

THE DETERMINANTS OF BOARD STRUCTURE AT THE INITIAL PUBLIC OFFERING*

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ABSTRACT

This paper describes board size and composition and investigates the role of venture capital in a sample of 1,116 firms' initial public offerings. First, firms backed by venture capital have fewer insider and instrumental directors and more independent outsiders. Second, we consider board composition as the outcome of a bargain between the CEO and outside shareholders. Representation of independent outsiders on the board decreases with the power of the CEO—tenure and voting control—and increases with the power of outside investors—venture capital backing and venture firm reputation. Third, within the sample of firms financed by venture capital and also consistent with a bargaining model, the probability that a founder remains as CEO is decreasing in venture firm reputation. Finally, we examine the influence of venture capital backing and board structure on firm outcomes in the 10 years after the initial public offering.

I. INTRODUCTION

ESTABLISHING effective corporate governance that protects minority shareholders is arguably most important at the time of an initial public offering (IPO), because the IPO represents the first time that most firms raise equity from dispersed investors.¹ One mechanism for overseeing the firm is with

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¹ See Michael C. Jensen & William H. Meckling, *Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure*, 3 *J. Fin. Econ.* 305 (1976); Eugene F. Fama & Michael C. Jensen, *Separation of Ownership and Control*, 26 *J. Law & Econ.* 301 (1983); Oliver Williamson, *Corporate Governance*, 93 *Yale L. J.* 1197 (1983); Andrei Shleifer & Robert W. Vishny, *A Survey of Corporate Governance*, 52 *J. Fin.* 737 (1997); and Benjamin E. Hermalin & Michael S. Weisbach, *Boards of Directors as an Endogenously Determined Institution: A Survey of the Economic Literature*, 9 *Econ. Pol'y Rev.* 7 (2003). Jensen and Meckling argue that conflicts between managers and investors can affect the willingness of both debt and equity holders to provide capital. In this spirit, Fama and Jensen and Williamson hypothesize that the

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the board of directors. With new data gathered from IPO prospectuses, we describe the board size and composition for 1,116 IPO firms. The empirical results shed light on two issues: the role of venture capital and the bargain between the CEO and outside investors.

Unlike much of the existing literature on the board of directors, our analysis is organized around a corporate event—the IPO—rather than in calendar time.² Because existing shareholders bear the cost of suboptimal governance, board structure is more likely to be chosen optimally at the time of the IPO. By contrast, in calendar time, board structure is as much a consequence of past performance as it is a measure of the quality of corporate governance.

An alternative view is that corporate governance is designed so that management can continue to enjoy private benefits of control after an IPO. In this spirit, Robert Daines and Michael Klausner³ and Laura Field and Jonathan Karpoff⁴ find that antitakeover provisions are common in IPO charters.⁵ Surprisingly, venture capitalists do not have a statistically significant effect. One possible explanation is that venture capitalists institute better internal governance mechanisms—board of directors and ownership structure—that substitute for the external market for corporate control. Once these mechanisms are in place, takeover defenses may have little effect on performance while potentially increasing the proceeds in a merger or acquisition. With this possibility in mind, we examine the board of directors.

First, by comparing the composition of boards backed by venture capital with boards not backed by venture capital, we are able to gain some insight into what venture capitalists do.⁶ Boards backed by venture capital have

composition of the board should be shaped by the need for oversight. Hermalin and Weisbach provide a recent survey of the empirical literature on the board of directors. Shleifer and Vishny provide a broader survey of corporate governance mechanisms.

² Two notable exceptions are Robert Gertner & Steven N. Kaplan, *The Value-Maximizing Board* (Working paper, Univ. Chicago 1996); and Randolph P. Beatty & Edward J. Zajac, *Managerial Incentives, Monitoring, and Risk Bearing: A Study of Executive Compensation, Ownership, and Board Structure in Initial Public Offerings*, 39 *Admin. Sci. Q.* 313 (1994). Gertner and Kaplan compare the board structure of reverse leveraged buyouts (LBOs)—arguably chosen to maximize valuation—to a matched sample of firms. They find that reverse LBO boards are smaller and retain a much larger ownership stake. Beatty and Zajac study the governance characteristics of a cross section of IPO firms.

³ Robert Daines & Michael Klausner, *Do IPO Charters Maximize Firm Value? Antitakeover Protection in IPOs*, 17 *J. L. Econ. & Org.* 83 (2001).

⁴ Laura Casares Field & Jonathan M. Karpoff, *Takeover Defenses of IPO Firms*, 57 *J. Fin.* 1857 (2002).

⁵ For example, Field and Karpoff, *id.*, find that 53 percent of their sample of 1,019 firms employ at least one takeover defense at the time of their IPO. While lower than in seasoned firms, this rate seems too high to be consistent with optimal governance.

⁶ A large theoretical literature has explored the mechanisms that venture capitalists use to reduce agency, information, and verifiability problems. The mechanisms include active monitoring and advice, screening, incentives to exit, syndication, and staging of the investment. For active monitoring and advice, see Francesca Cornelli & Oved Yosha, *Stage Financing and the Role of Convertible Securities*, 70 *Rev. Econ. Stud.* 1 (2003); Leslie M. Marx, *Negotiation and Renegotiation of Venture Capital Contracts* (Working paper, Univ. Rochester 1994); and

fewer inside and instrumental directors—interdependent decision makers, such as investment and commercial bankers, lawyers, accountants, and consultants, who provide advice to the firm—and more independent outsiders. The number of insiders is 27 percent smaller in firms backed by venture capital, and the number of instrumental directors is 20 percent smaller. In other words, in taking a board seat, a venture capitalist is not simply increasing board size or replacing alternative independent directors and holding board size constant. This is consistent with the notion that venture capitalists, in addition to providing capital, are active in monitoring management and providing value-added services to their portfolio companies.⁷

Second, we focus on board composition as the outcome of a bargain between the CEO and outside investors. According to Benjamin Hermalin and Michael Weisbach, the skill of the CEO, relative to the board's alternative candidates, influences the bargain with outside investors.⁸ In the sample of firms backed by venture capital, we measure the bargaining power of the CEO with tenure and voting control and the bargaining power of the outside investor with a proxy for venture firm reputation. The number of venture capitalist board seats decreases with CEO tenure and voting control and increases with venture firm reputation. Part of the power of a reputable venture firm is in its ability to find a competent replacement for the CEO. Consistent with this interpretation, we find that the probability that a founder remains in the role of CEO decreases as venture firm reputation increases.

Thomas Hellmann, The Allocation of Control Rights in Venture Capital Contracts, 29 *Rand J. Econ.* 57 (1998). For screening, see Yuk-Shee Chan, On the Positive Role of Financial Intermediation in Allocation of Venture Capital in a Market with Imperfect Information, 38 *J. Fin.* 1543 (1983). For incentives to exit, see Erik Berglöf, A Control Theory of Venture Capital Finance, 10 *J. L. Econ. & Org.* 247 (1994). For syndication, see Anat R. Admati & Paul Pfleiderer, Robust Financial Contracting and the Role of Venture Capitalists, 49 *J. Fin.* 371 (1994). For staging of the investment, see Dirk Bergemann & Ulrich Hege, Dynamic Venture Capital Financing, Moral Hazard, and Learning, 22 *J. Banking & Fin.* 703 (1998). In most cases, the critical role of venture capitalists is in gathering information and monitoring. The empirical literature has examined staging, syndication of investment, monitoring, compensation, CEO turnover, and board composition. For staging, see Paul A. Gompers, Optimal Investment, Monitoring, and the Staging of Venture Capital, 50 *J. Fin.* 1461 (1995). For syndication of investment, see Josh Lerner, The Syndication of Venture Capital Investments, *Fin. Mgmt.*, August 1994, at 16. For monitoring, see Michael Gorman & William A. Sahlman, What Do Venture Capitalists Do? 4 *J. Bus. Venturing* 231 (1989). For compensation, see Malcolm Baker & Paul A. Gompers, An Analysis of Executive Compensation, Ownership, and Control in Closely-Held Firms (Working paper, Harvard Univ. 1999). For CEO turnover and board composition, see Josh Lerner, Venture Capitalists and the Oversight of Private Firms, 50 *J. Fin.* 301 (1995).

⁷ This is similar in spirit to Randall S. Kroszner & Philip E. Strahan, Bankers on Boards: Monitoring, Conflicts of Interest, and Lender Liability, 62 *J. Fin. Econ.* 415 (2001), which uses board representation by bankers as a measure of involvement with firm management, and similar in interpretation to Thomas Hellmann & Manju Puri, Venture Capital and the Professionalization of Start-Up Firms: Empirical Evidence, 57 *J. Fin.* 169 (2002), which finds that venture capitalists assist in the professionalization of entrepreneurial management teams.

⁸ Hermalin & Weisbach, *supra* note 1, has a detailed survey of empirical evidence on endogenously chosen boards.

Third, we track our sample of IPO firms for 10 years following the IPO, recording merger offers, merger completions, and other delistings. As in the literature on board structure and operating performance, we find no strong link between venture capital backing, boards, and firm outcomes. There is some suggestive evidence that firms not backed by venture capital have a higher failure rate. Holding constant CEO and firm characteristics, venture capital backing reduces the probability of failure by about 7 percent.

