faced as a graduate student. I also want to thank all my fellow PhD students and the very supportive staff at Whitman. Finally, I wish to thank my family for their unstinted support all through.

CHAPTER 1

CORPORATE GOVERNANCE, UNDERPRICING, AND STOCK LIQUIDITY IN IPO FIRMS

1.1. INTRODUCTION

1.1.1. The IPO underpricing context.

The initial public offering (IPO) context has proved very fruitful to management scholars keen on studying the complexities managers face in making a firm public. Such complexities arise from the multiplicity of actors (like venture capitalists, underwriters, IPO firm's board of directors, investors etc.) with differing perspectives and goals, as well as from the information asymmetry and uncertainty that inevitably accompany any new issue. For example, the board may wish to retain control post-IPO and to leave as little money on the table as possible, the venture capitalist may want to cash out of the venture as quickly as possible, the underwriter may want to minimize its risks, and the retail investor may try her best to avoid a lemons problem. Given these conflicting priorities and the liability of newness, one of the most crucial decisions IPO firm managers make concerns underpricing, or the deliberate decision to set an offer price which is lower than the expected closing price of the issue after the first day's trading. A vast literature in finance has examined this first-day underpricing of IPOs (for review, see Ritter and Welch, 2002). The IPO underpricing phenomenon also finds increased mention in the management literature (e.g., Arthurs, Hoskisson, Busenitz, and Johnson, 2008; Certo, Covin, Daily, Cannella and Dalton, 2003; Higgins and Gulati, 2005). In particular, management research has looked at how corporate governance mechanisms like ownership and board structures, founder status and compensation contracts affect the pricing of new offerings. Here we first contend that the underpricing decision, because of this complexity, presents the IPO manager with a rather intractable problem. Next, we introduce long-term stock liquidity, and empirically test its relationship with both underpricing and the pre-IPO board ownership structure. In doing so, we seek to provide a clearer picture to the IPO manager of the long-term implications of managerial decisions made on the eve of the IPO. We believe that by looking at the underpricing problem in its totality, the IPO firm manager will be able to take better and impartial decisions when faced with the conflicting demands of various interest groups.

1.1.2. The advantages of stock liquidity.

It is important in this context to understand the importance of stock liquidity. Ensuring high stock liquidity is often considered one of the most important objectives of any IPO (e.g., Pham, Kalev and Steen, 2003). Liquidity is the ease of trading a security (Amihud, Mendelson and Pedersen, 2005). The liquidity of stock trading plays a very important role in empirical asset pricing, market efficiency and corporate finance (Goyenko, Holden, Lundblad and Trzcinka, 2009). Higher trading liquidity reduces the transactions costs of future equity issues (Ibbotson and Ritter, 1995), decreases required returns and increases firm value (Amihud and Mendelson, 1986), and also enables effective market monitoring and stronger managerial incentives by incorporating greater information in stock prices (Holmstrom and Tirole, 1993). Liquid secondary markets also facilitate acquisitions for IPO firms, and allow the pre-IPO owners to enhance the value of their equity holdings (Brau and Fawcett, 2006). A lack of liquidity (“illiquidity”), on the other hand, implies that transactions costs - comprising price impact costs (the price concession that a buyer or a seller of security makes when trading, which is the same as the bid-ask spread for small orders), search and delay costs (when a trader looks for a price better than that quoted on the market) and direct trading costs (exchange fees, taxes and brokerage)go up. This leads to the absence of continuous trading due to an imbalance in the number of buyers and sellers in the capital markets at a given time (Demsetz, 1968), not allowing pre-IPO owners to cash out of the business when necessary.

1.1.3. Stock liquidity as a dependent variable.

In spite of the importance of liquidity in decreasing the cost of capital and increasing the firm's net present value, and the fact that stock liquidity can, at least be in part, be determined by the actions of the manager (as we show in this paper), little research in management has looked at stock liquidity as a dependent variable. One important exception is Levitas & McFadyen (2009), who look at how the signaling and cash flow properties of patents and alliance forms affect a firm's need for liquid asset holdings. Their outcome variable is internal liquidity, defined as a firm's cash and marketable securities divided by the book value of its total assets. Another paper by Schnatterly, Shaw & Jennings (2008) looks at how the percentage of shares owned by the largest institutional owner increases the bid-ask spread in share prices (which acts as a proxy for the perceived information risk of the market-maker). In the finance literature, on the other hand, the bid-ask spread has more often been used as a proxy for a firm's liquidity – the higher the spread, the lower the liquidity. Here we look at the external rather than the internal liquidity of a firm's stock, explain movements in stock liquidity by looking at the bid-ask spread, and directly measure liquidity using commonly employed proxies like the Amihud measure. Notwithstanding the very different worldviews of financial economics and strategic management research (Lane, Cannella and Lubatkin, 1999), early studies have argued in favor of integrating the financial paradigm into strategic management research (e.g. Sandberg, Lewellen and Stanley, 1987). Indeed, as Kochhar (Pg. 714, 1996) mention, “a common viewpoint held by all is that financial decisions are important from a strategic perspective, and should be included in the domain of strategic management research”. Here we follow this tradition, and add to the strategic management literature by integrating concepts from finance and management.

1.1.4. Liquidity and external governance.

Our study also adds to the corporate governance literature. Most governance research in the IPO context has looked at internal governance mechanisms like board structure, stock options, ownership etc. Yet, as Dharwadkar, George & Brandes (Pg. 652, 2000) point out, “strong external control mechanisms are associated with the Anglo-American model of corporate governance, where shareholders are comparatively passive with respect to internal control mechanisms”. These external governance mechanisms include hostile takeovers, proxy contests, leveraged buy-outs and the legal protection of minority shareholder rights (Walsh and Seward, 1990). Also, the effectiveness of these external or market-based governance mechanisms depends in large measure on the liquidity of secondary equity markets (Tadesse, 2005). Liquidity promotes price discovery i.e. stock prices more accurately reflect the firm’s true state of affairs (Holmstrom and Tirole, 1993), enables the more active investors to build large positions and thereby put pressure on firm management for better firm governance (Maug, 1998), and facilitates the market for corporate control by allowing bidders to raise large amounts of capital at short notice (Tadesse, 2005). Therefore, by looking at the role of stock liquidity as an indirect proxy for external corporate governance, this paper also examines the implications of the underpricing decision for long-term firm monitoring and control.

1.1.5. IPO underpricing – causes and implications.

Lastly, we add to the IPO literature on underpricing. This literature takes several theoretical approaches, which can broadly be classified as asymmetric information approaches, institutional approaches, and ownership and control approaches (Jenkinson and Ljungqvist, 2001 – see Appendix A). The asymmetric information approach includes underpricing models based on adverse selection or the winner's curse (Rock, 1986), signaling (Grinblatt and Hwang, 1989; Ibbotson, 1975), principal-agent relations (Baron, 1982) and information revelation (Benveniste and Spindt, 1989). Institutional underpricing models include the legal insurance hypothesis (Hughes and Thakor, 1992) and the price support hypothesis (Ruud, 1991). Ownership and control theories view underpricing as a means to retain managers' private benefits of control (Brennan and Franks, 1997) or to cut down on agency costs (Stoughton and Zechner, 1998). However, most of this research on IPOs has focused on explaining the causes of first-day underpricing, while very little research has looked at the implications of underpricing for stock liquidity. Similarly, while the impact of the board's ownership structure on underpricing has been examined (e.g., Arthurs et al., 2008), no study has been done on the impact of these corporate governance variables on the long-term liquidity of the IPO firm. In this paper, we introduce aftermarket or secondary market liquidity (defined here as liquidity a year after the date of the IPO) as the missing link in the IPO underpricing puzzle, and thereby seek to present a more complete picture of this phenomenon. Our findings confirm that underpricing at the time of the IPO reduces long-term stock liquidity. We also find that the presence (at the pre-IPO stage) of outside directors with equity reduces long-term liquidity both directly (as we explain later) and indirectly (by reducing underpricing).

1.2. THEORY

1.2.1. Formal underpricing theories.

Two primary concerns relating to IPOs have come to the fore – the initial underpricing of IPO offerings and the long-term underperformance of IPOs (Gompers and Lerner, 2003; Ritter, 1991). Several theoretical perspectives have been advanced to explain these phenomena. Life-cycle theories, for example, indicate that firms go public when they reach a certain stage of their life-cycle (Zingales, 1995), while market-timing theories suggest that IPOs are issued when the market is strong. In both cases, the persistence of first-day underpricing cannot be explained merely in terms of compensating the risk-averse investor for transactions costs (bid-ask spread) in the market. Starting with Ibbotson (1975), more formal theories (which we briefly mentioned in the introduction) have emerged to explain this apparent anomaly. In this paper we borrow ideas from two of these theories, the information asymmetry perspective and the ownership and control perspective, to develop a holistic model of IPO underpricing.

1.2.2. Information asymmetry.

Our first theoretical lens is the asymmetric information perspective which states that there is an ex-ante uncertainty associated with IPOs arising out of factors like company age, offering characteristics, disclosure in the prospectus, underwriter reputation etc. (Beatty and Ritter, 1986). Information asymmetry is high in young, growth firms (Barabanov and McNamara, 2002). The problem is accentuated when market makers have to deal with informed traders (like inside directors with equity). Uninformed investors fear the winner's curse - receiving the full quota of unattractive offerings while facing competition from informed investors for the attractive offerings (Rock, 1986). [1] We base our hypotheses on a common proxy for liquidity, namely price impact (for standardized transactions the price impact is the bid-ask spread). We aver that liquidity is sticky, and therefore the influence of ownership structure and underpricing on premarket liquidity (i.e. liquidity in the market immediately following the IPO) is carried over to the aftermarket. Besides, information asymmetry is present not only in the premarket, but also in the aftermarket (Chen and Wilhelm, 2005). [2] This information asymmetry in the aftermarket further reduces stock liquidity as market makers react to increased trading costs by increasing bid-ask spreads and reducing quoted depths (Heflin and Shaw, 2000). We primarily use the asymmetric information perspective (though we also combine it

[1] Another strand within the asymmetric information approach assumes that underpricing is done in order to signal firm quality, so that potential investors are convinced of the real high value of the firm (Allen and Faulhaber, 1989; Grinblatt and Hwang, 1989).

[2] The uncertainty in the IPO aftermarket also depends, among other things, on how much information was disclosed at the IPO stage, which in turn depends on the IPO method used (bookbuilding, for example, elicits greater information than the fixed-price method).

with the trading or free-float hypothesis, as explained later) to understand the causes of illiquidity.

1.2.3. Ownership and control.

Our second theoretical lens is the ownership and control perspective (Brennan and Franks, 1997; Stoughton and Zechner, 1998). We contend that the impact of ownership structure and underpricing on post-IPO liquidity has long-term implications for market monitoring (i.e. by outside blockholders post-IPO) and control (i.e. of pre-IPO owners). However, current findings are conflicting in this regard. First, the ownership structure-liquidity relation predicts a trade-off between internal monitoring and control (by pre-IPO insiders owning equity) and liquidity (which ensures external monitoring by institutional investors). Concentrated ownership by pre-IPO owners resolves an immediate agency problem (by reducing underpricing), but it also reduces stock liquidity, which in turn hinders long-term market monitoring by outside blockholders (by incorporating lesser information in stock prices - Holmstrom and Tirole, 1993) and enables pre-IPO large owners to retain their private benefits of control. This view is supported by Maug (1998) who contends that liquidity enables market monitoring, as institutional investors can buy large blocks of shares which give them both the ability and the incentive to monitor. Second is the underpricing-liquidity perspective. Underpricing creates a dispersed ownership structure (via oversubscription and rationing) which promotes secondary market liquidity. However, ownership dispersion creates a free-rider problem and minimizes the possibility that outsiders will monitor firm management (Brennan and Franks, 1997). This view finds support from Bhide (1994) who states that liquidity promotes arm's length shareholding, and large investors prefer exit to voice. To sum, there is some consensus in the literature that ownership concentration reduces liquidity while underpricing increases liquidity; however, there is no consensus on whether liquidity promotes or hinders market monitoring. In other words, the ownership-monitoring-control theoretical lens well explains what causes illiquidity, but offers mixed results regarding its implications for monitoring (by outside blockholders like institutions) and retention of control (by pre-IPO large owners like directors). However, we still contend that ensuring long-term liquidity is a desirable objective for IPO issuers, given the many other benefits of liquidity we discussed earlier.

1.3. HYPOTHESES

1.3.1. Inside directors and underpricing.

The directors of an IPO firm want to reduce underpricing, as not doing so results in money left on the table both for themselves (depending on the number of shares they sell during the IPO) and for the firm (Arthurs et al., 2008). This motivation to retain wealth further increases when directors own equity stakes in the firm. Equity ownership by directors creates a psychological attachment to the organization, aligning owner interests with the interests of the firm (Jensen and Meckling, 1976). For example, greater equity ownership leads to lesser value-reducing diversification (Denis, Denis and Sarin, 1997). Greater equity ownership also confers greater legitimacy upon the board, which enables firms to influence investor perceptions and raise the required capital (Higgins and Gulati, 2005), since investors are willing to pay more for IPO shares that are backed by the equity commitment of board members. Inside directors also have expert firm-specific knowledge, and are likely to be more innovative and insightful in directing firm strategy. Certo, Covin, Daily and Dalton (2001) discuss the key role inside directors play in reducing underpricing in the specific context of the founder-managed firm, arguing that investment banks do not apply the founder bias discount (which increases underpricing) to insider-dominated boards.

Baysinger and Hoskisson (1990) similarly point out that insiders have a better understanding of environmental uncertainty and the intrinsic worth of the firm, and are therefore in a position to correctly judge the true value of the newly-floated enterprise. Inside directors also possess valuable tacit knowledge regarding the IPO venture, and therefore have both the ability (due to knowledge) and the incentive (due to ownership) to monitor (Kroll, Walters and Le, 2007). However, if we accept Baron’s (1982) contention that the issuer is less informed than the underwriter, the issuer’s discretion in underpricing might be curtailed by underwriters keen to increase underpricing in order to allocate those underpriced shares to their favored buy-side clients (Loughran and Ritter, 2002; Ritter and Welch, 2002). But when insider ownership is concentrated, insiders have lesser information asymmetry versus underwriters, which increases their relative influence (Chiang and Venkatesh, 1988). Also, firms with greater insider ownership are less risky (Beatty and Zajac, 1994), and therefore can command higher premiums from potential investors.

1.3.2. Outside directors and underpricing.

Turning to outside directors, we find that one of their key roles, viz. resource-acquisition, is primarily done by the venture capitalist and the investment bank at the time of the IPO. Likewise, their role as agents of shareholders is less direct and clear-cut at the time of the IPO, and therefore they may not play a traditional monitoring role (Certo et al., 2001). However, outside directors with equity stakes not only have a financial incentive, but also tend to identify with the IPO firm, making them more vigilant in their oversight (Filatotchev and Bishop, 2002). Outside directors also have their reputations to protect, and therefore have little incentive to collude with other self-serving agents (Fama & Jensen, 1983). As with inside directors, outside director presence acts as a strong signal of firm quality, adding more credibility to the IPO firm (Anderson, Mansi & Reeb, 2004, for example, argue that external parties like creditors place greater reliance on financial statements of firms with a majority of independent directors), and giving firm management greater bargaining power in its dealings with underwriters and venture capitalists. Outsiders' experience and connections also add greater diversity to the board, and makes up for any lack of experience and contacts of the inside directors of a young and growing IPO firm (Filatotchev and Bishop, 2002). In sum, outside directors with equity stakes play a strategic role in reducing underpricing in an IPO firm.

Hypothesis 1a) Greater board insider proportion reduces IPO underpricing
Hypothesis 1b) Greater ownership by board insiders reduces IPO underpricing
Hypothesis 1c) Greater ownership by board outsiders reduces IPO underpricing

1.3.3. Underpricing and liquidity.

One of the key objectives of any IPO is to ensure greater secondary market liquidity (Pham et al., 2003). IPO underpricing is a widely used mechanism to achieve higher aftermarket liquidity. Underpricing can bring about higher liquidity in two ways. First, underpricing acts as an incentive to attract uninformed investors who might otherwise fear the ‘winner’s curse’ and stay away (Rock, 1986). Second, underpricing ensures over-subscription of shares (Brennan and Franks, 1997). This way, current owners can discriminate against large applicants in the allocation process, protecting themselves against possible hostile takeover attempts, and ensuring a dispersed ownership pattern. Greater breadth and diffusion lead to active post-IPO trading and increased liquidity (Booth and Chua, 1996). Besides, liquidity in the secondary market is a path-dependent process so that higher initial liquidity attracts more investors, resulting in a persistently high level of liquidity even in the aftermarket (Carvalho and Tolentino, 2009).

Similarly, Reese (1998) finds that underpriced IPOs have significantly higher trading volume (and hence liquidity) not only during the first week of trading, but for more than three years after the IPO issue date. Here underpricing is used to incentivize potential investors to honestly reveal their interest in the offering (as in Benveniste and Spindt, 1989) so that greater investor interest leads to higher initial returns (in the premarket) and higher trading volumes (in the premarket as well as in the secondary market). Therefore, investor interest explains both the positive relation between underpricing and aftermarket liquidity, as well as its persistence. Zheng, Ogden and Jen (2005) find that underpricing reduces an investor’s reservation bid-ask spread, somewhat offsetting the severe problems of information asymmetry and heterogeneous expectations that accompany an

IPO issue. In the short run, both high and low value investors will be attracted, while in the long run, investors who have already researched the stock will continue to closely monitor it, since they have already made an information investment. Rajan and Servaes (1997) similarly contend that underpriced IPOs have greater analyst following, so that more investors hear of the stock, and it forms ‘part of the subset of tradable securities for a greater number of investors’ (Reese, 1998, pg. 8).

Miller and Reilly (1987), in their study of 510 IPO issues in 1982 and 1983, also find a positive relation between initial returns (higher underpricing) and trading volume (higher liquidity), as do Schultz and Zaman (1994) and Boehmer and Fishe (2001). Miller and Reilly’s contention though is that investor uncertainty (rather than investor interest) drives both greater underpricing and greater trading volume. Boehmer and Fishe (2001), on the other hand, look at underpricing not as a compensation to buy stock which does not have a perfect substitute in the secondary market, but rather as an allocation mechanism to attract low-valuation investors who act as flippers in the secondary market, thereby ensuring aftermarket liquidity. Underpricing can also indirectly facilitate liquidity. For example, underwriters initially go short on a few stocks to ensure price stabilization in the premarket. In the aftermarket, they cover their short position through the purchase of stocks at the issue price, purchase of stocks at the market price, or a combination of both (Carvalho and Tolentino, 2009). These activities, which enhance liquidity both in the premarket and the aftermarket, should be profitable for the underwriter only when she can buy back the stocks at the (underpriced) offer price or at an even lower market price. Underpricing therefore enables the underwriter to act as a market maker and as an active provider of liquidity. Finally, the positive relation between underpricing and liquidity is robust. For example, Hahn and Ligon (2006) find that the underpricing – liquidity relation holds for seven out of ten different measures of liquidity (based on transaction costs, turnover, volume etc.), both before and after the lock-up period, and after conducting a multivariate analysis with twenty different control variables (like trade size, number of trades, market capitalization etc.) that have been found in the literature to affect liquidity.

Hypothesis 2) IPO underpricing increases aftermarket liquidity

1.3.4. Director ownership and liquidity.

Most empirical studies reveal that while large shareholders reduce agency costs by acting as effective monitors (e.g., Shleifer and Vishny, 1986), they also reduce stock liquidity (e.g., Heflin and Shaw, 2000). The negative relation between ownership concentration and market liquidity has been widely documented in the finance literature (Bolton and Thadden, 1998; Chiang and Venkatesh, 1988; Demsetz and Lehn, 1985; Holmstrom and Tirole, 1993). Bolton and Thadden (1998), for example, aver that a reduction in market capitalization is the principal mechanism by which concentrated ownership reduces liquidity. Similarly, Sarin, Shastri and Shastri (2000) find that higher fractional ownership by both insiders and institutional investors increases effective spread and reduces quoted depth (thereby reducing liquidity), even after controlling for any potential endogeneity between ownership and liquidity. Both insiders and institutional investors can own blocks of shares during or immediately after an IPO. Here we focus on the impact of insider ownership, partly because it fits in with the rest of our hypotheses, but also because (a) in an IPO, undiversified inside blockholders (e.g., board members) are more likely to possess value-relevant private information than diversified outside blockholders like institutional investors (Lakonishok and Lee, 2001) and (b) insider ownership during IPOs is typically much higher than for publicly traded firms (Corwin, Harris and Lipson, 2004).

There are two main mechanisms through which insider block ownership can influence the IPO firm's aftermarket liquidity, namely, changing the firm's information environment or changing its trading activity level (e.g., Brockman and Chung, 2009). The adverse selection hypothesis is based on information asymmetry models in the market microstructure literature in which blockholders possess private information, and market makers react to the possibility of loss in dealing with informed traders by increasing bid-ask spreads (more specifically, the adverse selection component of the spread) and lowering quoted depths, thereby reducing stock liquidity (Glosten and Milgrom, 1985; Kyle, 1985). Also, while both inside and outside directors can be 'blockholding insiders' whose presence reduces liquidity, inside directors will likely possess more private information than outside directors with equity (just as both groups possess more information than institutional investors), hence the effect will be greater for greater inside directors' proportion. This so-called 'information friction' effect (Stoll, 2000) aptly applies to IPO firms, which are mostly young and have intangible growth prospects. Under the trading or free-float hypothesis, on the other hand, insider block ownership reduces the IPO firm's trading activity (in terms of the number of trades rather than the trade size) relative to a diffusely-owned firm. This is the 'real friction' effect (Stoll, 2000), wherein the fixed costs component of the spread (comprising order processing and inventory holding costs) goes up as real fixed costs are spread over fewer trades, thereby reducing liquidity (Brockman and Chung, 2009). [3]

Pham et al. (2003) look upon ownership structure as a moderator between underpricing and liquidity. They find that underpricing is positively related to the breadth and equality of the ownership structure formed after the allocation process, and a dispersed ownership structure in turn improves secondary market liquidity (and vice-versa). These results are robust to different specifications of the ownership structure and to different measures of liquidity (trading turnover and bid-ask spread measures). They also argue that monitoring by concentrated owners comes at the cost of liquidity, and the IPO firm decides on its level of underpricing depending on the marginal gains it derives from the resulting ownership structure and liquidity.

