A comparison of CEO pay–performance sensitivity in privately-held and public firms ☆

Huasheng Gao [a,1], Kai Li [b,2]

[a] Nanyang Business School, Nanyang Technological University, S3-B1A-06, 50 Nanyang Avenue, Singapore 639798, Singapore
[b] Sauder School of Business, University of British Columbia, 2053 Main Mall, Vancouver, BC V6T 1Z2, Canada

A B S T R A C T

In this paper we study CEO contract design employing a unique dataset on privately-held and public firm CEO annual compensation over the period 1999–2011. We first show that CEOs in public firms are paid 30% more than CEOs in comparable privately-held firms. We further show that both private and public firm CEO pays are positively and significantly related to firm accounting performance, and that the pay–performance link is much weaker in privately-held firms. We then show that the above findings are robust to accounting for firms' self-selection into being privately-held, and a number of important differences between privately-held and public firms, including CEO ownership, employee stock ownership, stock liquidity, discipline from the takeover market, and the availability of different performance measures. Overall, our results support the view that concentrated ownership substitutes for CEO performance-based compensation contracts.

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1. Introduction

Chief Executive Officer (CEO) contract design plays a number of important roles, including acting as a sorting mechanism, and providing incentives for effort and the retention of human capital. Despite a large literature examining CEO pay in U.S. public firms starting with the seminal works by Banker and Datar (1989), Harris and Raviv (1979), Holmström (1979), Jensen and Murphy (1990), Lambert and Larcker (1987), Murphy (1985), Ross (1973) and Sloan (1993), there is very little evidence regarding pay in large private companies in the U.S. The lack of information on CEO pay in privately-held firms makes it difficult to fully understand how CEO compensation contracts are structured, given that these firms play such an important role in the economy.

In this paper, we fill a gap in the literature by conducting one of the first large-sample studies of CEO contract design in large privately-held U.S. firms.

Our data, which provides detailed information on CEO annual compensation in a large number of privately-held firms in the U.S., is based on the following (relatively unknown) mandatory disclosure requirements by the Securities and Exchange Commission (SEC). First, a private firm must file an Exchange Act registration statement if it has more than $10 million in total assets and a class of equity securities, like common stock, with 500 or more shareholders.[3] After that, it is required to continue reporting via annual and quarterly reports (Form 10-K, which contains information on executive compensation, and Form 10-Q, respectively), and proxy statements (which may also contain information on executive compensation).[4] Second, if a company decides on a registered public offering, the Securities Act requires it to file a registration statement (Form S-1) with the SEC that contains information on executive compensation. Data for a vast majority (about 90%) of the private firm-year observations in our sample comes from Form 10-K; the remainder comes from Form S-1 due to public debt issuance.

We acknowledge that our sample of privately-held firms is probably not representative of the vast number of small entrepreneurial firms in the economy. Compared to an average privately-held firm in the economy, our sample firms are likely to be more economically important with more diffused ownership structure due to the disclosure requirements for privately-held firms as discussed above.[5] These differences actually make our sample of privately-held firms more comparable to public firms (than to small entrepreneurial firms), and thus work against us finding any significant difference between these two groups of firms. In other words, the differences in CEO contract design would likely be even bigger had we compared a "representative" sample of privately-held firms to public firms. Nonetheless, the reader should bear in mind sample selection imposed on us by the SEC disclosure requirements when deciding how our findings might be generalized.

Using a large sample of privately-held and public firms over the period 1999–2011, we first show that CEOs in public firms are paid 30% more than CEOs in comparable privately-held firms. We further show that both private and public firm CEO pays are positively and significantly related to firm accounting performance, and that the pay–performance link is much stronger in public firms. These findings remain after accounting for the role of CEO ownership in providing incentives and employee stock ownership and are robust to different accounting performance measures.

In addition to their differences in ownership structure, privately-held and public firms also differ in many other dimensions, for example, stock liquidity, threats from the market for corporate control, the availability of different performance measures, and CEO job responsibilities. However, as detailed in Section 5.2, none of these differences can explain our finding of weaker CEO pay–performance sensitivity in privately-held firms than in public firms.

We employ three different approaches to addressing self-selection concerns that companies may choose to go public or stay privately-held: using a sample of transitioning firms going through initial public offerings (IPOs) to become publicly listed, implementing propensity score matching based on observable firm and CEO characteristics, and running the two-stage least squares regression (2SLS) with an instrumental variable (IV). In all cases, we still find that privately-held firms exhibit weaker CEO pay–performance sensitivity than do public firms. Overall, our results are generally consistent with the view that concentrated ownership structure substitutes for performance-based CEO compensation contracts.

Our paper contributes to the CEO compensation literature along the following dimensions. First, by taking advantage of a unique dataset of CEO compensation in privately-held firms, we are able to speak to big-picture questions of CEO contract design in relation to corporate ownership structure, which is the real distinction of our paper from others.

Second, despite the fact that over 70% of U.S. firms with more than 500 employees are privately-held, and that private firms account for over 60% of U.S. production (Farre-Mensa (2014)), little is known about how privately-held firms compensate their CEOs due to data limitations. Our paper is the first to shed light on the level and structure of CEO pay in large U.S. privately-held firms.

Finally, in using privately-held firms, we join a recent surge of papers using data on these private firms to draw new insights into public firm behavior (see, for example, Cronqvist and Fahlenbrach (2013), Michaely and Roberts (2012), and Gao et al. (2013, forthcoming)).

Using a sample of 45 privately-held and 18 publicly-held insurers, Ke et al. (1999) show that there is a stronger association between ROA and the level of compensation for publicly-held insurers than for privately-held insurers. Our paper differs in a number of ways. First, our sample of privately-held firms covers a wide spectrum of industries (not limited to one highly-regulated industry—the insurance industry—as they do), which enables us to generalize our findings. Second, the inability of privately-held insurance companies to use equity-based pay limits their analysis and could possibly lead them to underestimate the CEO pay–performance sensitivity. As we show later in our paper, even in privately-held firms, equity-based pay is a nontrivial part of overall CEO compensation. Finally, our richer dataset on privately-held firms allows us to address self-selection issues associated with a firm's listing status, and thus providing a better identification of the effect of being privately-held on CEO performance-based pay. Using a sample of 144 IPO firms previously owned by private equity (PE) investors, Leslie and Oyer (2009) find that PE-owned firms provide higher managerial incentives to their top management: CEOs have almost twice as

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[3] Privately-held firms can be incorporated as either S corporations or C corporations. Given that S corporations are restricted to having no more than 100 shareholders (http://taxes.about.com/od/scorporations/qt/scorp_criteria.htm), almost all privately-held firms in our sample are C corporations.

[4] Filing obligations are suspended when the following "thresholds" are satisfied: The firm has fewer than 300 shareholders of the class of securities offered, or it has fewer than 500 shareholders of the class of securities offered and less than $10 million in total assets for each of its last three fiscal years.