These basic patterns of board composition and firm outcomes hold when we control for the endogeneity of venture capital financing and the underlying ownership structure of the firm. In the larger sample of IPOs, we instrument for venture capital financing with two variables: the state of operation, which explains about 14 percent of the variation in venture capital financing, and an indicator variable equal to one if the firm was founded after 1979. In 1979, the Employee Retirement Income Security Act was amended to allow pension funds to invest in venture capital partnerships, leading to a large, exogenous influx of capital to venture capital funds. In addition, we control for inside and outside ownership percentages. These two tests provide some comfort that venture capital is playing a causal role in board structure instead of being a passive mirror of some omitted firm characteristics.

Finally, many interesting descriptive statistics on board size and composition arise as a by-product of our main analyses. Not surprisingly, the boards are much smaller in our sample. Compared with boards of previous studies of larger public firms, our boards are smaller by half, with six directors on average.⁹ In addition, we look at the effect of CEO financial incentives, CEO retirement, and firm characteristics, such as asset tangibility, research and development, firm age, and cash flow, on the composition of the board.

The rest of this paper is organized as follows. Section II describes the data. Section II discusses the empirical results on the determinants of board size, board composition, whether a founder remains as CEO at the IPO, and firm outcomes. Section IV concludes.

II. DATA

The sample covers the period from 1978 to 1987. There are two advantages to this earlier time period in assessing the role of venture capital.¹⁰ The first is that venture capital financing is less widespread. Of the 1,116 firms we study, only a third are backed by venture capital. In recent years, the fraction

⁹ For example, see David Yermack, Higher Market Valuation of Companies with a Small Board of Directors, 40 *J. Fin. Econ.* 185 (1996).

¹⁰ Our results may not generalize to the recent wave of firms financed by venture capital. However, it is worth noting that the growth of the venture capital industry may strengthen the economic significance of some of our results. For example, venture capitalists now have access to a wider network of potential managers, increasing their bargaining power and board representation as a result.

of IPOs backed by venture capital has increased to over half.¹¹ The increase in venture capital fundraising has meant that IPOs in certain industries are predominantly financed by venture capital. By contrast, in the earlier time period, there is greater heterogeneity in the source of financing for IPO firms across and within industries, which helps us isolate the influence of venture capital on board structure.¹² The second advantage is that we can use the Employee Retirement Income Security Act of 1979 as an instrument for venture backing. Over half of the sample (53 percent) was founded prior to 1979. By contrast, only 6 percent of the 1999 and 2000 IPOs recorded by Securities Data Company (SDC) were founded prior to 1979.

Our initial sample consists of 1,553 firms. The sample of 1,120 firms not backed by venture capital and 433 firms backed by venture capital combines data from Jay Ritter¹³ and Christopher Barry and coworkers.¹⁴ The data on board structure were collected from IPO prospectuses. We were able to locate prospectuses for 1,306 firms. From this smaller sample, we eliminated 188 limited partnerships, real estate investment trusts, spin-offs, and financial firms. Of the remaining firms, we were able to gather data on the boards of directors for 1,116 firms. This final sample contains 42 firms with more than one class of common stock. Our final sample contains 19 firms that are classified by SDC as reverse leveraged buyouts (LBOs). In terms of governance characteristics, these firms may be more like those backed by venture capital than the sample of firms not backed by venture capital.¹⁵ However, when we reclassify these firms, none of our basic inferences change.¹⁶

Table 1 provides summary statistics for the sample. Board structure is summarized in panel A. Using descriptions in the IPO prospectus, we follow the board categories described by Barry Baysinger and Henry Butler.¹⁷ Di-

¹¹ According to Securities Data Company (SDC), 55 percent of the 922 IPOs in 1999 and 2000 were venture capital financed.

¹² Two-digit Standard Industrial Classification (SIC) codes explain over 16 percent of the variation in venture capital financing in 1999 and 2000 and less than 10 percent in our sample.

¹³ Jay R. Ritter, *The Long-Run Performance of Initial Public Offerings*, 46 *J. Fin.* 3 (1991).

¹⁴ Christopher Barry *et al.*, *The Role of Venture Capital in the Creation of Public Companies: Evidence from the Going-Public Process*, 27 *J. Fin. Econ.* 447, 453 (1990). The identification of venture-backed firms is as follows: "The venture-capital-backed IPOs are all new issues with venture-capital participation as reported in the *Venture Capital Journal* for which we could verify the identity of venture capitalists against *Pratt's Guide to Venture Capital Sources*. Venture-capital-backed offerings of limited partnership units and reverse LBOs are excluded." See the data description in Barry *et al.*, *supra*, for more detail on the sample selection and classification.

¹⁵ Gertner & Kaplan, *supra* note 2.

¹⁶ When we reclassify these 19 firms as venture capital backed, the summary statistics are almost unchanged. For example, board size is 6.23 (versus 6.21) for the group backed by venture capital. We also reproduce Tables 3 through 6 (available upon request). Because the change affects less than 2 percent of the sample, none of our inferences change under this alternative classification.

¹⁷ Barry D. Baysinger & Henry N. Butler, *Corporate Governance and the Board of Directors: Performance Effects of Changes in Board Composition*, 1 *J. L. Econ. & Org.* 101 (1985).

TABLE 1
SUMMARY STATISTICS

	<i>N</i>	Median	Mean	SD	Min	Max
A. Board composition:						
Board size	1,116	6.00	6.07	1.87	1.00	15.00
Insiders	1,116	3.00	2.96	1.37	.00	11.00
Quasi outsiders:						
Industry, related	1,116	.00	.30	.72	.00	10.00
Financier	1,116	.00	.60	.91	.00	7.00
Other instrumental	1,116	.00	.47	.75	.00	4.00
Outsiders:						
Industry, unrelated	1,116	.00	.20	.51	.00	4.00
Venture capitalist	1,116	.00	.66	1.11	.00	6.00
Other monitoring	1,116	.00	.34	.68	.00	5.00
B. CEO characteristics:						
Age	1,114	46.00	47.12	8.81	24.00	78.00
Tenure	1,101	5.00	7.19	7.26	.00	50.00
Founder	1,095	1.00	.55	.50	.00	1.00
C. Firm characteristics:						
Equity value (\$ millions)	1,104	42.09	84.51	160.73	1.86	2,187.39
Asset value (\$ millions)	1,025	48.99	94.51	173.66	1.87	2,318.09
Industry equity SD	1,116	.50	.50	.13	.09	1.14
IPO backed by venture capital	1,116	.00	.34	.47	.00	1.00
Dual-class IPO	1,116	.00	.04	.20	.00	1.00
PPE intensity (%)	812	19.15	25.52	20.71	.00	90.62
R&D intensity (%)	495	5.58	8.96	16.06	.00	244.57
Cash flow to sales (%)	798	2.98	-4.63	33.85	-248.20	66.62
Firm age	1,091	5.58	9.51	12.83	.08	166.00

NOTE.—Board composition, CEO characteristics, and firm characteristics for 1,116 initial public offerings (IPOs) between 1978 and 1987. The sample excludes limited partnerships, real estate investment trusts, spin-offs, and financial firms. Panels A and B use data from the IPO prospectus. In panel C, the equity value is price times shares outstanding (using Center for Research in Security Prices (CRSP) data), asset value is price times shares outstanding plus long-term debt (from Compustat data), and industry median standard deviation is calculated with monthly stock returns from CRSP for the year prior to the IPO. Industries are defined at the four-digit Standard Industrial Classification (SIC) code level provided there are at least four CRSP-listed firms. Otherwise, we use three-digit or two-digit SIC codes. In addition, we show status of venture capital backing from Paul A. Gompers, *Grandstanding in the Venture Capital Industry*, 42 *J. Fin. Econ.* 133 (1996). The other firm characteristics are the ratio of plant, property, and equipment (PPE) to total assets, the ratio of research and development (R&D) expense to total assets, and the ratio of cash flow to sales, with all data from Compustat. Finally, we calculate firm age with the founding date from the prospectus.

rectors serve one of three functions: executive, instrumental, and monitoring. The executive component consists of corporate officers, retirees, and other insiders. While not impartial monitors, insiders can bring information on a firm's operations to the board.¹⁸ The instrumental component consists of financiers, consultants, legal counsel, and other quasi outsiders. While also potential monitors, these interdependent decision makers primarily provide

¹⁸ In addition, senior managers can be evaluated for possible succession by serving on the board. Benjamin E. Hermalin & Michael S. Weisbach, *The Determinants of Board Composition*, 19 *Rand J. Econ.* 589 (1988).

expertise that may complement the CEO's skills and assist in management. Finally, the monitoring component consists of public directors, professional directors, private investors, and other outsiders. These independent decision makers clearly fit the notion of objective and independent monitors of the CEO's performance.

