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Blockholders on Boards and CEO Compensation, Turnover and Firm Valuation

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We find that the presence of independent directors who are blockholders (IDBs) in firms promotes better CEO contracting and monitoring, and higher firm valuation. Using a panel of about 11,500 firm-years with a unique, hand-collected dataset on IDB-identity and a novel instrument, we find that firms with IDBs have lower excess CEO pay, lower flow and stock of CEO equity incentives, and higher valuations. These effects are substantial and robust. Our findings imply that by making it easier for blockholders to obtain a board seat, proxy access rules or bylaws can benefit shareholders.

Keywords: Boards of directors; blockholders; executive compensation; CEO turnover; firm valuation.

JEL Classifications: G32, G34, J33, M52

"*The typical large company has a compensation committee. They don't look for Dobermans on that committee, they look for Chihuahuas..., Chihuahuas that have been sedated.*"

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Warren Buffett, at 2004 annual shareholders' meeting of Berkshire Hathaway,
CNNMoney.com, May 3, 2004

1. Introduction

There are two competing views of the chief excutive officer (CEO) contracting process in the United States. In one view, CEO contracts are determined by arms-length bargaining that leads to efficient outcomes (see, e.g., Holmstrom and Kaplan (2003), Edmans and Gabaix (2009), and Edmans *et al.* (2017)). An alternative ("skimming") view holds that powerful CEOs exercise enormous sway over boards, rendering the boards ineffective in setting appropriate CEO contracts (see, e.g., Bebchuk and Fried (2004) and Morse *et al.* (2011)). Bertrand and Mullainathan (BM, 2001) argue that both views have merit: bargaining takes place in firms with strong governance and skimming in firms with weak governance. Shleifer and Vishny (1986) show that a large shareholder, by overcoming the free-rider problem in monitoring managers, can serve as an effective governance mechanism. BM find that adding a large shareholder to the board substantially reduces what a firm pays its CEO for luck, i.e., changes in firm performance beyond the CEO's control.

As representatives of shareholders, boards of directors are charged with hiring, compensating, monitoring and disciplining CEOs. Given their substantial powers, boards can serve as an important governance mechanism. But boards' ability to monitor CEOs hinges on having strong, motivated and independent directors. A director is truly independent if she is not under undue influence of the CEO, allowing her to challenge the CEO if he pursues his interests at the expense of shareholders. Morck (2008) argues that a powerful CEO can usually subdue nominally independent directors, who often owe their board seats to the CEO. But a CEO's co-option of the board can break down in the face of a strong dissenting voice. Hence, often all that is needed to overcome a CEO's "rule" over the board is one truly independent director with a significant equity stake in the firm, who has a strong incentive to monitor the CEO and the ability to confront him should the need arise. This requirement is satisfied by an independent director who is a blockholder (IDB).[1] An IDB has both a strong incentive and the ability to monitor management. The incentive comes from large stockholdings, while the ability

[1]Following the literature on boards (see Adams *et al.* (2010) for a review), we define an independent director as a director who is not a current or past executive of the company, and does not have a business relationship with the company, e.g., as a supplier or customer.

comes from several sources. A board seat gives an IDB a regular forum for monitoring managers. Large shareholdings give an IDB direct voting power, the ability to form coalitions with other large shareholders, and greater influence on the board relative to other outside directors, who typically have negligible stockholdings.[2] Thus, an IDB can play a more potent governance role than a blockholder without a board seat or an independent director without a large shareholding.

Anecdotal evidence suggests that IDBs have a significant say in hiring, compensating, and firing CEOs, and consequently can influence firm performance. Some prominent recent examples of IDBs are Warren Buffett, an IDB of Kraft Heinz; Carl Icahn, an IDB of Xerox, Herbalife, PayPal and Lyft; John Paulson, an IDB of Valeant Pharmaceuticals; and Nelson Peltz, an IDB of Sysco and Mondelēz.[3] An IDB may be an activist who agitates for changes in the firm (e.g., Carl Icahn) or a long-term investor who works quietly behind the scenes (e.g., Warren Buffett). This distinction is a matter of an IDB's operating style, and different styles can work in different situations. Regardless of their *modus operandi*, both types of IDBs have the incentives and the ability to be effective monitors. So IDB presence can lead to arms-length bargaining in contracting with, monitoring and disciplining the CEO, resulting in benefits to all shareholders.

But an IDB can also use her unique position to collude with the CEO to extract private benefits at the expense of other shareholders. What is the net effect of IDB presence on CEO contracts and disciplining and on shareholder welfare? This is an open empirical question. To our knowledge, no prior study examines the determinants of IDB presence and its consequences for CEOs and shareholders. This paper is an attempt at filling this gap in the literature. We empirically examine the determinants of IDB presence in a firm, and the effects of IDB presence on the level and composition of CEO pay, the sensitivities of CEO wealth and CEO turnover to firm performance, and firm valuation. We examine these issues using a panel containing about 11,500 firm-years of data on S&P 1500 firms over fiscal years 1998–2006. We have put together a unique, hand-collected dataset on the identity of the IDBs in this sample.

[2]See Holderness (2003) for a review of the literature on blockholders.

[3]Blockholders often hold their equity stakes via investment firms controlled by them. For example, the investment vehicles of Buffett, Icahn, Paulson and Peltz are, respectively, Berkshire Hathaway Inc., Icahn Capital L.P. and Icahn Enterprises L.P., Paulson & Co., and Trian Fund Management.

Our main explanatory variable of interest, IDB, is likely endogenous: the presence of an independent blockholder (IB) who holds a board seat in a firm is obviously not a random occurrence. Large investors decide which firms to invest in and whether to try to obtain a board seat.[4] This endogeneity can affect our analysis through either omitted variables or selection bias. While concerns about endogeneity are generally difficult to rule out completely, we try to mitigate them in a number of ways. First, we control for a large number of known determinants of each dependent variable to reduce the possibility of omitted variables. We then employ four main econometric approaches to mitigate concerns about the endogeneity of IDB presence in a firm. These are: (1) firm fixed-effects regressions, (2) two-stage least squares (2SLS) regressions, (3) propensity score matching (PSM), and (4) Abadie and Imbens matching (AIM). The results of these approaches are presented in tables. In addition, we use Heckman's two-stage treatment effect model and the MLE treatment effect model by way of robustness checks, with qualitatively similar results. The results are also qualitatively similar using Fama and MacBeth (1973) regressions. Appendix B describes these methods and their implementation.

The 2SLS approach and the two treatment effect models (the last two methods discussed later) require instrumental variables for identification. We develop an instrument for IDB based on the idea that wealthy individuals tend to invest in public companies located nearby, either due to better monitoring ability or lower asymmetric information (see, e.g., Becker *et al.* (2011)).[5] Given individual wealth constraints and preferences for the type of firm they want to invest in, a wealthy individual investor is more likely to build up a substantial ownership stake in a local firm when there is a large selection of small and mid-sized firms to choose from. Getting a board seat is also somewhat easier in such firms compared to large firms. Moreover, a wealthy individual is more likely to be prominent in an area that has fewer other wealthy investors, making it somewhat easier for her to obtain a board seat in the firm. This is essentially a "big fish in a small pond" effect. The instrument we develop, which we call the *ease of* IDB *formation* (EIF), is a

[4] A board seat is not easy to obtain, especially for large shareholders, as shown by considerable anecdotal evidence and the strong opposition by the Business Roundtable to proxy access rules, which seek to make it easier for large shareholders to seek a board seat (see, e.g., Winstein (2009) and Holzer and Berman (2010)).

[5] The tendency of wealthy individuals to invest locally is consistent with the literature on local bias in investing (see, e.g., Lerner (1995), Coval and Moskowitz (1999), and Bailey *et al.* (2008)).

product of three binary variables that together capture the ease of block formation and obtaining a board seat in a firm. EIF = (*Fewer wealthy individuals * More Compustat firms * More small firms*). *Fewer wealthy individuals = 1*, if the number of million-dollar homes in the area is less than the sample median for the year. *More Compustat firms = 1*, if the number of Compustat firms in the area is greater than the sample median for the year. *More small firms = 1*, if at least two-thirds of the Compustat firms in the area have market values below the top quartile of the sample during the year. All three binary variables are based on an area that includes all counties within a 30-mile radius of the headquarters of a given firm. While EIF can explain IDB presence in a firm, and empirically it does so significantly, it is plausibly exogenous to our main dependent variables (the level and composition of CEO pay, CEO turnover and firm valuation).

We find that IDBs are more prevalent in firms where blocks or board seats are easier to acquire and in firms with greater need for IDB presence. These findings suggest that IDB presence in a firm is not a random occurrence; instead, it is systematically related to CEO, governance and other firm characteristics in economically sensible ways. After controlling for other variables, we find that CEOs of firms with IDBs have lower excess pay, and lower proportions of equity-based pay. These results hold up across several different regression and matching methods that account for potential endogeneity of IDB presence in a firm. CEOs of firms with IDBs have significantly lower pay-performance sensitivities under several matching methods. Our finding that both the grants and holdings of CEOs' equity incentives are lower in IDB presence is almost entirely driven by stock options; IDB presence has no discernible effect on stock grants or holdings. However, CEO turnover-performance sensitivity is unrelated to IDB presence. Finally, firms with an IDB have higher valuations, as measured by Tobin's *q*. This result is especially important given previous findings that blockholder presence is unrelated to firm valuation (see, e.g., McConnell and Servaes (1990) and Mehran (1995)). The magnitudes of these effects are substantial, and are generally stronger when an IDB serves on the board's compensation committee.

Our results on the level and structure of CEO pay and on firm valuation are robust to several alternative definitions of IDB presence in a firm, changes in disclosure rules on executive pay, the adoption of Sarbanes–Oxley Act, and an alternate method of computing industry-adjusted Tobin's *q*. Our results are also generally robust to controlling for the presence of an outside blockholder or a majority independent board. Finally, an analysis of firms that switched to or from having IDB presence further supports these results.

Our findings of lower excess CEO pay and higher firm valuation in IDB presence support the monitoring hypothesis over the private benefits hypothesis.[6] Our finding that both the flow and stock of CEO equity incentives are lower in IDB presence suggests that IDB monitoring acts as a substitute for CEO equity incentives. The absence of greater turnover-performance sensitivity in IDB presence suggests that IDBs do not rely solely on stock performance, which is not within the CEO's control, to discipline managers, instead relying on soft information gleaned from their first-hand experience on the board. Overall, our findings suggest that the presence of an independent blockholder on the board leads to better contracting with and monitoring of the CEO, and consequently leads to higher firm valuation.

Several prior studies have analyzed blockholders or independent directors in various contexts, but have not examined the role of IDBs in CEO contracting directly. For instance, in a broad-ranging examination of corporate policies (investment, leverage, cash holdings, CEO pay, and number of outside directors) and outcomes (operating performance and stock liquidity), Becker *et al.* (2011) present one table showing that the presence of large individual outside blockholders significantly reduces CEO pay and the proportion of CEOs' equity-based pay. They conjecture that blockholders influence CEO pay via the board, but do not examine whether these blockholders have board seats and whether they exercise their influence via those seats. We provide a direct examination of these issues and find that Becker *et al.*'s result on CEO pay appears to be driven by the presence of one particular type of blockholder, namely IDBs (see Sec. 8.1). Cyert *et al.* (2002) examine the influence of blockholders and boards on CEO compensation level. They find that the level of a CEO's equity-based compensation, but not cash compensation, is significantly negatively related to the stock holdings of the largest outside shareholder and of the directors serving on the compensation committee. Our finding that the proportion of a CEO's equity-based pay is lower in firms with IDBs extends this result.

BM (2001) examine whether CEO compensation increases for reasons that are beyond a CEO's control. They report that the magnitude of this pay-for-luck is lower when a non-CEO blockholder sits on the board. Bebchuk *et al.* (2010) find that firms with an independent compensation committee with at least one blockholder on it are less likely to engage in opportunistic timing of stock option grants to CEOs and directors. Weisbach (1988) finds that CEO

[6]Note that these results are after controlling for other things. So, lower CEO pay in IDB presence implies lower "excess" pay.

turnover-performance sensitivity is significantly higher in companies with boards dominated by outsiders. Guo and Masulis (2015) confirm this result using the 2003 exchange listing rules as a natural experiment and find that complete independence of nominating committees matters even in firms with independent boards. But Fisman *et al.* (2014) argue that firms with weak governance (as measured by Gompers *et al.* (2003) G-index or Bebchuk *et al.* (2009) E-index), where shareholders have less influence over corporate decisions, are insulated from pressure by biased or uninformed shareholders. They find that such firms make better long-run decisions on hiring and firing the CEO. We find that IDB presence, which indicates an independent director with a large shareholding, does not affect CEO turnover-performance sensitivity.

Several early studies examine the relation between some of the outcomes we examine here and board independence or the presence of outside blockholders. But most of these studies do not deal with the endogeneity of board independence and outside blockholder presence because they were conducted before the treatment of endogeneity became widespread in corporate finance. Moreover, the findings of these studies are mixed. For example, Core *et al.* (1999) find that CEO pay increases with board independence, but decreases with outside blockholder presence. Mehran (1995) finds that the proportion of executives' equity-based pay increases with board independence, but decreases with outside blockholdings. Yermack (1996) and Agrawal and Knoeber (1996) find that Tobin's q is negatively related to board independence, while McConnell and Servaes (1990) and Mehran (1995) find that it is unrelated to outside blockholdings. Denis *et al.* (1997) find that CEO turnover-performance sensitivity is higher in the presence of an unaffiliated blockholder.

As discussed previously, neither board independence nor outside blockholder presence alone may be a match for CEO power in most firms. As Morck (2008) and Morse *et al.* (2011) point out, nominally independent directors with negligible shareholdings may have neither sufficient incentive nor the ability to confront a powerful CEO, especially if they have been handpicked by the CEO. While an outside blockholder has an incentive to monitor the CEO, without a board seat, he may lack sufficient information and a regular forum for monitoring the CEO. Nevertheless, all our tests control for board independence and, in Sec. 8.1, outside blockholder presence. In all cases, the coefficient estimates of both these variables are either statistically insignificant or have the wrong sign. More important, their inclusion does not affect the coefficient estimates of IDB, our main explanatory variable.

Our analysis of an IDB's impact on contracting with and monitoring of the CEO contributes to a growing recent literature that examines the consequences of having directors with special backgrounds or skills on the board. For instance, Masulis and Mobbs (2011) find that firms that have inside directors with outside board seats have better operating and stock performance than firms with inside directors who do not have outside board seats. Fahlenbrach *et al.* (2011) find that firms that have their former CEO on the board have better accounting performance and higher CEO turnover-performance sensitivity. Fahlenbrach *et al.* (2010) find that the appointment of a CEO as an outside director just helps to certify the appointing firm and its management, but has no impact on operating performance or corporate policies. Celikyurt *et al.* (2014) find that VC-directors promote innovation in mature public firms. Litov *et al.* (2014) find that firms with lawyer-directors take less risk. Francis *et al.* (2015) find that CEOs of firms with academic directors have lower pay and higher forced turnover-performance sensitivity. Farrell and Hersch (2005) find that adding more women to the board does not improve firm performance. Adams and Ferreira (2009) find that mandating gender quotas for directors appears to reduce value for well-governed firms. Our paper contributes to this literature by focusing on the consequences of another important director characteristic, namely being a large shareholder.

Our paper is also related to the literature on institutional activism, which finds that while activism by institutional investors, such as pension funds, sometimes influences firms' governance, it does not improve their performance (see Gillan and Starks (2007) for an excellent review of this literature). This inability is often attributed to regulatory and institutional constraints. More recently, activist hedge funds have been more successful in influencing corporate boards and managements, yielding better returns and performance (see Brav *et al.* (2009) for a review of this literature). One potential concern with our paper is that the IDBs in our sample may be predominantly hedge funds, so we may simply be replicating the findings of the hedge fund activism literature. To address this issue, we hand-collect data on the identities of all the IDBs in our sample by reading their profiles in corporate proxy statements, Wikipedia, and a variety of Internet sources. We find that about three-fourths of the IDBs are individual investors, who drive most of our results; only about 2% are hedge funds. Our paper thus contributes to the literature on investor activism by identifying another group of investors, besides hedge funds, who are successful in improving firm governance and performance.

Finally, our findings on the role and effectiveness of IDBs in firms provide some guidance for governance and rulemaking. For instance, Delaware corporate law espouses a model of governance that rests on the principle of director primacy. Governance is provided through participation of all directors in a collective and deliberative decision-making process, which balances majority and minority rights and requires that the board majority does not disempower an IDB nor does an IDB bully other directors. While there are sporadic episodes where IDBs overstep these boundaries (see, e.g., Laster and Zeberkiewicz (2015)), our findings suggest that, on average, IDBs help in achieving better governance and performance. Similarly, our findings help inform the merits of the U.S. Securities and Exchange Commission's (SEC) recent proposal on modifying the blockholder disclosure rules (see, e.g., Bebchuk and Jackson, 2012).