[5] For example, in our sample, the median sales of private firms are $168 million compared to $288 million for public firms. By way of comparison, Cole and Mehran (2013) report median revenues of $1.9 million in 2003 for their sample of private firms drawn from the SSBF data.

much equity, lower salary, and more cash bonus than their counterparts at comparable public firms. Based on a sample of twenty leverage buyout (LBO)-target firms, Cronqvist and Fahlenbrach (2013) show that when firms transition from public to private ownership, the most significant change is that PE owners give target firm management a significant portion of equity grants based on pre-specified performance measures. Using the Survey of Small Business Finances data (SSBF, i.e., businesses with less than 500 employees), Cole and Mehran (2013) find that CEO pay in privately-held firms has fallen over the past decade and that privately-held firms have significantly higher pay-size elasticity compared to public firms. Our paper complements these studies by employing an extensive sample of large privately-held firms.

The paper is organized as follows. We develop our hypotheses in the next section. We describe the data and key variable construction in Section 3. We examine differences in CEO pay between privately-held and public firms in Section 4. We further examine differences in CEO pay–performance sensitivity between privately-held and public firms and explore alternative explanations for our findings in Section 5. Self-selection concerns are addressed in Section 6. We conclude in Section 7 with a brief summary.

2. Hypothesis development

Berle and Means (1932) are the first to point out that the separation of ownership and control in modern public corporations creates significant conflicts of interest between managers and shareholders—the quintessential agency problem. Jensen and Meckling (1976) formalize the agency theory of the firm and suggest that agency problems can be controlled through monitoring, bonding, and incentive contracts. Many papers thereafter have explored the incentive mechanisms that overcome those conflicts either from a theoretical perspective (see, for example, Banker and Datar (1989), Grossman and Hart (1983), Harris and Raviv (1979), Holmström (1979), Mirrlees (1975), Ross (1973), and Shavell (1979)), or by using CEO compensation data from public firms around the world (see, for example, Aggarwal and Samwick (1999), a recent book by Bebchuk and Fried (2004), Core et al. (1999), research on CEO pay across countries by Conyon et al. (2011) and Fernandes et al. (2013), Jensen and Murphy (1990), and Murphy (1985)).

Under the optimal contracting theory of Holmström (1979), shareholders design the compensation contract to maximize firm performance (such as profits) that depends on the manager's effort and some random noises. Firm performance is verifiable and explicitly observable; however, the manager's effort is non-verifiable and difficult to observe. The first-best contract is to compensate the manager based on his effort, which requires the shareholders to exert time and effort to monitor the manager and collect such information. When it is costly for the shareholders to do so, explicit (but noisy) performance measures can be used to determine the manager's pay (the second-best contract). The first-best contract is strictly preferred to the second-best one because the uncertainty caused by the random noises is eliminated and the manager can be better incentivized. The theory thus predicts that the use of explicit performance-based contracts is less likely when there are shareholders actively monitoring the manager.

Then the question is: Who are the monitoring shareholders? Shleifer and Vishny (1986) argue that large outside shareholders can serve as effective monitors because they have a lower marginal cost of acquiring and disseminating information, while receiving a bigger share of the benefits due to their large shareholdings.

Privately-held firms often have illiquid concentrated ownership that encourages shareholders to actively monitor managerial actions (Kahn and Winton (1998), Ke et al. (1999), and Maug (1998)). Cornelli et al. (2013) show that private firm boards with large shareholders indeed engage in active monitoring and that soft information (e.g., subjective evaluation) plays a much larger role than hard information (e.g., accounting performance) in boards' decisions to fire CEOs. On the other hand, the greater separation of ownership and control, along with the free-rider problem from highly liquid dispersed ownership, significantly decreases shareholder monitoring in public firms (Bhide (1993), Grossman and Hart (1980), and Jensen (1989)). In other words, significant differences in ownership concentration between privately-held and public firms should be associated with different levels of pay–performance sensitivity. For public (privately-held) firms there should be less (more) direct monitoring of managers by large outside shareholders and more (less) reliance on contracts that link CEO pay to explicit performance measures. The above argument leads to our first hypothesis:

H1. The shareholder monitoring hypothesis: CEO pay–performance sensitivity is weaker in privately-held firms than in public firms.

There is an alternative view to the optimal contracting theory of CEO compensation. The dispersed ownership in public firms prevents shareholders from negotiating compensation contracts with the CEO at arm's length, which results in too little pay–performance sensitivity or pay-without-performance (Jensen (1989)). Bebchuk and Fried (2004) and Core et al. (1999) argue that public firm CEOs have too much power in setting their own pay. Morse et al. (2011) further show that powerful CEOs can rig their incentive contracts, leading to poor future performance.

However, shareholders with large holdings and hence low monitoring costs can rectify the situation by limiting the amount of the pay given to the CEO and/or by putting more pressure on the CEO to improve firm performance, which leads to greater CEO pay–performance sensitivity (Almazan et al. (2005), Cadman et al. (2010), and Hartzell and Starks (2003)). This leads to our second hypothesis:

H2. The CEO power hypothesis: CEO pay–performance sensitivity is stronger in privately-held firms than in public firms.

Our empirical tests are designed to distinguish between the two hypotheses. In the next section we describe our data and key variable construction, and present descriptive statistics.

3. Sample formation and variable construction

3.1. Sample formation

We start with U.S. privately-held and public firms with available information on firm financials and CEO compensation in Capital IQ, an affiliate of Standard & Poor's, from 1999 to 2011.[6] We require that public firms be traded on the NYSE, AMEX, or NASDAQ. Privately-held firms, in contrast, do not have shares traded on any stock exchanges. Firms traded in the over-the-counter market or outside the three major exchanges are excluded. Capital IQ classifies a firm as privately-held or public based on its most recent status. We search the key dates for each firm in Capital IQ's IPO and delisting databases to help classify a firm's privately-held (or public) status by back filling. This initial sampling results in 8809 firm-year observations for privately-held firms and 48,094 firm-year observations for public firms. To clearly capture differences in CEO contract design between privately-held and public firms, we remove firm-year observations associated with going public transactions (i.e., IPOs, 1130 cases) and going private transactions (i.e., possibly LBOs, 61 cases). In the end, for privately-held firms, we have a sample of 7168 firm-year observations representing 2492 unique firms, and for public firms, we have a sample of 45,730 firm-year observations representing 5863 unique firms.[7] Data for a vast majority (88%) of the private firm-year observations in our sample comes from Form 10-K (i.e., annual reports), and the remainder (12%) comes from Form S-1 (and its supplemental Form 424B—less than 3% of the total) due to public debt issuance.[8]

Table 1 presents the industry distribution of our privately-held and public firm samples based on the industry classification in Fama and French (1997). It shows that our sample firms have broad industry representation, covering all 48 industries, with banking, business services, and retail having the highest representation among the privately-held firms; while banking, business services, and trading have the highest representation among the public firms. The broad industry coverage of our privately-held firm sample helps alleviate concerns about the representativeness of our private firm sample.