The average and median board size in the sample is six. This is less than half the median size for boards found by David Yermack.¹⁹ Martin Lipton and Jay Lorsch²⁰ argue that large boards are dysfunctional. The optimal size of the board of directors balances the costs and benefits of additional directors. While marginal directors bring additional information, expertise, or monitoring, large boards, burdened by free riding and complexity, may be ineffective. Yermack²¹ and Theodore Eisenberg and coauthors²² show that performance, measured by Q and operating ratios, is decreasing in proportion to the size of the board of directors. The median board size in the Yermack sample is 12; firms with a board size of less than seven have the highest levels of Q . Figure 1 presents the empirical distribution of board size. While we do find boards as small as one and as large as 15, the vast majority have between four and seven members.

Insiders hold roughly half of the board seats, three on average. The other half is split evenly between quasi outsiders and outsiders. Among the quasi outsiders, financiers make up the largest fraction, .60 seats on average. Among outsiders, venture capitalists represent the largest category of directors at .66 seats on average.²³ Baysinger and Butler²⁴ find a connection between board composition and subsequent performance.²⁵ Consistent with an optimal bal-

¹⁹ Yermack, *supra* note 9.

²⁰ Martin Lipton & Jay W. Lorsch, A Modest Proposal for Improved Corporate Governance, 48 *Bus. Law.* 59 (1992).

²¹ Yermack, *supra* note 9.

²² Theodore Eisenberg, Stefan Sundgren, & Martin T. Wells, Larger Board Size and Decreasing Firm Value in Small Firms, 48 *J. Fin. Econ.* 35 (1998).

²³ The average number of inside, quasi-outside, and outside board members does not add up to the total number of board members because certain board members could not be classified owing to a lack of biographical information.

²⁴ Baysinger & Butler, *supra* note 17.

²⁵ An alternative approach is to evaluate specific actions where conflicts of interest between managers and shareholders may arise. Empirical studies on board actions have produced more definitive results. When boards have more outsiders, bidder returns on takeovers are higher. See John W. Byrd & Kent A. Hickman, Do Outside Directors Monitor Managers? Evidence from Tender Offer Bids, 32 *J. Fin. Econ.* 195 (1992). Also, share price reactions to the enactment of poison pills are higher. See James A. Brickley, Jeffrey L. Coles, & Rory L. Terry, Outside Directors and the Adoption of Poison Pills, 35 *J. Fin. Econ.* 371 (1994). Outsider-dominated boards are more likely to replace CEOs in response to poor performance. See Michael S. Weisbach, Outside Directors and CEO Turnover, 20 *J. Fin. Econ.* 431 (1988); Kenneth A. Borokhovich, Robert Parrino, & Teresa Trapani, Outside Directors and CEO Selection, 31 *J. Fin. & Quantitative Analysis* 337 (1996); and Tod Perry, Incentive Compensation for Outside Directors and CEO Turnover (Working paper, Arizona State Univ. 2000). Finally, consider the effect of board independence in target firms on the probability of a hostile takeover and target

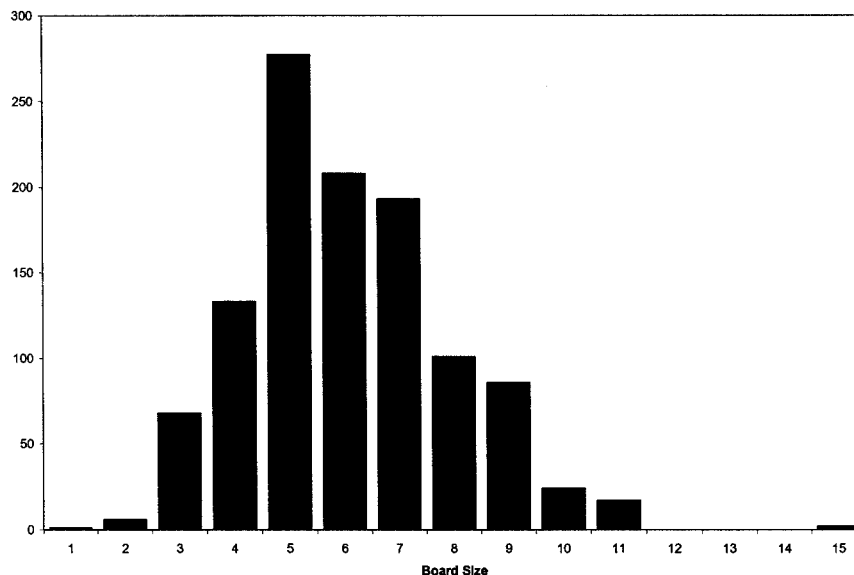


FIGURE 1.—The empirical distribution of board size for 1,116 IPOs between 1978 and 1987. Board size is the number of directors listed in the IPO prospectus.

ance between inside and outside directors, the authors show diminishing returns to board independence. Hermalin and Weisbach²⁶ argue that Baysinger and Butler's work on boards ignores the endogeneity of board structure. In particular, outside directors may be added in response to poor performance, muddying the empirical conclusions. In addition to using an instrumental-variables approach, Hermalin and Weisbach control for ownership structure and find no significant relationship between board composition and performance as measured by Tobin's Q .²⁷

The CEO characteristics from the IPO prospectus are summarized in panel B of Table 1. The median CEO is 46 years old, although there are CEOs as young as 24 and as old as 78. On average, the CEO has been with the firm for 7.2 years (median of 5 years). We also examine what fraction of the

firm returns during the takeover process. See Anil Shivdasani, Board Composition, Ownership Structure, and Hostile Takeovers, 16 *J. Acct. & Econ.* 167 (1993); and James F. Cotter, Anil Shivdasani, & Marc Zenner, Do Independent Directors Enhance Target Shareholder Wealth during Tender Offers? 43 *J. Fin. Econ.* 195 (1997).

²⁶ Benjamin E. Hermalin & Michael S. Weisbach, The Effects of Board Composition and Direct Incentives on Firm Performance, 20 *Fin. Mgmt.* 101 (1991).

²⁷ See also Hamid Mehran, Executive Compensation Structure, Ownership, and Firm Performance, 38 *J. Fin. Econ.* 163 (1995); April Klein, Firm Performance and Board Committee Structure, 41 *J. Law & Econ.* 275 (1998); and Sanjai Bhagat & Bernard Black, The Non-correlation between Board Independence and Long-Term Firm Performance, 27 *J. Corp. L.* 231 (2002).

TABLE 2
BOARD COMPOSITION BY VENTURE CAPITAL BACKING

	NUMBER OF BOARD SEATS			% OF BOARD SIZE		
	Yes	No	<i>p</i> -value	Yes	No	<i>p</i> -value
Number of firms	377	739		377	739	
Board size	6.21	5.99	.04	100.00	100.00	
Insiders	2.39	3.25	.00	39.19	57.12	.00
Quasi outsiders:						
Industry, related	.32	.29	.53	5.06	4.50	.37
Financier	.55	.62	.19	8.41	9.84	.09
Other instrumental	.30	.55	.00	4.82	8.63	.00
Outsiders:						
Industry, unrelated	.20	.20	.86	3.14	3.10	.93
Venture capitalist	1.73	.12	.00	28.46	1.92	.00
Other monitoring	.36	.34	.66	5.25	5.21	.95
Dual class (%)	1.59	5.41	.00			

NOTE.—Board composition for firms backed (yes) and not backed (no) by venture capital. Data on board members are from the initial public offering prospectus. The *p*-values against the null hypothesis of no difference between board composition in firms backed by venture capital and those not backed by venture capital are also shown.

current CEOs are founders of the firms. On average, 55 percent of the CEOs are listed among the founders of the firm.

Finally, panel C shows characteristics of the firm. Compared with firms in previous board studies, our firms are small. The average and median equity market values are \$84 and \$42 million, respectively. Equity market value is price times shares outstanding on the first day of trading in the IPO from the Center for Research in Security Prices (CRSP) converted to 1987 dollars using an inflation index from Ibbotson and Associates.²⁸ Asset value adds the Compustat book value of long-term debt. In addition, the firms are relatively young, with lower fixed assets, higher research and development (R&D) expenses, and negative cash flow on average. Firm age is the difference between the IPO year and the founding year in the IPO prospectus. Fixed-assets intensity is equal to plant, property, and equipment divided by assets. Research and development intensity is equal to research and development expenditures over assets, and cash flow to sales is equal to operating cash flow over revenue. All data are from Compustat for the year of the IPO. Thirty-four percent of our firms received venture capital financing while they were private, and 4 percent have more than one class of voting shares.

We also examine the differences in board composition between companies backed by venture capital and those not backed by venture capital. Table 2 presents summary statistics for board composition. We find that boards backed by venture capital are slightly larger, 6.2 members versus 5.9. This seems at odds with the view that venture capitalists create better boards—

²⁸ Ibbotson Associates, *Stocks, Bonds, Bills, and Inflation* (1999).

that is, if smaller boards are more effective. However, venture capital financing may lead to larger and more complicated firms, which require a larger board of directors for coordination.

Boards of firms backed by venture capital have fewer inside directors by a quarter, 2.4 insiders versus 3.2 insiders for those not backed by venture capital. This is consistent with venture capitalists creating boards with greater independence and oversight. In terms of quasi outsiders, companies financed by venture capital have fewer financiers and other instrumental board members. The difference in inside and instrumental members on the boards is more than offset by venture capitalist board members. We evaluate more formally in the next section whether venture capitalists substitute for inside and instrumental board members. The companies backed by venture capital have 1.7 venture capitalists, or over a quarter of the board on average, while those not backed by venture capital, not surprisingly, have only .1 on average.²⁹ Finally, over 5 percent of the companies not financed by venture capital have more than one class of common shares with different voting rights. This rate is lower by about 4 percent in firms backed by venture capital.