The remainder of the paper is organized as follows. Section 2 presents our testable hypotheses. Section 3 describes our sample, data and variables. Section 4 investigates the determinants of IDB presence in a firm. Section 5 examines the effect of IDB presence on the level and structure of CEO compensation and CEO pay-performance sensitivity. Sections 6 and 7 analyze the effect of IDB presence on CEO turnover-performance sensitivity and firm valuation, respectively. Section 8 and Appendix D present the results of several robustness checks and an analysis of firms that switch to or from having IDB presence. Section 9 concludes.

2. Hypotheses

Although a CEO generally wields considerable influence over the board, an IDB has, given her large equity stake and board seat, a strong incentive and the ability to monitor and bargain effectively with the CEO. So an IDB can counter-balance the CEO's power over the board. This implies that firms with an IDB should have lower excess CEO pay.

The effect of IDB presence on CEO turnover-performance sensitivity is unclear. Given an IDB's power on the board, one might expect IDB presence to make CEO turnover more sensitive to firm performance. However, with a board seat, an IDB is privy to soft private information on CEO performance, which does not always get incorporated in the stock price contemporaneously. Hence, monitoring by an IDB and her influence over the board can make the CEO retention decision insensitive to stock performance. If IDB monitoring and better contracting with the CEO leads the firm to make better decisions, that should also result in higher firm valuation. We call this the monitoring hypothesis.

Table 1. Hypotheses and predictions

Hypothesis	In IDB Presence:				
	CEO Pay Level	% of CEO's Equity-Based Pay	CEO's Pay-Performance Sensitivity	CEO Turnover-Performance Sensitivity	Firm Valuation
1. Monitoring hypothesis	Lower	?	?	Unrelated	Higher
2. Private benefits hypothesis	Higher	—	—	Lower	Lower

Jensen and Murphy (1990) argue that compensation via stock and options provides a powerful incentive to CEOs to maximize stockholder wealth. IDB monitoring can either substitute for CEO equity incentives (by reducing the need for high-powered equity incentives) or complement it (i.e., IDB monitoring is more effective in conjunction with strong equity incentives for the CEO). So the predicted relation between IDB presence and CEO equity incentives can be either negative or positive under the monitoring hypothesis. If IDB monitoring is a substitute (complement) for CEO equity incentives, firms with an IDB should have a lower (higher) proportion of equity-based pay in the CEO pay package, and the CEO should have lower (higher) pay-performance sensitivity.

Alternatively, an IDB can use his position to pursue private benefits at the expense of other shareholders by colluding with the CEO. In this case, we would expect firms with an IDB to have higher levels of CEO pay and lower CEO turnover-performance sensitivity. In addition, to the extent that the market knows about or suspects such skimming, it should result in lower firm valuation. For obvious reasons, we expect such skimming to be unobservable or imperfectly observable by the market and unverifiable in a court of law. We call this the private benefits hypothesis. Table 1 summarizes the predictions of the two hypotheses, which are not mutually exclusive. IDBs can improve CEO contracting and monitoring, but also extract private benefits. So our tests will measure the net effects of IDB presence in a firm.

3. Sample, Data and Variables

This paper examines the relation between IDB presence in a firm and the level and structure of CEO compensation, CEO pay-performance sensitivity, CEO turnover-performance sensitivity, and firm valuation. Doing this requires data on CEO compensation; characteristics of CEOs, directors, and corporate governance; and firms' accounting and stock price information.

Therefore, our largest possible sample (11,547 firm-years) consists of firm-years that are common in four databases — RiskMetrics[7] Directors (RM Directors), ExecuComp, Center for Research in Securities Prices (CRSP) and Compustat — over fiscal years 1998–2006 and meet our data requirements. We obtain data on G-index and E-index, defined in Sec. 4, from RiskMetrics Governance (RM Governance) database and on institutional ownership from Thomson Reuters (TFN Institutional) database. Finally, we hand-collect data on the identities of all the IDBs in our sample. For each of the 2,457 IDBs in our sample of 11,547 firm-years, we started by reading their director profiles from 1,790 proxy statements, accessed using LivEdgar. We then identified the nature of their ownership and investment vehicles from Wikipedia, Who's Who publications, business descriptions of investment vehicles on their websites, news stories in Factiva, and a variety of other Internet sources. Firms in our sample belong to the S&P 1500, which consists of the S&P 500, S&P Mid-cap 400 and S&P Small-cap 600. This is the universe of firms covered by RM Directors, RM Governance and ExecuComp databases.

Table 2 explains the construction of our sample. RM Directors obtains its data from proxy statements for shareholder meeting dates starting in 1996. Some of the key variables needed to compute a director's shareholdings are missing in the database for 1996. Also, some variables required for our analysis were not available after 2006 at the time of data collection. Hence, our analysis makes use of data for 1997–2006. During this period, there are 15,967 distinct firm-calendar years in RM Directors, all of which we find on CRSP. Since we use a fiscal year as the unit of time, we match each annual shareholder meeting date for a firm with the fiscal year in which the meeting is held. We obtain the fiscal year ending month for each firm from Compustat. We next match these 15,967 firm-fiscal years (henceforth, firm-years) with Compustat, and find 15,477 matches. After matching the annual meeting dates to the appropriate fiscal year, 83 firm-years fall under the 2007 fiscal year. Due to data limitations, we drop these observations. That leaves us with 15,394 RM Directors–CRSP–Compustat matched firm-years. Out of these, we find 13,929 firm-years with non-missing CEO data in ExecuComp. Our main analysis omits observations for the 1997 fiscal year because information on board committees starts in RM Directors database in 1998. In addition, we exclude 65 firm-years belonging to dual-class firms because they tend to be family-controlled (see, e.g., DeAngelo and DeAngelo (1985)). Thus, our final sample for the main analysis consists of 11,547 firm-years over 1998–2006.

[7]RiskMetrics was formerly called Investor Responsibility Research Center (IRRC).

Table 2. Sample construction.

Number of Firm-Year in the Sample *Reason for Dropping Firm-Years from the Sample*	Number of Firm-Years Dropped	Number of Firm-Years Remaining
Firm-years available in RM Directors during calendar years 1997–2006		15,967
Firm-years missing in CRSP	0	
		15,967
Firm-years missing in Compustat	490	
		15,477
After conversion to fiscal year, number of firm-years that belongs to fiscal year 2007	83	
		15,394
Firm-years missing in ExecuComp	1,465	
		13,929
Exclude dual-class firms based on RM Governance	1,158	
Exclude additional dual-class firms based on CRSP data	65	
		12,706
Exclude fiscal year 1997	1,159	
Number of firm-years in the final sample		11,547

Note: This table shows the steps in obtaining the base sample for our analysis from S&P 1500 firms for the period 1998–2006.

3.1. *Main variables and sample characteristics*

We define a blockholder as an individual who either controls 1% or more of the equity's voting power or owns 1% or more of the equity cash flow rights.[8,9] We define independent directors as directors classified as

[8]Prior studies typically define blockholders as holders of 5% or larger blocks, whose holdings are reported in proxy statements. Since we are interested in individual blockholders who are independent directors, we take advantage of another disclosure requirement in proxy statements, which disclose the equity ownership of directors, and define a blockholder as a holder of 1% or larger blocks to increase the power of our tests. Panel A of Table A.1 shows that, using a 1% (5%) ownership definition, 15.5% (4.6%) of the firm-years in our sample have an IDB. Given that IDB presence is our main explanatory variable, defining it using a 5% cut-off would cause it to be a column of nearly all zeros, and the variable would have minimal explanatory power. In addition, 1% of a large company's outstanding equity is a block of substantial size, especially for an individual investor. The mean (median) stockholding of a firm's largest IDB in our sample is 5.8% (2.6%) or $214 million ($32 million), which is much larger than the CEO's stockholding, with a mean (median) value of 2.2% (0.3%) for the full sample and 2.7% (0.6%) in IDB firm-years.

[9]With no dual class firms, in most cases voting power and cash flow rights are the same. Occasionally, one of them is missing or they differ slightly due to different reporting dates; we use the non-missing variable or the higher of the two.

independent or designated in RM Directors.[10] So an IDB is an independent director who is (or represents) a blockholder.[11] We define two main variables of interest for our analysis: (1) *IDB*, which is a binary variable that equals 1 if there is at least one IDB in a given firm-year, and equals zero otherwise; (2) *IDB_CC*, which is a binary variable that equals 1 if there is at least one IDB who sits on the board's compensation committee[12] in a given firm-year, and equals zero otherwise. We use a dummy variable for IDB or IDB_CC presence, instead of the holdings of IDBs, as our main explanatory variable to avoid the problems in blockholding data, such as double-counting and inconsistent reporting, pointed out by Dlugosz *et al.* (2006). Our simple binary variable abstracts from these issues.[13] In addition, it allows us to use several approaches to treatment of endogeneity, such as matching methods (propensity score and Abadie–Imbens) and treatment effect (Heckman and MLE) models, that cannot be used with a continuous endogenous variable.

Table A.1 provides an overview of our sample. Panel A reports the distribution of the number of IDBs in a firm-year. Although we define blockholdings at $\geq$1% ownership, for comparison, we also show the corresponding distribution for $\geq$5% ownership, as often used by prior studies. Of the 11,547

[10]RM Directors defines as independent a director who is neither a current company employee nor is "affiliated". A director is affiliated if she is a former employee of the company or of a majority-owned subsidiary; a provider of professional services — such as legal, consulting or financial — to the company or an executive of the service provider; a customer of or supplier to the company; a designee (i.e., a designated director) under a documented agreement between the company and a group, such as a significant shareholder; a director who controls more than 50% of the equity's voting power; a family member of an employee; an interlocking director or an employee of an organization or institution that receives charitable gifts from the company.

[11]Our blockholder dataset differs substantially from Dlugosz *et al.*'s (2006) Blockholders database. We construct our dataset from RM Directors database for S&P 1500 firms by extracting data on individual blockholders who are independent directors during 1997–2006. Dlugosz *et al.*'s database contains all types of blockholders (e.g., individuals, mutual funds, pension funds, etc.) using 1996–2001 Compact Disclosure CDs for S&P 1500 firms. We define blockholders as individuals who own or control 1% or more of a firm's outstanding equity (i.e., higher of cash flow rights or voting rights). They define blockholders as owners of 5% or more of the voting rights where reported; otherwise, higher of voting or cash flow rights, as per SEC Rule 13d-3 definition for proxy reporting. Dlugosz *et al.* find problems in blockholdings data mostly in cases where reported blockholdings are very large, mainly due to double-counting.

[12]In a firm with no compensation committee, the entire board serves as the compensation committee.

[13]The presence of multiple IDBs does not appear to have an incremental effect on our main results beyond IDB presence. When we add a dummy variable for multiple IDBs as an explanatory variable in our regressions, the coefficient and statistical significance of the IDB dummy remain virtually unchanged and the coefficient of multiple IDBs turns out to be statistically insignificant.

firm-years in our sample, 15.5% (4.6%) of the firm-years have one or more IDBs defined at 1% (5%) blockholding, and 4.2% (2.1%) have multiple IDBs. Panel B reports the breakdown of firm-years with and without an IDB_CC. Based on 1% (5%) blockholding level, of the 11,453 firm-years for which we have board committee membership information,[14] 9.1% (3.3%) of the firm-years have an IDB on the compensation committee. Panel C reports the distribution of the number of fiscal years a firm is present in our sample. Over the 1998–2006 period, our S&P 1500 sample contains 2,056 unique firms. Of these, there are 700 firms that are present in all nine years during 1998–2006 and 1,536 firms that are present in at least three years. Panel D shows the distribution of the proportion of a given firm's fiscal years that have an IDB. About 72% of the sample firms have no IDB for all the fiscal years that they are present in our sample, 10% of the firms have an IDB in all the years, and the remaining 18% of the firms have an IDB in some of the years. Panel E presents the number of firm-years in each fiscal year for all firms in the sample, firm-years with IDB, and firm-years with majority independent board. The full sample size ranges from 1,212 in 2006 to 1,340 in 2001. The percentage of firms with IDBs ranges from 12.1 in 2006 to 17.5 in 2001.

Panel F shows the distribution of the identity of the largest IDB in each firm as well as all IDBs in the sample. Since the two distributions are quite similar, we will focus on the former. About 77% of the IDBs are individual investors, 2% are hedge funds, 6% are private equity investors, 2% are venture capital investors, and 6% each represent corporations and fiduciary trusts.[15] The panel also shows the mean and median values of the percentage ownership of the largest IDB for each type of IDB. The median equity ownership is about 2% for IDBs that are individual investors, 10% for hedge funds, 14% for private equity firms and 6% for VCs. Corporations and trusts represented by IDBs own about 3% and 4%, respectively.

The distributions of our full sample, and of IDB firm-years, by industry and by the state of the headquarters location are generally quite similar. IDBs are not concentrated in firms in certain industries or states. To save space, we do not present these distributions.

[14] We do not have board committee membership data for 94 firm-years in our sample because their annual shareholder meeting took place in 1997 and RM Directors database reports this data starting in 1998.

[15] We classify IDBs as individual investors if they own the shares directly (which they do in about 82% of the cases) or indirectly via beneficial ownership of trusts or investment vehicles owned or controlled by them or their family.

3.2. *Dependent variables*

We measure the level of CEO pay as annual total compensation.[16] Total compensation is the sum of salary, bonus, the value of stock options and restricted stock granted during the year, long-term incentive payouts, and other miscellaneous compensation. Since compensation is highly skewed, we normalize it by taking the natural log of one plus the variable. We obtain all CEO compensation data from ExecuComp, convert it to constant year 2000 dollars[17] and express it in thousands. We measure the flow of CEO equity incentives as the equity compensation ratio, defined as the value of restricted stock, and the Black and Scholes (1973) value of stock options, granted to the CEO during the year divided by annual total compensation.

To examine CEO pay-performance sensitivity, we follow Hall and Liebman (1998) and define *PPS* as the dollar change in a CEO's wealth for a 1% change in stock price as (Total Delta $\times$ S $\times$ 0.01), where S equals the stock price, and Total Delta equals the number of shares (including restricted stock) owned by the CEO plus (Option Delta $\times$ number of options owned by the CEO). We use Core and Guay's (2002) methodology to calculate the delta of a CEO's previously granted options. We also compute *vega*, the sensitivity of a CEO's wealth to a 1% change in stock-return volatility.[18] Appendix C describes our computation of PPS and vega.

We use ExecuComp to identify a change in CEO. We record a CEO turnover for a given fiscal year, if the CEO for the year differs from the prior year's CEO. We measure firm valuation using industry-adjusted Tobin's q, defined as firm Tobin's q minus median industry Tobin's q, using Fama and French (1997) 48-industry classification. Tobin's q is computed as V/A, where A equals the book value of total assets, and V is an estimate of the market value of total assets computed as A plus the market value of equity minus the book value of equity. We reduce the influence of outliers by winsorizing the top and bottom one-half percent of PPS and industry-adjusted Tobin's q values in the sample.

Table A.2 provides descriptive statistics of these variables. The CEO's median annual total compensation in our sample is about \$2.7 million in constant 2000 dollars. The mean equity compensation ratio is about 0.40 (most of which comes from stock option grants), cash compensation ratio is

[16] Our main results are qualitatively similar using annual cash compensation, which is the sum of salary and bonus.

[17] We use the CPI – All Urban Consumer series from the US Department of Labor for inflation-adjustment.

[18] *Vega* is a control variable in our regressions of PPS.

about 0.47, and the remainder consists of long-term performance plans, certain benefits such as life insurance, and other miscellaneous pay. The mean (median) value of PPS indicates that a 1% increase in stock price increases the average CEO's stock and option wealth by \$327 (\$118) thousand, most of which comes from stock option ownership.[19] A CEO turnover occurs in about 12.4% of our firm-years. The median industry-adjusted Tobin's q is 0.06. There is substantial variation in all of our dependent variables across the firm-years.

3.3. *Independent variables*

In addition to the binary IDB and IDB_CC variables, the independent variables in our analysis consist of several financial ratios and characteristics of boards, CEOs, and firms. We also include year dummies as well as Fama–French 12 industry dummies.[20] We winsorize the top and bottom one-half percent of the observations of all financial ratios, CEO and institutional ownership variables, firm size variables, sales growth, market-adjusted stock return, and standard deviation of stock returns. Table A.2 provides definitions and descriptive statistics of these variables.

The median board size in our sample is nine members. The median proportion of independent directors is 0.7. Following Coles *et al.* (2014), several of our tests also control for CEO co-option, defined as the proportion of directors who joined a board after the current CEO's appointment to the CEO position. This is a measure of a CEO's influence on the board, since the CEO may have been influential in the appointment of some of these directors to the board. The median CEO co-option in our sample is 0.33. The CEO chairs the board in about 64% of the firms in our sample, is the only insider on the board in 49% of the firms, and serves on the board's nominating or corporate governance committee in about 30% of the firms. The last four variables measure aspects of CEO power.