Hypothesis 3a) Greater board insider proportion reduces aftermarket liquidity

Hypothesis 3b) Greater ownership by board insiders reduces aftermarket liquidity

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[3] There is also an opposite view which relies on Leland and Pyle's (1977) signaling theory to argue that reduction in trading activity is only one of two possible consequences of high insider ownership. Share retention by pre-IPO owners (both during and after the lock-up period) might actually act as a positive signal to attract more trades, thereby increasing liquidity (Li, Zheng and Melancon, 2005). We ignore this line of argument given the preponderance of evidence in favor of the real friction hypotheses (e.g., Brockman and Chung, 2009; Ginglinger and Hamon, 2007; Rubin, 2007).

Hypothesis 3c) Greater ownership by board outsiders reduces aftermarket liquidity

1.4 METHODS

1.4.1. Sample

We collected data from the prospectuses filed by all firms that undertook IPOs in the U.S. market between 2001 and 2004, for a total of 493 firms, which provided the issue and first-day prices. We also collected data about insider ratios; equity ownership by inside directors, outside directors, and venture capital firms; stock option grants; annual salaries; insiders' age, tenure, presence on other boards, and start-up experience; presence of the founder on the board; and dilution and risk factors. For data about daily stock returns and the daily dollar trading volume, we turned to CRSP and computed the Amihud measure of stock liquidity (see Appendix B). We assessed annual liquidity as the average of daily stock returns to trading volume for all trading days between the date of the IPO and one, two, and three years. Seventy-six firms in our sample had missing data, which yielded a final sample of 417 firms, which is consistent with recent management research in the context of IPOs. For example, Arthurs *et al*. (2008) have a sample size of 307, Bruton *et al*. (2010) have 224, Certo *et al*. (2001) have 368 and Filatotchev and Bishop (2002) have 251.

In spite of 9/11 and the dot com bubble in and around the 2001 period, and the resultant decline in IPO activity in the immediate post-2001 period, we contend that our sample is fairly generalizable and representative of a typical IPO year, for several reasons. While it is true that the number of IPO issues during 2001 – 2003 (not 2004, which had 213 issues included in our sample of 417) was significantly lower compared to the ten years or so preceding 2001 (and somewhat lower than in the post-2004 period), the characteristics of individual IPO issues were not much different. For example, the mean first day return for our IPO sample (2001 – 2004) is 12 percent, comparable to the mean return of 11 percent for the five-year period from 1990 – 1994 (the period used in Arthurs et al., 2008) and expectedly not in line with the bubble period (1999 – 2000) return of 64 percent.

For 3-year buy and hold returns too, our sample (with an average buy-and-hold return of 43 percent) is comparable to periods like 1990 – 1994 (with an average of 46 percent) but not to the bubble period of 1999 – 2000 (average loss of 53 percent). Our sample composition is also fairly representative of the larger population of US IPOs. For example, technology IPOs constitute 36 percent of all IPOs during the entire 1980 – 2010 period; the corresponding figure for 2001 – 2004 is 32 percent. Similarly, the number of IPOs that are backed by venture capital was 35 percent in the 1980 – 2010 period, and 37 percent in our sample. Thus our IPO sample is smaller in terms of the number of IPOs, but is similar to the population in terms of composition of the issue or the return characteristics of the average IPO.

1.4.2. Dependent Variables

IPO underpricing. We use two measures of IPO underpricing, both of which indicate first-day trading period returns. Our absolute measure is the dollar difference between the first-day closing price and the offer price. The relative measure is the first-day closing price, less the offer price, divided by the offer price (e.g., Certo *et al*., 2003). Offer prices were collected from FactSet and closing prices were obtained from CRSP.

Stock liquidity. We used the Amihud liquidity measure (Amihud, 2002; Goyenko *et al*., 2009), which is a low-frequency (e.g., daily) price impact proxy that includes the absolute (or percentage) price change per dollar of the daily trading volume. Following Amihud (2002), we took the natural logarithm of the measure to capture liquidity, defined as follows:

$$\text{Liquidity} = \text{Average}\,[|r_d| \,/\, \text{Volume}_d],$$

where $|r_d|$ is the absolute return on a stock on day d, and Volume_d is the daily volume in dollars. The average is calculated over all non-zero days, and a smaller liquidity value implies a lower price impact.

We calculated average liquidity estimates using daily stock returns and dollar volumes for all trading days during the year after the date of the IPO (see Appendix B).[4] As an illustration, liquidity equals .0005266 for Las Vegas Sands Corporation (an example of high liquidity) and it equals 1.461082 for BAM Entertainment Inc. (an example of low liquidity). To supplement our analyses and check the persistence of liquidity, we computed similar liquidity estimates two years and three years from the date of the IPO issue; we refer to these estimates as aftermarket liquidity. Prior literature uses several liquidity proxies to capture different benchmarks, such as the effective spread, realized

[4]In line with extant research (e.g. Aggarwal and Rivoli, 1990), we assume 250 trading days in a year.

spread, or price impact (Goyenko *et al*., 2009); as we did not have access to bid–ask quotes or intraday trading information, we rely on a well-accepted low-frequency price impact proxy of liquidity.

1.4.3. Independent Variables

Inside director ratio. This ratio is the number of inside directors on the firm's board, divided by the board size. This and all director ownership variables came from the firm's prospectus, part of the Securities and Exchange Commission (SEC) filings in the EDGAR database.

Inside director equity. This ratio indicates the proportion of total shares owned by the inside directors at the time of the IPO.

Outside director equity. This value is the proportion of total shares owned by the outside directors at the time of the IPO. Following Arthurs and colleagues (2008), we exclude affiliated directors (relatives, customers, former employees, lawyers, bankers, and suppliers) from our sample. The sample therefore comprises two types of outside directors: venture backed and non–venture backed. Venture-backed outside directors either own or have full voting power for the shares held by the venture capital firm. Following Baker and Gompers's (2003) definition of outside directors as comprising quasi-outside directors (similar to affiliated directors, whom we exclude) and truly independent outside directors (including public and professional directors, private investors, and venture capitalists), we classify both venture-backed and non–venture-backed outside directors as outside directors, and calculate outside director ownership as the sum of their combined ownership stakes (see also Kroll *et al*., 2007).[5]

1.4.4. Control Variables

Firm size. We control for firm size, because the greater information typically available about larger firms reduces information asymmetry. We assess this variable as the natural logarithm of the number of employees in the IPO firm (Welbourne and Andrews, 1996), and obtained the data from COMPUSTAT.

Firm age. Older firms generally perform better than younger firms, both prior to and after an IPO (Ritter, 1998). We calculate firm age as the natural logarithm of the difference in years between the date of IPO and the firm's founding date, and obtained this data from Jay R. Ritter's website (Ritter, 2003).

Risk factors. To add the risk factors mentioned in the prospectus, we use the summative index recommended by Welbourne and Andrews (1996), which includes

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[5] An example may clarify this tactic. Augustas Tai, an outside director with Blue Nile Inc. (IPO on May 20, 2004), owned 18.6% of Blue Nile's shares outstanding before the IPO. In addition, Trinity Ventures managed 18.6% of the funds. Tai was a general partner of Trinity Ventures, so we included his 18.6% as outside director ownership instead of venture capital ownership. Alternatively, we could consider such ownership venture capital ownership, but we argue that venture-backed outside directors are behaviorally more similar to other equity-owning independent outsiders than to other venture capital firms without board representation. Venture-backed outside directors likely take an active interest in running the IPO firm, play the same monitoring role, and have the same effect on information generation as other blockholding outside directors.

factors such as technological obsolescence, new products, etc. These data were included in the firm's IPO prospectus available through EDGAR.

Firm performance. We use return on assets as a proxy for firm performance (e.g., Michaely and Shaw, 1995) and obtained the data from COMPUSTAT.

Founder. Founders affect the extent of underpricing, so we include the founder as a dummy variable, equal to 1 if the founder sits on the firm's board at the time of the IPO and 0 otherwise (Certo *et al*., 2001). These data were available from the IPO prospectus

Underwriter spread. This per-share fee is charged by the underwriter to float an issue; it represents the risk to underwriters of an offering (Arthurs *et al*., 2008). We use the natural logarithm of the underwriter spread, as obtained from FactSet.

Dilution. Dilution measures the premium, above book value, that new investors pay for the offering. Managers are "less concerned about underpricing when they observe a significant increase in the wealth being raised" (Arthurs *et al*., 2008: 285). Therefore, dilution likely affects the amount of underpricing. We obtained these data from the IPO prospectus.

Underwriter reputation. Underwriter prestige should reduce underpricing, though recent work suggests that prestigious underwriters also may have greater leverage to underprice (Loughran and Ritter, 2004). Similarly, underwriter reputation could signal the quality of the IPO issue, thus influencing the level of investor demand and post-IPO stock liquidity. Underwriter reputation scores, obtained from Jay R. Ritter's website (Ritter, 2003), are based on the index developed by Carter and Manaster (1990) and

Carter, Dark, and Singh (1998). When an underwriter reputation ranking for a year is unavailable, we use the ranking for the immediately preceding year.

Noncontingent compensation. This natural logarithm reflects the sum of the annual salary paid to the CEO and other members of the top management team (Arthurs *et al*., 2008), as obtained from the IPO prospectus.

Contingent compensation. From the firm prospectus, we obtain the value of stock option grants to the CEO and the top management team during the year immediately preceding the IPO (Certo *et al*., 2003). Following Arthurs *et al*. (2008), we calculate stock option value as the natural logarithm of the product of each officer's number of options and their listed price.

Inside director start-up experience. This sum reflects the number of years of previous start-up experience that each inside director possesses. These and all other data regarding inside directors came from the IPO prospectus.

Inside directors on other boards. This count measure reflects the number of other boards on which inside directors sit, which indicates their experience and expertise (Arthurs *et al*., 2008).

Inside director tenure. This value is the average tenure of all inside directors.

Inside director age. This value is the average age of all inside directors. Insider age, similar to insider tenure, provides a good indicator of the risk perceptions of inside directors and therefore of their intention to monitor the IPO process (Arthurs *et al*., 2008).

Venture capital ownership. The proportion of total shares in the company owned by venture capitalists should be important because, as Megginson and Weiss (1991) argue, venture capitalists certify the value of an offering, which decreases information asymmetry and reduces underpricing. We obtained this information from the IPO prospectus.

All institutional ownership. Following Schnatterly, *et al*. (2008), we control for ownership by all institutional investors in our first set of liquidity models (Table 1.3: Models 1–4). We compute total institutional investor ownership at the end of the year. However, institutional ownership is absent on the eve of the IPO, so we do not add it as a control to predict the level of underpricing. These and all institutional ownership data came from 13F filings within the Thomson Financial database.

Largest institutional owner. Again following Schnatterly *et al*. (2008), we controlled for the largest institutional investor. The largest institutional owner holds a significant information advantage; the greater the percentage of shares held by the largest institutional owner, the lower the liquidity will be.

All but largest institutional owner. This value is the equity ownership of all institutional investors except the largest institutional investor at the end of the year. Along with the largest institutional investor ownership, this variable is a control.

Industry. Initial returns are higher in riskier firms, such that firms in technology industries may experience greater underpricing (Lowry and Murphy, 2007).Similarly, stock liquidity may vary by industry. We control for this factor using dummy codes that represent the firms' one-digit SIC classification (Barth *et al*., 1999), and was obtained from COMPUSTAT.

Year. We include four year dummies to account for the year fixed effects.

Insert Tables 1.1, 1.2, 1.3 and 1.4 about here

1.4.5. Analyses

To test our hypotheses, we used hierarchical linear regression analyses. In Table 1.2, we present the results of our corporate governance variables of interest and both absolute and relative underpricing. In Tables 1.3 and 1.4, we present the results of our corporate governance variables of interest and stock liquidity while also controlling for aspects of institutional ownership known to affect liquidity. We conducted numerous tests including a variation inflation factor (VIF) test for multicollinearity (Neter, Wasserman, and Kutner, 1985), which suggested no severe cases. A Cook's distance test (Cook and Weisberg, 1982) confirmed the absence of influential outliers. We tested for normality both graphically and using the D'Agostino test and made appropriate variable transformations (D'Agostino, Belanger, and D'Agostino, 1990). However, we still found evidence of heteroscedasticity, both graphically and with the Breusch-Pagan test (Breusch and Pagan, 1979). To adjust the standard errors and *p*-values, we ran the Huber robust correction for heteroscedasticity (Huber, 1967). Finally, to test the robustness of our results, we conducted numerous supplementary analyses for different periods of liquidity measures, among others.

1.5. RESULTS

1.5.1. Descriptive statistics and correlations.

We provide, in Table 1.1, the means, standard deviations, and correlations among variables in our model. Our mean liquidity value is .05, lower than the .01 for S&P 1500 firms over the last two decades. Our average level of (relative) underpricing (26%) is somewhat higher than that of Arthurs *et al*. (2008) or Certo *et al*. (2001) but consistent with Filatotchev and Bishop's (2002) mean of 29.6%. These authors suggest that underpricing levels may be increasing due to growing uncertainty and speculative trends in IPO markets. Our average inside director ownership level (18%) is slightly lower and our outside director ownership level (28%) is slightly higher than those of Arthurs *et al*. (2008) (33% and 22%, respectively), and our insider ratio (27%) is lower than the 39% identified by Certo *et al*. (2001). However, these studies refer to various IPO investigations, of which ours is the most recent. For example, among the other studies that examine the US IPO market, Arthurs *et al.* (2008) consider the period from 1990 to 1994, Certo *et al.* (2001) consider 1990 to 1998 and Certo et al. (2003) consider 1996 to 1997.

1.5.2. Main effects.

Table 1.2 contains the underpricing models, with a dependent variable of absolute underpricing in Models 1 and 2 and relative underpricing in Models 3 and 4. Reiterating prior findings, Hypothesis 1a predicts a negative relation between insider ratio and underpricing; our findings (Table 1.2, Model 2, $\beta = .01$, $p > .05$; Model 4, $\beta = .01$, $p > .05$) are consistent with Certo *et al*.'s (2001) result but not with Arthurs *et al*.'s (2008) finding that inside director ratio relates negatively to underpricing. Thus, insider ratio is not associated with underpricing. Regarding the proposed negative relation between inside director ownership and underpricing in Hypothesis 1b, we do not find any support (Table 1.2, Model 2, $\beta = .03$, $p > .05$; Model 4, $\beta = -.02$, $p > .05$), consistent with Filatotchev and Bishop (2002) and Arthurs, *et al*. (2008). Hence, inside director ownership is not associated with underpricing. In line with conventional theory, Hypothesis 1c predicts a negative relation between outside director ownership and underpricing, which was upheld for absolute underpricing (Model 2, $\beta = -.08$, $p < .05$; see Arthurs *et al*., 2008) but not for relative underpricing (Model 4, $\beta = -.06$, $p > .05$). All underpricing models in Table 1.2 are highly significant.

Tables 1.3 and 1.4 contain the results of our liquidity models; the dependent variable is Amihud's (2002) liquidity measure. Recall that a low value on this measure indicates high liquidity, whereas a high value on this measure indicates low liquidity. In Tables 1.3 and 1.4, we use the average liquidity estimates based on all trading days between the day of the IPO and one year later. In Table 1.3, we control for overall institutional ownership levels, and in Table 1.4, we consider the largest and all other institutional ownership separately in line with Schnatterly *et al*. (2008).

Hypothesis 2 predicts a positive relationship between underpricing and liquidity. We do find consistent and strong support for the effects of underpricing on liquidity in all four models across the different measures of underpricing and institutional ownership characteristics (Table 1.3, $\beta = -.16$, $p < .001$ and $\beta = -.12$, $p < .05$ for absolute and relative underpricing respectively in the presence of overall institutional ownership). Similarly, we find consistent and strong support for this hypothesis even when we consider the informational advantages of the largest institutional owner (Table 1.4, $\beta = -.15$, $p < .001$ and $\beta = -.12$, $p < .01$ for absolute and relative underpricing respectively in the presence of the largest institutional owner).

Regarding the proposed negative relation between inside director ratio (Hypothesis 3a), inside director equity (Hypothesis 3b), and outside director equity (Hypothesis 3c), and liquidity, we do not find any support for inside director ratio and inside director equity in both Tables 1.3 and 1.4. However, we do find consistent and strong support for the effects of outside director ownership and liquidity in all four models across the different measures of underpricing and institutional ownership characteristics (Table 1.3, $\beta = .13$, $p < .01$ and $\beta = .13$, $p < .01$ for both absolute and relative underpricing in the presence of overall institutional ownership). Similarly, we find consistent and strong support for the effects of outside director ownership even when we consider the informational advantages of the largest institutional owner (Table 1.4, $\beta = .10$, $p < .01$ and $\beta = .11$, $p < .01$ for both absolute and relative underpricing in the presence of the largest institutional owner). All liquidity models in Tables 1.3 and 1.4 are highly significant.

1.5.3. Controls.

In addition to the hypothesized relationships, the regression analyses reveal some interesting insights based on the control variables used in the models. In the underpricing models in Table 1.2, firm size and firm performance are positively associated with underpricing; the results for firm size contradict the findings of Arthurs et al. (2008), while the results for firm performance are consistent with their findings. In the liquidity models in Tables 1.3 and 1.4, firm size, firm performance, dilution, and underwriter reputation are all associated with higher liquidity while firm age has a negative influence on liquidity. More importantly, venture capital ownership and facets of institutional ownership also affect post-IPO liquidity. As expected, higher levels of venture capital ownership (in Table 1.3 only) and holdings of largest institutional owner (in Table 1.4) are associated with reduced liquidity. Additionally, overall levels of institutional ownership are positively associated with liquidity in all models in Tables 1.3 and 1.4. These findings are very consistent with both theory and previous findings regarding the effects of institutional ownerships in non-IPO contexts (Schnatterly et al., 2008).

1.5.4. Economic significance.

We have thus far discussed the statistical significance of our results. Of equal, if not greater importance, is the issue of the substantive or economic importance of the results as that allows us to look beyond the narrow, technical specifics of regression results. This is especially true in our case as we have a relatively small sample size. While in large samples (like national datasets) even very small changes may be strongly statistically significant but not economically significant, for small sample sizes (and a lot a control variables) lack of statistical significance does not necessarily imply a corresponding lack of economic importance. In addition, we do not have data on private firms, and it is therefore possible that results that are not statistically significant for this sample might still be both statistically and economically important if the entire population of firms could be considered. We therefore discuss the economic significance of our results.

To judge the impact of different predictors measured in different units (e.g., underpricing in dollars and ownership in percentage) in terms of a consistent metric like ‘multiples of standard deviation’, we use standardized coefficients (for both predictor and dependent variable) in reporting our regression results. Here raw regression coefficients (say ‘b’) are replaced by ‘b times s(X)/s(Y)’, where s(Y) is the standard deviation of the dependent variable, Y, and s(X) is the standard deviation of the predictor, X (this is equivalent to rescaling all regression variables to their z-scores by subtracting the mean and dividing by the standard deviation).

In addition we have a log-linear model (i.e. dependent variable is logged). Therefore, for the underpricing – liquidity relation, the standardized or beta coefficient of -.16 (-.12 for relative underpricing) in Table 1.3 implies that the dependent variable (log of liquidity) increases by .16 times standard deviations for a one standard deviation increase in underpricing. While the absolute underpricing-liquidity coefficient varies between -.15 and -.16 (in model 3, tables 1.3 – 1.4), the corresponding numbers for other important predictors / controls variables are -.15 (all but largest institutional owners), .10 (largest institutional owner), .10 to .13 (outside director equity), and .05 to .06 (venture capital ownership). Thus in terms of ‘relative importance’, both underpricing and all institutional owners have the largest effect in increasing liquidity, while the largest institutional owner and outside director equity have an equally strong but opposite effect that decreases liquidity.

To analyze the absolute economic importance of these predictors, we also ran (standardized) regressions of the same variables, this time with 'raw' liquidity values as the dependent variable. We find that a one standard deviation increase in underpricing increases liquidity by .07 standard deviations (though the results are now statistically insignificant). This number is economically significant as it implies an increase in liquidity (we take winsorized values) by approximately .006 (given a standard deviation of .08 for 'raw' liquidity), which is about thirty percent of the median value of liquidity (.02) for our sample. Thus there is a thirty percent increase in liquidity for a one standard deviation change in underpricing (i.e. US$ 9.17) (for mean liquidity of .05, it is a ten percent increase). The results are similar for all but largest institutional owners (beta = -.06), while median liquidity decreases for largest institutional owner and outside director equity are by about 20 percent (8 percent for mean). For venture capital ownership though, the numbers do not appear economically significant due to very low effect sizes.

There is yet another reason why the changes in liquidity have economic significance in our particular sample. The average liquidity for our sample of IPO firms is lower than the mean liquidity of large firms in the population (e.g., our mean is .05 and median is .02, compared to an average of .01 for S&P 1500 firms), likely because our sample firms are new and often small firms. Thus on the one hand their liquidity situation is likely to be more volatile and easily amenable to external influences (unlike large firms), and on the other, even small changes (e.g., due to underpricing) may have a magnified effect because of the low mean liquidity levels of these firms (which gives high 'absolute values'), with important implications for post-IPO survival (as we discuss later).

1.5.5. Robustness checks.

As noted earlier, we conduct numerous robustness checks. First, we compute the aftermarket liquidity estimates (i.e., the liquidity estimates two years and three years from the date of the IPO). Earlier, we had calculated liquidity for year one as an average based on daily stock returns and dollar volumes for the 250 trading days following the date of the IPO. We now compute liquidity estimates for year two in two ways – as an average based on all 500 trading days following the date of the IPO, and as an average based on trading days 251-500. Similarly, we compute year three liquidity based on all 750 trading days, as well as trading days 501-750. We find strong correlations ($p < .001$) between year one liquidity and liquidity estimates based on days 251-500 (r = .99) and days 501-750 (r = .85), as well as between liquidity estimates for days 251-500 and days 501-750 (r = .87). Of course the correlations based on all 500 or all 750 trading days are even higher. This confirms our conjectures regarding the "stickiness" of liquidity. We also find that our earlier regression results remain unchanged for both liquidity estimates for years two and three. Both absolute and relative underpricing are positively related to liquidity, while outside director ownership significantly reduces liquidity. As before, we find no relationship between liquidity and board insider proportion, or liquidity and board insider ownership.