3.2. Computing CEO pay

We define a CEO's total compensation (*Totalpay*) in a given year as the sum of salaries (*Salary*), bonuses (*Bonus*),[9] the grant-date value of restricted stock awards (*Stock*), and the grant-date Black–Scholes value of granted options (*Options*), and other pay (*Otherpay*) that includes items such as premiums for insurance policies and medical expenses.

Some privately-held firms in our sample pay their CEOs with restricted stock or the equivalent,[10] and they report in their SEC filings the dollar value of restricted stock granted based on a hypothetical market price. In our analysis, we take the value of restricted stock granted as reported.

With respect to the value of option grants, unlike ExecuComp, Capital IQ simply records the value as reported in firms' 10-K filings, proxy statements, or other SEC filings. If a firm just reports the number of shares underlying an option grant, Capital IQ records a zero value for that option grant.[11] To address this reporting issue in Capital IQ and to provide a fair comparison of the value of options granted to CEOs in privately-held and public firms, we estimate the value of option grants for all sample firms in a manner comparable to the ExecuComp's approach.

For privately-held firms, we read their SEC filings available through Capital IQ and hand collect relevant information about CEOs' option grants.[12] For each option grant, the firm typically states the expiration date and a hypothetical exercise price. We compute the option grant's Black–Scholes value by making the following assumptions: (1) the volatility is the return volatility of a public firm in the same industry and year with the closest cash flow volatility;[13] (2) the grant-date stock price is the exercise price (the option is granted at-the-money); (3) the dividend yield is the ratio of the dividend paid out in the last year to the exercise price; (4) the time to maturity is 70% of the stated maturity; and (5) the risk-free rate is the seven-year Treasury bond yield prevailing on the grant date. In Appendix 1, we provide a detailed example of how we compute a CEO's total pay for privately-held firms.

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[6] Since the late 1990s, Capital IQ has provided information on executive compensation for both privately-held and public firms in the U.S., with a level of detail similar to that provided by ExecuComp for S&P 1500 firms. Unique to Capital IQ, it also provides detailed background information about the CEO, including education, gender, and age.

[7] It is worth noting that the public firms in our sample are more representative of public firms in the economy than the ExecuComp firms, which focus on S&P 1500 firms.

[8] In untabulated analyses, we find no significant difference in the level and structure of CEO pay between firms disclosing due to their size and ownership (accounting for about 90% of our sample) and firms disclosing due to their access to public debt (accounting for about 10% of our sample). As a result, we pool both groups of private firms in our analyses.

[9] Due to the changes made to compensation disclosure in 2006, bonuses are the sum of bonuses and long-term incentive plans for the period 1999–2005, and bonuses are the sum of bonuses and non-equity incentives after 2005.

[10] Restricted stock awards is a data item disclosed under the stock awards column in the summary compensation table. According to Capital IQ, their restricted stock awards column discloses the dollar value of stock-related awards that do not have option-like features. Examples of these include restricted stock, restricted stock units, phantom stock, phantom stock units, common stock equivalent units, or other similar instruments that do not have option-like features.

[11] There are 709 private firm-year observations where Capital IQ has the dollar values of option grants as filed by the reporting firms. The correlation between the Capital IQ's option values and the values based on our own calculation using the modified Black–Scholes approach is 0.72.

[12] Anecdotal evidence suggests that there are at least three ways for privately-held firm executives to cash out their stock and options: (1) selling them back to the issuing company in a stock repurchase transaction; (2) selling them to the acquiring firm in an acquisition deal; and (3) selling them on the public market via an IPO.

[13] Note that using the levered volatility that accounts for the difference in leverage between a privately-held firm and its public peer firm does not change our main results (which are available upon request).

Table 1
Distribution of sample firms by industry.
The sample consists of 7168 private firm-year observations and 45,730 public firm-year observations from 1999–2011, obtained from Capital IQ. This table presents the sample distribution by industry.

Fama and French 48 industry	Privately-held firms	Percentage of total privately-held firms	Public firms	Percentage of total public firms	Total
1 Agriculture	37	0.52%	98	0.21%	135
2 Food products	419	5.85%	625	1.37%	1044
3 Candy & soda	12	0.17%	87	0.19%	99
4 Beer & liquor	3	0.04%	144	0.31%	147
5 Tobacco products	57	0.80%	58	0.13%	115
6 Recreation	49	0.68%	249	0.54%	298
7 Entertainment	156	2.18%	533	1.17%	689
8 Printing and publishing	133	1.86%	264	0.58%	397
9 Consumer goods	76	1.06%	507	1.11%	583
10 Apparel	45	0.63%	547	1.20%	592
11 Healthcare	99	1.38%	792	1.73%	891
12 Medical equipment	83	1.16%	1461	3.19%	1544
13 Pharmaceutical products	106	1.48%	2389	5.22%	2495
14 Chemicals	206	2.87%	835	1.83%	1041
15 Rubber and plastic products	128	1.79%	260	0.57%	388
16 Textiles	31	0.43%	111	0.24%	142
17 Construction materials	385	5.37%	656	1.43%	1041
18 Construction	45	0.63%	429	0.94%	474
19 Steel works etc.	64	0.89%	457	1.00%	521
20 Fabricated products	21	0.29%	73	0.16%	94
21 Machinery	144	2.01%	1357	2.97%	1501
22 Electrical equipment	38	0.53%	616	1.35%	654
23 Automobiles and trucks	97	1.35%	510	1.12%	607
24 Aircraft	48	0.67%	222	0.49%	270
25 Shipbuilding, railroad equipment	2	0.03%	75	0.16%	77
26 Defense	7	0.10%	113	0.25%	120
27 Precious metals	5	0.07%	115	0.25%	120
28 Non-metallic and industrial metal mining	30	0.42%	141	0.31%	171
29 Coal	10	0.14%	108	0.24%	118
30 Petroleum and natural gas	265	3.70%	1782	3.90%	2047
31 Utilities	416	5.80%	1335	2.92%	1751
32 Communication	210	2.93%	1135	2.48%	1345
33 Personal services	56	0.78%	451	0.99%	507
34 Business services	584	8.15%	5126	11.21%	5710
35 Computers	100	1.40%	1540	3.37%	1640
36 Electronic equipment	142	1.98%	2536	5.55%	2678
37 Measuring and control equipment	36	0.50%	1044	2.28%	1080
38 Business supplies	68	0.95%	398	0.87%	466
39 Shipping containers	22	0.31%	127	0.28%	149
40 Transportation	97	1.35%	965	2.11%	1062
41 Wholesale	362	5.05%	1285	2.81%	1647
42 Retail	511	7.13%	2096	4.58%	2607
43 Restaurants, hotels, motels	195	2.72%	721	1.58%	916
44 Banking	940	13.11%	6483	14.18%	7423
45 Insurance	128	1.79%	1475	3.23%	1603
46 Real estate	60	0.84%	242	0.53%	302
47 Trading	293	4.09%	2660	5.82%	2953
48 Other	147	2.05%	497	1.09%	644
Total	7168	100%	45,730	100%	52,898

For public firms, around 23,000 firm-year observations are covered by the ExecuComp and the Corporate Library, from which we retrieve relevant information about CEOs' option grants (including the number of options, strike price, grant date, and expiration date). For the remainder, we hand collect the information on option grants directly from 10-K filings, proxy statements, or other SEC filings. We then calculate the dollar value of each option grant based on the ExecuComp's modified Black–Scholes approach.[14] In Appendix 2, we compare data on CEO compensation obtained from Capital IQ with that from ExecuComp using overlapping public firm-year observations. We find that the data quality of Capital IQ appears to be comparable to that of ExecuComp.