III. RESULTS

This section documents and analyzes the size and composition of boards in IPO firms. We emphasize the role of venture capitalists in shaping the board of directors. First, our description of board composition in IPO firms reveals something about what venture capitalists do. Venture capitalists substitute for instrumental and inside board members, which suggests that they fill some of the functional roles and provide some of the value-added services that financiers, consultants, legal counsel, and other interdependent board members provide. Second, board composition appears to be the outcome of a bargain between the CEO and outside shareholders. Both the CEO and venture firm may bring essential human capital to the firm. As Hermalin and Weisbach³⁰ predict, we find that the number of venture capitalist board seats is decreasing in proportion to CEO tenure and a measure of voting control and increasing in proportion to the reputation of the lead venture firm. Finally, we consider another outcome of the bargain: whether a founder stays on as CEO. Firms backed by venture capital do not disproportionately replace the founder. However, the ability of a venture capitalist to replace the founder is a function of the venture firm's reputation.

²⁹ Venture capitalists occasionally serve on boards of directors without investing in the company.

³⁰ Benjamin E. Hermalin & Michael S. Weisbach, *Endogenously Chosen Boards of Directors and Their Monitoring of the CEO*, 88 *Am. Econ. Rev.* 96 (1998).

A. *Estimation Issues*

The decision by a firm to raise venture capital and the decision of a venture capitalist to provide finance are not exogenous. Firm and CEO characteristics may determine which firms are backed by venture capital. These same characteristics may influence the optimal size of the board of directors or its composition. This endogeneity makes the problem of estimating the impact of venture capital financing on board structure challenging.

The omission of unidentified firm and CEO characteristics may cause us to falsely impute a significant impact of venture capital. To address this problem, we employ an instrumental-variables approach. The ideal instrument is a variable that increases the probability of venture capital backing but otherwise is unrelated to the desired board structure. We use two instruments for venture capital backing.

The first is the state where the firm's headquarters are located. We gather this information from the prospectus and Compustat. Josh Lerner³¹ argues that the cost of monitoring is increasing in proportion to the distance between the firm and its venture capitalist. Furthermore, the venture capital industry is concentrated in several states, including Massachusetts, California, and Texas. For this reason, the probability of venture capital financing is related to location of the firm. A set of state categorical variables explains about 14 percent of the variation in venture capital backing. While location may itself be endogenous, we believe that after controlling for other firm characteristics such as R&D intensity, the location decision likely depends on exogenous factors such as where the firm's founder resides.

The second instrument is a categorical variable equal to one if the firm was founded after 1979. Paul Gompers and Lerner³² find that the amendment to the Employee Retirement Income Security Act in 1979, which allowed pension funds to invest in venture capital partnerships, had a dramatic impact on money flowing into venture capital funds. Venture capital commitments rose sevenfold between 1978 and 1983. As a result, the probability of venture capital backing is considerably larger for firms founded after 1979, increasing from 31 to 41 percent. Samuel Kortum and Lerner³³ use this instrument to measure the influence of venture capital on patenting activity. In the analysis below, we report the results of both ordinary least squares and instrumental-variables regressions.

³¹ Lerner, Syndication of Venture Capital Investments, *supra* note 6.

³² Paul Gompers *et al.*, What Drives Venture Capital Fundraising? Brookings Papers on Econ. Activity: Microecon., 1998, at 147.

³³ Samuel Kortum & Josh Lerner, Does Venture Capital Spur Innovation? (Working Paper No. 6846, Nat'l Bur. Econ. Res. 1998).

B. Board Size

We first explore the determinants of board size in a regression framework.³⁴ The independent variables fall into two categories. First, CEO characteristics may play a role in determining board size. We include CEO age, tenure, founder status, and an indicator variable equal to one if the CEO is more than 60 years old. Succession issues can influence board size and composition when the CEO nears retirement.³⁵ Second, we look at the influence of firm characteristics on board size. These are firm size, firm risk measured as the industry median standard deviation of stock returns in the year prior to the IPO, the intensity of fixed assets, research and development, cash flow, and firm age.

Table 3 presents results for board size. The first two columns show the influence of CEO and firm characteristics separately. The third column includes both, and the fourth column instruments for venture capital backing with state of operation and an indicator variable equal to one if the firm was founded after 1979. Board size is increasing in CEO age, firm size, and asset tangibility—the ratio of plant, property, and equipment to total assets. The firm size coefficient is intuitive. Larger and more complicated firms require more directors. Board size is lower for founder-run firms. None of the other CEO and firm characteristics is statistically significant. Both tenure and the CEO retirement indicator variable have negative signs. In the first three columns, firms backed by venture capital are larger by .3. However, when we instrument for venture capital backing, the coefficient decreases to .1 and is no longer statistically significant.

C. Board Composition

We next examine board composition. In Table 4, the dependent variables are listed in columns. Each column is a separate regression for the fraction of the board in each category.³⁶ For quasi outsiders and outsiders, we present results for the total share, as well as the fraction in each subcategory. In panel A, we estimate ordinary least squares regressions. Panel B controls for the endogeneity of venture capital backing with the instrumental-variables approach described above. Finally, we run, but do not report, regressions in which we include the ownership structure as additional independent variables.

³⁴ Board size, an integer between one and 15, is not normally distributed. We also run, but do not report, maximum-likelihood regressions where the dependent variable has a Poisson distribution. These produce identical results in terms of the sign and statistical significance of the coefficients.

³⁵ Hermalin & Weisbach, *supra* note 18.

³⁶ Like board size, board composition is not normally distributed. Because the fraction for a given category is often zero and sometimes one, we cannot perform a logistic transformation. Instead, we run, but do not report, Tobit regressions with two-sided censoring at zero and one. These produce identical results in terms of the sign and statistical significance of the coefficients.

TABLE 3
BOARD SIZE, BY NUMBER

	ORDINARY LEAST SQUARES			INSTRUMENTAL
	(1)	(2)	(3)	VARIABLES (4)
Venture characteristics:				
Venture capital backed	.35 (3.10)	.29 (2.32)	.34 (2.74)	.12 (.26)
CEO characteristics:				
CEO age (years)	.03 (4.28)		.03 (4.13)	.03 (3.74)
CEO tenure (years)	.01 (.85)		-.01 (-.70)	-.01 (-.79)
CEO is a founder	-.45 (-3.94)		-.35 (-2.88)	-.34 (-2.74)
CEO > 60	-.44 (-1.53)		-.41 (-1.38)	-.40 (-1.29)
Firm characteristics:				
Log(firm size)		.25 (3.73)	.23 (3.59)	.26 (3.00)
Firm risk		-.49 (-.98)	-.29 (-.59)	-.19 (-.38)
PPE intensity (%)		1.02 (3.05)	.93 (2.74)	.91 (2.48)
R&D intensity (%)		-.55 (-.91)	-.33 (-.59)	-.18 (-.33)
Cash flow to sales (%)		-.22 (-1.01)	-.21 (-.91)	-.19 (-.84)
Firm age		.01 (1.73)	.01 (1.20)	.01 (1.26)
Intercept	4.60 (12.54)	4.90 (14.91)	3.59 (7.45)	3.60 (7.42)
<i>N</i>	1,079	996	968	944
Adjusted <i>R</i> ²	.04	.05	.07	.07

NOTE.—The dependent variable is the number of directors listed in the initial public offering prospectus. For venture capital, we include an indicator variable for venture capital backing. We use firm location and a categorical variable equal to one if the firm was founded after 1979 as instruments for venture capital backing. CEO > 60 is a retirement indicator variable. PPE = firm fixed-assets intensity, and R&D intensity = research and development expenditures. Heteroskedasticity-robust *t*-statistics are shown in parentheses.

Including the inside and outside ownership share in the ordinary least squares regressions in panel A does not change the statistical significance of the basic results: Venture capitalists tilt the board composition away from insiders and quasi outsiders and toward independent directors.

The independent variables are the CEO and firm characteristics described above. The firm characteristics are identical: firm size, risk, asset tangibility, R&D, cash flow, and age. Smaller and younger firms, with greater founder involvement and CEO ownership, tend have more insiders.³⁷ The CEO char-

³⁷ Weisbach, *supra* note 25; Hermalin & Weisbach, *supra* note 18; and David J. Denis & Atulya Sarin, Ownership and Board Structures in Publicly Traded Corporations, 52 J. Fin. Econ. 187 (1999).