Second, to ensure models were not unduly influenced by outliers, we winsorize the top and bottom 1% of our observations, based on (absolute) underpricing values. As before we find a statistically significant negative relation between (absolute) underpricing and outside director equity, but not for inside director ratio/ownership. We then regress liquidity on absolute underpricing and find a strong positive relationship between (absolute) underpricing and liquidity. The same models reveal a significant negative relationship between outside director ownership and liquidity, but we again fail to find any relation between inside director ratio/ownership and liquidity. Next, we winsorize the top and bottom 1% of observations based on (relative) underpricing values. As in Table 2, we find no relationship between outside director ownership and (relative) underpricing, yet we find a strong and expected relationship between (relative) underpricing and liquidity and between outside director ownership and liquidity.

Third, it may have occurred to the reader that larger firms may have both higher underpricing and higher liquidity, and hence could be driving our results. Therefore, even though we controlled for firm size in both the underpricing and liquidity equations, we check if the ownership–underpricing–liquidity relationships may be driven by firm size. We first perform a quartile split on firm size and run the models with four dummies for firm size, each representing one of the four size quartiles. We also control for nonlinear size specifications by including the square of size as an additional control. Again, our results hold. Finally, with a median split by size, we conduct a Chow test to determine if the regression coefficients differ across the two groups (Rediker and Seth, 1995). We find no significant difference in the coefficient estimates between the two groups for (relative) underpricing, inside director ratio, inside director ownership, or outside director ownership. For (absolute) underpricing, there is weak evidence ($p < .10$) of a difference in the coefficient estimates. Therefore, we infer that firm size is not driving our underpricing–ownership / liquidity relationships.

Fourth, we used the Securities and Exchange Commission (SEC) mandated value of stock option grants in the year prior to the IPO, with the assumption that the IPO firm's stock price appreciates until its expiration at a compound annual rate of 10% (Certo *et al*., 2003). We take the natural logarithm of this measure. Our results hold across all models. Finally, both underpricing and liquidity may vary by exchanges, so we introduce a dummy variable to denote the exchange that lists the IPO firm. Following Bradley and Jordan (2002), we assign a value of 1 if the IPO is listed on NASDAQ and 0 otherwise (i.e., listed on NYSE or AMEX). Our underpricing and liquidity results remain unchanged for all models.

1.6. CONCLUSION

1.6.1. Review.

Our results largely support previous findings. Specifically, we find that inside director ratio and ownership do not affect IPO underpricing, but the presence of outside directors with equity reduces it. Following Arthurs *et al*., (2008), we surmise that monitoring by outside directors is an important activity in the IPO context, in contrast with those that suggest outside directors may not monitor during an IPO (Certo *et al*., 2001). We also highlight how underpricing and liquidity are related; specifically, we identify a potential benefit associated with underpricing. Consistent with previous research that has documented the numerous advantages of liquidity, we find that IPO firms that went bankrupt had statistically lower levels of liquidity in comparison to those that survived. For example, the 33 firms that eventually went bankrupt as of 2009, had an average liquidity of 2.06 a year after the IPO, while the 384 surviving firms had an average liquidity of .12 during the same period (where a higher value indicates lower liquidity). This trend persisted in years two and three. In addition, our robustness tests indicated that the presence of outside directors with equity reduces aftermarket liquidity for up to three years after the IPO. Director ownership in the IPO context is much higher than in a publicly traded firm. Outside director ownership is fairly significant in our sample, which likely accounts for the liquidity effect. Thus, though monitoring by outsider directors enables IPO firms to leave less money on the table in the short run, it also forces them to forego the substantial advantages of stock liquidity in the long run.

We speculate that our non-findings regarding the inside director–liquidity relationship might relate to the presence of at least four groups of informed investors in an IPO: inside directors, outside directors, venture capital owners, and large institutional investors. While both the information and real friction effects may reduce liquidity when inside director ownership is high, where institutions trade more frequently than insiders, increased trading actually increases liquidity, and this institutional effect (rather than the inside director effect) might be strong enough to suppress the inside director ownership–liquidity relationship (Rubin, 2007). In line with Schnatterly *et al*. (2008), we find a strong relation between total institutional ownership and liquidity in all our models.

1.6.2. Endogeneity.

One potential limitation of our study is endogeneity. Endogeneity in our particular context can arise from omitted variables bias. For example, studies (e.g., Zheng et al., 2005) have found that IPOs with a lock-up restriction have both greater underpricing and greater post-IPO trading volume (and hence liquidity). Since most IPOs these days feature a lock-up restriction, its presence may imply a spuriously strong positive relation between underpricing and liquidity (thereby weakening our findings, unless we also find evidence of that positive relation in non-lock-up IPOs). Similarly, other studies (e.g., Pham et al., 2003) find that certain firm characteristics influence both underpricing and/or ownership on the one hand, and liquidity on the other. For example, higher debt levels may trigger monitoring by debt-holders that reduce underpricing; conversely, debt-laden companies may want to rebalance their portfolios through future equity issues, leading to greater liquidity. Therefore it is likely that we may not find a positive underpricing-liquidity relation in high debt companies (again weakening our findings).

This study also ignores other potential determinants of underpricing and liquidity. For example, some studies note the impact of takeover defenses such as poison pills and staggered boards on underpricing. Field and Karpoff (2002) suggest that IPO firms should have in place at least one takeover defense when they go public so that managers can retain the private benefits of control. In such cases, takeover defenses can substitute underpricing as a means to reduce post-IPO monitoring (cf. Brennan & Franks, 1997), while the concomitant agency costs from high private benefits of control may dampen investor demand and subsequent liquidity. Thus the positive underpricing-liquidity relation is likely to be weaker (though still positive) in firms with takeover defenses. Market monitoring and liquidity can have other determinants. Stock liquidity levels may be affected by firm characteristics (e.g., size) and offer choices (e.g., underwriter quality), which we did include as controls, but it may also be affected by other macroeconomic factors (e.g., hot or cold markets, market volatility, and / or interest rates).

1.6.3. Other limitations.

Another limitation relates to the way we measure liquidity. As Amihud et al. (2005) contend, problems in measuring liquidity reduce power of tests used to assess possible impacts on liquidity. Besides, a single liquidity measure cannot capture all dimensions of liquidity, and the use of low-frequency data to create estimates (as we do here) further increases measurement noise. While we cross-check our results using the Amivest and Gibbs measures, future research might employ high-frequency datasets like NYSE's Trade and Quote (TAQ) dataset and data disclosed under SEC regulation 11Ac1-5 (Goyenko *et al*., 2009). Liquidity encompasses a number of transactional properties of markets (like tightness, depth and resiliency) and this makes it a slippery and elusive concept (Kyle, 1985). Besides, while the trading volume, volatility and price of an individual stock determine its liquidity to a large extent, stock liquidity is often not an attribute of a single asset, but co-move with each other (Chordia, Roll and Subrahmanyam, 2000). We need to consider these limitations in order to better understand the impact of ownership structure and underpricing on aftermarket liquidity.

1.6.4. Future directions.

With regard to further research, we recommend examinations of whether differences in stock liquidity affect post-IPO firm survival. In our sample of 417 IPOs, as of 2009, 265 firms remained as independent entities, whereas 152 had either failed (33 firms) or merged (119 firms) with another firm. For these two groups of 265 and 152 firms, post hoc analyses revealed that liquidity is greater among the 265 independently surviving firms than the 152 bankrupt / merged firms. Moreover, within the 152 firms, the 33 bankrupt firms had lower liquidity than the 119 merged firms (also see Appendix C). Another line of research could study the impact of stock liquidity on managerial discretion. For example, studies investigate stock market liquidity as a decision variable to determine firm payout policies (Banerjee, Gatchev, and Spindt, 2007), which might be extended to study managerial choices about capital structure, investment decisions, and so on. Because liquidity decreases the cost of raising new capital (Amihud and Mendelson, 1986), further studies could also examine its implications for corporate strategy decisions, including R&D expenditures or mergers and acquisitions.

In conclusion, our study provides evidence that the degree of IPO underpricing and (in certain cases) the pre-IPO ownership structure determine how liquid the IPO firm's stock will be in the long-run. We also aver that extant management research has not fully resolved the knotty puzzle of IPO underpricing, primarily because it has looked only at parts of a more general problem. By integrating ideas about governance, underpricing and liquidity, and by refocusing attention from the short to the long-run, we provide greater evidence about the nature, causes and implications of the underpricing phenomenon, as well as a unifying perspective. The introduction of stock liquidity into the underpricing framework causes a four-fold increase in model significance, clearly indicating where the IPO explanation lies. Stock liquidity is therefore able to provide a new and rather radical explanation for the wide prevalence of first-day underpricing among IPO firms.

CHAPTER 2

SIGNALING TYPE AND MARKET PERFORMANCE IN IPO FIRMS

2.1. INTRODUCTION

2.1.1. Information asymmetry in the IPO context.

The correct valuation of an initial public offering (IPO) often poses a significant challenge for its investors. In general, there is little publicly available information about firm quality and prospects, operating histories are short, past earnings may be window-dressed, and assets in place are likely negligible (Guo, Lev and Zhou, 2005), making IPO firms suffer from the liability of market newness. This information asymmetry may give rise to two types of opportunistic behavior, adverse selection (hidden information) and moral hazard (hidden action) (e.g., Bergen, Dutta and Walker, 1992). While hidden action (i.e. postcontractual agency problem) in an IPO setting arises after the principal and agent have already entered into a relation (i.e. investors have bought shares at an IPO), hidden information (i.e. precontractual agency problem) arises before investors have subscribed to IPO shares. IPO firms also face a multiple agency problem (Arthurs, Hoskisson, Busenitz and Johnson, 2008). This arises from the multiplicity of actors (e.g., inside and outside directors, venture capitalists, investment banks, investors etc.) with divergent goals and agenda, the dual roles of principal and agent some of these actors (e.g., venture capitalists)take on, and the monitoring of investment bank agents by managerial agents like board insiders.

2.1.2. Underperformance in IPOs.

Such informational inefficiencies, risks and goal-conflicts in the IPO market, among other causes, have led researchers to find evidence of long-run underperformance among IPO firms (Ritter, 1991), and prompted Wall Street brokers to joke that IPO stands for

“It’s Probably Overpriced” (Jenkinson and Ljunqvist, 2001). Several subsequent studies in other countries and time periods have confirmed this so-called “new issues puzzle” (Loughran and Ritter, 1995). Besides, evidence of this consistent underperformance has been recorded both in terms of adverse share price movements and post-IPO operating performance measures like operating return on assets and operating cash flows deflated by total assets(Jain and Kini, 1994).

2.1.3. Signaling in IPOs.

This context of information asymmetry and possible underperformance forces firms to employ mechanisms that can reassure uninformed investors who otherwise fear the ‘winner’s curse’ (Rock, 1986), i.e. ending up with the full quota of unattractive offerings while competing with informed investors (e.g., institutional investors) for the attractive IPOs. Hidden action agency problems are solved using behavior-based and outcome-based contracts (Eisenhardt, 1989), while hidden information problems are solved by signaling, or screening, or providing opportunities for self-selection, or by a combination of more than one of these mechanisms (Bergen *et al*., 1992).[6] The use of signals to address problems of information asymmetry and IPO performance has been quite popular in IPO research.[7] Thus research has examined how signals address short-term measures

[6] Hidden action models, which have much in common with the positive branch of agency theory, are outside the scope of this paper.

[7] While some IPO research in management has explicitly applied signaling theory (e.g., Sanders and Boivie, 2004), many others have used signals without formally employing a signaling framework (e.g., Heeley, Matusik and Jain, 2007), or indirectly studied the effect of signals on investors while framing it differently (e.g., Certo, Covin, Daily, Cannella and Dalton, 2003, who use behavioral decision theory), or

of IPO performance like proceeds raised, underpricing, price premium and market valuation, as well as long-term measures based on criteria like accounting returns (e.g., return on equity), market reactions (e.g., holding period returns) and survival (Certo, Holcomb and Holmes, 2009).

2.1.4. Research streams on signaling in IPOs.

To address performance issues across one or more of these short and long-term dimensions, several streams of IPO research have emerged using corporate governance, upper echelons, social influence and innovation perspectives (Certo *et al*., 2009). Signaling research using a corporate governance perspective has studied how mechanisms like stock-based incentives (Sanders and Boivie, 2004), board structures (Arthurs *et al*., 2008; Certo, 2003), ownership (Certo *et al*., 2003), founder status (Certo, Covin, Daily and Dalton, 2001) etc. affect IPO performance. Other signaling research has used perspectives like upper echelons (e.g., signaling by top management team – Higgins and Gulati, 2006), social influence (e.g., signaling by venture capitalists, investment banks and alliance partners – Stuart, Hoang and Hybels, 1999; Gulati and Higgins, 2003) and innovation (e.g., signaling by R&D expenditures and patents – Hsu and Ziedonis, 2007; Heeley *et al*., 2007). Still others have used unique perspectives like underpricing

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explained the power of signals using multiple theoretical frames (e.g., Higgins and Gulati, 2006, who use both signaling and upper echelons theories; Certo, 2003, who add institutional and sociological perspectives to signaling theory). In our reference to signaling research in management, we include such studies where signals and / or signaling theory have only been indirectly employed, or employed alongside other theories.

(Allen and Faulhaber, 1989; Grinblatt and Hwang, 1989) and dividend policy (Downes and Hienkel, 1982) to explain IPO firm performance.

2.1.5. Signal classification.

Yet this research has overlooked several important aspects. First, little management research looks at whether signals can be grouped. This is an important omission, as classifying signals according to common characteristics (like cost) has significant managerial implications in terms of whether, when and how much firms need to invest in developing signals, and how these decisions are likely to influence subsequent firm performance. Here we follow Kirmani and Rao (2000), and classify signals into two types: default-independent (hence DI) and default-contingent (hence DC). For DI signals, the firm incurs monetary loss independent of whether it defaults on its claim, while DC signals are costly only when the firm actually defaults. Besides being theoretically grounded, this classification is also relevant for managers, as DI signals require up-front expenditure, and are therefore cash-intensive, while DC signals involve losses to IPO owners only if future profit expectations are not met (Kirmani and Rao, 2000). We choose six commonly used IPO signals, namely patents, underpricing, underwriter reputation, inside director ownership, outside director ownership and venture capital ownership. We categorize the first three signals as DI and the last three as DC, and show that DI signals act as more credible indicators of firm value than DC signals.

2.1.6. Signal characteristics.

Second, we not only argue that DI and DC signals differ on when and whether they spend money, but also discuss how this conceptual distinction predicts basic underlying differences in signal dimensions that in turn determine signal strength and investor reactions. This is important, as current management research has studied the effects of individual signals without considering the underlying characteristics common to all signals, and how differences in these characteristics determine the strength of a signal for firm performance. Building on previous literature (e.g., Heil and Robertson, 1991; Spence, 1974), we collate five broad dimensions - cost, clarity, consistency, commitment and visibility - and then assign scores to the three DI and three DC signals across various sub-dimensions within each of these five main dimensions (see Table 2.3). Our theoretical framework and empirical findings both suggest that DI signals are more costly, clear, consistent, committed and visible compared to DC signals, making them more powerful predictors of IPO firm quality for uninformed investors.

2.1.7. Liquidity as a performance metric.

Third, we introduce a new measure of IPO performance, namely post-IPO stock liquidity. Liquidity is the ease of trading a security (Amihud and Mendelson, 1988). Technically, it can be defined in terms of price impact, or the daily price response associated with one dollar of trading volume (Amihud, 2002). Several studies contend that obtaining liquidity is one of the most important reasons for a private firm to go public (e.g., Amihud and Mendelson, 1988). Liquidity creates public shares that IPO firms can use in future acquisitions, and also enhances the value of equity holdings of pre-IPO owners (Brau and Fawcett, 2006). Liquidity enables effective market monitoring and stronger managerial incentives by incorporating more information into stock prices (Holmstrom and Tirole, 1993), reduces the transaction costs of future equity issues for IPO firms that go for a multi-stage sale policy (Ibbotson and Ritter, 1995), decreases required returns while increasing firm value (Amihud and Mendelson, 1986) and enhances the effectiveness of external governance mechanisms such as takeovers and proxy contests (Tadesse, 2005).

2.1.8. Market-based performance measures.

Finally, our premise is that the effect of signals on IPO performance is best gauged through market-based measures that directly reflect investor reactions to signals, rather than measures like return on equity or survival where the link between investor sentiment and performance metric is more difficult to establish. In addition to introducing stock liquidity as a market-based performance measure, we bring together three other market measures, namely gross proceeds during an IPO, market value of the IPO firm at the end of the year of the IPO, and Tobin's Q at the end of the second year after the year of the IPO (e.g., 31st December, 2003, for an IPO issued in 2001).[8] By employing multiple direct measures of market performance that span a broad temporal continuum (short-term, medium-term and long-term), we are able to provide a stronger test of signaling effects than other IPO studies in management that usually employ a single dependent variable (e.g., Certo *et al*., 2003; Arthurs *et al*., 2008; Walters, Kroll and Wright, 2010). For any given signal, the results are largely consistent for the different performance

[8] Other IPO performance metrics measuring investor sentiment are underpricing (e.g., Certo *et al*., 2001) and price premium /dilution (e.g., Certo *et al*., 2003); here we include underpricing as a signal rather than as a performance measure (e.g., Allen and Faulhaber, 1989), while dilution is used as a control variable (e.g., Arthurs *et al*., 2008).

metrics measured at different time points after IPO, suggesting that initial market sentiments create ‘information and availability cascades’(explained later) that sustain the ‘buzz’ about the signaling firm (Pollock and Gulati, 2007; Pollock, Rindova and Maggitti, 2008).

In sum, while extant management research has shown that signals can mitigate the pre-IPO information asymmetry problem, no attempt has been made to classify these signals into groups based on their underlying nature and characteristics, and then to show how signaling type can differentially influence market reaction and therefore post-IPO firm value in the near and long term. Hence our main research question: Are DI signals more powerful than DC signals in improving post-IPO firm performance?

2.1.9. Contributions.

Our study is important from both theoretical and practical perspectives. Theoretically, our study provides a classification of IPO signals based on whether the loss of money due to signaling is a sunk cost or depends on future profitability, and also on the clarity, consistency, commitment and visibility aspects of these signals. We find that up-front expenditures and other favorable characteristics of DI signals that make them more costly also make them more credible to the investing public, who may not be able to grasp the more subtle reasoning of DC signals (Rao, Qu and Ruekert, 1999). In sum, there is no gain without pain in case of IPO signals.

Practically, our study provides a preliminary framework for doing a cost-benefit analysis of different signal types. We suggest that pre-IPO managers need to weigh the likely improvement in firm value from DI signals against the cash-intensive nature of these signals. DI signals will be cost-effective for high quality firms where initial IPO investors go for a repeat purchase, or where such signals create information cascades about firm reputation for future investors (e.g., Kirmani and Rao, 2000). For example, signaling models of underpricing (a DI signal) suggest that underpricing is more beneficial for firms that go for a seasoned equity offer in the near future, as it allows them to recoup the initial costs of signaling (Grinblatt and Hwang, 1989). Conversely, DC signals being less costly, managers may also think of ways of using them more effectively (e.g., owner-managers entering into employment bonds, or subscribing to stock options, or voluntarily committing to a longer lock-up period).[9]

2.2. THEORY

2.2.1. Signaling theory.

We use signaling theory (Akerlof, 1970; Spence, 1973, 1974; Heil and Robertson,1991) as our theoretical point of reference. We follow Spence - whose early seminal work on signaling theory examined how in a competitive marketplace potential employees signal quality through costly activities like obtaining a degree - and define signals as “those observable characteristics attached to the individual that are subject to manipulation by

[9] The lock-up or lock-in period is a specified period of time (180 days in the USA) for which the original IPO owners cannot sell their shares after the IPO.

him" (Spence, 1973: 357). Thus signals should be both observable and alterable. Adding to the 'observable' attribute, later scholars have viewed signals as variables that are observable only at low measurement costs for the receiver, but which nevertheless are capable of changing the receiver's probability distribution of unobservable variables that such signals represent (Long, 2002). Similarly, scholars have stressed the 'alterable' attribute of signals by referring to them as "firm characteristics which are directly controllable by the firm at the time of the equity issue" (Downes and Heinkel, 1982: 3), or by explaining how firms undertake deliberate and strategic actions to change the perceptions of external parties (Gulati and Higgins, 2006).

2.2.2. Benefits of signaling.

The wide use of signaling to address the adverse selection problem at an IPO (e.g., Brau and Fawcett, 2006; Heeley *et al*., 2007; Leland and Pyle, 1977) is because signals enable the issuing firm to convey its true quality to investors in many ways. First, powerful signals create a 'separating equilibrium', whereby pursuing a signaling strategy assures maximum payoffs for high-quality firms while having a non-signaling strategy is optimum for low-quality firms (Spence, 1973).[10] Second, signals play an important role in attracting investor attention, increasing the visibility of the IPO firm, and reducing uncertainty (Pollock and Gulati, 2007). Third, the initial signal-induced demand often creates a buzz among IPO investors, analysts and the media, creating a self-sustaining

[10] Conversely, a 'pooling equilibrium' occurs when the gains from falsely claiming high quality outweigh the losses from being discovered, and customers cannot distinguish between high and low quality sellers (Kirmani and Rao, 2000).

pattern of demand even in the post-IPO period through mechanisms like information cascades and availability cascades (Pollock and Gulati, 2007; Pollock *et al.*, 2008).[11]Fourth, signals often involve certification by third parties after a detailed and exhaustive due-process examination (Ndofor and Levitas, 2004), and also transfer risks from the buyer to the seller (Sanders and Boivie, 2004). Fifth, IPO firms can use signals to gain 'strategic legitimacy' in terms of resources, roles and endorsement(Gulati and Higgins, 2006; Zimmerman and Zeitz, 2002).[12] Finally, signals are used by the investing public to form the basis for firm reputation (Fombrun and Shanley, 1990).