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[14] To compute the value of an option grant, ExecuComp assumes that the volatility is the annualized standard deviation of stock returns during the 60 months prior to the grant date; the grant-date stock price is the exercise price (the option is granted at-the-money), unless the company specifies otherwise; the dividend yield is the average dividend yields over a three-year period prior to the grant; the time to maturity is equal to 70% of the stated maturity; and the risk-free rate is the seven-year Treasury bond yield prevailing on the grant date.

3.3. Summary statistics

Table 2 presents descriptive statistics of our privately-held and public firm samples. All dollar values are in 2011 dollars. All continuous variables are winsorized at the 1st and 99th percentiles. The variables are defined in Appendix 3.

Panel A presents descriptive statistics of CEO pay. Columns (1)–(3) are based on the privately-held firm sample and columns (4)–(6) are based on the public firm sample. The mean (median) CEO total pay is $1.49 million ($566 thousand) for the privately-held firm sample, while the mean (median) CEO total pay is $3.02 million ($1.29 million) for the public firm sample.

Table 2

Descriptive statistics.

The sample consists of 7168 private firm-year observations and 45,730 public firm-year observations from 1999–2011, obtained from Capital IQ. Definitions of the variables are provided in Appendix 3. All dollar values are in 2011 dollars. All continuous variables are winsorized at the 1st and 99th percentiles. Panel A presents descriptive statistics of CEO pay. To form the matched public firms, we match each private firm-year observation to a public firm-year observation that is in the same (Fama–French 48) industry and closest in total assets. Panel B presents descriptive statistics of CEO characteristics. Panel C presents descriptive statistics of firm characteristics. The sample with available data on largest shareholding and ESOP variables consists of 4253 private firm-year observations and 28,310 public firm-year observations from 2004–2011. The last two columns of each table present test statistics of the t-test and the Wilcoxon test of differences in CEO pay, CEO characteristics, and firm characteristics between the privately-held and public firm samples.

Panel A: CEO pay characteristics

	Privately-held firms			Public firms			Matched public firms			Test of differences	
	Mean	Median	StdDev	Mean	Median	StdDev	Mean	Median	StdDev	t-Test	Wilcoxon test
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(7)–(1)	(8)–(2)
Totalpay (K)	1491	566	3030	3015	1291	4557	1976	875	2841	485***	309***
Salary (K)	402	324	337	562	471	355	486	400	328	84***	76***
Bonus (K)	355	60	768	584	193	1009	397	110	677	42***	50***
Cashpay/Totalpay	78%	93%	29%	62%	63%	29%	69%	76%	28%	−9%***	−17%***
Stock (K)	149	0	816	568	0	1459	330	0	916	181***	0***
Options (K)	318	0	1443	1013	76	2368	582	0	1405	264***	0***
Equity-based pay/Totalpay	12%	0%	24%	33%	30%	30%	26%	15%	28%	14%***	15%***
Stock/Totalpay	4%	0%	13%	11%	0%	19%	8%	0%	17%	4%***	0%***
Options/Totalpay	8%	0%	20%	22%	10%	26%	17%	0%	24%	9%***	0%***
Otherpay (K)	125	14	365	115	26	286	94	18	285	−31***	4***

Panel B: CEO characteristics

	Privately-held firms			Public firms			Test of differences	
	Mean	Median	StdDev	Mean	Median	StdDev	t-Test	Wilcoxon test
	(1)	(2)	(3)	(4)	(5)	(6)	(4)–(1)	(5)–(2)
MBA	0.18	0	0.38	0.23	0	0.42	0.05***	0***
Male CEO	0.97	1	0.16	0.98	1	0.16	0.01	0
Founder	0.08	0	0.28	0.11	0	0.31	0.03***	0***
Chairman	0.47	0	0.50	0.62	1	0.49	0.15***	1***
CEO age	53	53	8	55	55	8.12	2***	2***
Retiring CEO	0.21	0	0.41	0.29	0	0.45	0.08***	0***
CEO ownership	13.57%	2.12%	22.92%	4.75%	0.72%	10.13%	−7.44%***	−1.28%***

Panel C: Firm characteristics

	Privately-held firms			Public firms			Test of differences	
	Mean	Median	StdDev	Mean	Median	StdDev	t-Test	Wilcoxon test
	(1)	(2)	(3)	(4)	(5)	(6)	(4)–(1)	(5)–(2)
Total assets (M)	2776	313	10,515	4455	633	13,394	1680***	320***
Sales (M)	908	168	2506	2241	288	6194	1333***	120***
ROA	3.45%	4.08%	14.26%	4.49%	5.33%	13.61%	1.04%***	1.25%***
CF volatility	3.04%	1.74%	3.59%	2.66%	1.84%	2.78%	−0.38%***	0.11%
Sales growth	25.65%	6.59%	71.80%	17.80%	8.46%	51.94%	−7.85%***	1.87%
Capex	4.14%	2.10%	6.05%	4.15%	2.37%	5.45%	0.01%	0.27%***
Cash	10.18%	4.17%	16.58%	17.08%	7.60%	21.03%	6.90%***	3.43%***
Leverage	46.96%	46.53%	32.24%	25.21%	20.95%	20.43%	−21.74%***	−25.58%***
Firm age	28	11	36	44	28	39	16***	17***
Number of segments	1.51	1	1.03	2.02	1	1.41	0.51***	0***
Top1 ownership	37.71%	23.10%	36.95%	9.97%	7.21%	11.81%	−27.74%***	−15.89%***
Top5 ownership	46.69%	39.80%	40.34%	17.77%	14.11%	16.73%	−28.92%***	−25.69%***
ESOP	0.10	0	0.29	0.03	0	0.17	−0.07***	0.00***

*** Denotes statistical significance at 1% level.
** Denotes statistical significance at 5% level.
* Denotes statistical significance at 10% level.