TABLE 4
BOARD COMPOSITION

	QUASI OUTSIDER (%)					OUTSIDER (%)			
	INSIDER (%)	All	Related Industry	Financier	Other	All	Unrelated Industry	Venture Capitalist	Other
A. Ordinary least squares:									
Venture capital backed	-.164 (-11.43)	-.039 (-2.89)	.005 (.61)	-.013 (-1.20)	-.031 (-4.03)	.241 (18.37)	.003 (.58)	.238 (20.89)	.000 (-.05)
CEO:									
CEO age (years)	-.001 (-.95)	.001 (1.56)	.001 (1.64)	.000 (-.27)	.001 (1.60)	-.001 (-.69)	.000 (-1.06)	.000 (-.30)	.000 (.17)
Characteristics:									
CEO tenure (years)	.004 (3.43)	-.001 (-.73)	-.001 (-1.20)	.000 (-.06)	.000 (-.25)	-.003 (-3.42)	-.001 (-3.29)	-.002 (-4.68)	.001 (1.46)
CEO is a founder	.000 (.03)	.010 (.78)	.005 (.69)	-.003 (-.25)	.008 (1.00)	-.002 (-.18)	-.001 (-.25)	.007 (.80)	-.008 (-1.10)
CEO > 60 years	.039 (1.22)	-.027 (-1.00)	-.017 (-1.25)	.012 (.62)	-.021 (-1.37)	-.003 (-.16)	.003 (.25)	.005 (.34)	-.011 (-.88)
CEO elasticity	.058 (1.44)	.031 (.87)	.006 (.32)	-.009 (-.38)	.034 (1.67)	-.055 (-1.78)	.008 (.47)	-.043 (-1.99)	-.020 (-1.14)
Firm characteristics:									
Log(firm size)	-.012 (-1.66)	-.016 (-2.32)	-.005 (-1.64)	-.003 (-.66)	-.008 (-1.81)	.033 (5.70)	-.001 (-.45)	.025 (5.73)	.010 (2.66)
Firm risk	-.037 (-.67)	.050 (1.04)	.049 (1.70)	-.035 (-.87)	.037 (1.19)	.011 (.25)	-.035 (-1.28)	.047 (1.50)	-.001 (-.05)
PPE intensity (%)	-.062 (-1.64)	.079 (2.35)	.012 (.60)	.046 (1.80)	.020 (1.02)	-.060 (-2.11)	.008 (.51)	-.071 (-3.46)	.003 (.16)
R&D intensity (%)	-.021 (-.22)	-.005 (-.10)	.004 (.15)	.015 (.42)	-.023 (-.98)	.021 (.32)	-.009 (-.49)	.031 (.70)	-.001 (-.03)
Cash flow to sales (%)	.001 (.04)	.063 (3.08)	.011 (.89)	.027 (1.66)	.025 (2.10)	-.070 (-2.95)	-.007 (-.66)	-.032 (-1.52)	-.031 (-1.82)
Firm age	.000 (-.37)	.000 (-.71)	.000 (-2.06)	.000 (-1.39)	.000 (1.08)	.000 (.80)	.000 (.92)	.000 (.91)	.000 (-.34)
Intercept	.620 (10.04)	.157 (2.82)	-.001 (-.03)	.137 (3.26)	.020 (.58)	.069 (1.52)	.074 (2.77)	-.027 (-.75)	.022 (.90)
R ²	.17	.04	.02	.01	.05	.42	.02	.53	.02

B. Instrumental variables:									
Venture capital backed	-.158 (-3.06)	-.048 (-1.04)	.027 (1.00)	-.051 (-1.49)	-.024 (-.90)	.250 (6.18)	-.001 (-.04)	.266 (9.19)	-.014 (-.53)
CEO characteristics:									
CEO age (years)	-.001 (-1.06)	.002 (1.68)	.001 (1.81)	.000 (-.26)	.001 (1.52)	.000 (-.59)	.000 (-1.08)	.000 (-.07)	.000 (.04)
CEO tenure (years)	.005 (3.27)	-.001 (-.91)	.000 (-.45)	-.001 (-.84)	.000 (-.15)	-.003 (-2.74)	-.001 (-2.59)	-.002 (-3.44)	.001 (1.05)
CEO is a founder	-.001 (-.05)	.016 (1.19)	.004 (.59)	.002 (.23)	.009 (1.11)	-.004 (-.32)	-.003 (-.54)	.007 (.75)	-.007 (-1.04)
CEO > 60 years	.036 (1.13)	-.029 (-1.09)	-.015 (-1.05)	.007 (.36)	-.021 (-1.35)	.003 (.13)	.004 (.34)	.009 (.61)	-.010 (-.75)
Elasticity	.057 (1.41)	.035 (1.03)	.007 (.35)	-.005 (-.20)	.033 (1.69)	-.061 (-1.90)	.010 (.57)	-.052 (-2.40)	-.019 (-1.00)
Firm characteristics:									
Log(firm size)	-.012 (-1.30)	-.016 (-1.83)	-.008 (-1.78)	.001 (.11)	-.008 (-1.65)	.033 (4.35)	.000 (-.13)	.022 (4.19)	.011 (2.16)
Firm risk	-.046 (-.81)	.054 (1.07)	.044 (1.44)	-.027 (-.67)	.037 (1.14)	.016 (.37)	-.032 (-1.08)	.046 (1.42)	.002 (.07)
PPE intensity (%)	-.058 (-1.47)	.062 (1.77)	.018 (.82)	.025 (.94)	.019 (.91)	-.049 (-1.68)	.005 (.28)	-.054 (-2.68)	.001 (.05)
R&D intensity (%)	-.031 (-.31)	.001 (.01)	-.006 (-.23)	.033 (.82)	-.026 (-1.05)	.023 (.34)	-.008 (-.39)	.024 (.53)	.007 (.19)
Cash flow to sales (%)	.000 (.01)	.060 (2.91)	.010 (.78)	.026 (1.63)	.024 (1.97)	-.067 (-2.81)	-.008 (-.73)	-.030 (-1.44)	-.029 (-1.75)
Firm age	.000 (-.39)	.000 (-.47)	.000 (-1.93)	.000 (-1.17)	.000 (1.16)	.000 (.56)	.000 (.80)	.000 (.86)	.000 (-.57)
Intercept	.632 (10.18)	.149 (2.70)	-.003 (-.11)	.131 (3.11)	.021 (.60)	.063 (1.36)	.072 (2.66)	-.032 (-.87)	.023 (.91)
R ²	.18	.04	.01	.01	.04	.43	.02	.53	.02

NOTE.—For venture capital, we include an indicator variable for venture capital backing. We use firm location and a categorical variable equal to one if the firm was founded after 1979 as instruments for venture capital backing. CEO > 60 is a retirement indicator variable. PPE = firm fixed-assets intensity, and R&D intensity = research and development expenditures. Heteroskedasticity-robust *t*-statistics are shown in parentheses. In panel A, *N* = 952; in panel B, *N* = 933.

acteristics are similar. Firms also add outsiders following poor performance and insiders as the CEO nears retirement.³⁸ In addition to CEO age, tenure, founder status, and a retirement indicator variable, we add a measure of CEO incentives—the elasticity of CEO firm-specific wealth to shareholder value.³⁹ Explicit incentive contracts are an alternative to monitoring. As a result, there may be interactions between board structure and incentives. But, absent an independent board, it is not clear who sets these incentive contracts. Marianne Bertrand and Sendhil Mullainathan⁴⁰ argue that CEOs without independent boards set their own compensation.

The fraction of insiders is lower for companies backed by venture capital and increases with CEO tenure. This provides some support for a theory of board composition as the outcome of a bargain between the CEO and outside shareholders. Venture capital is a proxy for the power of outside investors, as in our earlier work,⁴¹ while tenure is proxy for the power of the CEO. With more essential human capital, a longer-serving CEO has more power to control board composition. The results in the next eight columns suggest that the bargain is over the substitution of independent outside directors for inside directors. The fraction of independent outsiders is higher by .24 in firms backed by venture capital and decreases by .02 for each standard deviation of CEO tenure. By contrast, the fraction of quasi outsiders is actually lower in firms backed by venture capital and unrelated to tenure.

Venture capitalists appear to serve an instrumental role on the board of directors, in addition to a role as monitors. Like the fraction of insiders on the board, the fraction of quasi outsiders decreases with venture backing, by .04, or about one-sixth of the sample average of .24. There is a small reduction in the fraction of financiers—investment and commercial bankers—and a larger decrease in other quasi outsiders—accountants, legal counsel, management consultants, and other interdependent decision makers. We interpret this correlation as an indicator that venture capitalists, on top of providing capital, provide advice and value-added services. These services otherwise might be performed by instrumental board members.

In addition, there are several interesting partial correlations on board composition. First, consistent with Hermalin and Weisbach,⁴² the fraction of in-

³⁸ Hermalin & Weisbach, *supra* note 18; Denis & Sarin, *supra* note 37.

³⁹ We identify from the prospectus four sources of CEO wealth: equity holdings, options, salary and bonus, and shares sold in the IPO. Each has a different estimated sensitivity to changes in shareholder value. We include a measure of the overall elasticity, which is described in the Appendix, as an additional independent variable. The need for monitoring and oversight may be a function of whether CEO incentives are closely aligned with shareholders. This gives rise to the empirical prediction that incentives are positively related to insiders and negatively related to independent outsiders on the board.

⁴⁰ Marianne Bertrand & Sendhil Mullainathan, Are CEOs Rewarded for Luck? The Ones without Principals Are, 116 Q. J. Econ. 901 (2001).