2.2.3. Signaling dimensions.

However, these signaling benefits at IPO are likely to vary by the power (strength) of the signal. To start with, DI signals involving upfront expenditure are likely to be more credible indicators for IPO investors than DC signals whose monetary loss depends on future profits. More importantly, however, this definitional difference between DI and DC signals reflects other, more fundamental, differences in their underlying nature that actually determine the relative power of these two signal groups. We collate five

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[11] Both information and availability cascades describe how social influences affect the focal actor's behavior under uncertainty; however, information cascades result when actors strive to gain information advantage, while availability cascades are generated from the need to reduce cognitive effort and act in ways acceptable to the majority (Pollock *et al*., 2008).

[12] Strategic legitimacy involves firms that actively endeavor to secure resources, unlike institutional legitimacy (Meyer and Rowan, 1977), wherein firms adjust to existing belief structures in a relatively passive way (Gulati and Higgins, 2006).

common, underlying dimensions of all signals: cost, clarity, consistency, commitment and visibility. Our thesis is that higher a signal's additive scores on these five dimensions, the greater its power to elicit positive investor reactions that lead to increased market value for the firm. We first explain these five dimensions of signal power and then discuss the relative strengths of our three DI and three DC signals on these five parameters.[13]

The cost of a signal (e.g., Kirmani and Rao, 2000) includes not only the actual monetary expenditure the firm undertakes to develop and transmit the signal, but also the opportunity costs of lost investments, as well as non-financial costs (e.g., spending social capital) to build a network of relationships (e.g., with underwriters or venture capitalists).Besides, the actual costs may vary from one firm to another (e.g., for any strong signal, a low-quality firm will find it much more costly to develop the signal than a high-quality firm). Signal clarity denotes that a signal is unambiguous and has a known cause (Heil and Robertson, 1991). A clear signal should also be measurable, should not be open to dual interpretation, and should have lesser noise due to its strong causal attribution. Consistency of signal looks at whether the signal deteriorates over time as investors have actual experiences about the firm (e.g., Pollock and Gulati, 2007). Signal commitment (Heil and Robertson, 1991) measures the time and effort the firm expends to develop the signal as well as its intentions to continue using the signal in future, while

[13] Even within DI and DC signaling types, signals vary across these five dimensions; however, the within-type differences are much smaller than the between-type differences(see Table 2.3), and hence that analysis is kept outside the purview of this paper.

signal visibility looks at a signal's ability to attract investor attention as well as to retain it (e.g., via information and availability cascades).

2.3. HYPOTHESIS

2.3.1. Patents (first DI signal).

Signaling via patents, our first DI signal, is costly because patenting typically requires significant investments in R&D and innovation, which includes developing technological capabilities and nurturing scientific talent (Stuart, Hoang and Hybels, 1999). Besides, the legalities of the patent application process can make it both complex and costly. Patents also act as clear signals as they can be readily linked to underlying innovation levels (Griliches, 1990), making them strong indicators of firm technological competence. Patents are also quantifiable ("the sheer numerosity of patents" - Long, 2002: 651) and directly measurable. However, the skewness in patent values (i.e., some patents are highly valuable, while many others have very low values) suggests that patents may have dual implications that can somewhat reduce the otherwise high clarity of patent signals. The fact that patents are intangible assets with little depreciation indicates high signal consistency, though the effect is weakened if investors subsequently suffer due to poor firm performance. Patent signals also denote high commitment as they usually entail large sunk costs; also, firms that have made specific investments and built scale will not be able to significantly change their investment trajectories in future. Finally, patents as signals have high visibility both during the IPO (e.g., via road shows, prospectus etc.) and after it (e.g., via annual statements, lawsuits against infringement etc.).

2.3.2. Underpricing (second DI signal).

Underpricing, our second DI signal, involves high opportunity costs. Loughran and Ritter (2002), for example, estimated that during 1990-1998 the average US IPO left $ 9.1 million on the table, a number that was about twice as large as the fees paid to investment bankers. Underpricing is also a clear signal. It unambiguously reflects firm quality as only good firms can recoup the cost of underpricing via subsequent issues (Allen and Faulhaber, 1989). It is also a measurable and well-researched variable with clear implications for investor demand (e.g., underpricing ensures oversubscription of IPO shares - Brennan and Franks, 1997). The underpricing signal also shows high consistency in that the effect of this signal persists in the post-IPO period (Pollock and Gulati, 2007). Likely causes of this persistence are that initial underpricing provides greater breadth and diffusion of post-IPO trading (Booth and Chua, 1996), and generates greater analyst following in the post-IPO market (Rajan & Servaes, 1997). Underpricing also signals the focal firm’s commitment to go for a secondary equity offering in future, or to subsequently engage in acquisitions (e.g., Grinblatt and Hwang, 1989). Finally, the underpricing signal is highly visible as it entails an extreme price reaction that attracts initial investor attention and leaves a sweet taste in their mouths (Welch, 1989), creating a self-sustaining chain of demand (Pollock and Gulati, 2007).

2.3.3. Underwriter reputation (third DI signal).

Our third and final DI signal, underwriter reputation, is also a powerful signal. Typically, underwriter spread or commission is very high in the US market (about seven percent of gross proceeds on average), and such fees will be even higher when the lead underwriter is a ‘bulge bracket’ investment bank (Chen and Ritter, 2000).[14] Apart from being costly, the underwriting signal also has high clarity. The selection of the underwriter is a two-way process that entails thorough evaluation and due diligence by the underwriter (e.g., Stuart *et al*., 1999), providing endorsement legitimacy to the IPO firm (Gulati and Higgins, 2006). Besides, reputed underwriters only choose less risky IPOs (Carter and Manaster, 1990), removing any ambiguity about firm quality. The underwriter signal also shows high consistency as underwriter reputation rankings are fairly stable over time and reputed underwriters are likely to actively monitor and influence post-IPO firm performance (e.g., via stabilization activities). Selection of a reputed underwriter also shows significant firm commitment in terms of social and financial capital invested, while the prominent display of big names like Goldman Sachs, Morgan Stanley and Merrill Lynch on the left of the cover of the prospectus, as well as the road shows, are likely to bring high visibility to the issuing firm.

2.3.4. Director ownership (first two DC signals).

We next discuss the DC signals. The two director-related DC signals (inside director ownership and outside director ownership) are costly to IPO firm directors because they now share in the substantial risks such firms face around an IPO. The typically high director ownership at IPO further underlines this risk. However, it does not involve immediate monetary involvement, and is costly only in case of future loss. In other

[14] Hiring reputed underwriters also has an indirect cost as they often insist on higher underpricing so that they can pass on the benefits to their favored clients, and also possibly need to undertake lesser post-IPO stabilization activities (Chen and Ritter, 2000).

words, director ownership at IPO does not involve upfront costs. The director ownership signal also lacks clarity for IPO investors. IPO actors often don several hats, giving rise to a multiple agency problem (Arthurs *et al*., 2008). Thus inside directors act both as managerial agents and as principals monitoring other agents, while outside directors may not monitor during an IPO as they still lack a clear role as agents of shareholders (Arthurs *et al*., 2008; Certo *et al*., 2001). Besides, directors with very high ownership may extract advantages from access to private information (e.g., resort to insider trading), worsening the information asymmetry problem such signals set out to redress in the first place (e.g., Chiang and Venkatesh, 1988). The director ownership signal also lacks consistency. For example, as new investors come in at later stages, there may be conflict of interests with pre-IPO owners on matters of firm control. Also, increasing ownership can motivate IPO directors to take sub-optimal decisions where such decisions involve significant personal risks (cf. Wright, Ferris, Sarin& Awasthi, 1996). IPO directors often sell significant equity stakes after lock-up, ensuring low signal commitment. Ownership signals also lack the kind of visibility associated with elite investment banks, a steep price rise on day one that is widely reported, or a breakthrough patent, and are usually reported in the prospectus along with sundry other items and footnotes.

2.3.5. Venture capital ownership (third DC signal).

Our third DC signal, venture capital ownership (e.g., Fischer and Pollock, 2004; Arthurs *et al*., 2008), share some of the attributes of director ownership signals. Venture capital ownership does not require any monetary expenditure over and above the venture capitalist's initial staged financing of the IPO firm, making it a less costly signal. This signal also lacks clarity. For one, venture capitalists as equity owners are principals in the firms they invest in, but they are also agents of the investors in the venture capital firm (Pratt and Foreman, 2000). Also, they have representatives on the board of directors, and therefore have access to private information. Finally, venture capital firms usually require a quick return on their investments. This short-term perspective may motivate them to window-dress the IPO balance sheet, and to rush the private firm to a quick IPO which is then used by the venture capitalist as a mode of exit (Gompers and Lerner, 1999; Fischer and Pollock, 2004).[15]The venture capital ownership signal is also inconsistent. Higgins and Gulati (2003), for example, find that any advantage of venture capital association is situation-specific, leading to IPO success only during cold markets. The fact that most venture capitalists sell their stakes either at or after the IPO further adds to this signal's inconsistency and lack of commitment. The visibility of this signal, however, can be high if the firm is funded by a reputed venture capitalist.

Integrating these discussions, our analyses of three DI signals (patents, underpricing and underwriter reputation) and three DC signals (inside director equity, outside director equity and venture capital ownership) in terms of five common underlying dimensions (cost, clarity, consistency, commitment and visibility) tell us that DI signals possess certain desirable attributes that DC signals do not, making DI signals more effective instruments in eliciting positive investor reactions and improving firm value at and after an IPO.

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[15] Some authors (e.g., Jain and Kini,1995), however, believe that venture capitalists have incentives to monitor both before and after an IPO.

Hypothesis. DI signals are more powerful than DC signals in improving IPO firm performance.

2.4. METHODS

2.4.1. Data and Sample

We collected data from the prospectuses filed by all firms that undertook IPOs in the U.S. market between 2001 and 2004, for a total of 493 firms, which provided the issue and first-day prices. We also collected data about insider ratios; equity ownership by inside directors, outside directors, and venture capital firms; stock option grants; annual salaries; insiders' age, tenure, presence on other boards, and start-up experience; presence of the founder on the board; and dilution and risk factors. We downloaded patent data on assignees, number of patents granted, and citation count, from the National Bureau of Economic Research (NBER) Patent Data Project website (https://sites.google.com/site/patentdataproject/Home/downloads). Underwriter reputation scores were obtained from Jay R. Ritter's website. For data about daily stock returns and the daily dollar trading volume, we turned to CRSP and computed the Amihud measure of stock liquidity (see Appendix B). Other data (e.g., to calculate Tobin's Q) were obtained from Compustat. Seventy-six firms in our sample had missing data, which yielded a sample of 417 firms. Of these, we removed another 105 firms belonging to industrial sectors like financial services, utilities, real estate and mutual funds that are subject to unique government regulations. This gave us a final sample size of 312 firms, which is consistent with recent management research in the context of IPOs. For example, Filatotchev and Bishop (2002) have a sample size of 251, Certo *et al*. (2003) have 193, Arthurs *et al*. (2008) have 307, and Bruton, Filatotchev, Chahine and Wright (2010) have 224.

2.4.2. Dependent Variables.

Gross proceeds. This measure, which is calculated as the natural logarithm of the product of the offer price and the number of shares sold, captures the capital raised at an offering, and is an indication of short-term IPO performance (Certo et al., 2009). This is obtained from FactSet.

Market value. This is the natural logarithm of the market value of the IPO firm as at the end of the year of the IPO, and is calculated as the number of shares outstanding multiplied by the price as at that date (year-end closing price).Data are obtained from CRSP and Compustat.

Liquidity. We used the Amihud liquidity measure (Amihud, 2002; Goyenko, Holden, and Trzcinka, 2009), which is a low-frequency (e.g., daily) price impact proxy that shows the absolute (or percentage) price change per dollar of daily trading volume. Following Amihud (2002), we took the natural logarithm of the measure to capture liquidity, defined as $Liquidity = Average\ [|r_d| / Volume_d]$,where $|r_d|$ is the absolute return on a stock on day d, and $Volume_d$ is the daily volume in dollars. We calculated average liquidity estimates using daily stock returns and dollar volumes for all trading days during the year starting the day after the date of the IPO (see Appendix B).[16] As an illustration, liquidity equals .0005266 for Las Vegas Sands Corporation (an example of high liquidity) and it equals 1.461082 for BAM Entertainment Inc. (an example of low liquidity). Prior literature uses several liquidity proxies to capture different benchmarks,

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[16] The Amihud ratio actually measures *illiquidity* rather than liquidity. So a high ratio value indicates high price impact and low liquidity, and vice versa. Also, in line with extant research, we assume 250 trading days in a year.

such as the effective spread, realized spread, or price impact (Goyenko *et al*., 2009); as we did not have access to bid–ask quotes or intraday trading information, we rely on a well-accepted low-frequency price impact proxy of liquidity.

Tobin's Q. We also calculate Tobin's Q, probably the most popular hybrid(accounting and market-based) performance measure (Richard, Devinney, Yip and Johnson, 2009), and one that has been widely used in the IPO context (e.g., Welbourne and Andrews, 1996). We compute its value at the end of the second year following the year of IPO (e.g., 31st December, 2003 for a stock issued in 2001). Following Villalonga (2004) and Khanna and Palepu (2000), we calculate Tobin's Q as [(market value of equity + book value of preferred stock + book value of debt) / book value of assets], where market value of equity is calculated using closing stock prices on the last trading day of the year.

2.4.3. Independent Variables.

Number of patents. This is the number of patents applied for by the IPO firm before the US Patent and Trademark Office (USPTO), as obtained from the NBER website. To reduce skewness, we used the natural logarithm of one plus the number of patents.

Underpricing. We define underpricing as the first-day closing price, less the offer price, divided by the offer price (e.g., Certo *et al*., 2003). Offer prices were collected from FactSet and closing prices were obtained from CRSP.

Underwriter reputation. Underwriter reputation can signal the quality of an IPO issue (Brau and Fawcett, 2006), thereby influencing the level of investor demand and post-IPO performance. Underwriter reputation scores, obtained from Jay R. Ritter's website (Ritter, 2003), are based on the index developed by Carter and Manaster (1990) and Carter, Dark, and Singh (1998), and vary from a low of 1 to a high of 9. When an underwriter reputation ranking for a year is unavailable, we use the ranking for the immediately preceding year.

Inside director equity. This ratio indicates the proportion of total shares owned by the inside directors at the time of the IPO.

Outside director equity. This is the proportion of total shares owned by the outside directors at the time of the IPO. Following Arthurs *et al.* (2008), we exclude affiliated directors (relatives, customers, former employees, lawyers, bankers, and suppliers) from our sample. Our sample therefore comprises two types of outside directors: venture backed and non–venture backed. Venture-backed outside directors either own or have full voting power for the shares held by the venture capital firm. Following Baker and Gompers's (2003) definition of outside directors as comprising quasi-outside directors (similar to affiliated directors, who we exclude) and truly independent outside directors (including public and professional directors, private investors, and venture capitalists), we classify both venture-backed and non–venture-backed outside directors as outside directors, and calculate outside director ownership as the sum of their combined ownership stakes (cf. Kroll, Walters and Le, 2007).

Venture capital ownership. Venture capitalists certify the value of an offering, which decreases information asymmetry and improves investor sentiment and post-IPO firm value (Megginson and Weiss, 1991). From the prospectus we obtained information on the equity ownership of the venture capitalist at the time of the IPO.

2.4.3. Control Variables.

Firm size. We control for firm size, because the greater information typically available about larger firms reduces information asymmetry. We assess this variable as the natural logarithm of the number of employees in the IPO firm (Welbourne and Andrews, 1996), and obtained the data from Compustat.

Firm age. Older firms generally perform better than younger firms, both prior to and after an IPO (Ritter, 1998). We calculate firm age as the natural logarithm of the difference in years between the date of IPO and the firm's founding date, and obtained this data from Jay R. Ritter's website (Ritter, 2003).

Risk factors. To add the risk factors mentioned in the prospectus, we use the summative index recommended by Welbourne and Andrews (1996), which includes factors such as technological obsolescence, new products, etc. These data were included in the firm's IPO prospectus available through EDGAR.

Firm performance. We use return on assets as a proxy for firm performance (Michaely and Shaw, 1995), and obtained the data from Compustat.

Founder. Founders influence IPO firm performance, so we include the founder as a dummy variable, equal to 1 if the founder sits on the firm's board at the time of the IPO and 0 otherwise (Certo *et al*., 2001). These data were available from the IPO prospectus.

Dilution. Dilution measures the premium above book value that new investors pay for the offering, and this premium is likely to affect investor demand at the time of the IPO. We obtained these data from the IPO prospectus.

Noncontingent compensation. This is the natural logarithm of the sum of the annual salary paid to the CEO and other members of the top management team (Arthurs *et al*., 2008), as obtained from the IPO prospectus.

Contingent compensation. From the firm prospectus, we obtained the value of stock option grants to the CEO and the top management team during the year immediately preceding the IPO (Certo *et al*., 2003). Following Arthurs *et al*. (2008), we calculate stock option value as the natural logarithm of the product of each officer's number of options and their listed price.

Inside director start-up experience. This sum reflects the number of years of previous start-up experience that each inside director possesses. These and all other data regarding inside directors came from the IPO prospectus.

Inside directors on other boards. This count measure reflects the number of other boards on which inside directors sit, which indicates their experience and expertise.

Inside director tenure. This value is the average tenure of all inside directors.

Inside director age. This value is the average age of all inside directors. Insider age, similar to insider tenure, provides a good indicator of the risk perceptions of inside directors and therefore of their intention to monitor the IPO process (Arthurs *et al*., 2008).

Inside director ratio. This ratio is the number of inside directors on the firm's board, divided by the board size.

Exchange dummy. Since capital raised, market value and post-IPO liquidity may vary by exchange, we introduce a dummy variable to denote the exchange that lists the IPO firm. Following Bradley and Jordan (2002), we assign a value of 1 if the IPO is listed on NASDAQ and 0 otherwise (i.e., listed on NYSE or AMEX). This information is obtained from CRSP.

All institutional investors. We control for total institutional investor ownership at the end of the year of the IPO. All institutional ownership data came from 13F filings within the Thomson Financial database. However, since institutional ownership is absent on the eve of the IPO, we do not include it as a control variable to predict gross proceeds.

Industry. Initial returns are higher in riskier firms, such that firms in technology industries may experience greater underpricing (Lowry and Murphy, 2007).Similarly, stock liquidity may vary by industry. We control for this factor using dummy codes that represent the firms' one-digit SIC classification (Barth, Beaver, Hand and Landsman, 1999), and was obtained from Compustat.

Year. We include four year dummies to account for the year fixed effects.

Insert Tables 2.1 and 2.2 about here

2.4.5. Analyses

To test our hypothesis, we used hierarchical linear regression analyses. We conducted numerous tests including a variation inflation factor (VIF) test for multicollinearity (Neter, Wasserman and Kutner, 1985), which suggested no severe cases. A Cook's distance test (Cook and Weisberg, 1982) indicated the absence of influential outliers. However, on a graphical analysis, four values of patent count appeared very large. We log-transformed patent count to reduce the impact of these four observations, and also conducted additional analyses with raw patent count after removing these observations. We tested for normality both graphically and using the D'Agostino test and made appropriate variable transformations (D'Agostino, Belanger and D'Agostino, 1990). However, we still found evidence of heteroscedasticity, both graphically and with the Breusch-Pagan test (Breusch and Pagan, 1979). To adjust the standard errors and *p*-values, we ran the Huber robust correction for heteroscedasticity (Huber, 1967). Finally, to test the robustness of our results, we conducted supplementary analyses.

2.5. RESULTS

2.5.1. Descriptive statistics.

In Table 2.1 we provide the means, standard deviations and correlations among our variables. Our mean underpricing level is 26.4 percent, which is higher than that of Arthurs *et al*. (2008) or Certo *et al*. (2001), but close to Filatotchev and Bishop's (2002) mean of 29.6 percent. These authors suggest that underpricing levels may be increasing due to growing uncertainty and speculative trends in IPO markets. 45 percent firms in our sample have patents, with an average of 9.79 patents per firm (after removing four outliers; logged mean is 1.06). The mean underwriter reputation score is 8.07. Our average inside director ownership level (17.3 percent) is lower than, for example, Arthurs *et al*. (2008) (33 percent), while our outside director ownership (31.8 percent) and venture capital ownership (38.3 percent) are higher (24 percent and 22 percent respectively for Arthurs *et al*., 2008). We speculate these differences are due to our choice of a more recent IPO period (2001 to 2004) compared to those authors (who choose 1990 to 1994). Our mean raw liquidity value of 0.07 (logged mean is -3.69)is much lower compared to S&P 1500 firms (mean of .01). About 71 percent of IPO firms in our sample are listed on NASDAQ.

2.5.2. Regressions.

Models 1 to 4 in Table 2.2 depict the regression results using the four dependent variables. Within each model we run four regressions: the first with all controls, the second and third adding DI and DC signals respectively, and the fourth having all controls and main effects. Institutional ownership is not used as a control variable in Model 1 (using gross proceeds at IPO as the dependent variable) since institutional investors buy shares only in the post-IPO market. Our hypothesis that DI signals are more effective than DC signals in improving post-IPO market value is largely supported across all four models. While our sample size is 312 for models 1, 2, and 3, we lose 43 observations due to lack of data when calculating Tobin's Q, giving a sample size of 269 for model 4.

2.5.3. Controls.

In the control models, we find that firm size has a significant positive relation with gross proceeds raised, market value and post-IPO liquidity.[17]The high correlation between firm size and firm age (r = 0.46, p< .001) also tells us that larger firms are older firms. These suggest that large IPO firms have lesser information asymmetry problems, and so are more attractive to the lay investor. However, firm size is negatively related to Tobin's Q, mirroring the findings of Welbourne and Andrews, 1996. We surmise that while the lesser information asymmetry of bigger firms increases their absolute market value, this better information availability also makes large firm market values closely resemble their book values. This lowers Tobin's Q (the market to book ratio) even where market and book values are both high. Apart from firm size, we also find that dilution (difference between book value and offer price at an IPO) is positively related to all four dependent variables, implying that investors' initial willingness to pay a premium over book value is a strong early indicator of future investor demand.