The median age of the CEOs in our sample is 55 years and they have held the CEO position for a median of five years. The median stock ownership of

[19] The sum of the mean values of the stock and option components of PPS does not add up to the mean value of PPS because these are winsorized variables.

[20] We obtain the Fama–French 12 industry classification from Professor Kenneth French's website: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html. Also, finer classifications, such as Fama and French (1997) 48 industries, result in partitions with many industries having only one or two firms in our sample. Since many of the board characteristics variables (e.g., classified board, CEO is chairman) are highly persistent over time, using industry dummies based on finer industry classifications would be tantamount to including firm-specific dummies.

the CEO is 0.31%. The median firm age is 22 years. The typical firm in the sample is fairly large, with a median market cap of about $1.6 billion in constant 2000 dollars and a median institutional ownership of 64%.

4. Determinants of IDB Presence

We begin by examining whether the presence of an IB on a firm's board is systematically related to firm and governance characteristics that are related to an investor's decision to acquire a large equity stake in a firm and to seek and be able to obtain a board seat. If an IDB's presence in a firm is merely a random occurrence, we should not expect it to be related to such characteristics. This analysis serves a dual purpose. First, it contributes to the recent literature on firms' use of outside directors with different professional backgrounds such as corporate CEOs and directors with experience in banking, finance, politics, government and the law (see, e.g., Agrawal and Knoeber (2001), Kroszner and Strahan (2001), Güner *et al.* (2008), and Fahlenbrach *et al.* (2010)). We extend this literature by analyzing firms' use of another type of outside director, namely an independent blockholder. Second, this analysis helps us to identify the characteristics of firms with IDBs that can be used to deal with possible endogenous relations between IDB presence and the other variables of interest in Secs. 5 through 7.

First, we expect IDB presence to be related to measures of CEO power. There are two opposing forces at work here, so we should observe their net effect. Since IBs have strong incentives and the ability to monitor the CEO, powerful CEOs are likely to resist IBs' appointment to the board, making IDB presence less likely in firms with powerful CEOs. But firms with strong (and perhaps entrenched) CEOs are precisely the ones that stand to benefit more from IDB presence, increasing an investor's incentive to acquire a large block and seek a board seat.[21] We use several measures aimed at capturing different aspects of CEO power, such as whether the CEO chairs the board, whether he is the only insider on the board (see Adams *et al.* (2005)), his tenure on the board or as CEO, whether he picks directors (by serving on the board's nominating or corporate governance committee; see Shivdasani and Yermack (1999)), and the proportion of other firms' CEOs on the board (who tend to support the CEO; see Fahlenbrach *et al.* (2010)).

[21] The acquisition of IDB status by Richard Breeden at H&R Block in 2007 and by Ron Burkle at Barnes & Noble in 2010 provide anecdotal evidence that activist investors target poorly performing firms with entrenched CEOs (see Stempel (2007) and Covert (2010)).

Second, an IDB's presence can increase firm value not only because of better monitoring, but also because of better advice and by signaling a reduction of agency problems to the market. So, *ceteris paribus*, CEOs with greater stock ownership have greater incentive to support IBs in their bids for board seats. This implies a positive relation between IDB presence and CEO stock ownership. Third, since firms with classified or staggered boards have fewer board seats open in a given year, it is harder for anyone, including IBs, to get board seats in such firms.[22] This implies a negative relation between IDB presence and a dummy variable for classified boards. Fourth, it is easier for a large shareholder to get a board seat in a firm where shareholders have more rights. We measure the number of anti-shareholder rights governing a company by Gompers *et al.* (2003) Governance (G) index or Bebchuk *et al.*'s (2009) Entrenchment (E) index.[23] Since both indices include the classified board provision, which we use as a separate explanatory variable, we exclude this provision from the indices and denote the resulting indices "Net G-index" or "Net E-index." We expect both indices to be negatively related to IDB presence in a firm. Fifth, IDB presence is more likely in firms with bigger and more independent boards. It should be easier for a blockholder to get a seat on a bigger board simply because it has more seats and on a more independent board because independent directors are more likely to support an independent blockholder's bid for a board seat than insiders or affiliated directors. Sixth, since institutional investors act as a substitute for blockholders as a monitoring force, we expect IDB presence to be negatively related to the percentage of institutional ownership in a firm.

Seventh, a blockholder has a stronger reason for seeking and getting a board seat in a poorly performing firm. So we expect IDB presence to be negatively related to measures of firm performance such as the prior year's industry-adjusted operating performance to sales (OPS), market-adjusted stock return, or Tobin's q. Eighth, since a blockholding of a given percentage of the outstanding equity is obviously more expensive in a larger firm, in the face of risk-aversion and wealth constraints, we expect the presence of individual blockholders and thus IDBs to be negatively related to measures of firm size. Ninth, blockholders may be more attracted to firms with better

[22] These are firms where the board is divided into n groups (n is typically three to five), and members of only one group come up for election in a given year. This is a form of takeover defense, intended to prevent an outside group from taking majority control of the board quickly.

[23] We follow these studies and replace missing values of G- or E-index in a given year by its value in the prior year.

growth opportunities because such firms have more room for managerial discretion. In addition, the potential return to good governance is higher in such firms, making IDB monitoring more productive. We control for growth opportunities via sales growth rate. Tenth, Jensen (1986) argues that managers like to pay out low dividends and hoard cash to extract private benefits from firms. Since such firms face greater agency problems, we expect IDB presence to be more useful in such firms. Accordingly, we control for the prior year's dividend yield and cash holdings (i.e., the ratio of cash and short-term investments to total assets). We expect IDB presence to be negatively related to dividend yield and positively related to cash holdings. Eleventh, IDB monitoring is likely less effective the more the uncertainty about the production function linking CEO actions to firm value. We measure this uncertainty via lagged R&D to sales and the standard deviation of stock returns and expect IDB presence to be negatively related to both. Twelfth, as discussed in the introduction, IDB presence should be positively related to the *ease of IDB formation* (*EIF*) dummy. This variable also serves as an instrument in our subsequent analyses. Finally, we control for year dummies and Fama–French 12 industry-sector dummies to allow for the possibility that IDB presence can vary over time and across industries. Accordingly, we estimate the following equation:

$$\begin{aligned}\text{IDB} = \text{f}\ (&\text{CEO power},\ \text{CEO stock ownership \%},\ \text{classified board dummy},\\ &\text{Net G-index or Net E-index},\ \text{board size},\ \text{board independence},\\ &\text{institutional ownership \%},\ \text{firm performance},\ \text{firm size},\ \text{growth}\\ &\text{opportunities},\ \text{dividend yield},\ \text{cash holdings \%},\ \text{firm uncertainty},\\ &\text{EIF},\ \text{year dummies},\ \text{Fama}-\text{French 12 industry-sector dummies}).\end{aligned} \tag{1}$$

4.1. *Univariate tests*

Table A.3 presents univariate comparisons of our main variables for firm-years with and without IDBs. Panel A deals with the dependent variables we analyze in Secs. 5 through 7; these are discussed in the relevant sections. Panel B deals with the independent variables used in this and the following sections. Panel B shows that firms with IDBs are smaller and younger than firms without IDBs. For example, the median total assets of IDB (non-IDB) firms is about \$1.1 (1.8) billion. The CEO of an IDB firm owns more stock, serves on the nominating committee more often, but chairs the board less often, and is less frequently the only insider on the board than the CEO of a

non-IDB firm. The boards of IDB firms are slightly larger, less independent, less likely to be classified, and have lower proportions of outside directors who are CEOs than boards of non-IDB firms. IDB firms have fewer anti-shareholder provisions (as measured by G- or E-index) than non-IDB firms. Compared to non-IDB firms, IDB firms tend to have higher growth rates and stock volatility; lower cash holdings, R&D spending and dividend yield; lower institutional ownership; and worse performance. There is a higher likelihood of having an IDB if the firm has a greater ease of IDB formation, i.e., it is located in an area that has fewer wealthy individuals but a large number of small or medium-sized firms. These results suggest that the presence of IDBs is not randomly distributed across firm-years in our sample.

4.2. *Regressions*

To examine whether these relations hold in a multiple regression framework, we estimate regressions of Eq. (1), where the dependent variable is IDB or IDB_CC. Since the dependent variable is binary (0, 1), we use the probit model. Columns (2) and (3) in Table 3 show estimated marginal effects (labeled "dy/dx") and p-values of probit models of IDB presence. For comparison, column (1) shows estimated coefficients and p-values of a linear probability model (i.e., OLS) regression of IDB presence. Column (1) is preceded by a column showing the predicted sign of each relation.

All the coefficient estimates in Table 3 have the predicted signs, except for cash holdings. The table yields several insights about the probability of IDB presence in a firm. First, IDBs are more likely in firms where CEOs are less powerful (i.e., where the CEO does not chair the board, and boards with smaller proportions of other firms' CEOs, who may be more likely to support the CEO); where boards are bigger, more independent and non-classified; and where shareholders have more rights. Second, IDBs are more likely in smaller firms, where blocks are less expensive, and firms with worse operating performance, where there is more need for IDB monitoring. Third, IDBs are more likely in high growth firms, where there is more room for managerial discretion and higher potential return to good governance, suggesting that IDB presence is more useful. Fourth, IDB presence is more likely in firms that hold less cash, spend less on R&D, pay lower dividends, and have lower stock volatility. Fifth, IDBs are more likely in firms with lower institutional ownership, consistent with the idea that institutional investors and blockholders act as substitute monitoring mechanisms. Finally, IDB presence is more likely in firms with greater ease of IDB formation, i.e., firms located in areas with

Table 3. Determinants of IDB presence.

	Predicted Relation with IDB Presence	OLS (1)		Probit (2)		Probit (3)	
		Coeff.	*p*-Value	*dy/dx*	*p*-Value	*dy/dx*	*p*-Value
Log CEO stock ownership	+	0.009	0.056	0.0078	0.081	0.0048	0.206
Max (CEO's board tenure, tenure as CEO)	+/−	−0.001	0.200	−0.0011	0.226		
CEO is chairman (1/0)	+/−	−0.026	0.051	−0.0229	0.064	−0.0249	0.040
CEO on nominating committee (1/0)	+/−	0.026	0.075	0.0197	0.135	0.0185	0.160
Ratio of other firms' CEO on the board	+/−	−0.090	0.030	−0.0902	0.032	−0.0842	0.046
Fraction of independent directors	+	0.119	0.003	0.0980	0.008	0.1044	0.004
Board size	+	0.018	0.000	0.0158	0.000	0.0157	0.000
Classified board (1/0)	−	−0.024	0.081	−0.0200	0.135	−0.0209	0.117
Net E-index	−	−0.016	0.024	−0.0157	0.022	−0.0154	0.025
Firm age		0.000	0.344	0.0004	0.389		
Log sales$_{t-1}$	−	−0.055	0.000	−0.0548	0.000	−0.0537	0.000
Cash holding$_{t-1}$	+	−0.183	0.000	−0.1915	0.000	−0.1949	0.000
Industry-adjusted OPS$_{t-1}$	−	−0.003	0.000	−0.0093	0.094	−0.0095	0.090
Dividend yield$_{t-1}$ %	−	−0.009	0.033	−0.0102	0.023	−0.0092	0.044
Tobin's q_{t-1}	−	−0.001	0.872	0.0001	0.982		
Sales growth	+	0.001	0.000	0.0014	0.000	0.0013	0.000
R&D to sales$_{t-1}$	−	−0.140	0.008	−0.1745	0.006	−0.1705	0.007
Market-adjusted stock return$_{t-1}$ %	−	−0.016	0.421	−0.0180	0.366		
Standard deviation of stock returns$_{t-1}$ %	−	−0.015	0.009	−0.0145	0.013	−0.0145	0.014
Total institutional ownership$_{t-1}$%	−	−0.001	0.000	−0.0008	0.000	−0.0008	0.000
Instrument: Ease of IDB formation (EIF)	+	0.077	0.004	0.0694	0.001	0.0682	0.001
N		10,057		10,057		10,014	
Adjusted or pseudo *R*-squared		0.1117		0.1347		0.1324	

Note: The table shows estimates of the linear probability model and probit regressions of IDB. The sample consists of non-dual class S&P 1500 firms during the period 1998–2006 with non-missing data. IDB is a binary variable that equals 1 if there is at least one IDB in a given firm-year; it equals zero otherwise. All other variables are defined in Table A.2. To reduce the influence of outliers, some variables, indicated in Table A.2, are winsorized at the top and bottom 0.5% of the sample. The regressions include year dummies and Fama–French 12 industry dummies. *p*-values of the regression coefficients and marginal effects are computed using robust standard errors clustered at the CEO-firm level.

fewer wealthy individuals but a large number of small and medium-sized firms.

The magnitudes of several of these effects are non-trivial. For example, based on estimates of model (2), an increase in firm size (log of sales) from the first to the third quartile of the sample results in a decrease of about 0.111 ($= 2.03 \times 0.0548$) in the probability of IDB presence. Compared to the unconditional probability of 0.155, this represents a decrease of about 72%. Similarly, an increase in board size equal to the inter-quartile range results in an increase of about 0.063 ($= 4 \times 0.0158$) in the probability of IDB presence, or about 41% of the unconditional probability. Firms with CEO chairs are about 0.023 (about 15% of the unconditional probability) less likely to have an IDB.

5. IDB Presence and CEO Compensation

This section examines the relation between IDB presence and the level (in Sec. 5.1) and composition (in Sec. 5.2) of CEO pay, and CEO pay-performance sensitivity (in Sec. 5.3). Panel A of Table A.3 shows that both total and cash pay of the CEO is substantially lower in firms with an IDB than in firms without an IDB. The CEO's median total compensation in IDB (non-IDB) firms is \$1.8 (\$2.9) million; her cash compensation is \$0.8 (\$1) million. Relative to their counterparts in non-IDB firms, CEOs of IDB firms receive more of their pay in salary or cash than in options or equity-based components. For example, the median proportion of their cash pay is about 0.5 (0.4) in IDB (non-IDB) firms, while the proportion of equity-based pay is about 0.36 (0.43). CEOs in firms with IDBs have lower PPS than in firms without IDBs. This difference is mostly due to CEOs' stock option holdings. Both mean and median values of PPS and its option component are substantially lower in firms with IDBs than firms without IDBs. All of these differences are statistically significant at the 1% level. While the mean value of the stock component of PPS is also significantly lower in firm-years with IDBs than without, the difference is not large and the median values are statistically indistinguishable between the two groups. But this evidence is preliminary because it does not control for other variables and does not account for the endogeneity of IDB presence in a firm, a task we turn to next.

5.1. *CEO compensation level*

In this section, we estimate regressions of CEOs' total and cash compensation. As discussed in Sec. 3.3, since both variables are highly skewed, we normalize them by taking the natural logarithm of one plus the variable.

The main explanatory variable of interest is IDB or IDB_CC. The monitoring hypothesis predicts that the coefficient of IDB or IDB_CC is negative. The private benefits hypothesis predicts a positive coefficient.

The regressions control for other determinants of the level of CEO pay. Prior studies find that these determinants include measures of CEO power, and CEO, board, governance and other firm characteristics. An increase in CEO power over the board increases the CEO's ability to negotiate a bigger pay package. For instance, CEO pay is higher when the CEO chairs the board (see, e.g., Cyert *et al.* (2002) and Core *et al.* (1999)), has more influence over director selection (see, e.g., Core *et al.* (1999) and Coles *et al.* (2014)), has longer tenure (see, e.g., Bebchuk *et al.* (2009)) and when the board has a higher fraction of outside CEOs (Faleye, 2011). We control for CEO power and other CEO characteristics via the following variables: CEO age, log of CEO stock ownership, max (CEO's board tenure, tenure as CEO), CEO is chairman, CEO co-option, fraction of outside CEO-directors, CEO is the only insider, and CEO on nominating committee.

A firm's board and governance characteristics also influence the level of CEO pay. Prior studies find that CEO compensation is positively related to board size and the proportion of outside directors on the board (see, e.g., Core *et al.* (1999) and Cyert *et al.* (2002)) We control for both board size and the proportion of outside directors. Hartzell and Starks (2003) find that CEO pay is negatively related to the concentration of institutional ownership. We control for institutional ownership. Agrawal and Knoeber's (1998) findings suggest that CEO pay is negatively related to the level of takeover protection in a firm. We control for Gompers *et al.* (2003) G-index as a measure of the level of takeover protection in a firm.

Prior studies also find that the level of CEO compensation is positively related to firm size, performance, growth opportunities and complexity (see, e.g., Murphy (1999), Smith and Watts (1992), and Core *et al.* (1999)). We control for firm size via log of lagged total assets; performance via lagged market-adjusted stock return, and lagged industry-adjusted ROA; growth opportunities via lagged Tobin's q, lagged R&D to sales, and sales growth rate; and firm complexity via lagged standard deviation of stock returns. The regressions include year dummies and Fama–French 12 industry dummies.