⁴¹ Baker & Gompers, *supra* note 6.

⁴² Hermalin & Weisbach, *supra* note 18.

siders is higher when the CEO is over 60 and near retirement. Board membership may be a part of the process of grooming insiders for the role of CEO. However, this effect is not statistically significant. Second, the fraction of outsiders decreases and the fraction of insiders increases with the elasticity of CEO firm-specific wealth to shareholder value. Although not significant at the 5 percent level, this result is consistent with a substitute role for the board of directors, in which monitoring replaces financial incentives. Third, firm size tilts the board toward independent outsiders and away from insiders and quasi outsiders. Larger firms may have internal substitutes for the instrumental function of the board. Finally, cash flow reduces the fraction of outsiders on the board. One plausible interpretation of the coefficients on firm size, cash flow, and venture capital backing is that board structure is an outcome of financing history. Those firms that require more and more frequent external finance have more outsiders on the board of directors.

Finally, we consider the endogeneity of venture capital financing. Both board structure and venture capital financing may arise from omitted firm and CEO characteristics. In attempt to test for this endogeneity problem, we instrument for venture capital backing using the state of operation and an indicator variable for whether the firm was started after 1979. The results in panel B of Table 4 provide some comfort that the coefficients for venture capital backing do not arise from endogeneity. In terms of economic significance, the results are identical: venture capital financing reduces the fraction of insiders by .16, reduces the fraction of quasi outsiders by .05, and increases the fraction of outsiders by .25. However, the coefficient for quasi outsiders is no longer statistically significant. Finally, we rerun, but do not report, the ordinary least squares regressions controlling for the total percentage of ownership stake of inside and outside board members to check whether board composition is a simple outcome of ownership structure. In these regressions, the coefficients for venture capital backing for all three categories of directors remain statistically significant at the 1 percent level. The coefficient for inside directors is smaller at .04, the coefficient on quasi-outsider directors is slightly larger and more statistically significant at .06, and the coefficient for outside directors is slightly smaller at .16. Not surprisingly, board and ownership structure are highly correlated, but there is an independent effect of venture capital on the board of directors, over and above its effect on ownership. In addition, the effect of CEO tenure remains significant at the 5 percent level.

D. Venture Capital and Bargaining

This section looks within the venture capital sample. We are particularly interested in understanding whether bargaining power has an effect on board composition. Hermalin and Weisbach⁴³ develop a dynamic model in which

⁴³ Hermalin & Weisbach, *supra* note 30.

board composition arises endogenously out of a bargaining game between the CEO and outside directors. A CEO whose ability, as perceived by the board, exceeds that of potential successors will have the power to fill vacant seats with insiders. Because we have information on the identity of outside investors in our subsample of firms backed by venture capital, the IPO is an ideal setting to look at the outcome of bargaining between the CEO and outside shareholders. This helps explain the empirical literature on boards, such as the weak link between independence and performance described above and the role of the CEO in filling empty board seats.⁴⁴

We employ a model described by James Heckman⁴⁵ to control for the self-selection of firms financed by venture capital. In the first stage, the dependent variable is whether or not the firm was backed by venture capital. The second stage predicts the fraction of board seats controlled by insiders and venture capitalists, conditional on the first-stage equation for venture capital financing.

The independent variables in the second stage are the familiar CEO and firm characteristics. We calculate two additional variables to measure the bargaining power of the CEO and the venture firm. First, we characterize the CEO bargaining power with a Shapley value. The Shapley value is the probability that the CEO equity position is pivotal in a simple majority voting game with the outside shareholders. Norman Shapiro and Lloyd Shapley⁴⁶ derive the formula for voting power in a game in which votes are distributed among a few significant players and a very large number of small players. Kristian Rydqvist⁴⁷ and Luigi Zingales⁴⁸ have used the Shapley value to measure the value of voting rights in firms with more than one class of shares. Furthermore, in addition to the direct effect on control, a venture capitalist can use covenants and additional restrictions to limit the actions of the CEO. As such, our Shapley values should be seen as an upper bound for the control of the CEO in firms backed by venture capital. This measure is not the same as ownership for two reasons: the Shapley incorporates both CEO ownership and the concentration of outside ownership, and for dual-class firms, voting control and cash flow ownership are not one and the same.

Second, we assume that higher-reputation firms backed by venture capital have more bargaining power. These firms are likely to have a network of

⁴⁴ Anil Shivdasani & David Yermack, CEO Involvement in the Selection of New Board Members: An Empirical Analysis, 54 *J. Fin.* 1829 (1999).

⁴⁵ James J. Heckman, Sample Selection Bias as a Specification Error, 47 *Econometrica* 153 (1979).

⁴⁶ N. Z. Shapiro & L. S. Shapley, Values of Large Games I: A Limit Theorem, 3 *Mathematics Operations Res.* 1 (1977).

⁴⁷ Kristian Rydqvist, Empirical Investigation of the Voting Premium (Working Paper No. 35, Northwestern Univ. 1987).

⁴⁸ Luigi Zingales, What Determines the Value of Corporate Votes? 110 *Q. J. Econ.* 1047 (1995).

top managers from the companies that they previously financed. A high-reputation venture capitalist would therefore find it easier to replace an existing CEO with a qualified alternate. The proxy for reputation is the reputation rank of the underwriters associated with the venture firm in prior IPOs.⁴⁹ Higher-quality venture capitalists are likely to take firms public through more reputable underwriters.⁵⁰ We determine the ranking of the underwriter using the work of Richard Carter, Frederick Dark, and Ajai Singh.⁵¹ For each venture organization, we calculate the average ranking of the lead underwriter in its prior IPOs.⁵² For each IPO firm, the venture reputation measure is an average of matched underwriter reputation. When there is more than one venture organization investing in the firm, we take an average, weighted by the size of the equity stake. We also run, but do not report, regressions using the age of the venture firm as a proxy for reputation. For survivorship reasons, older venture organizations on average are higher quality than younger firms.

The first four columns of Table 5 present the results. We use state of operation and an indicator variable equal to one when the firm was founded after 1979 as exogenous determinants of venture capital backing. In the unreported first-stage regression, the probability of being backed by venture capital is higher for firms in California, Massachusetts, and New York and for firms incorporated after 1979.

The coefficients on CEO Shapley value and venture capital firm reputation confirm that insiders are replaced by venture capitalists and are statistically significant at the 1 percent level. Increases in CEO voting control decrease the venture investors' board representation, while increases in venture firm reputation increase the fraction of board seats controlled by venture capitalists. Tenure of the CEO also enters negatively in the venture director regressions. However, tenure has a negative sign in explaining inside directors, and, in the venture director regressions, it is not significant at the 10 percent level. We conclude that Shapley value largely subsumes the effect of CEO tenure. The two are significantly correlated at .28.

These results shed additional light on the role of venture capitalists in closely held firms. In an earlier paper,⁵³ we argue that venture capital backing

⁴⁹ Underpricing of IPOs differs by venture firm age. See Barry *et al.*, *supra* note 14; Paul Gompers, Grandstanding in the Venture Capital Industry, 42 J. Fin. Econ. 133 (1996); and Lerner, *supra* note 6. We determine the age of each venture organization at the time of the IPO using the Venture Economics funds database. The results for this alternative reputation measure are similar.

⁵⁰ William L. Megginson & Kathleen A. Weiss, Venture Capital Certification in Initial Public Offerings, 46 J. Fin. 879 (1991), shows that higher-quality underwriters should be able to certify the offering more effectively, ensuring that more shares can be sold with a smaller discount.

⁵¹ Richard B. Carter, Frederick H. Dark, & Ajai K. Singh, Underwriter Reputation, Initial Returns, and the Long-Run Performance of IPO Stocks, 53 J. Fin. 285 (1998).

⁵² Venture firms with no prior IPOs are excluded.

⁵³ Baker & Gompers, *supra* note 6.