2.5.4. Model significance.

However, while overall *R-square* values range between 60 and 75 percent in the first three models for gross proceeds, market value and liquidity (refer to the sub-models with

[17] Since the Amihud measure of liquidity is actually a measure of *illiquidity*, the negative relation shown in the tables between firm size and liquidity is in effect a positive relation, i.e. liquidity *increases* with size.

all controls and regressors), the *R-square* for model 4 (Tobin's Q) is only about 27 percent. This is most likely because market signals well explain market value, but cannot explain Tobin's Q components like the book value of preferred stock, debt and assets. Also possible is the explanation that over time (Tobin's Q is measured at the end of the second year after the IPO) signals lose some of their explanatory power and / or exogenous variables come into play. Coming to our main results, we find strong support for our hypothesis. There are large increases in model *R-square* when we introduce the group of three DI signals. The respective *R-square* increases are 11.1 percent (gross proceeds), 10.85 percent (market value), 9.54 percent (liquidity), and 5.59 percent (Tobin's Q), and these increases in model predictive power are all significant at $p < .001$. Conversely, for the DC group, there is little *R-square* increase from the control model. Here the *R-square* increases are 0.38 percent ($p > 0.10$) for model1, 0.70 percent ($p > 0.10$) for model 2, 0.91 percent ($p > 0.10$) for model 3, and 0.40 percent for model 4 ($p > 0.10$).

2.5.5. Findings for DI signals.

Individually too, all three DI signals have a strongly positive and fairly consistent impact on performance. Underwriter reputation is the strongest signal for improving gross proceeds ($\beta = .36$, $p < .001$), market value ($\beta = .32$, $p < .001$) and stock liquidity ($\beta = -.31$, $p < .001$).[18]These results are in line with our assessment of the characteristics of underwriter reputation in terms of cost, clarity, consistency, commitment and visibility aspects (see Table 2.3) as well as with the extant literature (e.g., Gulati and Higgins,

[18] For all four models, we report the standardized coefficients for the sub-models having all controls and regressors.

2006, find a positive correspondence between underwriter prestige and several measures of IPO success). However, contrary to our expectations, underwriter reputation does not significantly influence Tobin's Q ($\beta = .09$, $p>.10$), most likely because of the features of Tobin's Q we discussed earlier. Patent count, as expected, is strongly positively related to all four measures of performance ($\beta = .13$, $p< .01$, model 1; $\beta = .20$, $p< .001$, model 2; $\beta = -.12$, $p< .05$, model 3; $\beta = .22$, $p< .01$, model 4). This confirms Long's (2002) conjecture that having patents reduces the future discount rates capital markets apply to value firms. We find mixed results for underpricing, our final DI signal. It creates long term firm value ($\beta = -.13$, $p< .05$ for liquidity; $\beta = .16$, $p< .05$ for Tobin's Q), but reduces short-term proceeds raised ($\beta = -.05$, $p< .10$) and is positive but insignificant for market value, suggesting that while underpricing leads to greater breadth and diffusion of post-IPO trading (Booth and Chua, 1996), this demand may be generated with a lag.

2.5.6. Findings for DC signals.

On the other hand, DC signals expectedly have little explanatory power. In models 1 to 3 (sub-models with all controls and regressors), both outside director and venture capital ownership have a negative but insignificant effect, and inside director ownership a positive but insignificant effect, on gross proceeds, market value and liquidity. The negative effect of outside director ownership is actually significant for market value ($\beta = -.08$, $p< .05$) and liquidity ($\beta = .10$, $p< .05$) in the sub-models with only the DC regressors added to controls. Our results suggest that inside director ownership does send positive vibes to investors, but these are not strong enough to convince investors of the insider's incentives to monitor and thereby reduce agency costs, rather than exploit any information advantages such insiders have. On the other hand, the market discounts signals of incentive alignment that ownership is supposed to confer on outside directors and venture capitalists, instead taking into account the information advantages of these large owners, and more so in the case of outside directors (cf. Schnatterly, Shaw and Jennings, 2008). These empirical findings confirm our theoretical predictions based on signal characteristics that DC signals have lesser credibility for investors both during and after an IPO.[19]

2.5.7. Economic significance

For a clearer interpretation of the substantive or economic importance of the effects of DI and DC signals on the four indicators of market performance, we consider the unstandardized coefficients. This avoids possible pitfalls in interpreting log-linear or log-log models (like we have here) in conjunction with standardized estimates, and allows us to study the effect on the actual dependent variable rather than on its logged version.

Starting with gross proceeds (logged), we find that for our log-linear model, a one unit change in underwriter reputation generates a 23 percent change in gross proceeds

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[19] We also conducted some robustness checks. We used raw patent count (after removing outliers), patent citation (to account for skewness in patent value) and patent dummy to confirm our results based on logged patent count. We tested our results for liquidity based on 500 days and 750 days after the IPO. We used venture capital dummy instead of ownership. We substituted one digit industry sic codes with two digit sic codes. We followed Schnatterly *et al*., 2008, and split institutional ownership into ‘largest, and all other’ (to account for information advantages of the largest institutional owner). In all these cases, our results do not change.

(actual).[20] Our median gross proceeds being US$ 90 million, this implies an increase of about US$ 20 million in median proceeds (US$ 40 million for the mean firm) for a one unit increase in underwriter reputation. However, this conclusion should be drawn with the caveat that underwriter reputation rankings in our sample are already very high (a mean of 8.07 and a median of 9 in our sample, on a scale of 0 to 9, and a standard deviation of just 1.49), not only suggesting that most firms are already aware of the gains from underwriter reputation, but also that future IPOs may not have a lot of leverage in increasing the already high levels of underwriter reputation to the maximum of 9.

The gross proceeds – patents regression is a log-log model, suggesting that a 100 percent increase in the number of patents will cause a 9 percent increase in actual proceeds, which translates to about US$ 8 million for the median firm (US$ 17 million for the mean).[21] In other words, firms need to double mean patent count to about 20 in order to earn this amount. Since the costs of developing 'real' patents may be higher, one policy implication for firms may be to develop 'cheap' patents that will act more as strategic tools rather than as effective barriers to imitation. However, besides the question of ethics, such a strategy may not be sustainable in the long-run if other firms follow the same strategy and / or investors become wiser in interpreting such fake signals. Coming to the other signals, we find that while underpricing has an almost equal but opposite

[20] In log-linear models (also called semi-log models), the slope coefficient (b) measures the relative change in Y for a given absolute change in X. Further multiplying the relative change in Y by 100 gives the percentage change or growth rate in Y for the absolute change in X (i.e. a one unit change in X is associated with a 100b% change in Y). Using simple calculus we can see that:

$$b = d(\ln Y)/dX = (1/Y)(dY/dX) = (dY/Y)/dX = [(Y_t - Y_{t-1})/(Y_{t-1})] / (X_t - X_{t-1})$$

[21] In log-log models, b is the elasticity of Y with respect to X, meaning that a 1% change in X is associated with a b% change in Y.

effect (a US$ 6 million loss for a unit increase in underpricing, and US$ 13 million for mean), the coefficient sizes for the DC signals are very small (in addition to being statistical insignificant), and are therefore likely to lack economic significance.

For market value – underwriter reputation (a log-linear model), a one unit change in underwriter reputation generates a 23 percent change in market value, which is US$ 75 million for the median year end market value of US$ 320 (and US$ 175 million for the mean firm value of US$ 760 million). For underpricing (also a log-linear model), there is an 11 percent (US$ 35 million) increase in median market value (US$ 83 million for mean), indicating a large effect size in spite of a lack of statistical significance. In case of the market-value – patents relation (a log-log model), a 100 percent increase in number of patents causes a US$ 50 million (median) increase in market value (US$ 120 million mean). Once again, the DC signals show very small effect sizes to be of any economic importance (in addition to them being statistically insignificant).

The very low effect sizes for DC signals is also evident for stock liquidity (logged), while the effect sizes are very high for all three DI signals. Here a one unit change in reputation causes a 37 percent rise in liquidity by .007 for the median firm with liquidity of .02 (and by .02 for mean of .06), indicating high impact (when comparing with mean industry liquidity for S&P 1500 firms, which is around .01). Underpricing has a similar (35 percent) impact on liquidity, while doubling patents (i.e. 100 percent increase) increases median liquidity by 17 percent (by about .003 for median and .01 for mean).

For Tobin's Q, we find that it increases by 11 percent (or .20) for the median firm in our sample (given a median value of 1.86) for one unit increase in reputation (.27 for mean of 2.46), and by 39 percent (or .73) for a unit increase in underpricing (.96 for mean). Considering that the median industry Tobin's Q for S&P 1500 firms has been 1.21 (mean of 1.69) over the 1995 – 2009 period, at least the underpricing effect (about 60 percent of both industry median and mean) is very large. Therefore, the large, combined economic benefits of underpricing for market value, liquidity and Tobin's Q appear to far outweigh the potential US$ 6 million median loss in gross proceeds we discussed earlier. Finally, a doubling of patent count causes a 25 percent increase of Tobin's Q (i.e., by .47 for median and .62 for mean). Expectedly, the DC signals have very low effect sizes to have any economic significance.

2.6. DISCUSSION AND CONCLUSION

2.6.1. Review.

IPO activity has been increasing rapidly in the recent past. Given that start-up firms often have short histories and little market reputation, and are in niche, often fast-moving industries (Long, 2002), it is imperative for both firm and investor to find genuine indicators of true business value. Signals can address the adverse selection problem at an IPO, and some management research has studied their impact on performance. This study proposes a typology of signals as DI and DC based on five fundamental characteristics on which these two classes of signals differ, and shows that DI signals act as more powerful predictors of firm value than DC signals. Our study is comprehensive as we bring together six different types of signals into these two groups, and examine their influence on four different measures of market performance at different time periods. Market performance measures are more relevant to the study of signals than accounting measures as they directly capture investor sentiments and reactions to signals. Also, liquidity is a new measure that we introduce, given the many advantages of stock liquidity for the firm and the investor that we discussed earlier.

Our results are comparable to earlier studies. For patents, our first DI signal, our findings that they consistently improve performance are in line with current understanding that patents boost investor estimates of firm value, increase venture capital financing, reduce underpricing etc. (Long, 2002; Heeley *et al*., 2007; Hsu and Ziedonis, 2007). Underpricing increases long-term value, consistent with Grinblatt and Hwang (1989), but contrary to Jain and Kini (1994), who do not find evidence of a relation between underpricing and long-term operating performance. Our strong and positive results for underwriter reputation mirror similar findings by Carter, Dark, and Singh (1998), Brau and Fawcett (2006), etc. Coming to the DC signals, the insignificant results for inside director ownership as well as the partially significant results (i.e. for some of the sub-models) for outside director ownership are consistent with Arthurs *et al*. (2008), but different from Sanders and Boivie (2004) who find that executive stock ownership at IPO increases market value while outside director ownership does not. For venture capital ownership too, the insignificance of our results are in line with Arthurs *et al*., (2008), but differ from Jain and Kini (1995). The different dependent variables for performance used in various studies may be at least partially responsible for these differences in results.

2.6.2. Endogeneity.

Our study is not without limitations, one of which is that we are unable to correct for endogeneity. Endogeneity in this context may arise from omitted variables bias. For example, a firm with high quality scientific talent may file for a larger number of patents as well as attract investor attention in the capital market (thereby increasing gross proceeds, market value etc.). In such cases, the positive association between patents and gross proceeds, or patents and market value, may be artificially inflated. Similarly, certain DI and DC signals may be inter-related. For example, since underpricing may lead to greater share retention (since pre-IPO owners lose more when selling an underpriced stock), it is possible that owners take simultaneous decisions on underpricing (a DI signal) and retained share ownership (a DC signal). This likely creates possible bias in our coefficient estimates. For example, the positive relation between underpricing and stock liquidity may be reduced if we consider that underpricing indirectly decreases liquidity by increasing share retention. Similarly, it is possible that the media attention that a firm got before its IPO (e.g., Google) enabled it to attract reputable underwriters as well as to generate significant investor interest. In such a case, the positive relation between underwriter reputation and gross proceeds, market value etc. may be largely driven by this initial media reaction.

Another common source of endogeneity in the IPO setting is self-selection. Some previous studies (e.g. Gulati and Higgins, 2003; Walters et al., 2010) adopt the Heckman selection model where factors like geographical location, founding year and business type that predict (via a first-stage Probit model) the likelihood of a firm going public, also influence post-IPO performance. However, we do not have access to data on the universe of firms that remained private during 2001 – 2004. While the Heckman two-step procedure is commonly used to address self-selection bias, the instrumental variables approach is equally applicable in such cases (Bascle, 2008). In all the above cases, the difficulty of application arose from that fact that we needed at least six different instruments (that meet the relevance and exogeneity criteria) for our six potentially endogenous regressors, namely the three DI and three DC signaling variables.

2.6.3. Other limitations.

Another limitation of this study is that some signals may not be strictly DI or strictly DC (e.g., underpricing can be a DC signal to the extent that its true cost depends on whether the firm performs well after IPO and is thus able to recoup the underpricing loss through an overpriced secondary issue). Plus there may be other signaling dimensions we have omitted. For example, Heil and Robertson (1991) mention signal aggressiveness and compatibility in the context of ‘competitive’ market signaling. This study also has certain other limitations in common with other signaling studies in management (e.g., Sanders and Boivie, 2004). For example, our assumption that investors are rational and have full knowledge of signaling pay-offs may be unrealistic. We also do not factor in postcontractual variables like managerial moral hazard or analyst following that may alter the impact of precontractual signals on post-IPO performance.

2.6.4. Future directions.

There are several avenues of future research. First, research can examine the idea of complementarities among signals. These complementarities can be explored through interactions among one or more DI and DC signals, as well as by bringing in new DI signals (like advertising), new DC signals (like dividend policy or product warranties) or signals from external actors like the media and analysts. For example, some preliminary analyses we did suggest that the interaction of patents and underpricing has a much stronger effect in increasing liquidity than any of these signals alone, and research can further explore the efficacy of such signal combinations. On similar lines, past studies have examined issues like how patents lead to underpricing in IPO firms (Heeley *et al*., 2007), how underwriter reputation reduces underpricing (Carter and Manaster, 1990), etc. Therefore, given that our six signals likely develop at and over different time periods, future research can explore if one or two basic signals used early in a firm's life not only affect performance but also determine whether and to what extent other signals will be used.

Additionally, here we characterize signals in terms of cost, clarity, consistency etc., while controlling for sender characteristics like firm size, age, performance, risk and governance structures. Future studies can explore other aspects of the complete signaling model (Heil and Robertson, 1991), such as how signaling effectiveness may vary by receiver characteristics (e.g., retail and institutional investors have different requirements and investment horizons), or how market and industry factors may influence signal interpretation (in addition to industry type and exchange listed on, which we control for).Also, our study has looked at the impact of signaling on capital market participants, and future studies can examine how signals like patenting and partner reputation influence labor market participants like potential employees.[22] Another fruitful area of inquiry is the idea of competitive market signaling, including how IPO signals elicit competitive reactions from rivals based on how they perceive the acting firm's motives and intentions, and how strategic signaling can be used for collusion (e.g., Heil and Langvardt, 1994).

Another line of research may be to extend both the size and years covered by our IPO sample, and see if the results are generalizable if examined longitudinally over, say, a ten year period. This is also important in order to reconcile the differences in some variable values we find when comparing with IPO studies that cover earlier periods like 1990 to 1994 (Arthurs *et al*., 2008), or 1996 to 1997 (Certo *et al*., 2003). Another way forward is to see if external contingencies moderate the impact of DI and DC signals on firm performance. Higgins and Gulati (2003) partially address this issue by examining how hot and cold equity markets present investors with different types of uncertainty, making different interorganizational partnerships suitable for different markets. Future research may answer this question by constructing an index that measures the degree of environmental uncertainty (cf. Ndofor and Levitas, 2004), and then examining how signal relevance varies when market uncertainty is added to uncertainties about the firm.

[22] To our knowledge, the only management study that has looked at labor market reactions is Ndofor and Levitas, 2004, but their discussion is conceptual and does not empirically test the relevant constructs.

Finally, our typology of signals is one of other possible ways to group signals at an IPO. An early study by Bhattacharya (1980), for example, classifies signals into dissipative and nondissipative. While dissipative signals (e.g., excess underpricing or low-value patents) are inefficient relative to the first best, nondissipative signals (e.g., underwriter reputation) have no ‘deadweight loss’ attached to them (Kirmani and Rao, 2000). Also, future research can further classify DI signals into sale-independent and sale-contingent, and DC signals into revenue-risking and cost-risking (Kirmani and Rao, 2000). Sale-independent DI signals are actions whose costs do not depend on how many shares the IPO firm sells at an IPO (e.g., underwriter reputation) while sale-contingent DI signals are those for which the expenditure takes place at the time the IPO shares are sold (e.g., underpricing). Conversely, all three of our DC signals are cost-risking for the pre-IPO owners but do not involve any direct revenue losses for the firm.

In conclusion, our study provides evidence that the efficacy of signaling during an IPO depends on the characteristics of these signals. Signals that involve upfront expenditure and are also otherwise more costly, clear, consistent, committed and visible, carry more credibility with IPO investors. The resultant market buzz creates a self-sustained stream of demand that draws in new investors, improving firm performance and creating value for the firm in the medium and long run. Since signal power is determined by signal attributes that are costly to the firm, IPO firm owners therefore need to trade off such costs against the likely prospects of long-term value creation for the firm.

APPENDICES

APPENDIX A

MODELS OF IPO UNDERPRICING

1. Asymmetric Information Approaches			
Theory	**Key References**	**Key Contentions**	**Empirical Evidence**
Adverse selection models (winner's curse)	Rock (1986); Beatty and Ritter (1986)	Issuers underprice to avoid the 'lemons' problem of adverse selection; some investors are perfectly informed while other investors, issuers and underwriters have little or no information about the real value of the firm	Mostly positive
Signaling models	Ibbotson (1975); Allen and Faulhaber	Issuers are perfectly informed while investors have little	Mixed

	(1989); Grinblatt and Hwang (1989); Higgins and Gulati (2005)	information about true firm value; issuers underprice to signal firm quality to investors so that they can subsequently issue seasoned equity at favorable prices	
Principal-agent models	Baron (1982)	Underwriters have superior information about potential demand for IPO shares; issuers therefore allow underwriters to underprice as a compensation for the use of their superior information	Mixed
Information revelation models	Benveniste and Spindt (1989)	Underwriters entice informed investors to reveal their superior information, and compensate them for truthful reporting by underpricing the issue and giving them priority in allocation of shares	Mostly positive

2. Institutional Approaches			
Theory	**Key References**	**Key Contentions**	**Empirical Evidence**
Legal liability models	Tinic (1988); Hughes and Thakor (1992)	Issuers underprice IPOs to avoid legal liabilities arising out of possible mis-statements in the prospectus	Mixed
Price support models	Ruud (1991); Schultz and Zaman (1994)	Underwriters do not actually underprice, but it appears as if they do; underwriters price IPOs at expected market values and support (via stabilizing bids and stabilizing trades) offerings whose price falls below the offer price in after-market trading, thereby censoring the left tail of the distribution of initial returns, and ensuring a positive	Mostly positive

		average price jump	
3. Ownership and Control Approaches			
Theory	**Key References**	**Key Contentions**	**Empirical Evidence**
Retention of control	Booth and Chua (1996); Brennan and Franks (1997)	IPO underpricing leads, via oversubscription and rationing, to a dispersed ownership structure which creates a free-rider problem; pre-IPO owners do not face external monitoring and continue to enjoy their private benefits of control	Mostly positive
Reduction of agency costs	Stoughton and Zechner (1998); Filatotchev and Bishop (2002); Arthurs, Hoskisson,	If pre-IPO owner-managers find that the agency costs from lack of external monitoring exceed the perceived benefits of control arising out of the	Mostly positive

	Busenitz and Johnson (2008)	free-rider problem, they may allocate shares to large outside investors and / or reduce underpricing to ensure a less dispersed ownership structure	

Note: This table is adapted from Jenkinson and Ljunqvist (2001).

APPENDIX B: Calculating the Amihud (2002) liquidity measure for two firms

BAM Entertainment Inc., Ticker: BFUN Low Liquidity Firm Date of Issue: November 15, 2001						Las Vegas Sands Corp., Ticker: LVS High Liquidity Firm Date of Issue: December 15, 2004					
Date	Absolute Daily Return (1)	Closing Price (2)	Volume (3)	Daily Dollar Volume (4) = {(2) * (3)}	Liquidity {(1) / (4)} *(10^6)	Date	Absolute Daily Return (1)	Closing Price (2)	Volume (3)	Daily Dollar Volume (4) = {(2) * (3)}	Liquidity {(1) / (4)} *(10^6)
11/16/01	.0815155	8.00	1310858	10486864	.0077731	12/16/04	.054768	49.110001	7839900	385017494	.0001422
11/19/01	.005	8.04	205950	1655838	.0030196	12/17/04	.0792099	53.00	4762500	252412500	.0003138
11/20/01	.0012438	8.0299997	80585	647097.5	.0019221	12/20/04	.0830189	48.599998	6105900	296746731	.0002798
11/21/01	.0373599	7.73	839587	6490007.5	.0057565	12/21/04	.0251028	47.380001	3210500	152113493	.000165
…	…	…	…	…	…	…	…	…	…	…	…
11/07/02	.0140846	.72	120267	86592.24	.162654	12/06/05	.0094834	40.450001	871700	35260265.7	.000269
11/08/02	.125	.63	59742	37637.46	3.32116	12/07/05	.011372	40.91	499600	20438635.9	.0005564
11/11/02	.1587302	.53	31200	16536	9.599069	12/08/05	.0070888	41.200001	870400	35860480.7	.0001977
11/12/02	.1509435	.61	90019	54911.59	2.748846	12/09/05	.0240292	40.209999	842700	33884966.2	.0007091
Average for 250 Trading Days					1.461082	Average for 250 Trading Days					.0005266

Note 1: The yearly average is based on all transactions for 250 trading days after the day of the IPO. Note 2: Data is obtained from CRSP. 'Price' denotes closing price; 'absolute daily return' is the absolute value of the daily holding period return.