Given that there is a size difference between the privately-held and public firm samples (shown in Table 2 Panel C) and that firm size is a first-order driver of CEO pay, in columns (7)–(9), we formed a size- and industry-matched public firm sample.[15] Specifically, for each private firm-year observation, we match it to a public firm-year observation that is in the same (Fama–French 48) industry and closest in total assets. We find that CEOs in matched public peer firms receive significantly higher pay (especially higher equity-based pay) than CEOs in privately-held firms: The mean (median) CEO total pay is $1.98 ($875 thousand) for the matched public firm sample, representing a 30% pay premium over the average pay of private firm CEOs. Moreover, we find that the mean (median) ratio of equity-based pay to total pay is 26% (15%) for the matched public firm sample, while the mean (median) ratio is 12% (0%) for the privately-held firm sample. The two-sample t-test and Wilcoxon-test both reject the null that CEO total pay (equity-based pay) in privately-held firms is the same as that in public firms at the 1% level.

In summary, CEO total pay in privately-held firms is significantly lower compared to CEO total pay in public firms, and private firm CEOs are paid significantly less with equity-based pay. The pay difference shows up in the cash component of total pay (salary and bonus), but is particularly evident in the equity-based components of pay: restricted stock and option grants.

Panel B presents descriptive statistics of CEO characteristics. Private firm CEOs are less likely to have an MBA and are slightly younger than their counterparts in public firms. Notably, private firm CEOs in our sample are less likely to be founders or to serve as Chairman of the Board. Further, CEO ownership also differs significantly between these two groups of firms: CEOs in privately-held firms own on average 13.6% of their companies, as opposed to 4.8% for public firm CEOs. The median CEO ownership in privately-held firms is 2.1%, while the median in public firms is 0.7%. The difference in CEO ownership across these two groups of firms is statistically significant at the 1% level.

Panel C presents descriptive statistics of firm characteristics. We show that privately-held firms tend to be smaller, younger firms with weaker accounting performance, higher cash flow volatility, slower sales growth, lower capital expenditures, lower cash holdings, much higher leverage, and fewer segments than public firms. It is worth noting that most of these differences are both statistically significant and economically meaningful, suggesting that these two groups of firms do differ somehow in terms of size, growth opportunities, and operational complexity. For example, the average size for privately-held firms is $2.78 billion in total assets, while the average size for public firm is $4.46 billion. The average age for privately-held firms is 28 years, while the average age for public firms is 44 years. The average number of segments for private firms is 1.51, while the average number of segments for public firms is 2.02.

We show even more significant differences in levels of ownership concentration between these two groups of firms. The mean (median) ownership by the largest outside shareholder (*Top1 ownership*) in privately-held firms is 37.7% (23.1%), while the mean (median) ownership by the largest outside shareholder in public firms is 10% (7.2%). The mean (median) ownership by the five largest outside shareholders (*Top5 ownership*) in privately-held firms is 46.7% (39.8%), while the mean (median) ownership by the five largest outside shareholders in public firms is 17.8% (14.1%).[16] These statistics provide strong support for us using the privately-held firm status as a proxy for greater ownership concentration in our multivariate analyses. Moreover, we find that employee stock ownership is more prevalent in privately-held firms than in public firms.

In summary, compared to other studies of privately-held firms in the literature (see, for example, Cole and Mehran (2013), Engel et al. (2002), and Ke et al. (1999)), the privately-held firms in our sample are more comparable to public firms in terms of the quality of accounting information, size, growth opportunities, and operational complexity, and are subject to the same disclosure requirements with respect to CEO compensation as public firms.

4. CEO pay in privately-held and public firms

The univariate analyses in the previous section indicate significant differences in CEO contract design between privately-held and public firms; in particular, public firm CEOs receive higher total compensation than their private firm counterparts. It also shows that public firms differ from private firms along a number of dimensions, such as firm size and leverage. In this section, we examine whether and how firm and CEO characteristics influence the level of CEO pay in privately-held and public firms.

Under the view that privately-held firms rely more on soft information and less on objective information to compensate their CEOs, we expect that (explicit) firm and CEO characteristics (such as firm size and CEO ownership) have smaller effects on CEO compensation in privately-held firms than in public firms. Using an approach similar to the one used in Conyon et al. (2011) and Fernandes et al. (2013) to examine cross-country pay differences, we estimate the following OLS regression to compare determinants of CEO pay in privately-held and public firms:

$$Ln(CEO\ Pay) = \alpha + \beta_1 Private + \beta_2 Ln(total\ assets) + \beta_3 Performance\ measures \\ + \beta_4 Other\ firm\ characteristics + \beta_5 CEO\ characteristics + Industry\ FEs + Year\ FEs + \varepsilon, \tag{1}$$

where the dependent variable is the natural logarithm of CEO total pay. *Private* is an indicator variable that takes the value of one if the firm is a privately-held firm in that year, and zero otherwise. We introduce firm size, other firm characteristics, and CEO characteristics in stages when presenting our regression results in Table 3. Because we include some time-invariant CEO

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[15] We thank an anonymous referee for suggesting this comparison.

[16] Capital IQ started to provide information on the largest shareholders in 2004. Hence the sample period for our analyses involving largest shareholder ownership is from 2004–2011.

Table 3

CEO pay in privately-held and public firms.

The sample consists of 7168 private firm-year observations and 45,730 public firm-year observations from 1999–2011, obtained from Capital IQ. The dependent variable is the natural logarithm of CEO total pay. Definitions of the variables are provided in Appendix 3. All dollar values are in 2011 dollars. All continuous variables are winsorized at the 1st and 99th percentiles. Industry and year fixed effects (FEs) are included in the regressions and the heteroskedasticity-consistent standard errors (in brackets) account for possible correlation within a firm cluster.

	Full sample			Privately-held firms	Public firms	F statistic of Chow test (5)–(4)
	(1)	(2)	(3)	(4)	(5)	
Private	−0.389***	−0.313***	−0.258***			
	[0.023]	[0.025]	[0.025]			
Ln(total assets)	0.451***	0.470***	0.447***	0.389***	0.460***	29.61***
	[0.005]	[0.005]	[0.006]	[0.011]	[0.007]	
ROA		0.734***	0.765***	0.205*	0.810***	21.18***
		[0.059]	[0.058]	[0.115]	[0.066]	
Stock return					0.123***	
					[0.008]	
CF volatility		3.200***	3.146***	1.619***	3.593***	10.89***
		[0.264]	[0.263]	[0.520]	[0.301]	
Sales growth		0.024***	0.018*	0.021	0.007	0.37
		[0.009]	[0.009]	[0.019]	[0.011]	
Capex		0.965***	0.945***	0.706**	0.989***	0.78
		[0.149]	[0.147]	[0.274]	[0.169]	
Cash		0.693***	0.692***	0.463***	0.706***	4.35**
		[0.051]	[0.049]	[0.105]	[0.053]	
Leverage		−0.064*	−0.054	0.029	−0.079*	2.02
		[0.036]	[0.036]	[0.062]	[0.044]	
Ln(firm age)		0.006	0.005	0.010	−0.002	0.54
		[0.008]	[0.008]	[0.013]	[0.009]	
Number of segments		0.012*	0.015**	0.079***	0.006	16.09***
		[0.007]	[0.007]	[0.017]	[0.007]	
MBA			0.121***	0.135***	0.108***	0.34
			[0.017]	[0.043]	[0.019]	
Male CEO			0.045	0.220**	0.011	3.42*
			[0.041]	[0.105]	[0.043]	
Founder			−0.042	0.004	−0.038	0.31
			[0.031]	[0.067]	[0.034]	
Chairman			0.147***	0.072**	0.155***	4.62**
			[0.015]	[0.035]	[0.017]	
Retiring CEO			−0.111***	0.007	−0.115***	7.59***
			[0.016]	[0.041]	[0.017]	
CEO ownership			−0.698***	−0.408***	−1.039***	19.03***
			[0.074]	[0.103]	[0.102]	
Constant	4.796***	4.141***	4.524***	5.451***	4.223***	
	[0.135]	[0.143]	[0.148]	[0.284]	[0.168]	
Industry FEs	Yes	Yes	Yes	Yes	Yes	
Year FEs	Yes	Yes	Yes	Yes	Yes	
Observations	52,898	52,898	52,898	7168	45,730	
Adj R²	54%	56%	57%	56%	56%	