Panel A of Table 4 reports regression estimates of log of annual total CEO compensation, using three regression approaches.[24] In OLS regressions, total

[24]The results for annual cash compensation are quite similar to these. They are not tabulated to save space.

Table 4. IDB presence and the level of CEO pay.

Panel A: Regression results

Variables	OLS		FFE		IV-2SLS		OLS		OLS	
	Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value
IDB (1/0)	−0.138	0.017	−0.075	0.050	−0.868	0.388				
IDB_CC (1/0)							−0.155	0.002		
Individual IDBs (1/0)									−0.183	0.009
High-Powered Incentive IDBs (1/0)									0.075	0.388
Representative IDBs (1/0)									0.003	0.970
CEO age	−0.002	0.358	0.002	0.569	−0.003	0.275	−0.002	0.359	−0.003	0.348
Log CEO's stock ownership	−0.043	0.030	−0.004	0.775	−0.035	0.035	−0.043	0.034	−0.042	0.030
Max (CEO's board tenure, tenure as CEO)	−0.008	0.029	−0.009	0.007	−0.008	0.025	−0.008	0.033	−0.008	0.035
CEO as chairman (1/0)	0.178	0.000	0.054	0.111	0.157	0.001	0.180	0.000	0.176	0.000
CEO co-option	0.223	0.000	0.133	0.017	0.201	0.001	0.222	0.000	0.224	0.000
Ratio of other firms' CEOs on the board	0.147	0.136	0.122	0.477	0.079	0.512	0.151	0.130	0.154	0.120
CEO is the only insider (1/0)	0.036	0.194	−0.001	0.982	0.046	0.155	0.035	0.196	0.033	0.233
CEO on the nomination committee (1/0)	−0.070	0.063	−0.057	0.038	−0.046	0.263	−0.069	0.073	−0.071	0.059
Board independence	0.114	0.277	0.079	0.591	0.180	0.266	0.102	0.327	0.128	0.229
Board size	−0.007	0.292	0.000	0.963	0.007	0.733	−0.009	0.194	−0.008	0.281
Governance index	0.019	0.002	0.011	0.364	0.014	0.202	0.019	0.002	0.019	0.003
Log total asset$_{t-1}$	0.426	0.000	0.235	0.000	0.393	0.000	0.428	0.000	0.425	0.000
Tobin's q_{t-1}	0.116	0.000	0.087	0.000	0.112	0.000	0.116	0.000	0.115	0.000
Industry-adjusted ROA$_{t-1}$	0.342	0.016	0.417	0.022	0.249	0.214	0.355	0.012	0.344	0.015
R&D to sales$_{t-1}$	0.057	0.672	−0.047	0.838	−0.034	0.853	0.061	0.650	0.058	0.665
Sales growth	0.003	0.009	0.000	0.760	0.004	0.049	0.003	0.009	0.003	0.010
Market-adjusted stock return$_{t-1}$ %	0.279	0.000	0.119	0.031	0.279	0.000	0.277	0.000	0.279	0.000
Standard deviation of stock returns$_{t-1}$ %	0.065	0.000	0.017	0.176	0.050	0.070	0.065	0.000	0.064	0.000
Total institutional holding$_t$ %	0.004	0.000	0.004	0.000	0.003	0.002	0.004	0.000	0.004	0.000
Intercept	4.223	0.000	5.430	0.000	4.583	0.000	4.210	0.000	4.226	0.000

Table 4. (*Continued*)

Panel A: Regression results

Variables	OLS		FFE		IV-2SLS		OLS		OLS	
	Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value
Year, industry fixed effects	Yes		No		Yes		Yes		Yes	
N	9,881		9,881		9,878		9,881		9,881	
Adjusted R^2/[chi-square *p*-value]	0.433		0.047		[0.000]		0.432		0.434	
Test for exogeneity (*p*-value)					0.465					
F-statistics for first-stage IVs					9.076					

Panel B: Matching results on average treatment effect for the treated (ATT)

	Abadie–Imbens Matching				Propensity Score Matching			
	Simple Matching		Bias-Adjusted Matching		Radius Caliper Matching		Kernel Matching	
	Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value
IDB (1/0)	−0.289	0.000	−0.101	0.000	−0.120	0.000	−0.132	0.000

Panel C: OLS regression results on types of IDBs

Individual		Hedge Fund		Private Equity		Venture Capital		Corporate		Fiduciary Trust	
Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value
−0.183	0.009	−0.205	0.056	0.222	0.066	−0.112	0.592	−0.012	0.924	0.017	0.816

Note: Panel A shows estimates of OLS, firm fixed-effects (FFE), and 2SLS instrumental variable (IV-2SLS) regressions of log total annual CEO compensation. The sample consists of non-dual class S&P 1500 firms during the period 1998–2006 with relevant non-missing data. The main explanatory variable(s) of interest are: IDB or IDB_CC or Individual IDB, High-powered incentive IDB and Representative IDB. IDB is a binary

Table 4. (*Continued*)

variable that equals 1 if there is at least one IDB in a given firm-year; it equals zero otherwise. IDB_CC is a dummy variable that equals 1 if there is at least one IDB who sits on the board's compensation committee in a given firm-year; it equals zero otherwise. Individual IDB is a binary variable that equals 1 if the largest IDB is an individual who owns the shares directly or indirectly, e.g., via a family or investment firm controlled by her; it equals zero otherwise. High-powered incentive IDB is a binary variable that equals 1 if the largest IDB represents the ownership of a hedge fund, private equity firm or venture capital firm; it equals zero otherwise. Representative IDB is a binary variable that equals 1 if the largest IDB represents the ownership of a corporation (including bank) or fiduciary trust; it equals zero otherwise. All other variables are defined in Table A.2. To reduce the influence of outliers, some variables, indicated in Table A.2, are winsorized at the top and bottom 0.5% of the sample. We use robust standard errors clustered at the CEO-firm level. Each regression (except firm fixed effect) includes year and Fama–French 12 industry dummies. The second stage of the 2SLS instrumental variable estimation uses the same covariates as the OLS, but instruments IDB by the *ease of IDB formation* (*EIF*) dummy. The table reports the p-value of Wooldridge's (1995) over-identification test, the p-value of Durbin–Wu–Hausman test for exogeniety, and the F-test for the IVs of the first stage estimation; standard errors are clustered at the CEO-firm level. Panel B reports the average treatment effect for the treated (i.e., ATT) of log total compensation on IDB using four different matching methods. The first two (simple matching and bias-adjusted matching) are computed using Abadie *et al.*'s (2004) method for Abadie–Imbens matching (AIM). The last two (radius caliper matching and kernel matching) are computed using Leuven and Sianesi's (2003) method for propensity score matching (PSM). For AIM and PSM, we use all variables in model (2) of Table 3 as covariates for estimating the ATT of IDB; we use the same set of variables for bias-correction in AIM. We use a maximum of four nearest neighbors for AIM. We impose common support and estimate standard errors using 100 bootstrap replications for PSM. We set the caliper at 0.02 for radius caliper matching. We set the bandwidth at 0.06 and use the Epanechnikov kernel for kernel matching. Panel C shows estimates of an OLS regression of log total compensation similar to Panel A except the IDB variable is replaced with on five different types of IDB dummy variables. Each dummy variable represents the value 1 if the largest IDB ownership is represented by an individual, hedge fund, private equity fund, venture capital firm, corporation, and fiduciary trust, respectively; zero otherwise.

CEO pay is negatively related to IDB presence. CEO pay in firms with IDB is 12.89% [$= e^{-0.138} - 1$] lower than in firms without IDB, after controlling for its other determinants. CEO pay is negatively related to the CEO's stock ownership, tenure, and membership on the nominating committee; positively related to other measures of CEO power, such as CEO is chairman and CEO co-option; and positively related to G-index, institutional ownership, and measures of firm size, performance, growth opportunities and complexity. All of these relations are statistically significant.

Next, we use four different methods, discussed in Sec. 3.2 and Appendix B, to account for the potential endogeneity of IDB presence. First, we use firm fixed-effects (FFE) regressions, which explicitly account for unobservable firm-specific omitted variables that are time-invariant. The coefficient of IDB continues to be significantly negative, although the estimated magnitude of IDBs' effect on CEO pay is somewhat lower than in the OLS regression. Here, CEO pay in firms with an IDB is 7.2% [$= e^{-0.075} - 1$] lower than in firms without IDB. Second, we employ 2SLS regressions. Here, the test of exogeneity has a p-value of 0.465, which suggests that our inclusion of many relevant control variables does a reasonably good job of overcoming a potential bias due to omitted variables here. So the OLS is preferred to 2SLS in our regressions of the level of CEO pay.[25] Column (4) shows that replacing IDB by IDB_CC in the OLS regression has a slightly more negative effect on the level of CEO pay. CEO pay in firms with an IDB on the board's compensation committee is 14.36% [$= e^{-0.155} - 1$] lower than in firms without an IDB on this committee.

In Panel B of Table 4, we use two covariate matching methods (simple and bias-adjusted) and two propensity score matching methods (radius caliper and kernel) using model (2) of Table 3. The ATTs estimated by these four methods are all negative and statistically significant; they range from −0.101 to −0.289, implying that IDB presence reduces a CEO's abnormal total pay on average by 9.6% to 25.1%.

We next examine whether the effect of IDB presence on CEO pay varies depending on the type of IDB. Panel F of Table A.1 shows the sample distribution of six types of IDBs. To increase the sample sizes for smaller categories, we initially classify all IDBs into three groups. Accordingly, in the last column in Panel A of Table 4, we replace the IDB variable in the OLS regression of column (1) by three binary variables based on the type of IDB: individual IDBs, IDBs with high-powered incentives (hedge funds, private

[25] See Wooldridge (2010, pp. 129–136) for a detailed discussion of this test.

equity firms or venture capital firms), and representative IDBs (representing the stakes of corporations, banks or fiduciary trusts). The coefficient estimate of only individual IDBs is statistically significant; it is negative, with a magnitude that is slightly larger than that for all IDBs in column (1). In Panel C, we replace the IDB variable in the OLS regression of column (1) by six binary variables, one for each type of IDB shown in Panel F of Table A.1. The results show that CEO pay is lower in firms with individual or hedge fund IDBs, and is higher in firms with private equity IDBs. The remaining types of IDBs have no effect on CEO pay.[26] Overall, this evidence strongly favors the monitoring hypothesis that the presence of an IB on the board or the compensation committee limits excessive CEO pay. Moreover, these results appear to be primarily driven by IDBs that are individual investors, who comprise about 75% of the IDBs in our sample (see Panel F of Table A.1 in Appendix A).

5.2. *CEO compensation structure*

We next examine the relation between IDB monitoring and the flow of a CEO's equity incentives. To do that, we estimate regressions of the proportion of equity-based pay in a CEO's total pay. The main explanatory variable of interest is IDB. Under the monitoring hypothesis, the coefficient of IDB should be negative (positive), if IDB monitoring is a substitute (complement) for CEO equity incentives.

To do this, we need to control for other determinants of CEO compensation structure. First, as Aggarwal and Samwick (1999) point out, one of the main predictions of principal–agent models of incentive contracting is that riskier firms will tie less of their executives' pay to firm performance (as measured, for example, by stock price). This implies that the proportion of a CEO's equity-based pay should be negatively related to the standard deviation of stock returns. We control for lagged standard deviation of stock returns. Second, Smith and Watts (1992) argue that managers' actions are less observable in firms with higher growth opportunities, so such firms will tie a higher proportion of CEO pay to stock price. This implies that the proportion of equity-based compensation should be positively related to measures of a firm's growth opportunities. We control for growth opportunities via lagged Tobin's q, lagged R&D to sales, and sales growth rate. Third,

[26]In this regression, all six dummies for different types of IDB are included in the same regression. The results are similar when we estimate six separate regressions, where we replace IDB with one of the six types of IDB.

Mehran (1995) finds that the proportion of a CEO's equity-based pay is positively related to the proportion of outside directors on the board and negatively related to the CEO's stock ownership; we control for both of these variables. Fourth, CEOs of larger firms are expected to have higher dollar incentives from equity, but these incentives increase at a decreasing rate with firm size (see Baker and Hall (2004)). Fifth, Hartzell and Starks (2003) find a positive relation between institutional ownership and the use of incentive compensation. Our regressions control for firm size (log of lagged total assets) and institutional ownership. The regressions also include year dummies and Fama–French 12 industry dummies.

As discussed in Sec. 3.3, the dependent variable in these regressions is the CEO's equity compensation ratio, which equals the value of stock options and restricted stock granted during the year divided by total annual compensation. Panels A and B of Table 5 report the regression and matching results, respectively. Since the dependent variable exhibits substantial censoring at zero (i.e., it is non-negative and about 27% of the observations equal zero), we estimate Tobit regressions.

In Panel A, the coefficient estimate of IDB is significantly negative. The proportion of equity compensation in the CEO pay package is about 2.6% lower (i.e., 6.6% of the sample mean of 39.53%) in the presence of an IDB in a firm. The equity compensation ratio is negatively related to the CEO's stock ownership, and positively related to board independence, institutional holdings, and measures of firm size, growth opportunities and risk. All of these relations are highly statistically significant.

As in Sec. 5.1, we next use several approaches to deal with the potential endogeneity of IDB presence in a firm. First, we use the Smith–Blundell two-stage procedure instead of Tobit regressions. For identification, we use the ease of IDB formation as the instrument. Use of this IV in the Smith–Blundell model is justified based on the exclusion criteria. But the test for exogeneity[27] suggests that IDB presence is not endogenous in this regression, suggesting that the Tobit results are unbiased. Given that the Tobit regression is more efficient, those results are preferable to the Smith–Blundell regression.

Second, Panel B of Table 5 reports estimated ATTs based on four different matching methods. The estimates of ATTs are negative for all four methods and statistically significant for the two AIM methods. Under the AIM

[27] In Smith–Blundell regressions, the test for exogeneity is the test on the coefficient of the first-stage residual term in the second-stage Tobit regression.

Table 5. IDB presence and the flow of CEO's equity incentives.

Panel A: Regression results

Variables	Tobit		Smith–Blundell		Tobit		Tobit	
	Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value
IDB (1/0)	−0.026	0.049	−0.123	0.646				
IDB_CC (1/0)					−0.042	0.013		
Individual IDBs (1/0)							−0.033	0.026
High-Powered Incentive IDBs (1/0)							0.022	0.540
Representative IDBs (1/0)							−0.015	0.621
Log CEO's stock ownership	−0.023	0.000	−0.023	0.000	−0.023	0.000	−0.023	0.000
Board independence	0.167	0.000	0.173	0.000	0.160	0.000	0.168	0.000
Log total asset$_{t-1}$	0.040	0.000	0.036	0.001	0.039	0.000	0.039	0.000
Tobin's q_{t-1}	0.021	0.000	0.021	0.000	0.022	0.000	0.022	0.000
R&D to sales$_{t-1}$	0.146	0.004	0.140	0.008	0.142	0.005	0.147	0.004
Sales growth	0.002	0.000	0.002	0.004	0.002	0.000	0.002	0.000
Standard deviation of stock returns$_{t-1}$ %	0.023	0.000	0.021	0.002	0.022	0.000	0.022	0.000
Total institutional holding$_t$ %	0.001	0.000	0.001	0.003	0.001	0.000	0.001	0.000
Residual			0.101	0.709				
Intercept	−0.119	0.013	−0.064	0.686	−0.109	0.021	−0.118	0.013
Year, industry fixed effects	Yes		Yes		Yes		Yes	
N	10,921		10,839		10,834		10,921	
Pseudo R^2	0.298		0.298		0.432		0.298	

Panel B: Matching results on average treatment effect for the treated (ATT)

	Abadie–Imbens Matching				Propensity Score Matching			
	Simple Matching		Bias-Adjusted Matching		Radius Caliper Matching		Kernel Matching	
	Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value
IDB (1/0)	−0.032	0.000	−0.015	0.080	−0.012	0.117	−0.011	0.201

Table 5. (*Continued*)

Panel C: Tobit regression results on types of IDBs

Individual		Hedge Fund		Private Equity		Venture Capital		Corporate		Fiduciary Trust	
Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value
−0.033	0.026	0.057	0.414	0.049	0.261	−0.192	0.085	0.023	0.509	−0.054	0.243

Note: Panel A shows estimates of Tobit and Smith–Blundell regressions of the CEO's equity compensation ratio. The sample consists of non-dual class S&P 1500 firms during the period 1998–2006 with relevant non-missing data. The main explanatory variable(s) of interest are: IDB or IDB_CC or Individual IDB, High-powered incentive IDB and Representative IDB. These variables are defined in Table 4. All other variables are defined in Table A.2. To reduce the influence of outliers, some variables, indicated in Table A.2, are winsorized at the top and bottom 0.5% of the sample. We use robust standard errors clustered at the CEO-firm level. Each regression (except fixed effect) includes year and Fama–French 12 industry dummies. Smith and Blundell (1986) method uses a two-stage procedure. In the first stage, we compute the residual from the OLS regression of the potentially endogenous regressor (i.e., IDB) on the instruments and all the control variables of the main equation. In the second stage, we estimate the main Tobit regression after including the first-stage residual as an additional regressor. If the coefficient of this residual term is statistically insignificant, we conclude that IDB is not endogenous. The instrument for IDB is the *ease of IDB formation* (*EIF*) dummy. Panel B reports the average treatment effect for the treated (i.e., ATT) of equity compensation ratio on IDB using four different matching methods. The first two (simple matching and bias-adjusted matching) are computed using Abadie *et al.*'s (2004) method for Abadie–Imbens matching (AIM). The last two (radius caliper matching and kernel matching) are computed using Leuven and Sianesi's (2003) method for propensity score matching (PSM). For AIM and PSM, we use all variables in model (2) of Table 3 as covariates for estimating the ATT of IDB; we use the same set of variables for bias-correction in AIM. We use a maximum of four nearest neighbors for AIM. We impose common support and estimate standard errors using 100 bootstrap replications for PSM. We set the caliper at 0.02 for radius caliper matching. We set the bandwidth at 0.06 and use the Epanechnikov kernel for kernel matching. Panel C shows estimates of an OLS regression of equity compensation ratio similar to Panel A except the IDB variable is replaced with on five different types of IDB dummy variables. Each dummy variable represents the value 1 if the largest IDB ownership is represented by an individual, hedge fund, private equity fund, venture capital firm, corporation, and fiduciary trust, respectively; zero otherwise.

method, IDB presence reduces a CEO's equity compensation ratio by about 1.5% to 3.2% (or 3.8% to 8.1% of the sample mean of 39.53%).