APPENDIX C

Survival Analysis

To determine if some of the variables in our analyses are associated with firm survival or failure times (which are dependent variables that are not normally distributed, and are also subject to censoring), we conduct survival / failure time analyses. We employ Cox's proportional hazards model (Cox, 1972) because of its advantages. It is a non-parametric approach that does not make any untenable distributional assumptions about the underlying survival distribution. The proportionality assumption also means that the hazard rate is an easy constant. Cox's model is also widely used (e.g., in biostatistics). The basic idea is that

$h_i(t) = h_0(t)\exp(\beta_1 x_{i1} + \beta_1 x_{i2} + \ldots + \beta_k x_{ik})$,

or, $\log [h_i(t) / h_0(t)] = \beta_1 x_{i1} + \beta_1 x_{i2} + \ldots + \beta_k x_{ik}$

where $h_0(t)$ is a baseline hazard rate, x_{ik} is the value of the kth covariate for the ith participant, and, β_k is a coefficient of the kth covariate that indicates the effect of the covariates on the actual hazard rate. If β_k is equal to 0, the kth covariate does not have any effect on hazard rate, while a positive value of β_k indicates that higher scores of the covariate are associated with higher mortality rates.

First, we define IPO firm failure as bankruptcy leading to Chapter 11 filing and delisting from the primary exchange. There are 33 such firms. We calculate the time to bankruptcy in days starting the date of IPO issue. The non-bankrupt firms are right-censored as of

31st December, 2009. Since five years following an IPO has been suggested as the time frame during which a company may be considered a newly public firm (Fischer & Pollock, 2004), our end date of 31^{st} December, 2009, provides a strong test of survival even for firms with IPO issue dates in December, 2004. We construct a dichotomous outcome variable that equals 1 for a bankrupt firm, 0 otherwise. Second, we construct similar variables for the 119 firms that are delisted due to merger.

For the sample of 417 firms (Chapter 1), we find that when all controls are thrown in, the illiquidity main effect for years two and three predicts bankruptcy (with statistically significant hazard ratios of 1.3 and 1.4 respectively). Year one illiquidity does not predict bankruptcy in the presence of all control variables (though the hazard ratio is 1.1, i.e. still greater than 1) but does so (with a hazard ratio of 1.3) when only the illiquidity main effect is considered. For merged firms, illiquidity actually reduces the chances of a merger (though the results are not statistically significant).

In a separate analysis, we had also found that while both bankrupt and merged firms were delisted from their exchange, the merged firms had much higher liquidity than bankrupt firms throughout. Indeed, the average three-yearly liquidity levels of the 119 merged firms were only slightly lower than the 265 independent firms (0.11 compared to 0.07). We would have expected merged firms to have even higher liquidity than independent firms, since it is likely that firms that are subsequently acquired will have greater investor and analyst following to start with. That it is not the case leads us to surmise that merger activities are likely driven by factors (e.g., CEO hubris) that cannot be explained in terms of capital market variables (like liquidity) alone. Overall, the results from survival analyses suggest that illiquidity predicts bankruptcy but is unable to have a statistically significant effect in reducing merger activity of IPO firms.

For the sample of 312 firms (Chapter 2), our results from Cox's proportional hazards model (*considering only the main effects*) indicates that among the DI variables, underwriter reputation *reduces* the risk of bankruptcy (hazard ratio is 0.71), while the other two DI signals (patents and underpricing) have no effects. Expectedly, the DC signals (venture capital ownership, inside director ownership, and outside director ownership) do not have any statistically significant effect in reducing the probability of bankruptcy. Considering the dependent variables in the main regressions as independent covariates in the Cox regressions (but without all the control variables thrown in), we find that higher gross proceeds and higher liquidity have statistically significant impact in reducing the risks of bankruptcy. We do not find any effect of Tobin's Q on survival probability, while the impact of year-end market value in reducing bankruptcy is significant only at the ten percent level of significance.

Results of Cox Proportional Hazards Model for Bankrupt and Merged Firms (Chapter 1)

	Bankrupt (33 firms)						Merged (119 firms)					
	Year 1		Year 2		Year 3		Year 1		Year 2		Year 3	
	H.R.	S.E.	H.R.	S.E.	H.R.	S.E.	H.R.	S.E.	H.R.	S.E.	H.R.	S.E.
MAIN EFFECT												
Liquidity (log)	1.10	.13	1.28	.12*	1.41	.13***	.97	.07	.98	.06	.96	.06
CONTROLS												
Firm size (log)	.75	.09*	.81	.10*	.87	.11	1.00	.07	1.01	.07	.98	.08
Firm age (log)	1.08	.22	1.01	.21	.89	.20	.85	.09	.85	.09	.82	.10
Risk factors	.97	.13	.96	.13	1.03	.14	.88	.06†	.88	.06†	.90	.07
Firm performance (log)	1.00	.01	1.00	.01	1.00	.01	.99	.00	.99	.00	.99	.01*
Founder	.84	.38	.80	.36	.82	.38	.99	.22	1.03	.24	.98	.24
Underwriter spread (log)	.20	.13*	.24	.15*	.10	.09**	4.99	4.21†	4.13	3.44†	2.79	2.35
Dilution	1.01	.03	1.02	.03	1.01	.03	1.02	.01	1.02	.01	1.01	.02
Underwriter reputation	.77	.09*	.79	.09*	.80	.09	.95	.07	.95	.07	.95	.07
Non-contingent compensation (log)	1.03	.08	1.03	.08	1.19	.19	1.11	.06†	1.12	.07†	1.13	.07†
Contingent compensation (log)	1.06	.03†	1.05	.03	1.04	.03	1.00	.01	1.00	.01	1.00	.02
Inside director start-up experience	1.03	.03	1.02	.03	1.01	.04	1.00	.02	1.00	.02	1.01	.02
Inside directors on other boards	1.03	.10	1.04	.10	1.05	.10	.91	.06	.92	.06	.94	.06
Inside director tenure	.99	.06	1.00	.05	1.01	.06	.97	.03	.97	.03	.98	.03
Inside director age	.99	.03	.99	.03	.99	.03	1.01	.01	1.01	.01	1.02	.02
Venture capital ownership	1.00	.01	1.00	.01	1.00	.01	1.00	.00	1.00	.00	1.00	.00
All institutional owners	1.12	.87	1.41	1.08	1.64	1.27	1.47	.54	1.65	.62	1.80	.73
Inside director ratio	.74	1.08	.52	.79	.67	1.05	.29	.23	.31	.25	.52	.43
Inside director equity	.99	.01	1.00	.01	.99	.01	1.00	.00	1.00	.01	1.00	.01
Outside director equity	.99	.01	.99	.01	.99	.01	1.00	.00	1.00	.00	1.00	.00
-2 log likelihood	-166.65		-163.57		-151.03		-667.61		-637.51		-548.21	
Chi-square	34.95*		40.94**		45.02 **		32.56*		31.85*		29.75†	

Note 1: H.R. i.e. hazard ratios (or, exponentiated coefficients) are reported along with corresponding standard errors. A hazard ratio greater than one implies increased risks of bankruptcy, while a hazard ratio less than one implies a reduced risk. An alternative is to report the raw coefficients. However, while this alternate reporting affects how results are displayed, it does not influence the underlying estimation process.

Note 2: Results are displayed only for the liquidity main effect in chapter 1. The results for the main effects in chapter 2 are largely insignificant, and completely go away when control variables are also introduced. Hence they are not reported

Note 3: Even for year 1, when only the main effect is considered, illiquidity significantly increases a firm's hazard of bankruptcy

Note 4: *** $p < .001$, ** $p < .01$, * $p < .05$, † $p < .10$; $n = 417$

APPENDIX D

ANALYSES USING ARCHIVAL DATA

To test some of the main effects for an extended time period, we collected data from Risk Metrics and Compustat databases for the ten-year period 1996 to 2005. We collected this data on 740 S&P 1500 firms that continuously appeared in the databases during this period. We collected data on a host of variables that are close in definition to our hand-collected IPO sample. These included inside director ratio, inside director ownership, outside director ownership, firm size (defined as log of employees), net income, number of directors sitting on outside boards, director mean age, director mean tenure, and the sum of institutional holdings, ownership of largest institutional owner and all but the largest institutional owner. We also use dummy variables to control for industry using two-digit sic codes. Removing all duplicates, we have 5031 firm- year observations.

Since our secondary sample, though large, does not exhaust the population, we run a random effects regression (however, our basic results do not change even if we run the fixed effects regression). The results uphold our hypotheses and in fact strengthen our current findings in the IPO context. As hypothesized in Hypotheses 3 in Chapter 1, we find that inside director ratio decreases stock liquidity ($\beta = 1.11$, $p < 0.001$), as do inside director ownership ($\beta = 0.01$, $p < 0.001$ and $\beta = 0.03$, $p < 0.001$ respectively). As in the main study, ownership by the largest institutional investor reduces stock liquidity due to informational advantages, while total institutional ownership increases it. Coming to chapter 2, wedo not have access to data on patents, underpricing or underwriter reputation for these 740 firms. We also do not have data for gross proceeds for the IPO issue, a key dependent variable. We therefore regressed the other three dependent variables (market value, liquidity and Tobin's Q) on the two available DC signals, namely inside director ownership and outside director ownership. We do not find any statistically significant results for Tobin's Q, while market value is actually found to be reduced when using the DC signals ($\beta = -0.01$, $p < 0.01$ and $\beta = -0.01$, $p < 0.05$ respectively for inside and outside director equity).

Descriptive Statistics and Correlations for the archival data sample

Variable	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13
Liquidity (log)	-6.52	1.92	1												
Market value (log)	21.86	1.55	-.90	1											
Tobin's Q	1.61	1.51	-.29	.32	1										
Inside director ratio	.33	.18	.20	-.13	.10	1									
Inside director equity (%)	3.86	12.13	.18	-.12	.04	.25	1								
Outside director equity (%)	.67	3.16	.12	-.07	.01	-.01	.12	1							
Firm Size (log of employees)	9.25	1.40	-.60	.68	.01	-.07	-.06	-.05	1						
Firm Performance (net income)	483.82	1625.19	-.43	.51	.13	-.05	-.05	-.04	.36	1					
Directors on other boards	8.28	8.16	-.41	.44	-.04	-.26	-.02	.02	.41	.25	1				
Director age	59.82	3.47	.02	-.00	-.15	-.06	.08	.01	.03	.03	.06	1			
Director tenure	9.34	3.96	.19	-.15	.09	.41	.30	.11	-.08	-.04	-.22	.40	1		
Largest institutional owner (%)	.09	.05	.15	-.13	-.09	.02	.03	.10	-.05	-.12	.02	-.01	.01	1	
All but largest institutional owner (%)	.56	.19	-.29	.14	.08	-.19	-.14	-.10	.13	-.02	.14	-.01	-.13	.17	1

Note 1: All correlations greater than or equal to |.10| are significant at $p < .05$

Note 2: N = 5031; years covered are 1996 – 2005

Random Effects Panel Data Regression Results

	Chapters 1 & 2	Chapter 2	
	dep var 1: Liquidity (log)	dep var 2: Market Value (log)	dep var 3: Tobin's Q
Constant	3.62 ***	14.41 ***	6.52 ***
MAIN EFFECTS(see Note 1)			
Inside director ratio	1.11***	-.12†	.61***
Inside director equity (%)	.01***	-.01**	.00
Outside director equity (%)	.03***	-.00*	.00
CONTROLS			
Firm Size (log of employees)	-.84***	.66***	-.26***
Firm Performance (net income)	-.00***	.00***	.00***
Directors on other boards	.01***	.00	.01*
Director age	-.02**	.00	-.06***
Director tenure	.01	.01	.04***
Largest institutional owner (%)	1.65***	-1.02***	-1.39***
All but largest institutional owner (%)	-3.01***	1.32***	.76***
Wald Chi-square	2928.68***	2762.58***	408.97***
R^2	58.13	68.0	24.6

Note 1: For chapter 2, inside director ratio is a control variable, while inside director equity and outside director equity represent DC signals

Note 2: N = 5031; years covered are 1996 – 2005; *** p < .001, ** p < .01, * p < .05, † p < .10; two-digit dummy codes for industry are not reported here for brevity

APPENDIX E

C-INDEX & E-INDEX

Additionally, we also checked to see if governance provisions based on the C-Index and the E-Index have implications for firm survival. Data was collected from the prospectus on the C-Index (a dummy variable that equals one if a firm has a classified board, zero otherwise), and was available for 376 firms. We also collected data on the E-Index (entrenchment index), comprising in addition to staggered boards, limitations on amending bye-laws and charters, supermajority to approve merger, golden parachutes and poison pills. This time missing data brought down the sample to just 146 firms. We ran logistic regression models with unstandardized coefficients. Our analyses show that while having a classified board reduces the chances of failure ($\beta = -.29$, Odds Ratio = .75. $p > .10$, i.e. results are not statistically significant), it increases the chances of merger ($\beta = .72$, Odds Ratio = 2.07, $p < .01$) and concomitantly reduces the chances of remaining as an independent entity ($\beta = -.60$, Odds Ratio = .55, $p < .05$). This leads us to surmise that in the IPO context directors serving staggered terms are less inclined to extract benefits from their entrenched positions, and more likely to use their secure longer-term associations to increase firm value in a way that makes the firm a more attractive value proposition for potential suitors. For E-Index, however, the results no longer statistically significant (e.g., $\beta = .25$, Odds Ratio = 1.28. $p > .10$ for merger, $\beta = .03$, Odds Ratio = 1.23, $p > .10$ for independent firms).

Results of Logistic Regression Analyses for C-Index and E-Index

	C-Index			E-Index	
	Bankrupt	**Merged**	**Independent**	**Merged**	**Independent**
Constant	2.88	-5.22†	1.36	-2.51	-1.80
Controls					
Firm size	-.29†	.03	.07	-.09	.30†
Firm age	.46†	-.22	.06	-.34	.21
Risk factors	-.01	-.20*	.18*	-.21	.26†
Firm performance	-.01	-.01†	.01*	-.03†	.02
Founder	-.18	.02	.13	-.98	.90
Underwriter spread	-.86	1.30	-.56	.87	.48
Dilution	-.01	.00	-.01	-.01	-.00
Underwriter reputation	-.40**	-.02	.16	-.28	.27
Noncontingent compensation	.01	.12	-.08	.21	-.21
Contingent compensation	.09*	-.01	-.01	.02	-.07*
Inside director start-up experience	.03	.02	-.03	-.02	.02
Inside directors on other boards	.07	-.10	.06	-.05	-.04
Inside director tenure	.02	-.02	.00	-.03	.05
Inside director age	-.02	.01	-.00	.03	-.02
Venture capital ownership	.00	.00	-.00	.00	.00
All institutional investors	.05	1.12*	-1.00*	-.48	-.06
Inside director ratio	.22	-.89	.06	-.37	-.40
Inside director equity	-.02	.00	.00	-.01	-.01
Outside director equity	-.01	.00	-.00	.01	-.00
Main Effects					
Classified Board	-.29	.73**	-.60*	na	na
Entrenchment Index	na	na	na	.25	.03
Pseudo R^2	16.70	8.58	8.11	.14	.14
Chi-square	30.71†	36.29*	38.05 **	19.67	22.75

Note 1: *** $p < .001$, ** $p < .01$, * $p < .05$, † $p < .10$, n = 376 for C-Index and n=146 for E-Index

Note 2: We do not report a 'bankruptcies' column for E-Index because the very low number of bankruptcies in the reduced sample of 146 does not allow a meaningful interpretation

Note 3: Unstandardized coefficients are reported as the idea of one standard deviation increase for a dummy predictor (like classified board) lacks an intuitive interpretation; an alternative would be to report the odds ratios by running the 'logistic' command in Stata instead of the 'logit' command

Note 4: 'Bankrupt', 'merged' and 'independent' are dichotomous variables measured as 1 or 0

APPENDIX F

Future Directions (Chapter 2)

We have used hierarchical linear regressions to test the effects of the three DI and three DC regressors on the four dependent variables of interest. Here we outline several supplementary analytical approaches that may strengthen both our methodology and our findings. However, the actual application of one or more of these analytical methods require some combination of the following: new sample construction, use of software like Latent GOLD or Mplus, substantial data management based on current sample, and new data analyses techniques. We therefore set aside such approaches as possible directions for the future.

Step 1: Latent Class Analysis

Latent class analysis (LCA) can help do a confirmatory study to affirm our theoretical predictions that underwriter reputation, underpricing and patents fall in the DI signals category while ownership by venture capitalists, inside directors and outside directors can be classified as DC signals. The idea is that the latent variables (here DI and DC) divide the population into mutually exclusive classes, and are measured using multiple observed or manifest variables (in this case, the three variables mentioned above for the two groups). While the manifest variables are usually categorical, LCA can also be extended to account for continuous variables. Once the model is fit to the data, it will give an estimate of the probability of these six items to be members of a particular latent class. Our sample is particularly amenable to LCA as we have a non-panel dataset over a limited four-year time span (this means that the latent variable structure likely does not change during this time) and our sample size of 312 is above the usually acceptable cut-off of 300 observations used for LCA model fitting (assuming the model does not have an identification problem, i.e. the number of parameter estimates is consistent with the sample size). While LCA can be implemented in Stata using the 'gllamm' command, the Latent GOLD and LEM statistical packages are more suitable for LCA.

In sum, step 1 (LCA) is a confirmation that we have correctly classified the variables into DI and DC categories.

Step 2a: Nested ANOVA

Analysis of variance (ANOVA) tests whether the means of 'y' vary across categories of 'x' (and therefore tests whether both categories of 'x' belong to the same underlying distribution). While one-way ANOVA deals with only one categorical variable, namely 'x', N-way ANOVA generalizes this approach to deal with two or more categorical variables. In our specific case, we aver that the nested ANOVA approach (e.g., McGahan & Porter, 1997) is more applicable. Nested ANOVA is an extension of one-way ANOVA. Here we have a single (hence nested one-way rather than two-way ANOVA is appropriate) higher-level nominal variable (that equals 1 if DI, and 0 if DC) divided into three sub-groups each (that may be either continuous or nominal, as in ANCOVA models), and these sub-groups are also distinct from one another, i.e. the data is not 'crossed', as required for a nested model. Two different samples (one each for DI and DC) need to be constructed, and then data on the six sub-groups pulled together and stacked vertically in one table. The Stata command is: anova outcome group / group|sub-group.

Some authors adopt a different (iterative) methodology to implement a nested ANOVA design. Here the idea is to partition the observed variance in the dependent variables (gross proceeds, market value, liquidity and Tobin's Q) into components that are specific to the DI and DC effect classes. In other words, standard OLS assumptions are employed to check what percentage of variance is explained by each of the two effect-class models (that are dummy variables). Thus $R^2$and adjusted-$R^2$are computed for the two effect groups, and the F-statistic predicts the incremental explanatory power of the newly-introduced effect. In the null model, both DI and DC effects are zero, and the intercept (grand mean) is the only explanatory variable. The residuals from this null model (that portion of the dependent variable that is not explained by the intercept) are used as the dependent variable in the next stage where the DI effect-class is introduced as regressor, and the F-test conducted. The residuals from this model will then be used to test the impact of the DC effect-class. The major drawback of this method though is that the results can be affected by the sequence of effect introduction; so the results need to be verified by introducing DC ahead of DI.

Assuming our classification scheme was upheld in step 1, step 2a (nested ANOVA) is a way to partition the observed variance in the dependent variables between DI and DC components.

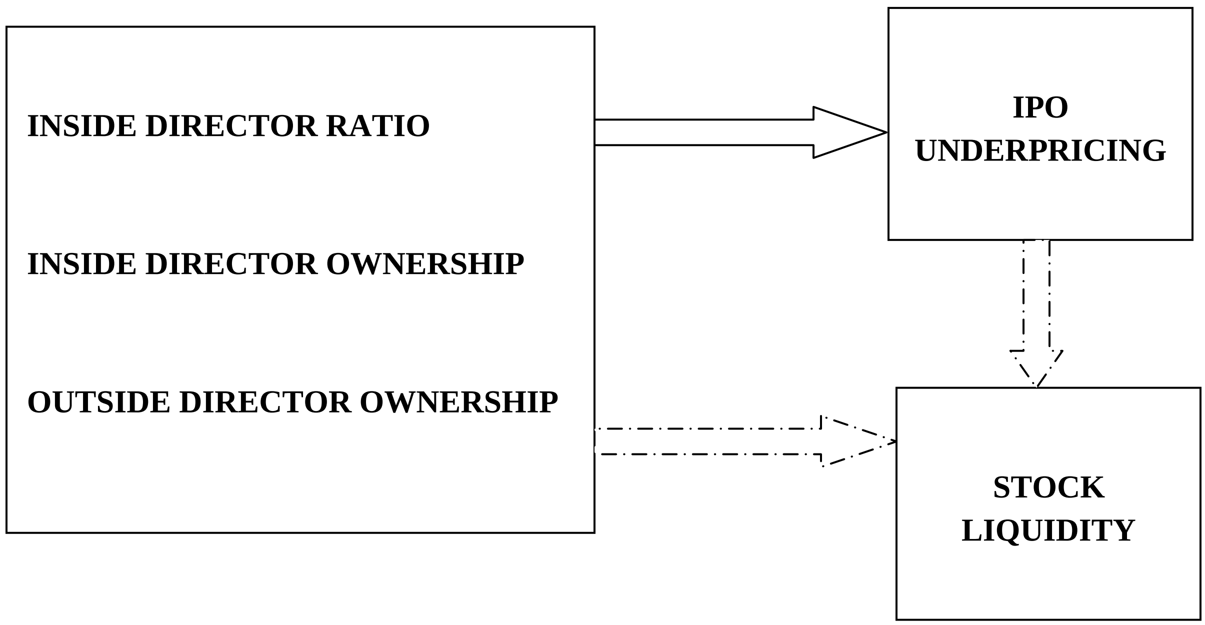
Step 2b: Components of Variance (COV)

Since the levels of the three DI and three DC effects we study here are likely to be sub-sets of the larger population of these effects, a reasonable assumption to make is that DI and DC effects are drawn via an independent, random draw from the underlying population of the class of effects (McGahan & Porter, 1997; Schmalensee, 1985). The main advantage of this approach is that it allows us to generalize beyond the specific results from our sample. On the flipside, COV does not allow us to test for the significance of the individual effects. Also, while ANOVA tests the significance of an effect while controlling for all previously introduced effects (via residuals), COV assumes that the effect classes as well as the residuals are totally uncorrelated to one another.