*** Denotes statistical significance at 1% level.
** Denotes statistical significance at 5% level.
* Denotes statistical significance at 10% level.

characteristics (such as having an MBA degree and being a male) in Eq. (1), we control for industry fixed effects instead of CEO fixed effects. The coefficient on the *Private* indicator variable thus measures the difference in levels of CEO pay between privately-held and public firms that cannot be accounted for by differences in firm and CEO characteristics and industry and year fixed effects.

In column (1), we only control for firm size and industry and year fixed effects. The coefficient on the *Private* indicator variable is negative and significant, implying a privately-held firm paying its CEO less than its public firm counterpart. The lower CEO pay in privately-held firms is consistent with the optimal contracting theory that public firm CEOs will demand higher compensation for bearing the risk associated with greater pay–performance sensitivity (Harris and Raviv (1979) and Holmström (1979)). Further, CEO pay is positively and significantly associated with firm size, as first shown by Murphy (1985). In column (2), we introduce other firm characteristics known to be important determinants of CEO pay (see, for example, Brick et al. (2006), Cichello (2005), Core et al. (1999), Dey et al. (2011), Gao (2010), Gao et al. (2012), and Sloan (1993)). The coefficient on the *Private* indicator variable remains negative and significant. Further, CEO pay is positively and significantly associated with firm size, operating performance, cash flow volatility, sales growth, capital expenditures, cash holdings, and the number of segments, and negatively and significantly associated with leverage. In column (3), we further add CEO characteristics and show that the coefficient on the *Private* indicator variable remains negative and significant. In addition to the significant firm-level determinants

uncovered in column (2), pay is higher for CEOs who have an MBA degree or who are also Chairman of the Board, while pay is lower for CEOs close to retirement or CEOs with large ownership.

Columns (1)–(3) are based on a pooled regression where we restrict the coefficients on the firm and CEO characteristics to be the same across privately-held and public firms. In columns (4) and (5), we separately examine pay determination in privately-held and public firms to further explore the differences across these two groups of firms. The regression specifications in columns (4) and (5) are similar to that in column (3), except that there is no *Private* indicator variable, and in column (5) for public firms there is a contemporaneous stock return variable. We report the F statistics associated with the Chow-test for different coefficients on the same firm characteristics across these two groups of firms in column (6).

We find that the coefficients on firm characteristics tend to be significantly larger in public firms than those in privately-held firms (with the exception of the coefficient on the number of segments). In particular, even after controlling for stock market performance (column (5)), the coefficient on ROA for the public firm sample is still significantly larger than that for the privately-held firm sample (column (4)). This evidence provides support for our conjecture that due to a lack of direct shareholder monitoring in public firms, these firms rely more on objective performance measures, including firm size, ROA, and capital expenditures. Moreover, we show that the coefficients on CEOs being Chairman of the Board, close to retirement, and CEO ownership are significantly larger in public firms than those in privately-held firms (with the exception of the coefficient on the CEO being a male), suggesting that in the absence of direct shareholder monitoring in public firms, CEO pay in these firms is more influenced by CEO power (being Chairman of the Board), CEO career concerns (whether close to retirement or not), and CEO–shareholder alignment (CEO ownership).

Despite our best effort to control for observable differences in firm and CEO characteristics between privately-held and public firms, it remains that working for a privately-held firm is not the same as working for a public firm. Leading a public firm may entail more stress, less privacy regarding compensation, more exposure to negative media coverage, and more effort dealing with investors/analysts. Any or all of these factors could contribute to public firm CEOs being paid more than their private firm counterparts. Further, given the different challenges of leading a public firm, it is certainly possible that these firms require executives with greater talent, and thus may pay a premium for this talent. We acknowledge these possibilities, which are beyond the scope of the current paper.

In summary, the results in Table 3 provide support for the shareholder monitoring hypothesis (H1) that direct shareholder monitoring associated with concentrated ownership reduces boards' reliance on (explicit) performance-based contracts.

5. CEO pay–performance sensitivity in privately-held and public firms

So far, we have focused on the differential effects of firm and CEO characteristics on the level of CEO pay across privately-held and public firms. In this section, we provide a formal test of the relation between corporate ownership and CEO pay structures.

5.1. Main findings

We estimate the following panel data regression (see, for example, Aggarwal and Samwick (1999), Graham et al. (2012), John et al. (2010), and Murphy (1985)):

$$Ln(CEO\ Pay) = \alpha + \beta_1 Private + \beta_2 ROA + \beta_3 Private \times ROA + \beta_4 Ln(total\ assets) +$$
$$\beta_5 CF\ volatility + \beta_6 Leverage + \beta_7 CEO\ ownership + CEO\ FEs + Year\ FEs + \varepsilon, \tag{2}$$

where the dependent variable is the natural logarithm of CEO total pay or cash pay. In contrast to the cross-sectional analysis in Eq. (1), we include CEO fixed effects to control for differences in the average level of compensation across CEOs in the sample. Only the variations in a CEO's pay and his firm's performance relative to their averages over the sample period are used to identify the pay–performance sensitivity. The inclusion of CEO fixed effects in Eq. (2) also helps control for unobservable managerial ability (or other time-invariant managerial attributes), which could be different across privately-held and public firms and drive CEO compensation contracts. Further, we include year fixed effects to account for the time trend. The coefficient on the *Private* indicator variable thus measures the difference in levels of CEO pay between privately-held and public firms that cannot be accounted for by differences in firm and CEO characteristics and CEO and year fixed effects. The coefficient on the interaction term *Private* × *ROA* captures the incremental difference in pay–performance sensitivities across these two groups of firms. The results are reported in Table 4.