In column (3) of Panel A in Table 5, we report the results of a Tobit regression similar to that in column (1), except that we replace IDB by IDB_CC. The results are similar, except the magnitude of the effect is now somewhat bigger. The presence of an IDB or IDB_CC results in the CEO being paid slightly less via stock and options and slightly more via other pay components such as salary and bonus. Overall, these results suggest that IDB monitoring is a substitute for CEO equity incentives.

We next examine whether the IDB effect on the equity component in CEO pay differs by the type of IDB. Column (4) in Panel A shows that these results are mainly driven by IDBs who are individual investors. In Panel C, while the estimate of this effect is larger for IDBs who are VCs, its p-value is 0.085 and less than 2% of the IDBs in our sample are VCs (see Panel F of Table A.1).

5.3. *CEO pay-performance sensitivity*

While the proportion of stock and options in CEO pay captures the flow component of a CEO's equity incentives, the vast majority of such incentives come from previously granted stock and options (see, e.g., Jensen and Murphy (1990) and Hall and Liebman (1998)). So we next examine the relation between IDB presence and a CEO's pay-performance sensitivity (PPS), i.e., the stock rather than the flow of equity incentives.

We start by estimating regressions (OLS, firm fixed-effects and IV-2SLS) of PPS, where the main explanatory variable is IDB. We control for CEO tenure, CEO-chair dummy, Standard deviation of stock returns$_{t-1}$, Tobin's q_{t-1}, R&D to sales$_{t-1}$, Sales growth rate, Fraction of independent directors, Financial leverage, Log total assets$_{t-1}$, Total institutional holdings$_t$, Log (1+Vega), Year dummies, and Fama–French 12 industry dummies. The coefficient of IDB is statistically insignificant in all three regressions. To conserve space, we do not tabulate these results.

We next estimate ATTs of IDB presence using each of the four matching methods. Row 1 of Panel B in Table 6 shows that the ATT is negative and statistically significant under all but one matching methods. Our estimates (that are statistically significant) imply that in IDB presence, the CEO's PPS is between $26,000 and $58,000 lower, depending on the method used. Since the lower PPS in IDB presence can come from a combination of the CEO's stock and option holdings, we next isolate the two components and report

Table 6. IDB presence and CEO pay structure, pay-performance sensitivity, and their components.

Matching results on average treatment effect for the treated (ATT)								
IDB (1/0)	Abadie–Imbens Matching				Propensity Score Matching			
	Simple Matching		Bias-Adjusted Matching		Radius Caliper Matching		Kernel Matching	
	Coeff.	p-Value	Coeff.	p-Value	Coeff.	p-Value	Coeff.	p-Value
Panel A: CEO compensation ratios								
All equity	−0.032	0.000	−0.015	0.080	−0.012	0.117	−0.011	0.201
Stock	−0.003	0.554	0.002	0.625	0.003	0.515	0.002	0.575
Options	−0.030	0.000	−0.018	0.033	−0.016	0.060	−0.016	0.014
Panel B: CEO pay-performance sensitivity ($'000)								
All equity	−57.736	0.000	−4.934	0.708	−25.912	0.018	−30.576	0.004
Stock	−0.200	0.875	0.268	0.817	−1.936	0.056	−1.949	0.070
Options	−57.737	0.000	−4.926	0.705	−25.932	0.002	−30.597	0.003

Note: This table reports the average treatment effect for the treated (i.e., ATT) of CEO's pay structure and pay-performance sensitivity on IDB using four different matching methods. The first two, simple matching and bias-adjusted matching, are computed using Abadie *et al.*'s (2004) methods (denoted Abadie–Imbens matching or AIM). The last two (radius caliper matching and kernel matching) are computed using Leuven and Sianesi's (2003) methods for propensity score matching (PSM). For AIM and PSM, we use all the variables in model (2) of Table 3 as covariates for estimating the ATT of IDB; we use the same set of variables for bias-correction in AIM. All of these variables are defined either in Table 4 or in Table A.2. To reduce the influence of outliers, some variables, indicated in Table A.2, are winsorized at the top and bottom 0.5% of the sample. We use a maximum of four nearest neighbors for AIM. We impose common support and estimate standard errors using 100 bootstrap replications for PSM. We set the caliper at 0.02 for radius caliper matching. We set the bandwidth at 0.06 and use the Epanechnikov kernel for kernel matching. The sample consists of non-dual class S&P 1500 firms during the period 1998–2006 with relevant non-missing data. Panel A reports the ATTs of CEO compensation ratios (all equity, stock, and option) on IDB under each of the four methods. Panel B reports the ATTs of CEO pay-performance sensitivity (all equity, stock, and option) on IDB.

their ATTs separately in rows 2 and 3 of Panel B. The ATT of the stock component of PPS is essentially zero. Almost all of the effect comes from CEOs' stock option holdings.

Finally, we isolate the stock and option components of CEOs' equity compensation ratio (analyzed in the aggregate in Table 5) and present their ATTs under each matching method in Panel A of Table 6. Once again, almost all of the negative effect of IDB presence on CEOs' equity compensation ratio (row 1) comes from option grants (row 3).

Together, these results suggest that IDB monitoring substitutes for a CEO's equity incentives, both in terms of the flow and the stock of such

incentives. This effect is dominated by stock options. IDB presence significantly reduces CEO stock option grants and holdings, while it has virtually no effect on their stock grants and holdings. Why does IDB presence have such a pronounced negative effect on CEO stock options? Given our finding that IDBs are predominantly individual investors (see Panel F of Table A.1), wealth constraints and the evidence in Faccio *et al.* (2011) suggest that IDBs likely hold under-diversified portfolios. This conjecture is consistent with our finding in a companion paper (Agrawal and Nasser, 2018) that firms tend to reduce risk in IDB presence. IDBs' greater risk-aversion would explain their distaste for the extreme risk-incentives that stock options provide to CEOs.

6. IDB Presence and CEO Turnover-Performance Sensitivity

This section examines the relation between IDB presence and CEO turnover-performance sensitivity. We do this by estimating an empirical model of the likelihood of CEO turnover. The dependent variable in this model is *CEO turnover*, a binary variable that equals 1 if the CEO changed in the current year, and equals zero otherwise. Prior studies find that the likelihood of CEO turnover is negatively related to prior stock performance (see, e.g., Warner *et al.* (1988)). We control for *market-adjusted stock return*$_{t-1}$, computed as the daily average of the stock return for a firm over the prior year minus the corresponding return on the CRSP equal-weighted market index. The coefficient of this variable negatively measures the CEO turnover-performance sensitivity, i.e., the more negative the coefficient, the higher the sensitivity. To examine whether this sensitivity differs in the presence of an IDB, we add an interaction term, *IDB*market-adjusted stock return*$_{t-1}$, as an explanatory variable in the regression.[28] The monitoring hypothesis does not have a clear prediction about the coefficient of this interaction variable, while the private benefits hypothesis predicts that it is positive (i.e., the turnover-performance sensitivity is lower, see Sec. 2 and Table 1).

The regression controls for other determinants of the probability of CEO turnover. First, DeFond and Park (1999) find that the probability of CEO turnover increases with stock price volatility, so we control for the standard deviation of daily stock returns over the previous year. Second, a significant part of CEO turnover is likely due to normal retirement. To control for it, we follow Murphy and Zimmerman (1993) and use a dummy variable *CEO*

[28] We do not include IDB as a separate explanatory variable in the regression because unlike CEO turnover-performance sensitivity, there is no reason to expect CEO turnover per se to depend on IDB presence.

Age64, which equals 1 if the CEO's age is 64 years or more, and equals zero otherwise. Third, the probability of normal retirement increases as the CEO's tenure increases; we control for CEO's tenure as max (CEO's tenure on the board, tenure as CEO).

Fourth, following Yermack's (1996) finding that CEO turnover is negatively related to board size and CEO ownership, we control for both these variables. Fifth, Goyal and Park (2002) find that the probability of CEO turnover is significantly lower when the CEO chairs the board. We control for a dummy variable *CEO is chairman*. Sixth, Weisbach (1988) finds that CEO turnover is negatively related to board independence; we control for the proportion of independent directors on the board. Seventh, Huson *et al.* (2001) find that CEO turnover is positively related to firm size; we control for the log of sales as a measure of firm size. All explanatory variables (except for IDB, the fraction of independent directors and board size) are lagged by one year to ensure that they relate to the departing CEO.

We start with our analysis with the simple linear probability model (LPM). The column labeled *OLS* in Table 7 shows the coefficient estimates and p-values for this model. The probability of CEO turnover is negatively related to the market-adjusted stock return. In other words, the turnover-performance sensitivity is negative. But this sensitivity is unrelated to the presence of an IDB. The probability of CEO turnover is negatively related to CEO ownership and positively related to stock volatility, CEO is chairman, CEO tenure, CEO age and firm size. All these relations are statistically significant and generally consistent with prior studies. The column labeled *Probit* shows that the results of probit regressions are quite similar to the LPM results. But these results do not take into account the potential endogeneity of the interaction variable, *IDB*market-adjusted stock return*$_{t-1}$.

To account for the endogeneity of the interaction term, we use two different models: (1) Two-stage linear probability model (2SLS-LPM), and (2) Instrumented probit regression (IV-probit). Since the endogeneity of the interaction variable arises from the endogeneity of IDB, we use the same IV for IDB as the IVs for the interaction term. Although, we find that the estimated coefficient of the interaction variable in the 2SLS regression is still insignificant, the F-statistic for the first-stage IV is 2.58. This value is considerably below the F-statistic threshold suggested by Staiger and Stock (1997), which signals a weak instrument in this context. The results of the IV-probit model are similar to the baseline results, and the Wald test for exogeneity for the IV-probit regression indicates that the interaction variable

Table 7. IDB presence and CEO turnover-performance sensitivity.

Variables	OLS		Probit	
	Coeff.	p-Value	Coeff.	p-Value
IDB* Market-adjusted stock return$_{t-1}$ %	0.020	0.728	0.089	0.755
Market-adjusted stock return$_{t-1}$ %	−0.111	0.000	−0.536	0.000
Standard deviation of stock returns$_{t-1}$ %	0.016	0.000	0.078	0.000
Log CEO's stock ownership$_{t-1}$	−0.038	0.000	−0.188	0.000
CEO is chairman$_{t-1}$ (0/1)	0.022	0.001	0.118	0.002
Max (CEO's board tenure, tenure as CEO)$_{t-1}$	0.003	0.000	0.012	0.000
CEO Age64$_{t-1}$ (0/1)	0.153	0.000	0.602	0.000
Log sales$_{t-1}$	0.005	0.062	0.024	0.071
Fraction of independent directors	−0.018	0.378	−0.096	0.358
Board size	0.001	0.330	0.007	0.356
Intercept	0.027	0.363	−1.638	0.000
Year, industry fixed effects	Yes		Yes	
N	10,090		10,090	
Adjusted or pseudo R^2	0.036		0.047	

Note: The table shows estimates of OLS and probit regressions of CEO turnover on the interaction between IDB and market-adjusted stock return$_{t-1}$ and control variables. The sample consists of non-dual class S&P 1500 firms during the period 1998–2006 with relevant non-missing data. CEO turnover is a dummy variable that equals 1 if the CEO in year t differs from the CEO in year $t-1$; it equals zero otherwise. IDB is a binary variable that equals 1 if there is at least one IDB in a given firm-year; it equals zero otherwise. All other variables are defined in Table A.2. To reduce the influence of outliers, some variables, indicated in Table A.2, are winsorized at the top and bottom 0.5% of the sample. Each regression includes year and Fama–French 12 industry dummies; robust standard errors are clustered at the firm level.

is exogenous. So we do not report these regressions for brevity. Overall, our findings support the monitoring hypothesis.

7. IDB Presence and Firm Valuation

This section examines the relation between IDB presence and firm valuation. The monitoring hypothesis predicts that firm valuation will be higher in IDB presence, while the private benefits hypothesis predicts that it will be lower. We measure firm valuation as industry-adjusted Tobin's q. We define Tobin's q as (the book value of total assets plus the market value of equity minus the book values of equity) divided by the book value of total assets. Chung and Pruitt (1994) find that this simple measure of q explains more than 95% of the variation in more complicated q measures. We compute industry-adjusted Tobin's q as firm q minus the median industry q, using the Fama and French (1997) 48-industry classification.

Panel A of Table A.3 shows that both the mean and median values of the industry-adjusted q are significantly higher in firm-years with an IDB than those without it. While these univariate results are generally consistent with the monitoring hypothesis, they do not control for other determinants of Tobin's q and do not account for the endogeneity of IDB presence, a task we turn to next.

Panel A of Table 8 shows coefficient estimates from regressions of industry-adjusted q on IDB and control variables. We use contemporaneous and lagged market-adjusted stock return and contemporaneous standard deviation of stock returns to control for stock performance and volatility. Following Yermack (1996), we also control for contemporaneous and lagged industry-adjusted ROA, firm size (measured by log of market capitalization), CEO ownership, the proportion of independent directors, and board size. Since Tobin's q also reflects growth opportunities, we control for R&D to sales, advertising expenses to sales, and sales growth rate. We control for anti-shareholder rights using Gompers *et al.* (2003) G-index, and include year dummies.

Using OLS in column (1), we find that IDB presence is significantly and positively related to industry-adjusted q. The adjusted-R^2 of the regression is 0.463. Coefficient estimates of the other explanatory variables are generally consistent with prior studies; except for G-index, all are highly significant. The proportion of independent directors is negatively related to q, consistent with the findings of Yermack (1996) and Agrawal and Knoeber (1996). Board size is also negatively related to Tobin's q, a finding consistent with Yermack (1996). The remaining significant explanatory variables are positively related to q, consistent with the findings of recent studies (e.g., Coles *et al.* (2014)). After controlling for its other determinants, industry-adjusted q is about 0.20 higher in firms with IDB presence than in firms without it. The results are quite similar in column (4), where we replace IDB by IDB_CC.

We use two methods to account for the potential endogeneity of IDB presence in a firm.[29] First, we estimate a firm fixed-effects (FFE) regression and find similar results, shown in column (2) of Panel A. Second, we estimate ATTs using two Abadie–Imbens and two propensity-score matching methods. Panel B of Table 8 shows that in all four cases, the estimated ATTs are significantly positive, suggesting that the presence of an IDB increases firm valuation. The estimated ATTs are quite similar across the four matching

[29]We also estimate 2SLS regressions, but do not report the result because the IV is weak as indicated by first-stage F-statistics.

Table 8. IDB presence and firm valuation (Industry-adjusted Tobin's Q).