Given its generalizability, Step 2b (COV) can be used to confirm the results in step 2a (nested ANOVA). However, nested ANOVA appears to be the better technique to use in case of a conflict in findings, as COV does not offer tests of significance, and also because nested ANOVA (unlike COV) additionally allows us to consider possible correlations between DI and DC signals (e.g., the relation between patents, underwriter reputation and underpricing).[23]

[23] Additionally, and for a more careful analysis (since we do not have information on the normality or otherwise of the underlying population distributions), we can conduct rank-based non-parametric tests like Kruskal-Wallis (comparable to the parametric one-way ANOVA). However, the actual data construction (e.g., conversion of measurement variables into ranks for both samples) for a nested model (as in our case) is likely to pose a significant challenge. Similarly, instead of conducting latent class analysis, the area under the non-parametric Receiver Operating Characteristics (ROC) curve can be used to evaluate the performance of classification models like logistic regressions and / or discriminant analysis (in terms of 'sensitivity' and 'one minus specificity') when the target is binary (as in our case). Here too, the difficulty of application arises from knowing the exact variables that feed into the classification models in the first place.

Figure 1.1: Relationships among governance factors, IPO underpricing, and stock liquidity*



*Solid lines represent existing relationships; Hashed lines represent theoretical/empirical advances studied in this paper.

Table 1.1: Descriptive statistics and correlations

Variable	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Liquidity	-3.84	1.81	1																					
Underpricing (absolute) ($)	2.27	9.17	-.31	1																				
Underpricing (relative)	.26	.69	-.22	.70	1																			
Inside director ratio	.27	.16	.05	.05	.04	1																		
Inside director equity (%)	17.61	23.74	.11	.02	-.00	.35	1																	
Outside director equity (%)	28.01	35.16	.07	-.06	-.04	-.28	-.21	1																
Firm Size (log)	6.29	1.94	-.48	.22	.19	-.05	-.14	.04	1															
Firm Age (log)	2.38	1.13	-.13	.09	.05	-.03	-.07	.05	.48	1														
Risk Factors	4.79	1.39	.06	-.07	-.06	-.00	.07	-.03	-.12	-.07	1													
Firm Performance (%)	.87	21.56	-.36	.20	.13	.15	.05	-.05	.35	.21	-.12	1												
Founder	.46	.50	.17	-.05	-.06	.24	.33	-.02	-.28	-.29	.14	-.12	1											
Underwriter Spread (log)	1.89	.18	.22	-.04	.01	-.03	.08	.09	-.32	-.14	.11	-.07	.10	1										

Dilution ($)	9.78	7.57	-.38	.13	.07	-.01	.02	.18	.35	.19	.06	.24	-.07	-.14	1									
Underwriter Reputation	7.96	1.52	-.45	.10	.03	-.14	-.23	.14	.36	.21	.02	.11	-.14	-.07	.31	1								
Noncontingent compensation (log)	13.21	2.97	-.11	-.07	-.05	-.14	-.01	.14	.15	.16	.04	.03	-.01	.00	.11	.10	1							
Contingent compensation (log)	8.63	6.88	.04	.00	-.02	-.12	-.07	.15	-.07	-.07	.12	-.12	.03	.04	.06	.09	.20	1						
Inside director start-up experience	2.67	5.43	.12	-.04	.02	.10	.21	-.10	-.24	-.18	.07	-.06	.22	.02	-.10	-.18	-.07	.05	1					
Inside directors on other boards	1.14	2.12	-.11	.05	.04	.23	.11	-.15	.16	.16	.00	.04	.00	-.10	.08	.13	-.07	-.09	.08	1				
Inside director tenure	4.91	4.11	.04	.05	.04	.06	.22	.04	.07	.27	.04	.11	.29	.05	.07	-.01	.01	.04	-.03	-.01	1			
Inside director age	49.53	7.74	-.09	.03	-.01	-.05	-.06	-.02	.11	.18	-.09	.14	-.19	.00	.04	-.04	.01	-.06	.06	.16	.17	1		
Venture capital ownership(%)	35.92	35.68	-.02	.02	.05	-.14	-.22	.08	.10	-.00	.03	.04	-.15	.01	.05	.20	.05	.14	-.09	-.06	-.05	.01	1	
All institutional investors (%)	35.10	26.73	-.23	.09	.08	-.09	-.07	-.02	.07	.09	-.04	.13	-.03	-.02	.05	.10	.12	-.07	.02	.07	-.04	.10	.02	1
Top institutional investors (%)	8.16	9.77	-.03	.02	.05	-.14	-.09	.18	.06	.07	-.03	.06	-.07	.04	.10	.13	.06	.02	-.02	-.05	-.06	-.05	.07	.60

Note 1: All correlations greater than or equal to |.10| are significant at p < .05

Note 2: While inside director, outside director and venture capital ownership figures are at the time of the IPO, institutional ownership figures are at the end of the year of the IPO

Note 3: The raw means for the logged variables are as follows:

Liquidity = 0.05; firm size (number of employees) = 3684; firm age = 19.62 (years); underwriter spread = 6.69 (percent); non-contingent compensation = 1.23 (million dollars); contingent compensation = 2.36 (million dollars)

Table 1.2: Results of heteroscedasticity-corrected linear regression analyses for IPO underpricing

Variable	Absolute underpricing		Relative underpricing	
	Model 1	Model 2	Model 3	Model 4
Controls				
Constant	2.26	.99	.78	.74
Firm size	.16 **	.16 **	.19 **	.19 **
Firm age	-.01	-.01	-.09	-.09
Risk factors	-.07	-.07	.06	-.07
Firm performance	.09 †	.08 †	.03	.03
Founder	.03	.03	-.03	-.03
Underwriter spread	.06	.07	.08 †	.09 †
Dilution	.08	.09	.05	.06
Underwriter reputation	.03	.04	-.04	-.03
Noncontingent compensation	-.10 †	-.10 †	-.04	-.03
Contingent compensation	.06	.07	.00	.01
Inside director start-up experience	-.02	-.03	.04	.04
Inside directors on other boards	.01	-.01	.02	.01
Inside director tenure	.03	.02	.08	.08 †
Inside director age	-.00	.00	-.07	-.07
Venture capital ownership	-.04	-.03	-.01	-.01
Main Effects				
Inside director ratio		.01		.01
Inside director equity		.03		-.02
Outside director equity		-.08 *		-.06
R^2	12.48	13.14	12.59	12.89
Adjusted R^2	6.89	6.87	7.00	6.60
F	2.13 **	2.02 **	2.00 **	1.82 **
ΔR^2		.66 †		.30

Note: Standardized coefficients are reported; industry and year dummies are not reported for brevity

*** p< .001, ** p < .01, * p < .05, † p < .10, n = 417

Table 1.3: Results of heteroscedasticity-corrected linear regression analyses for stock liquidity

Variable	Model 1	Model 2	Model 3	Model 4
Controls				
Constant	-.43	-.32	-.29	-.08
Firm size	-.33 ***	-.32 ***	-.30 ***	-.30 ***
Firm age	.13 **	.13 **	.13 **	.12 **
Risk factors	-.01	.01	-.01	-.00
Firm performance	-.14 **	-.14 **	-.12 *	-.13 **
Founder	.02	.02	.02	.01
Underwriter spread	.07	.05	.06	.06
Dilution	-.20 ***	-.22 ***	-.21 ***	-.21 ***
Underwriter reputation	-.31 ***	-.32 ***	-.31 ***	-.32 ***
Noncontingent compensation	.01	.00	-.01	-.00
Contingent compensation	-.02	-.03	-.02	-.03
Inside director start-up experience	.04	.04	.04	.05
Inside directors on other boards	-.01	-.00	-.00	.00
Inside director tenure	.02	.02	.02	.03
Inside director age	-.04	-.04	-.04	.05
Venture capital ownership	.06	.06 †	.06	.06 †
All institutional investors	-.09 *	-.09 *	-.08 *	-.08 *
Main Effects				
Inside director ratio		.01	.01	.01
Inside director equity		.02	.02	.02
Outside director equity		.14 ***	.13 **	.13 **
Absolute underpricing			-.16 ***	
Relative underpricing				-.12 *
R^2	50.98	52.59	54.78	53.94
Adjusted R^2	47.71	49.04	51.27	50.36
F	13.64 ***	13.01 ***	14.68 ***	12.60 ***
ΔR^2		1.61 **	2.19 ***	1.35 *

Note: Standardized coefficients are reported; industry and year dummies are not reported for brevity

*** $p < .001$, ** $p < .01$, * $p < .05$, † $p < .10$, n = 417

Table 1.4: Results of heteroscedasticity-corrected linear regression analyses for stock liquidity

Variable	Model 1	Model 2	Model 3	Model 4
Controls				
Constant	-.45	-.40	-.37	-.16
Firm size	-.33 ***	-.33 ***	-.30***	-.31 ***
Firm age	.13 **	.13 **	.13**	.12 **
Risk factors	-.00	.01	-.00	-.00
Firm performance	-.14 **	-.14 **	-.12 *	-.13 **
Founder	.03	.02	.03	.02
Underwriter spread	.06	.04	.05	.06
Dilution	-.21 ***	-.23 ***	-.21 ***	-.22 ***
Underwriter reputation	-.32 ***	-.32 ***	-.32 ***	-.33 ***
Noncontingent compensation	.02	.01	-.00	.01
Contingent compensation	-.03	-.04	-.03	-.04
Inside director start-up experience	.03	.04	.04	.05
Inside directors on other boards	.00	.01	.01	.01
Inside director tenure	.03	.02	.03	.03
Inside director age	-.02	-.02	-.02	-.03
Venture capital ownership	.06	.06	.05	.06
Largest institutional investor	.12 ***	.11 **	.10 ***	.11 **
All but largest institutional investor	-.18 ***	-.16 ***	-.15 ***	-.16 ***
Main Effects				
Inside director ratio		.01	.02	.02
Inside director equity		.01	.02	.01
Outside director equity		.12 **	.10 **	.11 **
Absolute underpricing			-.15 ***	
Relative underpricing				-.12 **
R^2	53.36	54.38	56.45	55.68
Adjusted R^2	50.12	50.83	52.94	52.11
F	14.27 ***	13.57 ***	15.43 ***	13.39 ***
ΔR^2		1.02 *	2.07 ***	1.30 **

Note: Standardized coefficients are reported; industry and year dummies are not reported for brevity

*** $p < .001$, ** $p < .01$, * $p < .05$, † $p < .10$, n = 417

TABLE2.1: Descriptive Statistics and Correlations

Variable	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Gross proceeds (log)	4.58	1.00	1																								
Market value (log)	19.72	1.12	.79***	1																							
Liquidity (log)	-3.69	1.86	-.74***	-.78***	1																						
Tobin's Q	2.46	1.81	-.10	.07	-.10	1																					
Number of patents (log)	1.06	1.51	.07	.17**	-.01	.28***	1																				
Underpricing	.26	.71	.04	.11†	-.22***	.10	-.12*	1																			
Underwriter reputation	8.07	1.49	.60***	.54***	-.48***	.02	.09	.01	1																		
Inside director equity (%)	17.30	23.02	-.17**	-.11†	.07	.12†	-.06	.03	-.26***	1																	
Outside director equity (%)	31.78	36.92	-.03	-.01	.05	.03	-.07	-.09	.10†	-.23***	1																
Venture capital ownership (%)	38.33	36.15	.07	.05	-.04	.04	-.02	.07	.18**	-.21***	.08	1															
Firm size (log)	6.43	1.87	.66***	.54***	-.51***	-.22***	-.14*	.15**	.37***	-.11†	-.02	.10†	1														
Firm age (log)	2.48	1.02	.27***	.22***	-.14*	-.20**	.01	.02	.17**	-.11†	-.00	.03	.46***	1													
Risk factors	4.85	1.41	-.13*	-.12*	.10†	.04	.11†	-.03	-.03	.11*	-.04	.04	-.17**	-.15**	1												
Firm performance (%)	-.78	24.15	.35***	.32***	-.38***	-.28***	-.16**	.13*	.13*	.02	-.04	.06	.44***	.29***	-.14*	1											
Founder	.47	.50	-.30	-.23	.21	.18	.05	-.05	-.17	.39***	-.05	-.15**	-.27***	-.33***	.19***	-.16**	1										
Dilution ($)	10.68	7.80	.51***	.50***	-.50***	.06	-.00	.07	.29***	.00	.12*	.04	.36***	.18**	-.01	.28***	-.10†	1									
Noncontingent compensation (log)	13.19	2.94	.07	.23***	-.08	.06	.10†	-.07	.09	-.03	.16**	.07	.14*	.09	-.00	.01	.03	.10†	1								
Contingent compensation (log)	9.33	6.61	-.07	.04	.08	.09	.17**	-.03	.02	-.05	.12*	.08	-.14*	-.13*	.10†	-.14*	.07	-.02	.19***	1							

Inside director start-up experience	2.42	4.89	-.16***	-.16***	.15***	.04	-.04	.03	-.18**	.25***	-.11†	-.08	-.24***	-.18**	.05	-.08	.27***	-.13*	-.10†	.06	1						
Inside directors on other boards	1.13	2.24	.22***	.15**	-.09†	-.02	.00	.03	.11†	.13*	-.17**	-.04	.18**	.16**	-.01	.04	.01	.08	-.08	-.10†	.12*	1					
Inside director tenure	5.19	4.10	-.10†	-.04	.07	.01	.04	.03	-.06	.24***	.03	-.11†	.03	.23***	.03	.12*	.29***	.04	-.01	-.00	-.00	-.03	1				
Inside director age	48.89	8.00	.17**	.20***	-.09	-.07	.06	-.03	.03	-.09†	.04	.03	.15**	.24***	-.13*	.13*	-.20***	.09	.01	-.06	.01	.16**	.21***	1			
Inside director ratio	.28	.16	-.02	-.05	.00	.00	-.07	.05	-.14*	.32***	-.31***	-.15**	.00	.02	-.01	.16**	.23***	-.04	-.15**	-.13*	.13*	.28***	.06	-.05	1		
Exchange dummy	.71	.45	-.47***	-.34***	.32***	.19**	.12*	-.06	-.08	.12*	.14*	-.09	-.44***	-.23***	.08	-.27***	.26***	-.21***	.11†	.14*	.12*	-.12*	.06	-.20***	-.05	1	
All institutional investors (%)	31.12	24.25	.27***	.17**	-.21***	-.04	.00	.16**	.22***	-.14*	.09	.12*	.22***	.16**	-.05	.15**	-.07	.22***	.13*	-.08	-.03	.06	-.01	.09	-.11†	-.04	1

Note 1: *** $p < .001$, ** $p < .01$, * $p < .05$, † $p < .10$; n = 312 (for Tobin's Q, n = 269)

Note 2: Our liquidity measure actually measures illiquidity, which is the inverse of liquidity

Note 3: Market value is at the end of the year of the IPO; liquidity is for the 250 trading days (first year) starting the day after the IPO date; Tobin's Q is at the end of the second year after the IPO year (e.g., 12/31/2003 for a 2001 IPO).

TABLE2.2: Results of heteroscedasticity-corrected hierarchical linear regression analyses

	Model 1: Gr Proceeds (log)				Model 2: Market Value (log)				Model 3: Liquidity (log)				Model 4: Tobin's Q			
Constant	2.74***	1.54***	2.87***	1.63***	17.04***	15.71***	17.23***	15.80***	-1.30	1.15	-1.49†	1.06	3.63**	2.77*	3.45**	2.45†
Firm size (log)	.51***	.40***	.50***	.40***	.39***	.29***	.39***	.29***	-.41***	-.30***	-.41***	-.30***	-.15†	-..20*	-.15†	-.18*
Firm age (log)	-.04	-.07	-.04	-.08	-.05	-.07	-.06	-.07	.15**	.15**	.15*	.15**	-.14*	-.13†	-.13*	-.12†
Risk factors	-.00	-.03	-.00	-.03	-.00	-.02	-.01	-.03	-.03	-.01	-.02	-.00	-.08	-.08	-.08	-.09
Firm performance (log)	.08†	.08*	.09†	.08*	.17**	.16**	.17**	.17***	-.14*	-.14*	-.14*	-.14*	-.22	-.21†	-.23†	-.22†
Founder	-.07†	-.07†	-.07	-.07†	-.08	-.06	-.08	-.08†	.08	.06	.08	.07	.00	-.02	.00	.02
Dilution	.30***	,24***	.31***	.24***	.33***	.27***	.34***	.27***	-.34***	-.28***	-.35***	-.29***	.20*	.16*	.20*	.16†
Noncontingent comp. (log)	-.01	-.01	.00	-.00	.10**	.11**	.11**	.11**	.03	.02	.02	.02	.02	.02	.02	.02
Contingent comp. (log)	.05	.01	.05	.02	.09†	.05	.09	.06	-.02	.02	-.02	.01	-.04	-.06	-.04	-.06
Inside director start-up exp.	.01	.04	.01	.03	-.02	.01	-.03	-.01	.04	.02	.05	.04	.01	.00	.00	-.00
Inside directors on other boards	.09*	.06	.09*	.05	.05	.03	.05	.02	-.01	.02	.00	.04	.03	.02	.03	.02
Inside director tenure	-.09*	-.06†	-.08*	-.07*	-.06	-.05	-.06	-.06	.05	.04	.05	.05	.05	.03	.05	.02
Inside director age	.04	.04	.04	.04	.10*	.11**	.10*	.11**	-.01	-.03	-.02	-.04	-.04	-.04	-.03	-.03
Inside director ratio	-.01	.04	-.01	.02	.01	.04	-.02	.01	-.06	-.09*	-.03	-.06	.03	.04	.03	.04
Exchange dummy	-.13*	-.19***	-.13*	-.19***	-.07	-.12**	-.05	-.12**	.04	.10*	.03	.09†	.02	-.02	.03	-.02
All institutional investors					-.00	-.05	.00	-.04	-.05	.01	-.05	-.00	.02	-.01	.03	-.01
Main Effects																
Number of patents		.14**		.13**		.21***		.20***		-.14**		-.12*		.20**		.22**
Underpricing		-.05†		-.05†		.07		.07		-.13*		-.13*		.16*		.16*
Underwriter reputation		.34***		,36***		.30***		.32***		-.30***		-.31***		.09†		.09
Inside director equity			-.05	.02			-.01	.06			-.00	-.06			.05	.07
Outside director equity			-.05	-.04			-.08*	-.05			.01*	.08†			-.02	.03
Venture capital ownership			-.03	-.06			-.04	-.06			-.00	.03			.05	.06
R^2	63.21	74.31	63.59	74.77	55.64	66.49	56.34	67.32	49.16	58.70	50.07	59.60	21.14	26.73	21.54	27.28
Adjusted R^2	60.27	71.96	60.26	72.18	51.92	63.29	52.18	63.82	44.90	54.78	45.32	55.28	13.39	18.52	12.75	18.12
F	18.98***	25.49***	17.56***	23.78***	12.19***	23.16***	11.03***	21.22***	10.52***	14.11***	9.78***	13.01***	3.87***	3.93***	3.37***	3.42***
ΔR^2		11.10***	.38	11.56***		10.85***	.70	11.68***		9.54***	.91	10.44***		5.59***	.40	6.14**

Note: Standardized coefficients are reported; industry and year dummies are not reported for brevity; *** $p < .001$, ** $p < .01$, * $p < .05$, † $p < .10$; n = 312 for models 1, 2 and 3; n = 269 for model 4; R^2 changes are with respect to the basic model having only controls; Model 1does not have institutional ownership as a control variable as there are no institutional owners at the time of the IPO; Our liquidity measure actually measures illiquidity, which is the inverse of liquidity.

TABLE 2.3: Scores for signal characteristics at IPO

Characteristic	Default-independent signals			Default-contingent signals		
	P	**UP**	**UR**	**IE**	**OE**	**VO**
Cost (2 x 4 = 8)						
Upfront cash expended	2	0	2	1	1	1
More costly for bad firms	2	2	2	1	1	0
Opportunity costs	2	2	0	0	0	0
Non-financial costs (e.g. social capital)	1	0	2	0	0	2
Clarity (2 x 4 = 8)						
Unambiguous (known cause)	2	2	2	1	1	1
Measurability	2	2	2	2	2	2
No dual implications	0	2	2	0	0	0
Low channel noise	2	2	2	1	1	1
Consistency (2 x 1 = 2)						
Efficiency over time	1	2	2	0	0	0
Commitment (2 x 2 = 4)						
Time / effort for development	2	1	2	0	0	1
Future time / effort to be expended	2	1	2	0	0	0
Visibility (2 x 1 = 2)						
Ability to attract investor attention	2	2	2	1	1	2
Total score (maximum 24)	20	18	22	7	7	10
Average score by type (DI vs. DC)	20			8		

Note 1: P = patents, UP = underpricing, UR = underwriter reputation, IO = inside director equity, OO = outside director equity, VO = venture capital ownership.

Note 2: Scores for each sub-characteristic are based on a scale of 0 to 2, with 2 being given to a signal characteristic that makes the signal powerful and attractive to investors, and 0 being given to a characteristic that makes the signal weak and unattractive. Therefore, 2 = high, 1 = medium, 0 = low. We assign equal weightage to each sub-characteristic.

Note 3: Assigned values are based on assessments of signal strengths and weaknesses discussed in the theory / hypothesis section.

BIBLIOGRAPHY

Aggarwal R, Rivoli P. 1990. Fads in the initial public offering market? Financial Management 19(4): 45-57.

Akerlof, G. A. 1970. The market for ‘lemons’: Qualitative uncertainty and the market mechanism. Quarterly Journal of Economics, 84: 488 – 500.

Allen F, Faulhaber GR. 1989. Signalling by underpricing in the IPO market. Journal of Financial Economics 23(2): 303-323.

Amihud Y. 2002. Illiquidity and stock returns: cross-section and time-series effects. Journal of Financial Markets 5(1): 31-56.