Panel A columns (1) and (2) present the full sample results when the dependent variable is the natural logarithm of CEO total pay. The coefficient on contemporaneous accounting performance indicates that pay is largely responsive to performance in both groups of firms. Further, the coefficient on the interaction term *Private* × *ROA* is negative and statistically significant, indicating that CEO pay responds less strongly to performance in privately-held firms compared to public firms. The difference is also economically large. Taking column (2) for example, the coefficient on *ROA* is 0.875 and the coefficient on the interaction term *Private* × *ROA* is −0.604. A one-standard-deviation increase in *ROA* (13.7%) is associated with an increase of public firm CEO pay by 12.7% ($= e^{(13.7\% \times 0.875)} - 1$) but with an increase of private firm CEO pay by only 3.8% ($= e^{(13.7\% \times (0.875 - 0.604))} - 1$). This result is consistent with the shareholder monitoring hypothesis (H1) that privately-held firms with greater ownership concentration and hence stronger shareholder monitoring employ less performance-based pay than public firms do.

Table 4

CEO pay–performance sensitivity in privately-held and public firms.

The sample consists of 7168 private firm-year observations and 45,730 public firm-year observations from 1999–2011, obtained from Capital IQ. Definitions of the variables are provided in Appendix 3. All dollar values are in 2011 dollars. All continuous variables are winsorized at the 1st and 99th percentiles. Panel A presents the baseline regression results. Panel B presents the regression results controlling for the effect of *CEO ownership* on pay–performance sensitivity. Panel C presents the regression results using alternative performance measures. Panel D presents the regression results controlling for employee stock ownership. The sample period is from 2004–2011. CEO and year fixed effects (FEs) are included in the regressions and the heteroskedasticity-consistent standard errors (in brackets) account for possible correlation within a firm cluster.

Panel A: CEO total and cash compensation

	Ln(Totalpay)		Ln(Cashpay)	
	(1)	(2)	(3)	(4)
Private	−0.329***	−0.136***	−0.294***	−0.157***
	[0.037]	[0.036]	[0.034]	[0.034]
ROA	1.099***	0.875***	1.087***	0.930***
	[0.040]	[0.039]	[0.037]	[0.037]
Private × ROA	−0.909***	−0.604***	−0.748***	−0.556***
	[0.156]	[0.152]	[0.149]	[0.147]
Ln(total assets)		0.333***		0.236***
		[0.007]		[0.007]
CF volatility		1.588***		1.063***
		[0.183]		[0.174]
Leverage		−0.219***		−0.111***
		[0.024]		[0.023]
CEO ownership		−0.454***		−0.437***
		[0.049]		[0.047]
Constant	14.225***	7.446***	13.640***	8.817***
	[0.013]	[0.154]	[0.012]	[0.146]
CEO and year FEs	Yes	Yes	Yes	Yes
Observations	52,898	52,898	52,898	52,898
Adj R^2	10%	44%	8%	32%

Panel B: Controlling for the effect of CEO ownership on pay–performance sensitivity

	Ln(Totalpay)		
	(1)	(2)	(3)
	Full sample	Subsample whose CEO ownership ≤ 1%	Subsample whose CEO ownership ≤ 1% and the dollar value of CEO ownership < Totalpay
Private	−0.140***	−0.029	−0.050
	[0.036]	[0.047]	[0.062]
ROA	0.920***	0.825***	0.637***
	[0.043]	[0.065]	[0.069]
Private × ROA	−0.508***	−0.725**	−0.787**
	[0.157]	[0.309]	[0.315]
Ln(total assets)	0.332***	0.293***	0.294***
	[0.007]	[0.012]	[0.014]
CF volatility	1.576***	1.437***	1.024***
	[0.183]	[0.305]	[0.342]
Leverage	−0.219***	−0.303***	−0.153***
	[0.024]	[0.038]	[0.044]
CEO ownership	−0.424***		
	[0.051]		
CEO ownership × ROA	−0.778**		
	[0.324]		
Constant	7.450***	8.429***	8.538***
	[0.154]	[0.253]	[0.303]
CEO and year FEs	Yes	Yes	Yes
Observations	52,898	27,950	17,091
Adj R^2	44%	43%	46%

Panel C: Using alternative performance measures

	Ln(Totalpay)		
	(1)	(2)	(3)
Private	−0.141***	−0.132***	−0.144***
	[0.037]	[0.038]	[0.037]
CF	0.484***		
	[0.039]		
Private × CF	−0.344**		
	[0.161]		

Table 4 (continued)

Panel C: Using alternative performance measures

	Ln(Totalpay)		
	(1)	(2)	(3)
EBITDA		0.801***	
		[0.040]	
Private × EBITDA		−0.384**	
		[0.161]	
Two-year ROA			0.450***
			[0.023]
Private × Two-year ROA			−0.267***
			[0.102]
Ln(total assets)	0.343***	0.338***	0.325***
	[0.007]	[0.007]	[0.007]
CF volatility	1.417***	1.540***	1.605***
	[0.184]	[0.183]	[0.183]
Leverage	−0.228***	−0.225***	−0.217***
	[0.024]	[0.024]	[0.024]
CEO ownership	−0.455***	−0.453***	−0.456***
	[0.050]	[0.049]	[0.049]
Constant	7.268***	7.323***	7.598***
	[0.154]	[0.154]	[0.155]
CEO and year FEs	Yes	Yes	Yes
Observations	52,898	52,898	52,898
Adj R²	44%	44%	44%

Panel D: Controlling for the effect of employee stock ownership on CEO pay–performance sensitivity

	Ln(Totalpay)	
	(1)	(2)
Private	−0.089*	−0.092*
	[0.048]	[0.048]
ROA	0.722***	0.727***
	[0.054]	[0.054]
Private × ROA	−0.598***	−0.539***
	[0.181]	[0.186]
Ln(total assets)	0.336***	0.336***
	[0.011]	[0.011]
CF volatility	1.356***	1.363***
	[0.243]	[0.243]
Leverage	−0.213***	−0.212***
	[0.033]	[0.033]
CEO ownership	−0.654***	−0.653***
	[0.071]	[0.071]
ESOP	−0.115***	−0.100**
	[0.041]	[0.042]
ESOP × ROA		−0.255
		[0.198]
Constant	7.385***	7.384***
	[0.218]	[0.218]
CEO and year FEs	Yes	Yes
Observations	32,563	32,563
Adj R²	44%	44%

*** Denotes statistical significance at 1% level.

** Denotes statistical significance at 5% level.

* Denotes statistical significance at 10% level.

Columns (1) and (2) also identify other factors that are related to CEO total pay. We show that firm size is positively related to levels of CEO pay, as is cash flow volatility. On the other hand, leverage and CEO ownership are both negatively related to levels of CEO pay. All these findings are consistent with prior studies; see, for example, Aggarwal and Samwick (1999) and Gabaix and Landier (2008).