Panel A: Regressions								
Variables	OLS		FFE		OLS		OLS	
	Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value
IDB (1/0)	0.202	0.000	0.206	0.000				
IDB_CC (1/0)					0.205	0.001		
Individual IDBs (1/0)							0.207	0.000
High-Powered Incentive IDBs (1/0)							0.214	0.177
Representative IDBs (1/0)							0.145	0.186
Market-adjusted stock return$_{t-1}$ %	0.896	0.000	0.605	0.000	0.882	0.000	0.896	0.000
Market-adjusted stock return$_t$ %	1.295	0.000	0.836	0.000	1.270	0.000	1.296	0.000
Industry-adjusted ROA$_{t-1}$	0.634	0.013	−0.080	0.623	0.722	0.003	0.636	0.013
Industry-adjusted ROA$_t$	1.273	0.000	0.883	0.000	1.195	0.000	1.271	0.000
Standard deviation of stock returns$_t$ %	0.057	0.001	0.134	0.000	0.057	0.001	0.057	0.001
Log market capitalization$_t$	0.277	0.000	0.500	0.000	0.272	0.000	0.278	0.000
R&D to sales$_t$	0.860	0.002	−0.691	0.212	0.869	0.002	0.860	0.002
Advertising expense to sales$_t$	4.829	0.000	−4.609	0.088	4.788	0.000	4.832	0.000
Sales growth	0.003	0.095	0.001	0.352	0.003	0.084	0.003	0.097
G-index	−0.009	0.254	−0.079	0.000	−0.009	0.243	−0.009	0.250
Board independence	−0.300	0.020	−0.809	0.000	−0.299	0.020	−0.301	0.019
Board size	−0.075	0.000	−0.019	0.047	−0.072	0.000	−0.075	0.000
Log CEO's stock ownership	0.038	0.003	0.054	0.000	0.037	0.004	0.038	0.003
Intercept	−0.919	0.000	−2.455	0.000	−0.908	0.000	−0.919	0.000
Year, industry fixed effects	Year		None		Year		Year	
N	10,264		10,264		10,177		10,264	
Adjusted R^2	0.298		0.244		0.296		0.298	

Table 8. (*Continued*)

Panel B: Matching results on average treatment effect for the treated (ATT)

	Abadie-Imbens Matching				Propensity Score Matching			
	Simple Matching		Bias-Adjusted Matching		Radius Caliper Matching		Kernel Matching	
	Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value
IDB (1/0)	0.119	0.000	0.065	0.008	0.099	0.000	0.095	0.000

Panel C: OLS regression results on types of IDBs

Individual		Hedge Fund		Private Equity		Venture Capital		Corporate		Fiduciary Trust	
Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value
0.207	0.000	0.280	0.422	−0.003	0.980	1.444	0.002	0.110	0.255	0.180	0.366

Note: Panel A shows estimates of OLS and firm fixed-effects (FFE) regressions of industry-adjusted Tobin's q. The sample consists of non-dual class S&P 1500 firms during the period 1998–2006 with relevant non-missing data. The main explanatory variable(s) of interest are: IDB or IDB_CC or Individual IDB, High-powered incentive IDB and Representative IDB. These variables are defined in Table 4. All other variables are defined in Table A.2. To reduce the influence of outliers, some variables, indicated in Table A.2, are winsorized at the top and bottom 0.5% of the sample. Panel B of the table reports the average treatment effect for the treated (i.e., ATT) of industry-adjusted Tobin's q of IDB using four different matching methods. The first two (simple matching and bias-adjusted matching) are computed using Abadie *et al.*'s (2004) method for Abadie–Imbens matching (AIM). The last two (radius caliper matching and kernel matching) are computed using Leuven and Sianesi's (2003) method for propensity score matching (PSM). For AIM and PSM, we use all variables in model (2) of Table 3 as covariates for estimating the ATT of IDB; we use the same set of variables for bias-correction in AIM. We use a maximum of four nearest neighbors for AIM. We impose common support and estimate standard errors using 100 bootstrap replications for PSM. We set the caliper at 0.02 for radius caliper matching. We set the bandwidth at 0.06 and use the Epanechnikov kernel for kernel matching. Panel C shows estimates of an OLS regression of industry-adjusted Tobin's q similar to Panel A except the IDB variable is replaced with on five different types of IDB dummy variables. Each dummy variable represents the value 1 if the largest IDB ownership is represented by an individual, hedge fund, private equity fund, venture capital firm, corporation, and fiduciary trust, respectively; zero otherwise.

methods, ranging between 0.065 and 0.119. In untabulated results, the ATTs are substantially larger when an IDB sits on the compensation committee. Panel C and column (4) of Panel A show that these results are driven by IDBs who are individual investors or VCs.

In other words, these results suggest that the presence of an IB on the board or the compensation committee leads to higher firm valuation. This finding is consistent with the monitoring hypothesis, i.e., IDB monitoring adds value to a firm and on the net, IDB presence benefits all shareholders. A larger magnitude of Tobin's q when the IDB sits on the compensation committee suggests that part of the value added by an IDB comes from arms-length bargaining in setting CEO compensation contracts.

8. Robustness Checks

Section 8.1 analyzes whether the effects of IDB presence persist after controlling for the presence of an outside blockholder. Section 8.2 examines changes in the level and composition of CEO pay and in industry-adjusted q when a firm switches from IDB = 0 to 1, or from 1 to 0. Appendix D presents the results of six additional robustness checks.

8.1. *Controlling for outside blockholder presence*

We next examine whether our results on IDB presence hold after controlling for the presence of an outside blockholder in the firm. There is no disclosure requirement for 1% blockholdings for non-directors and reliable data on 5% blockholdings, reported in corporate proxy statements, are not available in machine-readable form. But Dlugosz *et al.* (2006) have compiled and cleaned the data on 5% blockholdings for S&P 1500 firms for annual meeting dates during 1996–2001. We use their database to obtain data on the presence of an outside blockholder (OBH) for the subset of our sample that overlaps with their database.[30] After matching annual meeting dates with fiscal years, we have data on OBH presence for 4,743 firm-years in our sample during 1998–2002.[31] We estimate two sets of regressions for this sub-sample. First, we estimate regressions similar to those in Tables 4, 5, 7 and 8 to examine whether our main results hold for this sub-sample. Second, we add a binary variable for OBH presence (or *OBH*market-adjusted stock return* in Table 7) as an explanatory variable in the regressions.

[30] We are grateful to Andrew Metrick for sharing this database.

[31] This sample includes 76 firms for the 2002 fiscal year whose annual meeting took place in 2001.

Our results (untabulated) on the level of CEO pay, CEO turnover-performance sensitivity and firm valuation for this sub-sample are quite similar to the results for our full sample reported in Panel A of Table 4, Table 7, and Panel A of Table 8. When we add the OBH (or OBH*market-adjusted stock return in Table 7) variable to these regressions, the coefficient of the added variable is statistically insignificant in all cases, except in regressions of CEO pay level (Table 4), where it is significantly *positive* in OLS. Importantly, the addition of the OBH variable leaves the signs, significance and magnitudes of the coefficient estimates of the IDB (or IDB*market-adjusted stock return in Table 7) variable essentially unchanged. In regressions of equity compensation ratio similar to Panel A of Table 5, the coefficient of IDB is statistically insignificant for this sub-sample. When we add the OBH variable to the regression, the coefficient estimates of IDB and OBH are both statistically insignificant.

8.2. *Switches to and from IDB presence*

Our sample of 11,547 firm-years over 1998–2006 contains 247 firm-years that switched from having no IDB to having an IDB ($0 \rightarrow 1$ switch), and 334 firm-years that experienced an opposite ($1 \rightarrow 0$) switch. We take advantage of these switches to examine whether the level and composition of CEO pay and Tobin's q change in the year of the switch in a manner consistent with our main results.[32] In untabulated results, we find that the CEO's median total pay reduces by 1% in the year of a $0 \rightarrow 1$ switch, while it increases by about 8% in the year of an opposite switch. The former change is statistically insignificant, but the latter is highly significant. The difference between the two changes is significant at the 5% level based on the Mann–Whitney U-test. The mean equity compensation ratio reduces by a statistically significant 4% in the year of a $0 \rightarrow 1$ switch, and by an insignificant 1% in the year of the opposite switch, although the difference between the two changes is insignificant. Finally, the mean industry-adjusted Tobin's q reduces by a statistically insignificant 0.035 in the year of a $0 \rightarrow 1$ switch, while it reduces by a highly significant 0.204 in the year of an opposite switch. The difference between the two changes has a p-value of 0.06. These results are generally consistent with the substitute version of the monitoring hypothesis and add

[32]The switches to or from IDB presence do not appear to be caused by the increase in the representation of independent directors on boards mandated by the Sarbanes–Oxley Act of 2002 (SOX). Both types of switches are almost uniformly distributed over our sample period.

to our evidence that IDB presence leads to lower CEO pay, lower equity incentives for the CEO and higher firm valuation.

9. Summary and Conclusions

This paper examines whether and how the presence of an independent director-blockholder (IDB) affects several aspects of contracting with the CEO, such as the level and composition of CEO pay, CEO pay-performance sensitivity and CEO turnover-performance sensitivity, and whether IDB presence affects overall firm valuation. An IDB has strong incentives and the ability to monitor the CEO. But whether the IDB uses her unique position to pursue the interests of all shareholders or to extract private benefits from the firm is an empirical question. Moreover, the presence of an IDB is likely endogenous, as an investor decides which firm to invest in and whether to try to obtain a board seat. Therefore, addressing these issues requires analytical frameworks that account for the endogeneity of an IDB's presence in a firm. In this paper, we address these questions using a variety of methods that account for different sources of endogeneity. We analyze a panel that consists of 11,547 firm-years of data on S&P 1500 firms over fiscal years 1998–2006 and a unique, hand-collected dataset on the identity of the IDBs in the sample.

We find that IDBs are more prevalent in firms where blocks or board seats are easier to acquire (such as smaller firms and firms with less powerful CEOs, bigger and more independent boards and more shareholder rights) and in firms with greater need for IDB presence (such as firms with worse prior performance, lower institutional ownership and higher growth rates). We find that CEOs of firms with IDBs have lower excess pay, and lower proportions of equity-based pay. These results are robust across several regression approaches and matching methods that account for the potential endogeneity of IDB presence. CEOs of firms with IDBs have lower pay-performance sensitivities under several matching methods. Our finding that both the flow and stock of CEOs' equity incentives are lower in IDB presence is almost entirely driven by stock options; IDB presence has no discernible effect on grants or holdings of stock. CEO turnover-performance sensitivity is unrelated to the presence of an IDB in OLS and probit regressions. Finally, firms with an IDB have higher valuation, as measured by industry-adjusted Tobin's q.

The magnitudes of these effects are substantial and are generally larger when an IDB serves on the board's compensation committee. For example, after controlling for other variables and accounting for endogeneity, IDB

presence reduces a CEO's total pay by about 7% in the firm fixed-effects regression and an average of 16% in matching methods. Moreover, the valuation (industry-adjusted q) of firms with an IDB is significantly and substantially higher by about 0.2 in firm fixed-effects regressions and an average of 0.09 under matching methods. About three-fourths of the IDBs in our sample are individual investors, who drive most of our results.

Our results on the level and composition of CEO pay and on firm valuation are robust to several alternative definitions of IDB presence in a firm, changes in disclosure rules on executive pay, the adoption of Sarbanes–Oxley Act, and an alternate method of computing industry-adjusted Tobin's q. Our results are also generally robust to controlling for the presence of an outside blockholder. An analysis of firms that switched to or from having IDB presence further lends credence to these results.

Our findings of lower CEO excess pay and higher firm valuation in IDB presence support the monitoring hypothesis over the private benefits hypothesis. Our finding that both the grants and holdings of CEO stock options are lower in IDB presence suggests that IDB monitoring acts as a substitute for CEO equity incentives and that IDBs, who are likely underdiversified, are averse to the extreme risk-incentives that stock options provide to CEOs. Altogether, our findings suggest that the presence of an independent blockholder on the board promotes better contracting with and monitoring of the CEO, and consequently leads to higher firm valuation.

The recent literature on hedge fund activism (see the review by Brav *et al.* (2009)) finds an abnormal return of 3% to 8% over roughly a one-month window around the announcement of an activism event. This return does not revert for up to one year after the announcement. Consistent with this, there is also an improvement in the target firms' valuation (Tobin's q) of about 0.2 from the year before targeting to one or two years after targeting. These findings contrast with prior findings of essentially no effect of institutional activism on firm performance or valuation (see the review by Gillan and Starks (2007)). Our finding that IDB presence leads to lower CEO pay, higher CEO turnover-performance sensitivity and higher firm valuation in a panel setting suggests that IDBs represent another effective control mechanism, besides activist hedge funds, that reduces agency costs and improves firm valuations. Brav *et al.* (2009) also find that CEOs of firms targeted by hedge fund activists experience an increase in pay-performance sensitivity, while we find that IDB presence leads to lower PPS, driven mostly by stock options. This difference is likely attributable to the greater risk-tolerance of

activist hedge funds compared to IDBs, who tend to be mostly individual investors.

Finally, our findings inform the ongoing policy debate on director elections (see, e.g., Bebchuk (2007), and Virginia Law Review (2007); see Cai *et al.* (2009) for related empirical work). Under the SEC's proxy access rules adopted in 2010, holders of 3% of a company's shares for three years would have been allowed to place a director-nominee on the corporate proxy statement (see Holzer and Berman (2010)).[33] In striking down the rule in 2011, the D.C. Circuit Court of Appeals said the SEC failed to back up its claim that the rule would improve shareholder value and board performance (see Holzer (2011)). Our findings that the presence of an independent blockholder on the board is beneficial for shareholders imply that a proxy access rule that makes it easier for blockholders to obtain a board seat can improve corporate governance. Finally, our findings support the recent move by U.S. public companies toward voluntary adoption of bylaws making proxy access easier, as reflected in the fact that over 60% of the S&P 500 firms have adopted such bylaws by the end of the 2017 proxy season (see, e.g., Gerber (2017)).

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[33]The SEC's original rule proposal allowed holders of 1% of a large company's shares for one year to do so (see McCracken and Scannell (2009) and SEC (2009)).

Appendix A. Additional Tables

Table A.1. Firm, year, and firm-year distributions.

Panel A: Number of IDBs with at least 1% or at least 5% ownership

Count	≥ 1% Ownership		≥ 5% Ownership	
	Firm-Year Frequency	Percentage	Firm-Year Frequency	Percentage
0	9,757	84.50	11,015	95.39
>0	1,790	15.50	532	4.61

Panel B: Number of IDBs on compensation committee with either at least 1% or 5% ownership

Count	≥ 1% Ownership		≥ 5% Ownership	
	Firm-Year Frequency	Percentage	Firm-Year Frequency	Percentage
>0	1,042	9.10	380	3.32

Panel C: Number of years a firm is present in the sample

Number of Years	Number of Firms	
	Full Sample	Firms with IDB
1	275	71
2	245	69
3	139	32
4	171	46
5	150	48
6	128	40
7	121	39
8	127	41
9	700	193
Total	2,056	579

Panel D: Percentage of firm-years of a firm that has IDBs

Percentage of Firm-Years (pct)	Number of Firms	Percentage
pct = 0	1,477	71.84
0.00 < pct <= 12.5	53	2.58
12.5 < pct <= 25.0	76	3.70
25.0 < pct <= 37.5	49	2.38
37.5 < pct <= 50.0	80	3.89
50.0 < pct <= 62.5	28	1.36
62.5 < pct <= 75.0	44	2.14
75.0 < pct <= 87.5	34	1.65
87.5 < pct < 100	12	0.58
pct = 100	203	9.87
Total	2,056	100

Panel E: Year distribution

Year	Total Number of Firm-Years	Firm-Years with IDB		Firm-Years with Majority Independent Board	
		Number	Percentage of Total	Number	Percentage of Total
1998	1,317	220	16.70	1,017	77.22
1999	1,297	215	16.58	1,014	78.18
2000	1,293	220	17.01	1,048	81.05
2001	1,340	234	17.46	1,111	82.91
2002	1,282	216	16.85	1,114	86.90

Table A.1. (*Continued*)

Panel E: Year distribution

Year	Total Number of Firm-Years	Firm-Years with IDB		Firm-Years with Majority Independent Board	
		Number	Percentage of Total	Number	Percentage of Total
2003	1,305	203	15.56	1,195	91.57
2004	1,272	177	13.92	1,197	94.10
2005	1,229	158	12.86	1,169	95.12
2006	1,212	147	12.13	1,146	94.55
Total	11,547	1,790	15.50	9,757	84.50

Panel F: Distribution by IDB-identity

	Largest IDB			All IDBs
	Percentage	Ownership		Percentage
		Mean	Median	
Individual	76.71	4.31	2.1	73.84
Hedge fund	2.31	14.64	10	2.14
Private equity	6.49	14.90	14.5	8.25
Venture capital	1.92	6.37	5.9	1.81
Corporations and banks	6.54	8.69	3.4	7.15
Fiduciary trust	6.03	6.89	4.5	6.82
Total	100	5.72	2.5	100

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Table A.2. Descriptive statistics and variable definitions.