Amihud Y, Mendelson H. 1986. Asset pricing and the bid-ask spread. Journal of Financial Economics 17(2): 223-249.

Amihud, Y., & Mendelson, H. 1988. Liquidity and asset prices: Financial management implications. Financial Management, 17: 5-15.

Amihud, Y., Mendelson, H., & Pedersen, L. H. 2005.Liquidity and asset prices. Foundations and Trends in Finance, 1(4): 269 – 364.

Anderson RC, Mansi SA, Reeb DM. 2004.Board characteristics, accounting report integrity, and the cost of debt. Journal of Accounting and Economics 37(3): 315 – 342.

Arthurs JD, Hoskisson RE, Busenitz LW, Johnson, RA. 2008. Managerial agents watching other agents: multiple agency conflicts regarding underpricing in IPO firms. Academy of Management Journal 51(4): 277-294.

Baker M, Gompers PA. 2003. The determinants of board structure at the initial public offering. Journal of Law and Economics 46(2): 569-598.

Banerjee S, Gatchev VA, Spindt PA. 2007. Stock market liquidity and firm dividend policy. Journal of Financial and Quantitative Analysis 42(2): 369-397.

Barabanov SS, McNamara MJ. 2002. Market perception of information asymmetry: concentration of ownership by different types of institutions and bid-ask spread. Working paper, University of St. Thomas.

Baron DP. 1982. A model of the demand for investment banking advising and distribution services for new issues. Journal of Finance 37(4): 955-976.

Barth ME, Beaver WH, Hand JRM, Landsman WR. 1999. Accruals, cash flows, and equity values. Review of Accounting Studies 4(3-4): 205-229.

Bascle, G. 2008. Controlling for endogeneity with instrumental variables in strategic management research. Strategic Organization, 6: 285-327.

Baysinger B, Hoskisson RE. 1990. The composition of boards of directors and strategic control: effects on corporate strategy. Academy of Management Review 15(1): 72-87.

Beatty RP, Ritter JR. 1986.Investment banking, reputation, and the underpricing of initial public offerings. Journal of Financial Economics 15(1-2): 213 – 232.

Beatty, R. P., & Zajac, E. J. 1994. Managerial incentives, monitoring, and risk bearing: A study of executive compensation, ownership, and board structure in initial public offerings. Administrative Science Quarterly, 39: 313 – 335.

Benveniste LM, Spindt PA. 1989. How investment bankers determine the offer price and allocation of new issues. Journal of Financial Economics 24(2): 343-361.

Bergen, M., Dutta, S., & Walker, O. C. Jr. 1992. Agency relationships in marketing: A review of the implications and applications of agency and related theories. Journal of Marketing, 56: 1-24.

Bhattacharya, S. 1980. Nondissipative signaling structures and dividend policy. Quarterly Journal of Economics, 95: 1-24.

Bhide A. 1994. Efficient markets, deficient governance. Harvard Business Review 72(6): 128-139.

Boehmer, E., & Fishe, R. P.H. 2001.Equilibrium rationing in initial public offerings of equity. Unpublished Manuscript.

Bolton P, Thadden EV. 1998. Blocks, liquidity and corporate control. Journal of Finance 53(1): 1-25.

Booth JR, Chua L. 1996. Ownership dispersion, costly information, and IPO underpricing. Journal of Financial Economics 41(2): 291-310.

Bradley DJ, Jordan BD. 2002. Partial adjustment to public information and IPO underpricing. Journal of Financial and Quantitative Analysis 37(4): 595-616.

Brau JC, Fawcett SE. 2006. Initial public offerings: an analysis of theory and practice. Journal of Finance 61(1): 399-436.

Brennan MJ, Franks J. 1997. Underpricing, ownership and control in initial public offerings of equity securities in the UK. Journal of Financial Economics 45(3): 391- 413.

Breusch TS, Pagan AR. 1979.A Simple test for heteroscedasticity and random coefficient variation. Econometrica, 47(5): 1287-1294.

Brockman P, Chung DY, Yan X(S). 2009. Block ownership, trading activity and market liquidity. Journal of Financial and Quantitative Analysis 44(6): 1403-1426.

Bruton GD, Filatotchev We, Chahine S, Wright M. 2010. Governance, ownership structure, and performance of IPO firms: the impact of different types of private equity investors and institutional environments. Strategic Management Journal 31(5): 491 – 509.

Carter RB, Dark FH, Singh AK. 1998. Underwriter reputation, initial returns, and the long-run performance of IPO stocks. Journal of Finance 53(1): 285-311.

Carter RB, Manaster S. 1990. Initial public offerings and underwriter reputation. Journal of Finance 45(4): 1045-1067.

Carvalho AGD, Tolentino RA. 2009. Price stabilization in IPOs and long-term stock liquidity. Working paper. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1397346.

Certo, S. T. 2003. Influencing initial public offering investors with prestige: Signaling with board structures. Academy of Management Review, 28: 432-446.

Certo ST, Covin JG, Daily CM, Cannella AA Jr., Dalton DR. 2003. Giving money to get money: how CEO stock options and CEO equity enhance IPO valuations. Academy of Management Journal 46(5): 643-653.

Certo ST, Covin JG, Daily CM, Dalton DR. 2001.Wealth and the effects of founder management among IPO-stage new ventures. Strategic Management Journal 22(6-7): 641-658

Certo, S. T., Holcomb, T. R., & Holmes, R. M. Jr. 2009.IPO research in management and entrepreneurship: Moving the agenda forward. Journal of Management, 35: 1340-1378.

Chen, H. C., & Ritter, J. R. 2000.The seven percent solution. Journal of Finance, 55: 1105–1131.

Chen, Z., & Wilhelm, W. 2005.A theory of the transition to secondary market trading of IPOs, Working Paper. University of Virginia.

Chiang R, Venkatesh PC. 1988. Insider holdings and perceptions of information asymmetry: a note. Journal of Finance 43(4): 1041-1048.

Chordia, T., Roll, R., & Subrahmanyam, A. 2000.Commonality in liquidity. Journal of Financial Economics. 56: 3 – 28.

Cook RD, Weisberg S. 1982. Residuals and influence in regression. Chapman and Hall: London.

Corwin SA, Harris JH, Lipson ML. 2004. The development of secondary market liquidity for NYSE-listed IPOs. Journal of Finance 59(5): 2339-2374.

Cox, D.R. 1972.Regression models and life tables. Journal of the Royal Statistical Society Series B. 34: 187 – 220.

D'Agostino RB, Belanger A, D'Agostino RB Jr. 1990. A suggestion for using powerful and informative tests of normality.The American Statistician 44(4): 316-321.

Demsetz H. 1968. The cost of transacting.Quarterly Journal of Economics 82(1): 33-53.

Demsetz H, Lehn K. 1985. The structure of corporate ownership: causes and consequences. Journal of Political Economy 93(6): 1155-1177.

Denis, D. J., Denis, D. K., & Sarin, A. 1997. Agency problems, equity ownership, and corporate diversification. The Journal of Finance, 52(1): 135-160.

Dharwadkar R, George G, Brandes P. 2000. Privatization in emerging economies: an agency theory perspective. Academy of Management Review 25(3): 650-669.

Downes, D. H., & Heinkel, Y. R. 1982. Signaling and the valuation of unseasoned new issues. Journal of Finance, 37: 1-10.

Eisenhardt, K. M. 1989. Agency theory: An assessment and review. Academy of Management Review, 14: 57–74.

Fama, E. F., & Jensen, M. C. 1983.Separation of ownership and control. Journal of Law and Economics. 26: 327 – 349.

Filatotchev We, Bishop K. 2002. Board composition, share ownership and 'underpricing' of U.K. IPO firms. Strategic Management Journal 23(10): 941-955.

Fischer, H.M., & Pollock, T.G. 2004. Effects of social capital and power on surviving transformational change: The case of Initial Public Offerings. 47(4): 463 – 481.

Fischer, H. M. & Pollock, T. G. 2004. Effects of social capital and power on surviving transformational change: The case of Initial Public Offerings. Academy of Management Journal, 47: 463-481.

Fombrun, C. & Shanley, M. 1990. What's in a name? Reputation building and corporate strategy. Academy of Management Journal, 33: 233-258.

Ginglinger E, Hamon J. 2007. Ownership, control and market liquidity. Working paper. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1071624.

Glosten LR, Milgrom PR. 1985. Bid, ask and transaction prices in a specialist market with heterogeneously informed traders. Journal of Financial Economics 14(1): 71-100.

Gompers, P. A., & Lerner, J. 2003. The really long-run performance of initial public offerings: The pre-Nasdaq evidence. The Journal of Finance, 58(4): 1355-1392.

Goyenko RY, Holden CW, Trzcinka CA. 2009. Do liquidity measures measure liquidity? Journal of Financial Economics 92(2): 153-181.

Griliches, Z. 1990. Patent statistics as economic indicators: A survey. Journal of Economic Literature, 28: 1661-1707.

Grinblatt M, Hwang CY. 1989. Signalling and the pricing of new issues. Journal of Finance 44(2): 393-420.

Gulati, R., & Higgins, M. C. 2003. Which ties matter when? The contingent effects of interorganizational partnerships on IPO success. Strategic Management Journal, 24: 127-144.

Guo, R., Lev, B., & Zhou, N. 2005.The valuation of biotech IPOs. Working paper. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=660281.

Hahn, T., & Ligon, J. A. 2006.Liquidity and initial public offering underpricing. Unpublished Manuscript.

Heeley, M. B., Matusik, S. F., & Jain, N. 2007.Innovation, appropriability, and the underpricing of initial public offerings. Academy of Management Journal, 50: 209-225.

Heflin F, Shaw KW. 2000. Blockholder ownership and market liquidity. Journal of Financial and Quantitative Analysis 35(4): 621-633.

Heil, O. P., & Langvardt, A. W. 1994.The interface between competitive market signaling and antitrust law. Journal of Marketing, 58: 81-96.

Heil, O., & Robertson, T. S. 1991. Toward a theory of competitive market signaling: A research agenda. Strategic Management Journal, 12: 403–418.

Higgins MC, Gulati R. 2005. Stacking the deck: the effects of top management backgrounds on investor decisions. Strategic Management Journal 27(1): 1-25.

Holmstrom B, Tirole J. 1993. Market liquidity and performance monitoring. Journal of Political Economy 101(4): 678-709.

Hsu, D., & Ziedonis, R. H. 2007.Patents as quality signals for entrepreneurial ventures. Working Paper, DRUID Summer Conference.

Huber PJ. 1967. The behavior of maximum likelihood estimates under nonstandard conditions. In Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics and Probability, Berkeley, CA. University of California Press: 1: 221- 233.

Hughes PJ, Thakor AV. 1992. Litigation risk, intermediation, and the underpricing of initial public offerings. Review of Financial Studies 5(4): 709-742.

Ibbotson RG. 1975. Price performance of common stock new issues. Journal of Financial Economics 2(3): 235-272.

Ibbotson RG, Ritter JR.1995. Initial public offerings. In Handbooks in Operations Research and Management Science: Finance, Jarrow RA, Maksimovic V, Ziemba WT (eds). North-Holland: Amsterdam; 9: 993-1016.

Jain, B. A., & Kini, O. 1994.The post-issue operating performance of IPO firms. Journal of Finance, 49: 1699-1726.

Jain, B. A., & Kini, O. 1995. Venture capitalist participation and the post-issue operating performance of IPO firms. Managerial and Decision Economics, 16: 593–606.

Jenkinson T, Ljunqvist A. 2001. Going Public: The Theory and Evidence on how Companies Raise Equity Finance.Oxford University Press.

Jensen MC, Meckling WH. 1976. Theory of the firm: managerial behavior, agency costs and ownership structure. Journal of Financial Economics 3(4): 305-360.

Khanna, T., & Palepu, K. 2000. Is group affiliation profitable in emerging markets? An analysis of diversified Indian business groups. Journal of Finance, 55: 867–891.

Kirmani, A., & Rao, A. R. 2000. No pain, no gain: A critical review of the literature on signaling unobservable product quality. Journal of Marketing, 64: 66-79.

Kochhar, R. (1996). 'Explaining firm capital structure: The role of agency theory vs. transaction cost economics', Strategic Management Journal, 17(9), pp. 713–728.

Kroll M, Walters BA, Le SA. 2007.The impact of board composition and top management team ownership structure on post-IPO performance in young entrepreneurial firms. Academy of Management Journal 50(5): 1198-1216.

Kyle, AS. 1985. Continuous auctions and insider trading. Econometrica 53(6): 1315 – 1335.

Lakonishok J, Lee We. 2001. Are insider trades informative? Review of Financial Studies 14(1): 79-111.

Lane, P.J., Canella, A.A., & Lubatkin, M.H. (1999). Ownership Structure and Corporate Strategy: One Question Viewed from Two Different Worlds. Strategic Management Journal, 20, 1077-1086.

Leland HE, Pyle DH. 1977. Informational asymmetries, financial structure, and financial intermediation. Journal of Finance 32(2): 371 – 387.

Levitas E, McFadyen MA. 2009. Managing liquidity in research-intensive firms: signaling and cash flow effects of patents and alliance activities. Strategic Management Journal 30(6): 659-678.

Li M, Zheng SX, Melancon MV. 2005. Underpricing, share retention, and the IPO aftermarket liquidity. International Journal of Managerial Finance 1(2): 76 – 94.

Long, C. 2002. Patent signals. The University of Chicago Law Review, 69: 625 – 679.

Loughran, T., & Ritter, J. R. 1995. The new issues puzzle. Journal of Finance, 50: 23-51.

Loughran T, Ritter JR. 2002. Why don't issuers get upset about leaving money on the table in IPOs? Review of Financial Studies 15(2): 413-444.

Loughran T, Ritter JR. 2004. Why has IPO underpricing changed over time? Financial Management 33(3): 5-37.

Lowry M, Murphy KJ. 2007. Executive stock options and IPO underpricing. Journal of Financial Economics 85(1): 39-65.

Maug E. 1998. Large shareholders as monitors: is there a trade-off between liquidity and control? Journal of Finance 53(1): 65-98.

McGahan, A M., & Michael, E. P. 1997. How much does industry matter, really? Strategic Management Journal,18(51) 15–30.

Megginson, WL, &Weiss, KA. 1991. Venture capitalist certification in initial public offerings. Journal of Finance, 46(3): 879 – 903.

Meyer, J. W., & Rowan, B. 1977. Institutional organizations: Formal structure as myth and ceremony. American Journal of Sociology, 83: 340-363.

Michaely R, Shaw WH. 1995. Does the choice of auditor convey quality in an initial public offering? Financial Management, 24(4): 15 – 30.

Miller, R. E., & Reilly, F. K. 1987.An examination of mispricing, returns, and uncertainty for initial public offers. Financial Management, 16(2): 33 – 38.

Ndofor, H. A. & Levitas, E. 2004.Signaling the strategic value of knowledge. Journal of Management, 30: 685-702.

Neter J, Wasserman W, Kutner M. 1985. Applied Linear Statistical Models (2nded.). Homewood, IL: Irwin.

Pham PK, Kalev PS, Steen AB. 2003. Underpricing, stock allocation, ownership structure and post-listing liquidity of newly listed firms. Journal of Banking & Finance 27(5): 919-947.

Pollock, T. G., & Gulati, R. 2007.Standing out from the crowd: The visibility enhancing effects of IPO-related signals on alliance formations by entrepreneurial firms. Strategic Organization, 5: 339–372.

Pollock, T. G., Rindova, V. P., & Maggitti, P. G. 2008. Market watch: Information and availability cascades among the media and investors in the U.S. IPO market. Academy of Management Journal, 51: 335–358.

Pratt, M. G., & Foreman, P. O. 2000.Classifying managerial responses to multiple organizational identities. Academy of Management Review, 25: 18-42.

Rajan R, Servaes H. 1997.Analyst following of initial public offers. Journal of Finance 52(2): 507 – 529.

Rao, A. R., Qu, L., & Ruekert, R. W. 1999.Signaling unobservable product quality through a brand ally. Journal of Marketing Research, 36: 258-268.

Rediker KJ, Seth A. 1995.Boards of directors and substitution effects of alternative governance mechanisms. Strategic Management Journal 16(2): 85-99.

Reese WA. 1998. IPO underpricing, trading volume, and investor interest. Working paper, Tulane University. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=115348.

Richard, P. J., Devinney, T. M., Yip, G. S., & Johnson, G. 2009. Measuring organizational performance: Towards methodological best practice. Journal of Management, 35: 718 - 804.

Ritter, J. R. 1991. The long-run performance of initial public offerings. The Journal of Finance, 46(1): 3-27.

Ritter, J. R. 1998. Initial public offerings. Contemporary Finance Digest, 2: 5 – 30.

Ritter JR. 2003 (last updated 2 June, 2010).University of Florida. Available at: http://bear.warrington.ufl.edu/RITTER/ipodata.htm.

Ritter JR, Welch We. 2002. A review of IPO activity, pricing, and allocations. Journal of Finance 57(4): 1795-1828.

Rock K. 1986. Why new issues are underpriced. Journal of Financial Economics 15(1-2): 187-212.

Rubin A. 2007. Ownership level, ownership concentration and liquidity. Journal of Financial Markets 10(3): 219 – 248.

Ruud JS. 1991. Another view of the underpricing of initial public offerings. Federal Reserve Bank of New York Quarterly Review 16(1): 83-85.

Sandberg, M. Carl, Lewellen, G. Wilbur and Stanley, L. Kenneth. Financial strategy: planning and managing the corporate leverage position. Strategic Management Journal, Vol. 8, No. 1. (Jan.-Feb., 1987), pp. 15-24.

Sanders, W. G., & Boivie, S. 2004. Sorting things out: Valuation of new firms in uncertain markets. Strategic Management Journal, 25:167-186.

Sarin A, Shastri KA, Shastri K. 2000. Ownership structure and stock market liquidity. Working paper, Santa Clara University and University of Pittsburgh.

Schnatterly K, Shaw KW, Jennings WW. 2008. Information advantages of large institutional owners. Strategic Management Journal 29(2): 219-227.

Schultz PH, Zaman MA. 1994. Aftermarket support and underpricing of initial public offerings. Journal of Financial Economics 35(2): 199-219.

Shleifer A, Vishny RW. 1986. Large shareholders and corporate control. Journal of Political Economy 94(3): 461-488.

Spence, A. M. 1973. Job market signaling. Quarterly Journal of Economics, 87: 355 – 379.

Spence, A. M. 1974. Market signaling: Information transfer in hiring and related processes. Cambridge, MA: Harvard University Press.

Stoll, HR. 2000. Friction.Journal of Finance 55(4): 1479-1514.

Stoughton NM, Zechner J. 1998. IPO-mechanisms, monitoring and ownership structure.Journal of Financial Economics 49(1): 45-77.

Stuart, T. E., Hoang, H., & Hybels, R. C. 1999.Interorganizational endorsements and the performance of entrepreneurial ventures. Administrative Science Quarterly, 44: 315-349.

Tadesse S. 2005. Stock markets liquidity, corporate governance and small firms. Working paper number 883, The William Davidson Institute, University of Michigan at Ann Arbor. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1017585.

Tinic SM. 1988.Anatomy of initial public offerings of common stock.Journal of Finance 43(4): 789-822.

Villalonga, B. 2004.Diversification discount or premium? New evidence from the Business Information Tracking Series. Journal of Finance, 59: 479–506.

Walsh, J. P., & Seward, J. K. 1990.On the efficiency of internal and external corporate control mechanisms. Academy of Management Review, 15(3): 421-458.

Walters, B. A., Kroll, M., & Wright, P. 2010. The impact of TMT board member control and environment on post-IPO performance. Academy of Management Journal, 53: 572 - 595.

Welbourne TM, Andrews AO. 1996. Predicting the performance of initial public offerings: should human resource management be in the equation? Academy of Management Journal 39(4): 891 – 919.

Welch, We. 1989. Seasoned offerings, imitation costs, and the underpricing of Initial Public Offerings. Journal of Finance, 44: 421-449.

Wright, P., Ferris, S. P., Sarin, A., & Awasthi, V. 1996.Impact of corporate insider, blockholder, and institutional equity ownership on firm risk taking. Academy of Management Journal, 39: 441-463.

Zheng, S. X., Ogden, J. P., & Jen, F. C. 2005.Pursuing value through liquidity in IPOs: Underpricing, share retention, lockup, and trading volume relationships, Review of Quantitative Finance and Accounting, 25(3): 293 – 312.

Zimmerman, M. A., & Zeitz, G. J. 2002. Beyond survival: Achieving new venture growth by building legitimacy. Academy of Management Review, 27: 414-431.

Zingales, L. 1995. Insider ownership and the decision to go public. Review of Economic Studies, 62: 425-448.

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Research in Progress

1. Deb, P., Dharwadkar, R., & Brandes, P. *A Mixed Blessing: Trade-offs between Internal and External Governance Mechanisms in IPO Firms*

   (presented at BPS division of AOM conference, Montreal, 2010; currently under review at journal)

2. Deb, P., Balasubramanian, N., & Dharwadkar, R. *Signaling Type and Market Performance in IPO Firms*

   (accepted for presentation at BPS division of AOM conference, San Antonio, Texas, 2011)

3. Deb, P. & Wiklund, J. *CEO Ownership and Founder Status as Antecedents of Entrepreneurial Orientation: A Contingency Based Approach*

   (presented at Entrepreneurship division of AOM conference, Chicago, 2009)

4. Brandes, P., Dharwadkar, R., &Deb, P. Peer-reviewed book chapter titled *Executive Remuneration and Corporate Governance* in *Handbook of Corporate Governance*(edited by Mike Wright, Donald S Siegel, Kevin Keasey & Igor Fitatotchev)

Teaching Experience and Evaluations

Course Name: SHR 247 (Introduction to Strategic Management)

- Spring 2010: 4.7 / 5; (28 students)
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Professional Service Activities

Ad hoc Reviewer

- Journal of Business Research
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Awards and Distinctions

- Won National Scholarship awarded by Government of India for undergraduate performance
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Grants

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Affiliations

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Business Experience

- Senior Consultant, Finance consulting practice of Accenture India (based in Mumbai with assignments in Minneapolis), 2006-2007

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- Officer, Council of Scientific & Industrial Research, 1996 - 2001