TABLE 5
BOARD STRUCTURE, CEO CONTROL, AND VENTURE CAPITALIST REPUTATION

	INSIDE DIRECTORS (%)		VENTURE CAPITALIST DIRECTORS (%)		FOUNDER IS CEO (5)
	(1)	(2)	(3)	(4)	
Bargaining:					
Shapley value	.191 (4.34)	.200 (4.33)	-.238 (-4.87)	-.227 (-4.58)	
Venture capitalist reputation		-.009 (-2.96)		.018 (5.82)	-.02 (-2.49)
CEO characteristics:					
CEO age (years)	.000 (.06)	.000 (-.14)	-.001 (-.64)	.000 (.13)	
CEO tenure (years)	-.001 (-.27)	-.001 (-.41)	-.005 (-1.76)	-.005 (-1.50)	
CEO is a founder	.034 (1.68)	.032 (1.55)	.014 (.65)	.034 (1.55)	
CEO > 60 years	.090 (1.58)	.101 (1.77)	.022 (.35)	-.014 (-.23)	
CEO elasticity	-.024 (-.34)	-.040 (-.55)	-.030 (-.37)	.012 (.15)	
Firm characteristics:					
Log(firm size)	-.002 (-.19)	.007 (.56)	.040 (3.24)	.017 (1.34)	.014 (.47)
Firm risk	.011 (.13)	.002 (.03)	.099 (1.09)	.154 (1.74)	-.043 (-.17)
PPE intensity (%)	.073 (1.29)	.064 (1.11)	-.087 (-1.42)	-.061 (-.99)	.224 (1.35)
R&D intensity (%)	.087 (1.33)	.099 (1.52)	.028 (.38)	-.013 (-.19)	.198 (.99)
Cash flow to sales (%)	-.020 (-.50)	-.018 (-.45)	-.014 (-.32)	-.034 (-.80)	.354 (3.00)
Firm age	-.001 (-.42)	-.001 (-.53)	.001 (.42)	.002 (.94)	-.014 (-3.71)
Intercept	.272 (2.13)	.345 (3.21)	.274 (2.54)	.145 (1.35)	
<i>N</i>	1,029	1,011	1,029	1,011	1,033
Censored <i>N</i>	325	307	325	307	329

NOTE.—Heckman regressions of inside directors, venture directors, and founder status on CEO and venture bargaining power. We also include firm and CEO characteristics. The dependent variable in an unreported first-stage regression is an indicator variable for venture capital backing. We use firm location and a categorical variable equal to one if the firm was founded after 1979 as instruments for venture capital backing. The dependent variables in the second stage are percentage of inside directors, percentage of venture directors, and founder status. The CEO Shapley value is the probability that the CEO is pivotal in a voting game with the noninsider directors. Venture reputation is the average underwriter ranking for the previous IPOs backed by the venture investors. Heteroskedasticity-robust *t*-statistics are shown in parentheses. For all regressions, the *p*-value of χ^2 is .00. PPE = plant, property, and equipment; R&D = research and development.

reduces both the control of entrepreneur and the consumption of pecuniary (and perhaps nonpecuniary) benefits of control. The results in this paper on board structure suggest that CEOs with greater bargaining power may exert greater influence over board structure: the fraction of insiders on the board of directors decreases with proxies for CEO power. The presence of an experienced venture capitalist reduces this correlation: Among firms financed by venture capital, the fraction of insiders on the board of directors decreases with the experience of the venture capital organization.

The effect of this proxy for venture reputation has a particular interpretation in the context of the Hermalin and Weisbach⁵⁴ model. The ability of the CEO relative to the board's alternatives is what determines bargaining power. As a corollary, the bargaining power of outside directors is enhanced with access to a better pool of managers. Perhaps more reputable venture capitalists gain power because they can more easily replace the founder with a suitable alternative. Higher-tier venture capital groups have financed many successful companies in the past and very likely have a large network of seasoned entrepreneurial managers to tap. This leads to the prediction that venture firm reputation is associated with higher founder turnover.

Weisbach⁵⁵ finds that outsiders on the board of directors affect the probability of CEO turnover in response to poor performance. We examine a similar issue in our sample. In particular, we look at the likelihood that a founder of the firm remains as CEO of the company at the time that the firm goes public. While we do not measure founder turnover in response to poor performance, we examine how venture capital financing affects the probability. Many venture capitalists claim to engage in "founder redeployment"—they take technical founders and move them aside in favor of traditional managers. The skills of a founder may no longer be adequate as the firm grows in size and complexity. Because the founder may not leave voluntarily, we focus on the bargaining power of the venture capitalist in this context.

The last column of Table 5 presents regression results. The dependent variable is a dummy variable that equals one if the CEO of the firm was also a founder. The independent variables are the same firm characteristics and venture capital characteristics from the board composition tests. Again, we use the Heckman approach described above, where the first, and unreported, stage determines whether a firm is venture capital backed with exogenous instruments.

The founder is less likely to remain as CEO when a high-reputation venture firm provides finance. We interpret this in the context provided by Hermalin and Weisbach.⁵⁶ The reason that high-reputation venture firms are able to control a larger fraction of the board is bargaining power. By having access

⁵⁴ Hermalin & Weisbach, *supra* note 30.

⁵⁵ Weisbach, *supra* note 37.

⁵⁶ Hermalin & Weisbach, *supra* note 30.

to a pool of alternative CEOs, an experienced venture capitalist has power over the founder. The results on founder turnover provide additional evidence supporting this view.

Two other partial correlations are worth noting. Not surprisingly, we find that older firms are less likely to have a founder as the CEO at the time of the IPO. We also find a positive coefficient on cash flow to sales. This has two possible interpretations. The first is that cash flow is a measure of performance. Firms that perform better are more likely to retain the founder as CEO. Another possibility is the effect of internally generated funds. A founder can retain control if no external finance is required.

E. Firm Outcomes

The final section examines the impact of venture backing and board composition on firm outcomes. Like Anil Shivdasani⁵⁷ and James Cotter, Shivdasani, and Marc Zenner,⁵⁸ we are interested in how the board of directors influences takeover process and outcome. On the one hand, a well-governed firm may perform better and be less likely to become the target of a tender offer. On the other hand, an independent board may be more receptive to takeover offers and, as a consequence, make a more appealing target. The prediction for takeovers is ambiguous. For this reason, we also look at firm failure rates. Failure rates are somewhat less ambiguous. A well-governed firm either performs well and remains independent or performs poorly and is acquired. An outright failure is less likely in both cases. Like past studies of the link between board structure and performance, this analysis has the usual endogeneity problem. Board structure may be determined by performance characteristics rather than the other way around. We have two advantages. First, with the use of data on venture backing, we have some hope of identifying exogenous variation in board structure. And second, we are looking in event time rather than calendar time. We observe each firm at the IPO and 10 years later.

Table 6 shows two sources of data for firm outcomes. The first source is SDC. For each firm with a public offering after 1980, we record all announced merger or acquisition offers over the 10 years following the IPO.⁵⁹ Prior to 1981, SDC has incomplete coverage of takeovers. The first row shows that about 38 percent receive at least one takeover offer. In this sample, we look at the percentage of firms that were actually acquired and the percentage of firms that received only friendly bids. Firms backed by venture capital and

⁵⁷ Shivdasani, *supra* note 25.

⁵⁸ Cotter, Shivdasani, & Zenner, *supra* note 25.

⁵⁹ The sample excludes deals in the SDC mergers database classified as leveraged buyouts, spin-offs, recapitalizations, self-tenders, exchange offers, repurchases, minority stake purchases, acquisitions of remaining interests, and privatizations. It also excludes rumors and acquirers seeking an unspecified target or targets seeking an unspecified buyer.

TABLE 6
SUMMARY STATISTICS OF FIRM OUTCOMES ON FIRM AND
VENTURE CAPITAL CHARACTERISTICS

	VENTURE CAPITAL BACKED?		OUTSIDERS $> \frac{1}{3}$	
	Yes	No	Yes	No
SDC outcome:				
Takeover offer (%)	40.17	37.36	40.60	37.37
Firm was acquired (%)	76.98	70.26	76.86	70.73
Offers were classified as friendly (%)	84.89	89.22	84.30	89.20
CRSP outcome:				
Firm was active (%)	48.28 ⁺	42.49	45.83	43.91
Firm was acquired (%)	30.77	27.06	31.73	26.99
Firm was delisted for other reasons (%)	20.95**	30.45	22.44*	29.10

NOTE.—The outcome variables are constructed separately from Securities Data Company (SDC) and Center for Research in Security Prices (CRSP) for the period beginning with the initial public offering date and ending 10 years later.

⁺ Significant at the 10% level.

* Significant at the 5% level.

** Significant at the 1% level.

boards with more outside directors are slightly more likely to receive a takeover offer, to be acquired conditional on receiving an offer, and to receive at least one hostile offer. However, none of the differences are statistically significant. The second source is CRSP. Ten years after the IPO, we determine whether the firm was acquired (CRSP delisting code between 200 and 399), failed (CRSP delisting code 400 to 599), or remained active. The CRSP results corroborate the takeover data from SDC. Firms backed by venture capital and boards with more outside directors are slightly more likely to be acquired. However, the only difference that is statistically (and economically) significant for both venture backing and board composition is firm failure. Boards backed by venture capital are about 10 percent less likely to be liquidated or delisted.