***Variable*:** Definition and Explanations	Obs.	Mean	$Q1$	Median	$Q3$	Std.
Dependent and other variables of interest						
***Total compensation*:** ExecuComp data item TDC1 that includes sum of the CEO's salary, bonus, the value of stock options and restricted stock granted during the year, long-term incentive payouts, and other miscellaneous compensation; in thousands of constant 2000 dollars†	11,547	5,584	1,285	2,695	5,669	22,484
***Cash compensation*:** ExecuComp data item TOTAL_CURR that includes sum of the CEO's salary and bonus; in thousands of constant 2000 dollars†	11,547	1,428	606	972	1,686	1,681
***Log total compensation*:** Log (total compensation + 1)†	11,547	7.908	7.159	7.899	8.643	1.166
***Log cash compensation*:** Log (cash compensation + 1)†	11,547	6.883	6.408	6.881	7.431	1.000
***Option compensation ratio*:** Option compensation/Total compensation; in %. Data obtained from ExecuComp†	11,538	0.3249	0	0.2969	0.5578	0.2966
***Equity compensation ratio*:** Equity based compensation/Total compensation; in %. Data obtained from ExecuComp†	11,538	0.3953	0	0.4196	0.6479	0.3060
***Cash compensation ratio*:** Salary and bonus/Total compensation; in %. Data obtained from ExecuComp†	11,538	0.4669	0.2467	0.4129	0.6539	0.2797
***Salary compensation ratio*:** Salary/Total compensation; in %. Data are from ExecuComp†	11,538	0.2929	0.1262	0.2245	0.3895	0.2336
PPS: Pay-performance sensitivity, defined as the dollar change in CEO stock and option portfolio for 1% change in stock price, measured using Core and Guay (2002) methodology (in thousands of constant 2000 dollars)†	11,547	326.574	37.830	118.356	325.864	649.767
***PPS: Stock component*†**	11,547	22.679	1.051	4.483	16.814	59.940
***PPS: Option component*†**	11,547	326.636	37.906	118.427	326.157	649.743
***CEO turnover*:** A change of CEO as shown in ExecuComp (0/1)	11,547	0.1239				
***Tobin's q*:** (Book value of total assets + Market value of equity – Book value of equity)/Book value of total assets; from Compustat†	11,533	1.959	1.146	1.467	2.154	1.444
***Industry-adjusted Tobin's q*:** Tobin's q – median Tobin's q for the firm's Fama–French 48 industry; from Compustat†	11,533	0.4312	−0.1514	0.0633	0.5606	1.3019

Table A.2. (*Continued*)

Variable: Definition and Explanations	Obs.	Mean	$Q1$	Median	$Q3$	Std.
Independent variables: Board characteristics						
Board size: Number of directors on the board; calculated from RM Directors	11,547	9.46	7	9	11	2.86
Fraction of independent directors: Fraction of independent directors on the board; calculated from RM Directors	11,547	0.671	0.570	0.700	0.800	0.169
CEO co-option: Fraction of directors joined the board after the CEO appointment; calculated from RM Director and ExecuComp	11,406	0.387	0.091	0.333	0.667	0.324
Outside CEO-directors: Fraction of non-employee directors that are active CEOs; calculated from RM Director	11,547	0.145	0	0.125	0.222	0.134
CEO is chairman: CEO is also the chairman of the board; obtained from ExecuComp (1/0)	11,547	0.6359				
CEO is the only insider: CEO is the only employee-director; based on RM Director and ExecuComp (1/0)	11,267	0.4860				
CEO on nominating committee: CEO is on the nominating committee or on the corporate governance committee when there is no nominating committee; based on RM Director and ExecuComp (1/0)	11,453	0.2972				
Independent variables: CEO characteristics						
CEO age: CEO's age on fiscal year t; based on ExecuComp data	11,519	54.71	50	55	59	7.24
CEO age64: (0/1) CEO's age is 64 or above based on ExecuComp data	11,519	0.0951				
Tenure as CEO: Number of years as CEO; calculated from ExecuComp data	11,069	7.54	3	5	10	7.08
CEO's board tenure: Number of years as on the board; calculated from RM Directors	11,518	9.84	3	7	14	8.68
Max (CEO's board tenure, tenure as CEO): Higher of the number of years as CEO (calculated from ExecuComp) and the number of years as on the board (calculated from RM Directors)	11,543	10.41	4	8	15	8.62

Table A.2. (*Continued*)

***Variable*:** Definition and Explanations	Obs.	Mean	$Q1$	Median	$Q3$	Std.
***CEO stock ownership %*:** CEO ownership percentage as the ratio of shares held by CEO and the number of shares outstanding; based on ExecuComp data†	11,088	2.234	0.094	0.306	1.130	5.714
***Log CEO stock ownership*:** Log ((CEO stock ownership*100) +1)†	11,088	3.649	2.338	3.454	4.182	1.874
Vega: Dollar change in CEO option holdings for a 1% change in stock return volatility, in 2000 dollars, using Core and Guay (2002) methodology†	11,547	57,170	5,499	21,999	62,914	103,479
Independent variables: Firm characteristics						
***Firm age*:** Max(CRSP listing age, Compustat listing age)	11,547	28.37	12	22	41	19.88
***Market cap*$_{t-1}$:** Market value of equity, in millions of constant 2000 dollars; obtained from Compustat†	11,533	7,272	626	1,570	4,975	20,190
***Total assets*$_{t-1}$:** In millions of constant 2000 dollars; obtained from Compustat†	11,545	11,284	574	1,649	6,010	41,426
***Sales*$_{t-1}$:** In millions of constant 2000 dollars; obtained from Compustat†	11,542	4,497	504	1,276	3,881	9,487
***Log market cap*$_{t-1}$:** Log (market cap$_{t-1}+1$)†	11,533	7.53	6.44	7.36	8.51	1.54
***Log total assets*$_{t-1}$:** Log (total assets$_{t-1}+1$)†	11,545	7.62	6.35	7.41	8.70	1.68
***Log sales*$_{t-1}$:** Log (sales$_{t-1}+1$)†	11,542	7.27	6.23	7.15	8.26	1.49
***G-index*:** Governance Index equals the number of anti-takeover provisions in a firm out of 24 different bylaws, charter provisions, and state laws from Gompers *et al.* (2003); original data from RM Governance	10,775	9.39	8	9	11	2.62
***E-index*:** Entrenchment Index consists of six different anti-takeover provisions from bylaws and charter amendments, from Bebchuk *et al.* (2009); original data from RM Governance	10,775	2.32	1	2	3	1.27
***Classified board*:** Firm has a classified or staggered board; original data from RM Governance (1/0)	10,775	0.6195				
***Net E-index*:** E-index excluding classified board; original data from RM Governance	10,775	1.70	1	2	2	1.03

Table A.2. (*Continued*)

***Variable*:** Definition and Explanations	Obs.	Mean	$Q1$	Median	$Q3$	Std.
***Total institutional ownership*$_{t-1}$ %:** Percentage of the total shares outstanding held by institutional investors; data from TFN Institutional†	11,547	58.86	45.82	64.00	78.02	26.44
***Sales growth %*:** It is the mean of yearly sales growth rate of the past three year (i.e., sales growth is computed as $\frac{1}{3}\sum_{s=1}^{3}\log(\frac{\text{sales}_{t-s}}{\text{sales}_{t-s-1}})$ and expressed in percentage); from Compustat†	11,538	12.69	3.13	9.74	18.91	16.63
***Tobin's q*$_{t-1}$:** (Book value of total assets + Market value of equity – Book value of equity)/Book value of total assets; from Compustat†	11,530	2.07	1.16	1.50	2.24	1.66
***Market-adjusted stock return*$_{t-1}$ %:** The average market-adjusted daily stock returns. Adjusted by subtracting the daily return on the CRSP (NYSE, AMEX and Nasdaq) equal-weighted market index†	11,385	−0.0142	−0.1178	−0.0241	0.0715	0.1764
***Standard deviation of stock retuns*$_{t-1}$ % :** Standard deviation of daily stock returns over the fiscal year $t-1$. We require that at least two-thirds of the daily stock returns over this period be available on CRSP†	11,385	2.7694	1.8237	2.4501	3.3966	1.3366
Independent variables: Financial ratios						
***ROA*$_{t-1}$:** Net income/Total assets; from Compustat.†	11,545	0.0393	0.0130	0.0422	0.0823	0.0966
***Industry-adjusted ROA*$_{t-1}$:** ROA$_{t-1}$ minus Fama–French 48 industry median ROA$_{t-1}$†	11,545	0.0449	−0.0004	0.0267	0.0809	0.1122
***OPS*$_{t-1}$:** Earnings before depreciation, interest, and tax/Sales; from Compustat†	11,394	0.1808	0.0948	0.1566	0.2580	0.1722
***Industry-adjusted OPS*$_{t-1}$:** OPS$_{t-1}$ minus Fama–French 48 industry median OPS$_{t-1}$†	11,394	0.0288	−0.0010	0.0512	0.1298	3.5838
***Cash holding*$_{t-1}$:** Cash and short-term investment/Total assets; from Compustat†	11,544	0.1314	0.0192	0.0561	0.1810	0.1674
***Cash flow*$_{t-1}$:** (Income before extraordinary items + Depreciation and amortization)/Sales; from Compustat†	11,542	0.1082	0.0595	0.1059	0.1685	0.1747

Table A.2. (*Continued*)

***Variable*:** Definition and Explanations	Obs.	Mean	$Q1$	Median	$Q3$	Std.
***R&D to sales*$_{t-1}$:** R&D expense/Sales; from Compustat. Any missing value of R&D expenditure is replaced with zero†	11,542	0.0422	0	0	0.0330	0.1093
***Advertising expenses to sales*$_{t-1}$:** Advertising expenses/Sales; from Compustat†	11,542	0.0088	0	0	0.0065	0.0219
***Capital expenditure to total assets*$_{t-1}$:** Capital expenditure/Total assets; from Compustat†	11,542	0.0752	0.0196	0.0403	0.0810	0.1216
***Dividend yield*$_{t-1}$ % :** Common dividend/Market value of common stock; from Compustat†	11,533	1.2414	0	0.5200	1.9800	1.6702
Independent variable: Instrument						
***EIF*:** Ease of IDB formation equals 1 if the area covering all counties within a 30-mile radius centered at firm headquarters has the following characteristics: (1) the number of million-dollar homes in the area is less than the sample median for the year, (2) the number of firms in the area is greater than the sample median for the year and (3) at least two-thirds of the firms in the area have market values below the top quartile of the sample during the year; it equals zero otherwise; from Compustat, FIPS county code and National Historical Geographic Information System (NHGIS) (1/0)	11,464	0.055				

Note: †Top and bottom half percent values of the variables are winsorized.

Table A.3. Univariate tests.

	Mean			Median		
	IDB Firm-Years	Non-IDB Firm-Years	t-Test	IDB Firm-Years	Non-IDB Firm-Years	z-Value
Panel A: Dependent and other variables of interest						
Total compensation ($'000)	3,899	5,893	−3.451***	1,808	2,884	−15.151***
Cash compensation ($'000)	1,083	1,492	−9.485***	803	1,009	−11.507***
Option compensation ($'000)	1,880	2,675	−2.900**	349	689	−8.738***
Equity-based compensation ($'000)	2,322	3,311	−2.997***	562	989	−8.950***
Salary compensation ratio	0.353	0.282	11.843***	0.293	0.213	12.732***
Cash compensation ratio	0.530	0.455	10.376***	0.498	0.401	10.411***
Option compensation ratio	0.295	0.330	−4.700***	0.253	0.306	−4.582***
Equity compensation ratio	0.362	0.401	−4.978***	0.365	0.431	−4.978***
PPS ($'000)	218.772	346.351	−7.655***	84.598	126.607	−9.551***
PPS: Stock component ($'000)	19.760	22.679	−2.242**	4.549	4.483	1.140
PPS: Option component ($'000)	218.786	346.422	−7.659***	84.598	126.618	−9.561***
CEO turnover (1/0)	0.122	0.121	0.143			
Tobin's q_t	1.951	1.961	−0.264	1.429	1.473	−2.449**
Industry-adjusted Tobin's q_t	0.486	0.421	1.940*	0.089	0.056	3.466***
Panel B: Independent variables						
Firm age	24.753	29.037	−8.404***	19	23	−7.422***
Market cap$_{t-1}$ (in $000,000)	4,089	7,858	−7.274***	1,034	1,750	−13.642***
Total assets$_{t-1}$ (in $000,000)	6,266	12,205	−5.583***	1,087	1,779	−11.009***
Sales$_{t-1}$(in $000,000)	2,661	4,833	−8.931***	724	1,401	−15.907***
CEO stock ownership %	2.662	2.157	3.362***	0.551	0.283	10.615***
Vega	37,529	60,773	−8.764***	14,295	24,319	−11.055***

Table A.3. (*Continued*)

	Mean			Median		
	IDB Firm-Years	Non-IDB Firm-Years	t-Test	IDB Firm-Years	Non-IDB Firm-Years	z-Value
Tenure as CEO	7.741	7.506	1.253	6	5	0.719
CEO's board tenure	10.274	9.756	2.317**	8	7	2.598***
Max (CEO's board tenure, tenure as CEO)	10.796	10.337	2.072**	9	8	2.476**
Board size	9.725	9.412	4.253***	9	9	2.870***
Fraction of independent directors	0.656	0.674	−4.059***	0.670	0.700	−5.269***
CEO co-option	0.387	0.387	0.005	0.333	0.333	−0.484
Outside CEO-directors	0.131	0.147	−4.779***	0.111	0.125	−4.222***
CEO is chairman (1/0)	0.566	0.649	−6.696***			
CEO is the only insider (1/0)	0.451	0.492	−3.146***			
CEO on nominating committee (1/0)	0.395	0.279	9.837***			
Classified board (1/0)	0.592	0.624	−2.437**			
G-index	8.973	9.464	−6.910***	9	9	−6.982***
Net G-index	8.381	8.840	−6.998***	8	9	−6.923***
E-index	2.175	2.347	−4.982***	2	2	−5.159***
Net E-index	1.583	1.722	−4.964***	2	2	−5.017***
Sales growth %	15.553	12.159	7.956***	11.220	9.489	5.962***
Market-adjusted stock return$_{t-1}$%	−0.015	−0.014	−0.097	−0.022	−0.024	0.357
Standard deviation of stock returns$_{t-1}$ %	2.814	2.761	1.524	2.514	2.437	2.200**
Total institutional ownership$_{t-1}$	53.610	59.820	−9.168***	57.264	65.185	−11.361***
Tobin's q_{t-1}	2.040	2.070	−0.697	1.453	1.505	−2.869***
Industry-adjusted ROA$_{t-1}$	0.035	0.047	−3.944***	0.022	0.028	−2.707***
Industry-adjusted OPS$_{t-1}$	−0.275	0.084	−3.856***	0.049	0.052	−2.101**

Table A.3. (*Continued*)

	Mean			Median		
	IDB Firm-Years	Non-IDB Firm-Years	*t*-Test	IDB Firm-Years	Non-IDB Firm-Years	*z*-Value
Cash holding$_{t-1}$	0.114	0.135	−4.807***	0.043	0.059	−6.694***
Cash flow$_{t-1}$	0.105	0.109	−0.941	0.108	0.105	0.023
R&D to sales$_{t-1}$	0.036	0.043	−2.815***	0	0	−4.721***
Advertising expenses to sales$_{t-1}$	0.010	0.009	1.830*	0	0	−1.215
Capital expenditure to total assets$_{t-1}$	0.078	0.075	1.024	0.038	0.041	−4.138***
Dividend yield %	1.138	1.260	−2.849***	0.525	0.520	−2.163**
Ease of IDB formation — EIF (1/0)	0.076	0.051	4.282***			

Note: Panel A (B) shows univariate comparisons of mean and median values of dependent (independent) variables and their corresponding *t*-statistics for differences in means and *z*-statistics of the Wilcoxon test for differences in distributions, between IDB and non-IDB firms. Statistical significance at the 1%, 5% and 10% levels in two-tailed tests is indicated by ***, **, and *, respectively. The sample consists of non-dual class S&P 1500 firms during the period 1998–2006 with relevant non-missing data. Option compensation is the Black–Scholes value of stock options granted to the executive during the year. Equity-based compensation is option compensation plus the value of restricted stock granted during the year. All CEO compensation data are obtained from ExecuComp, converted to constant 2000 dollars and expressed in thousands. CEO turnover is a dummy variable that equals 1, if the CEO in year t differs from the CEO in year $t-1$; zero otherwise. Net G-index is G-index minus classified board. All other variables are defined in Table A.2, which also indicates the variables winsorized at the top and bottom 0.5% of the sample. The sample size of IDB (non-IDB) firm-years ranges from 1,586 (9,377) to 1,790 (9,759).

Appendix B. Treatment of Endogeneity

We employ six different methods to reduce concerns about the endogeneity of IDB presence in a firm. First, we use firm fixed-effects regressions to explicitly account for unobservable firm-specific omitted variables that are constant over time. Second, we use two-stage least squares (2SLS) estimation to account for other unobservable omitted variables. We use the linear probability model (LPM) for the first-stage regression because the potential endogenous variable is binary.[34] Using LPM for the first-stage regression generates consistent second-stage estimates even with a binary endogenous variable (Angrist and Krueger, 2001).

While the 2SLS estimator is not unbiased, it is consistent; and having a large sample makes the 2SLS results more reliable. We test for exogeneity using the Durbin–Wu–Hausman test, which examines the statistical difference between OLS and 2SLS coefficient estimates of the suspect endogenous variable.[35] In addition, Bound *et al.* (1995) caution about weak instruments and suggest that one should not rely solely on the over-identifying restriction. Staiger and Stock (1997) suggest that the F-statistic of the IVs used in the first-stage regression should be reasonably high (more than 10). Unfortunately, not all of our 2SLS estimations has F-statistic higher than 10, and those with below 10 are not tabulated.

Our dependent variable in Sec. 5.2, equity compensation ratio, is censored. Given that our main explanatory variable, IDB, is potentially endogenous, we use the method suggested by Smith and Blundell (1986) to test for endogeneity. This method uses a two-stage procedure. In the first stage, we compute the residual from the OLS regression of the potentially endogenous regressor (i.e., IDB) on the instruments and all the control variables of the main equation. In the second stage, we estimate the main Tobit regression after including the first-stage residual as an additional regressor. If the coefficient of this residual term is statistically insignificant, we conclude that

[34] Using a nonlinear model, such as the probit model, for the first stage is a forbidden regression (see, e.g., Angrist and Pischke, 2009). An alternative to using LPM in the first stage is to use the predicted value of the potential endogenous variable using a nonlinear model and use it as the instrument. The nonlinear fitted value as an instrument (generated IV) provides a "backdoor" identification. But we avoid using this approach because IDB and our main dependent variables in Secs. 5 through 7 share many determinants in common, causing the generated IV to be highly correlated with the main dependent variables.

[35] We compute robust standard errors clustered at the CEO-firm level because each CEO brings in distinct skills, strategy, and corporate culture to a firm. Bertrand and Schoar (2003) find that there are systematic differences in corporate decision-making across CEOs, which are related to differences in firm performance.

IDB is not endogenous. If so, the test of exogeneity is valid without any distributional assumption on the error term in the first-stage regression (see Wooldridge (2010, p. 682)). If this method fails to reject endogeneity, we use IV-Tobit methodology as an imperfect solution.[36] In addition our main dependent variable in Sec. 6, CEO turnover, is binary. Here, we use the MLE of the probit model with an endogenous regressor, namely IV-probit (see Wooldridge (2010, p. 591)).

The third and fourth methods we use are propensity score matching (PSM) and Abadie and Imbens matching (AIM) to reduce the selection bias based on observables and estimate the average treatment effect for the treated (ATT). With the assumption of conditional independence, an appropriate control group of untreated observations can be the proxy for unobserved potential outcomes without any resulting bias. To achieve this end, Rosenbaum and Rubin (1983) suggest using a balancing score computed as a function of observable covariates, X, such that the conditional distribution of X given the balancing score is independent. PSM, the probability of participating in the treatment given observable variables X, is one such balancing score. Similarly, Abadie and Imbens (2006a, 2007) develop a simple and a bias-corrected matching estimator, where assignment to the treatment is exogenous, conditional on a set of control variables.

Potential IDBs likely decide to invest in the firm and seek board seats based on some observable firm and CEO characteristics. This makes both AIM and PSM approaches appropriate methods for estimating ATT and controlling for selection bias. ATT is estimated from the difference between the actual mean of the treated and its counterfactual mean. We estimate the counterfactual mean using either AIM or PSM, and use the following methods: (1) Simple matching, (2) Bias-corrected matching, (3) Radius caliper matching and (4) Kernel matching. The first two are based on the AIM method and the last two are based on the PSM method (see Imbens (2004) and Caliendo and Kopeinig (2008) for discussions of these methods).

Çolak and Whited (2006) provide an excellent exposition of the simple and bias-corrected AIM estimators developed in Abadie and Imbens (2006a, 2007). Abadie and Imbens (2006b) argue that because standard bootstrapping is invalid for the standard nearest-neighbor matching estimator with replacement, the simple matching estimator is a better alternative. However, an asymptotic bias may be present in simple matching estimators.

[36]The IV-Tobit methodology assumes that the endogenous variable is continuous. We use it here in the same spirit as the IV-probit model.

This bias can arise if the control and treated groups are insufficiently comparable. This implies that there is an incomplete overlap between the distributions of control variables between the treated and control groups. Bias-corrected matching corrects for this asymptotic bias. For both AIM methods, we match the treated observation with a maximum of four nearest neighbors from untreated observations, and match with replacement. We use the procedure suggested by Abadie *et al.* (2004) to estimate the ATT for both simple matching and bias-corrected matching.

Using a tolerance level on the maximum propensity score distance (caliper), radius caliper matching matches all the observations in the control group within the caliper. This helps avoid the risk of bad matches when the nearest neighbor is not too near, and at the same time, uses as many matches as the caliper allows. We use a caliper of 0.02. Kernel matching, on the other hand, uses weighted averages of all observations in the control group to estimate counterfactual outcomes. The weight is calculated by the propensity score distance between a treatment case and all control cases. We set the bandwidth at 0.06 and use Epanechnikov kernel for matching. For both of these methods, we impose common support restriction and estimate standard errors using 100 bootstrapped replications. Matching is done with replacement. We use Leuven and Sianesi's (2003) procedures to estimate the ATT for both radius caliper and kernel matching.

Fifth, the binary nature of the IDB variable also allows us to use treatment effect models. Heckman's (1979) two-stage treatment effect model is appropriate for estimating the average treatment effect and correcting for sample selection bias. In this model, the inverse Mill's ratio (Lambda), computed from the first-stage probit regression, is added as a covariate in the second-stage regression to account for any selection bias. Standard errors of the two-stage treatment effect model are estimated using 1,000 bootstrap replications. Finally, we use a MLE treatment effect model to estimate the selection and main equations simultaneously. We use the Wald test for the correlation between the error terms of the two equations to check for endogeneity.

Appendix C. Calculating PPS and Vega

A CEO's *PPS* is calculated from his holdings of stock and options. We first calculate delta, the dollar change in a CEO's stock and option holdings in response to a \$1 increase in the stock price. Each share has a delta of 1 and the delta of an option is given by the Black and Scholes (1973) formula, $e^{-dT}N(z)$

where $z = (\frac{\ln(\frac{P}{X}) + (r - d + \frac{\sigma^2}{2})T}{\sigma\sqrt{T}})$ and $N =$ the cumulative normal distribution function.

Here, d is the continuously compounded expected dividend yield, given by *bs_yield*,[37] and σ is the expected volatility of stock return, given by *bs_volatility*. Option maturity, T, is calculated using the option's maturity date, *exdate*. If *exdate* is unavailable, we assume a maturity of 10 years. P is the stock price at the end of the fiscal year, given by *frccf*; X is the strike price of the option, given by *expric*; and r is the continuously compounded risk-free rate.[38]

CEO option holdings can be of two types: new grants (made during the current year) and previous grants (made during prior years). For newly granted options, all variables in the Black–Scholes formula are readily available. A CEO may receive multiple new grants in a year. We calculate the delta of each option grant, multiply it by the number of options in the grant (*numsecur*), and sum across grants to calculate the delta for newly granted options.

Since X and T are not directly available for options granted prior to the current year, we use Core and Guay's (2002) methodology to calculate their delta. We then add the delta of stock (shares owned, including restricted shares) and option holdings. We then calculate a CEO's pay-performance sensitivity, *PPS*, as (total delta $\times$ $S \times 0.01$).

Using a similar approach, we compute *Vega*, the sensitivity of a CEO's wealth to a 1% change in stock-return volatility as $(e^{-dT}N'(z)S\sqrt{T} * 0.01)$, where $N' =$ normal probability density function.

Appendix D. Additional Robustness Checks

Here, we examine whether our results on the level and composition of CEO pay, and on firm valuation are sensitive to several alternate definitions of our main explanatory variable, IDB (in Secs. D.1 and D.2); changes in disclosure rules on executive pay (Sec. D.3); and the adoption of Sarbanes–Oxley Act (Sec. D.4). We then examine whether our valuation results are affected by an alternate method of computing industry-adjusted q (Sec. D.5). We take advantage of the fact that the OLS results in Tables 4 and 8 and the Tobit

[37] All data are from ExecuComp, unless indicated otherwise.

[38] We obtain Treasury Constant Maturity Rate for securities of different maturities from FRED (Federal Reserve Economic Data). For options with maturities $T > 7$, $7 \geq T > 5$, $5 \geq T > 3$, $3 \geq T > 2$, $2 \geq T > 1$ and $1 \geq T$, we use the rates from Series ID GS10, GS7, GS5, GS3, GS2 and GS1, respectively, as proxies for the risk-free rate.

results in Panel A of Table 5 are qualitatively similar to the results from more sophisticated methods. So for the purpose of these robustness checks, we use OLS regressions of CEO pay level and industry-adjusted q, and Tobit regressions of the percentage of a CEO's equity-based pay. Finally, we consider an alternative interpretation of our findings on CEO pay level (Sec. D.6).

D.1. *IDB defined by dollar holdings*

In the analysis so far, we have defined an IDB as an independent director who owns 1% of a firm's outstanding equity. Consider two firms, A and B, with market caps of $10 billion and $100 million, respectively. By definition, an IDB owns an equity stake of at least $100 million in firm A, but only $1 million in firm B. These substantial differences in an IDB's dollar stakes can have different incentive effects. So we next consider an alternate definition of an IDB based on dollar, rather than percentage, holdings. We define IDB$15m as an independent director who has an equity stake of at least $15 million in constant 2000 dollars, which represents about 1% of the median market cap of the firm-years in our sample (see Table A.2).[39] About 14.9% of the firm-years in the sample have an IDB by this definition. We then estimate OLS regressions of CEO pay level (Log total compensation) corresponding to column 1 in Panel A of Table 4, Tobit regressions of CEO pay composition (equity compensation ratio) similar to column 1 in Panel A of Table 5, and OLS regressions of industry-adjusted q similar to column 1 in Panel A of Table 8, after replacing the IDB variable by IDB$15m. Column 1 of Panel A in Table D.1 shows these results, which are quite similar to our baseline results in Tables 4 and 8. IDB presence results in significantly lower total CEO pay and higher industry-adjusted q; while the effect on the proportion of CEO pay via equity continues to be negative, it is statistically insignificant.

D.2. *IDB defined by percentage holdings based on firm size*

We next consider another alternate definition of an IDB to account for differences in firm size. We define a binary variable IDB%Variable that equals 1 if a firm-year has an independent director who owns at least 1% (3%) [5%] of the outstanding equity and the firm is in the top (middle) [bottom] tercile of all the firm-years in the sample, based on market capitalization in constant 2000 dollars; it equals zero otherwise. About 9.9% of the firm-years in the

[39] The results are similar using IDB$20m, defined using an equity stake of at least $20 million.

Table D.1. Robustness checks.

	IDB$15m		IDB%Variable		1998–2005	
	Coeff.	*p*-Value	Coeff.	*p*-Value	Coeff.	*p*-Value
Panel A: Alternate definitions of IDB and omission of 2006 fiscal year						
Log total compensation	−0.098	0.034	−0.117	0.002	−0.131	0.021
Equity compensation ratio	−0.018	0.151	−0.023	0.101	−0.026	0.050
Industry-adjusted Tobin's *q*	0.231	0.000	0.160	0.002		
Maximum sample size (firm-years)	10,921		10,921		9,735	
Firm-years with IDB=1	1,627		1,084		1,545	
	IDB*Pre-Sox		IDB*Post-Sox		*p*-Value of F-Test	
	Coeff.	*p*-Value	Coeff.	*p*-Value		
Panel B: Pre- and post-Sarbanes–Oxley Act						
Log total compensation	−0.107	0.054	−0.194	0.009	0.123	
Equity compensation ratio	0.025	0.113	−0.079	0.000	0.000	
Industry-adjusted Tobin's *q*	0.280	0.000	0.107	0.060	0.011	
Maximum sample size	10,921					
Firm-years with IDB = 1	915		664			

Note: Panel A reports the regression coefficient and *p*-value of IDB using two alternate definitions of IDB (i.e., IDB$15 m and IDB%Variable) or after omitting the 2006 fiscal year (i.e., 1998–2005) from regressions in Table 4 (OLS regressions of Log total compensation), Table 5 (Tobit regressions of Equity compensation ratio), and Table 8 (OLS regressions of industry-adjusted Tobin's *q*). IDB$15m is a binary variable that equals 1 if a firm-year has an independent director whose equity holdings equal $15 million or more in constant 2000 dollars; it equals zero otherwise. IDB%Variable is a binary variable that equals 1 if a firm-year has an independent director who owns at least 1%, 3% or 5% of the outstanding equity of a firm in the top, middle or bottom tercile of all the firm-years in the sample, respectively, based on market capitalization in constant 2000 dollars; it equals zero otherwise. The last two rows report the maximum sample size among the six regressions for a given column, and the number of firm-years with IDB = 1 in this regression. Panel B reports the coefficient estimates and *p*-values from regressions similar to those in Panel A, where IDB and year dummy variables are replaced by IDB*Pre-SOX and IDB*Post-SOX. Pre-SOX (Post-SOX) is a binary variable that equals 1 for an observation from fiscal years 1998–2002 (2003–2006); it equals zero otherwise. The last column of Panel B reports the *p*-value of the F-test for the equality of the coefficients of IDB*Pre-SOX and IDB*Post-SOX.

sample have an IDB by this definition. Column 2 in Panel A of Table D.1 shows that the results generally mirror those discussed in Sec. D.1 above.

D.3. *Changes in disclosure rules on executive pay*

There was a major change in SEC disclosure rules on executive compensation for fiscal years ending after December 2005, which has changed the format and content of executive compensation reporting in proxy statements. In

response to these changes, ExecuComp changed the definition of its total compensation (TDC1) variable starting in fiscal 2006. For example, ExecuComp replaced its Black and Scholes (1973) valuation of option grants by company-reported option values under FAS 123R. These changes have shifted the reported levels of compensation somewhat. To examine whether these changes in compensation reporting affect our results, we re-estimate our baseline results reported in Tables 4 and 5 on the level and composition of CEO pay, after omitting the 2006 fiscal year. The results, reported in the last column of Panel A in Table D.1, are essentially unchanged.

D.4. *Adoption of the Sarbanes–Oxley Act*

The adoption of Sarbanes–Oxley Act in 2002 and concurrent changes in listing requirements of NYSE, AMEX and Nasdaq have changed the structure of many corporate boards. The literature (e.g., Chhaochharia and Grinstein, 2009) has also documented a structural break in CEO compensation around that time. So we next examine whether IDBs are as important post-SOX as they were before it. We estimate regressions similar to those in Sec. D.1 above, except that we replace IDB and year dummy variables by IDB*Pre-SOX and IDB*Post-SOX. Pre-SOX (Post-SOX) is a binary variable that equals 1 for an observation from fiscal years 1998–2002 (2003–2006); it equals zero otherwise. Panel B of Table D.1 shows the coefficient estimates and p-values of IDB*Pre-SOX and IDB*Post-SOX from these regressions, followed by the p-value of the F-test for the equality of the two coefficients. The results are quite interesting. First, after controlling for other determinants, total CEO pay is substantially and significantly lower in the presence of IDBs both pre- and post-SOX, with no significant difference in the magnitude of this effect between the two periods. Second, pre-SOX, the proportion of CEO pay via equity is insignificantly higher in the presence of an IDB; post-SOX, this proportion is about 7.9% lower with IDB presence. The difference is statistically significant. Third, industry-adjusted q is significantly higher in the presence of an IDB both pre- and post-SOX. The magnitude of this effect is significantly lower post-SOX. All these results support the monitoring hypothesis. The second result supports the IDB monitoring-substitutes hypothesis post-SOX.

D.5. *Alternate method of computing industry-adjusted Tobin's q*

In Sec. 7 and Table 8, we compute industry-adjusted q as firm q minus the median q of the firm's Fama and French 48 industry out of all firms on

Compustat in that year. Since firms in our sample (S&P 1500) are generally larger than firms on Compustat, the median q of firms in an industry on Compustat may differ from q of the median firm in the industry within our sample. To account for this possibility, we recompute industry-adjusted q using the median q in each industry for each year within the set of S&P 1500 firms. We then reestimate the regressions in Panel A of Table 8. The results (untabulated) are essentially unchanged.

D.6. *Level and risk of CEO pay*

We find that in firms with an IDB, (1) the CEO's total compensation is lower (see Sec. 5.1 and Table 4), and (2) the proportion of the CEO's equity-based pay is lower (see Sec. 5.2 and Table 5). The first finding is consistent with the hypothesis that IDB monitoring curbs excessive CEO pay. But given (2), the first finding is also consistent with the idea that risk-averse executives require lower levels of pay when their pay is less risky, as when the proportion of their equity-based pay is lower. To control for this risk effect on pay level, we add the CEO's equity compensation ratio as an additional control variable in the regressions of CEO's total compensation in Panel A of Table 4. In support of a risk effect, the coefficient of equity compensation ratio is positive and statistically significant in all five regressions (untabulated). But consistent with the monitoring hypothesis, the coefficient estimates and statistical significance of IDB or IDB_CC are essentially unchanged.

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