Table 7 investigates the relationship between governance and firm failure in more detail. Larger, less risky, and better performing firms may be more likely to receive venture capital financing and to have outsiders on the board of directors. If so, the causality in the first panel is unclear: venture capitalists may simply identify better and more stable firms. We include CEO and firm characteristics along with venture backing and board composition in the probit regression of failure. The coefficient on venture backing remains a statistically significant 7 percent when we control for the book value of assets. However, when we control for the market value of assets, the coefficient decreases by half and is no longer statistically significant. Because the market value of assets itself captures the quality of governance, we place more weight on the book value results. Board composition is not significant in either specification. Finally, we rerun the first specification with book values using the

TABLE 7
 PROBIT REGRESSIONS ON FIRM FAILURE OF FIRM OUTCOMES ON FIRM
 AND VENTURE CAPITAL CHARACTERISTICS

	VENTURE CAPITAL BACKING		OUTSIDER REPRESENTATION	
	Book Value of Assets	Market Value of Assets	Book Value of Assets	Market Value of Assets
Board characteristics:				
Venture capital backed	-.07 (-2.00)	-.04 (-1.32)		
Outsiders > $\frac{1}{3}$			-.05 (-1.38)	-.02 (-.67)
CEO characteristics:				
CEO age (years)	.00 (-1.82)	-.01 (-2.62)	.00 (-1.66)	-.01 (-2.53)
CEO tenure (years)	.00 (-1.24)	.00 (-1.36)	.00 (-1.18)	.00 (-1.29)
CEO is a founder	.02 (.58)	.02 (.55)	.02 (.53)	.02 (.49)
CEO > 60 years	.11 (1.51)	.12 (1.68)	.11 (1.50)	.12 (1.67)
CEO elasticity	.05 (.61)	.16 (1.93)	.04 (.49)	.16 (1.90)
Firm characteristics:				
Log(firm size)	-.06 (-4.81)	-.10 (-5.74)	-.06 (-4.83)	-.10 (-5.97)
Firm risk	-.01 (-.10)	.06 (.51)	-.03 (-.24)	.05 (.43)
PPE intensity (%)	-.06 (-.73)	-.12 (-1.49)	-.06 (-.70)	-.12 (-1.46)
R&D intensity (%)	-.73 (-3.35)	-.55 (-2.88)	-.76 (-3.52)	-.58 (-3.01)
Cash flow to sales (%)	-.47 (-5.60)	-.47 (-6.06)	-.49 (-5.69)	-.48 (-6.10)
Firm age	.00 (1.11)	.00 (.74)	.00 (1.17)	.00 (.78)
Intercept	886 .00	952 .00	886 .00	952 .00
<i>N</i>	886	952	886	952

NOTE.—Firm and CEO characteristics are included in probit regressions, where the dependent variable is equal to one if the firm is delisted for a reason other than a merger or acquisition. Heteroskedasticity-robust *t*-statistics are shown in parentheses. For all regressions, the *p*-value of χ^2 is .00. PPE = plant, property, and equipment; R&D = research and development.

instrumental-variables approach described above. The coefficient on venture capital backing increases to 16 percent but is significant only at the 10 percent level. In sum, we find some evidence that links venture capital backing and long-term firm failure rates, although the mechanism is only partly captured by board composition.

IV. SUMMARY AND CONCLUSIONS

Using data from 1,116 IPO prospectuses, we describe board size and composition for a set of firms with a median age of less than 6 years and a median equity capitalization of \$42 million. This analysis gives insights on the role that venture capitalists play—beyond providing money—and the bargaining process between the CEO and outside shareholders.

The board backed by venture capital has fewer insiders and quasi outsiders and more independent outside directors. These results hold when we control for ownership structure and the endogeneity of venture capital financing, which suggests a causal relationship in which venture capitalists, in addition to monitoring management and providing capital, give advice and value-added services that otherwise might be performed by instrumental board members.

Our evidence is also consistent with the Hermalin and Weisbach⁶⁰ notion that board structure is the outcome of a bargain between the CEO and outside investors. First, the fraction of outsiders on the board of directors decreases with CEO tenure and voting control. Venture capitalists appear to be a counterweight to CEO control. Not only do venture capitalists reduce inside representation indirectly by reducing the control of the CEO with their concentrated outside ownership stakes, but reputable venture firms are also directly associated with greater outsider representation on the board. Second, a possible interpretation of the venture reputation effect is that reputable venture firms gain power by having access to adequate replacements for the founder. Consistent with this notion, the probability that a founder remains on as CEO at the time of the IPO decreases with venture firm reputation. Finally, we present some suggestive evidence that venture capital backing improves long-term firm outcomes.

APPENDIX

CALCULATING INCENTIVES

We define CEO incentives as the sensitivity of changes in CEO firm-specific wealth to changes in shareholder wealth. The prospectus identifies four sources of CEO firm-specific wealth: equity holdings after the IPO, options, salary, and shares sold. Each source of CEO wealth has an elasticity with respect to changes in shareholder wealth. The elasticity of equity holdings (η_e) is 1.0. A 1-percent change in shareholder wealth increases the value of CEO equity holdings by 1 percent. The Black-Scholes formula provides an estimate of the elasticity of the value of option holdings to shareholder wealth. A dollar increase in share price increases the value of the option

⁶⁰ Hermalin & Weisbach, *supra* note 30.

by $N(d_1)$, Black-Scholes delta (Δ).⁶¹ Converting this dollar change to a percentage change yields the elasticity of the option as a function of delta (Δ), the stock price (P) at the close of the first day of trading, and the Black-Scholes value of the call option (c):

$$\eta_o = \Delta \frac{P}{c}. \quad (\text{A1})$$

Because our data are a snapshot at the time of the IPO, we cannot measure the elasticity of salary and bonus to shareholder wealth (η_s). Instead, we rely on the average elasticity reported in past studies of large firms.⁶² This is approximately .1. Finally, the CEO wealth derived from shares sold at the IPO has no sensitivity ($\eta_{\text{sales}} = 0$) to changes in shareholder wealth.

Table A1 describes the construction of the elasticity measure for venture-backed CEOs and CEOs not backed by venture capital. The overall elasticity of CEO wealth is a weighted average of the four separate elasticities of equity, options, salary, and shares sold. The weights are the fraction of CEO firm-specific wealth that each source represents. Wealth is equal to the price at the end of the first day of trading times shares owned for equity, the Black-Scholes value c times options owned, a present value for salary and bonus, and the proceeds from the sale of equity for shares sold. The present value capitalizes the CEO's salary through a retirement age of 65 or for 3 years, whichever is greater. The total elasticity can be decomposed into its four parts, the incentives from equity (E^{CEO}), options (O^{CEO}), salary (S^{CEO}), and shares sold, which have an elasticity of zero and drop out of the equation:

$$\eta = \frac{E^{\text{CEO}}}{W^{\text{CEO}}} \eta_e + \frac{O^{\text{CEO}}}{W^{\text{CEO}}} \eta_o + \frac{S^{\text{CEO}}}{W^{\text{CEO}}} \eta_s. \quad (\text{A2})$$

The incentives for the two groups of CEOs are similar at an average of .7. The vast majority of incentives come from equity ownership for both groups. Option holdings represent about 5 percent of incentives in venture-backed firms and less than 3 percent in firms not backed by venture capital.

⁶¹ Delta (Δ) is the derivative of the Black-Scholes formula with respect to the stock price. We assume that no dividends are paid during the life of the option. The variable $N(\cdot)$ is the cumulative normal distribution function, and d_1 is defined as a function of the standard deviation of the stock returns (σ), the stock price (P), the exercise price (X), the risk-free rate (r_f), and the time to maturity (T):

$$d_1 = \frac{1}{\sigma\sqrt{T}} \left[\ln\left(\frac{P}{X}\right) + \left(r_f + \frac{\sigma^2}{2}\right)T \right].$$

⁶² Michael C. Jensen & Kevin J. Murphy, Performance Pay and Top-Management Incentives, 98 J. Pol. Econ. 225 (1990).

TABLE A1
AVERAGE CEO FIRM-SPECIFIC WEALTH ELASTICITY

Elasticity Measure ^a	Percentage of CEO Pay	Elasticity	Contribution to η	Percentage of Mean η
A. Companies backed by venture capital:				
CEO equity (E^{CEO})	66.70	1.00	.67	91.46
CEO options (O^{CEO})	3.06	1.15	.04	4.82
CEO salary	27.08	.10	.03	3.71
CEO shares sold	3.16	.00	.00	.00
Average η			.73	100.00
Standard deviation			.18	24.84
Minimum			.10	13.71
Maximum			1.00	137.68
Median η			.76	104.79
B. Companies not backed by venture capital:				
CEO equity (E^{CEO})	66.34	1.00	.66	93.58
CEO options (O^{CEO})	1.44	1.25	.02	2.53
CEO salary	27.52	.10	.03	3.88
CEO shares sold	4.70	.00	.00	.00
Average η			.71	100.00
Standard deviation			.22	31.29
Minimum			.10	14.11
Maximum			1.62	229.00
Median η			.76	107.12

NOTE.—Incentives are measured by η , the elasticity of CEO firm-specific wealth to shareholder wealth:

$$\eta = \frac{dW^{\text{CEO}}/W^{\text{CEO}}}{dE/E} = \frac{E^{\text{CEO}}}{W^{\text{CEO}}} \times 1 + \frac{O^{\text{CEO}}}{W^{\text{CEO}}} \times \left(\frac{\Delta P}{c} \right) + \frac{S^{\text{CEO}}}{W^{\text{CEO}}} \times .1.$$

CEO equity (E^{CEO}) is equal to the CEO ownership percentage times total equity. CEO options (O^{CEO}) are calculated using the Black-Scholes formula. The present value of CEO salary is salary until retirement discounted at a real rate of 3%. Years to retirement is the larger of 65 minus CEO age or 3 years. The elasticity of the CEO options to shareholder wealth is equal to Black-Scholes delta (Δ) times the first-day closing price (P) divided by the Black-Scholes option value (c). The elasticity of CEO salary to shareholder wealth is assumed to be .1, a level reported in previous large-firm studies. CEO firm-specific wealth is equal to the sum of CEO equity, options, shares sold, and salary.

^a Elasticity of CEO pay to shareholder wealth (η) times 100.

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