One concern about our analysis in columns (1) and (2) is that for private firm CEOs, the value of their stock option grants is measured with error due to the lack of information on stock prices and stock return volatility in privately-held firms. Columns (3) and (4) present the regression results when the dependent variable is the natural logarithm of CEO cash pay. We find similar results. Cash pay is positively associated with accounting performance in both privately-held and public firms, but this association is significantly weaker in privately-held firms than in public firms. It is also worth noting that the mean (median) fraction of

equity-based pay (including both restricted stock and option grants) to CEO total pay is 12% (0%) in privately-held firms, while the mean (median) fraction is 33% (30%) in public firms.[17]

Another concern is that CEOs care about sensitivity of their wealth to performance, thus their stock ownership may serve a purpose similar to direct shareholder monitoring, reducing the need for equity-based pay. Although we control for CEO ownership in Eq. (2), it is possible that CEO ownership affects not only the level of pay, but also the sensitivity of pay to firm performance. To account for this possibility, we add the interaction term between CEO ownership and ROA to Eq. (2) and report the regression results in Panel B column (1). The coefficient on the interaction term *CEO ownership × ROA* is negative and statistically significant, consistent with the above conjecture that high CEO ownership reduces the need of performance-based compensation contracts. Importantly, we continue to show that the pay–performance link is stronger in public firms than in privately-held firms.

A third concern is that our results might be driven by family firms. Table 2 Panel C shows that CEO ownership in privately-held sample firms is about three times of that in public sample firms, suggesting that some of our privately-held firms are family firms where the CEO is a member of the founding family or the founder himself. For those CEOs, annual pay may be of second-order importance and performance-based pay may not be required as it is their legacy to run the business, which could explain our findings of lower level of pay and weaker pay–performance sensitivity in privately-held firms.[18]

We address the above concern by focusing on a subsample of firms whose CEO ownership is less than 1% (resulting in 2284 private firm-year observations and 25,066 public firm-year observations). For this subsample, it is highly unlikely that these privately-held firms are mostly family firms or founder-run firms. As a result, the incentives provided from CEO annual compensation become more economically meaningful. Panel B column (2) presents the results. We still find that CEO pay in privately-held firms is less sensitive to firm performance than CEO pay in public firms. One caveat to the above analysis is that even a small ownership stake can be economically important to a CEO if the firm under management is large. To address this possibility, in addition to the 1% ownership cutoff, we further require that the dollar value of CEO ownership (computed as CEO ownership × total assets) is smaller than the CEO's total annual compensation (resulting in 2066 private firm-year observations and 15,025 public firm-year observations). By imposing this condition, we ensure that for this subsample of firms, CEO annual compensation is more important than his equity ownership. Panel B column (3) presents the results. We continue to find that the association between pay and performance is significantly weaker in privately-held firms than in public firms. We conclude that our findings of stronger pay–performance sensitivity in public firms are unlikely to be mostly driven by public firm CEOs' small ownership stakes or by private firm CEOs from founding families or being founders (with large ownership stakes).[19]

A fourth concern is that there might be differing incentives for tax purposes between privately-held and public firms that would affect our results. Privately-held firms generally care less about financial reporting and are more likely to reduce financial accounting results to save taxes, adding noise to firm accounting performance and hence weakening the pay–performance link. To address this concern, Panel C columns (1) and (2) present the regression results when we employ a number of cash flow-based performance measures that are less susceptible to earnings management and may be more informative of managers' actions: operating cash flow and EBITDA (Cronqvist and Fahlenbrach (2013) and Nwaeze et al. (2006)). We show that pay–performance sensitivity in privately-held firms compared to public firms is still weaker, whether we use operating cash flow or EBITDA as a firm performance measure. It is worth noting that our privately-held sample firms have to file audited financial statements to the SEC as the public firms do, which helps mitigate the concern that differences in earnings quality (and mandated disclosure) drive our results (see, for example, Craighead et al. (2004) and Vafeas and Afxentiou (1998)).

Moreover, CEO compensation may be determined by not only the contemporaneous but also the lagged performance. To account for this possibility, in column (3) we use two-year cumulative ROA from year $t - 1$ to t as the performance measure, and still find that CEO pay–performance sensitivity is weaker in privately-held firms than in public firms.

Finally, employee stock ownership plans (ESOP) may play a more important role in privately-held firm, which might drive our results.[20] To investigate this possibility, we collect information on employee stock ownership from Capital IQ since 2004 when the data first became available. *ESOP* is an indicator variable which takes the value of one if employee stock ownership accounts for more than 5% of the total shares outstanding, and zero otherwise. Panel D presents the results where we control for the effect of ESOP. We continue to find stronger pay–performance sensitivity in privately-held firms than in public firms. Moreover, we find that the coefficient on the interaction term *ESOP × ROA* is not significantly different from zero, suggesting that ESOP does not have an important influence on CEO pay–performance sensitivity.

Overall, the results in Table 4 show that both private and public firm CEO pays are positively and significantly related to firm accounting performance, with private firm CEO pay exhibiting a weaker association with performance. These results are consistent with the view that direct monitoring incentives are stronger in privately-held firms, which often have shareholders with large illiquid ownership serving as active monitors. As a result, boards in privately-held firms rely more on subjective performance evaluation for setting CEO pay compared to public firm boards. Our large sample evidence in support of the shareholder monitoring hypothesis (H1) is consistent with findings in Engel et al. (2002) and Ke et al. (1999).

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[17] In untabulated analyses, we remove privately-held firms that pay restricted stock or stock options to their CEOs and we still find stronger pay–performance sensitivity in public firms than in privately-held firms.

[18] We thank an anonymous referee for suggesting the economics behind our analysis in Table 4 Panel B.

[19] We do not include CEO ownership in Panel B columns (2)–(3) because there is little cross-sectional variation in CEO ownership for these two subsamples (by construction).

[20] We thank an anonymous referee for suggesting this analysis.

5.2. Alternative explanations

So far we have focused on the difference in ownership concentration between privately-held and public firms to explain the differential pay–performance sensitivity. These two groups of firms also differ in some other dimensions that have implications for CEO performance-based pay, including stock liquidity, threats from the market for corporate control, the availability of different performance measures, and CEO job responsibilities.

First, public firms clearly have more liquid stock than privately-held firms; greater liquidity increases the information content in stock prices, leading to more adoption of stock-based compensation in public firms (Holmström and Tirole (1993)). Jayaraman and Milbourn (2012) show that stock liquidity indeed increases the sensitivity of CEO pay to stock returns, but has no impact on the sensitivity of CEO pay to accounting performance. Given that we are comparing CEO pay–performance sensitivity with respect to accounting performance across privately-held and public firms, stock liquidity is unlikely to drive our results.

Second, without publicly-traded stock, privately-held firms are less likely to be the targets of hostile takeovers than are public firms. Davila and Penalva (2006) find that firms with greater takeover protection put more weight on accounting-based performance measures (such as ROA) in setting CEO pay. Thus, the lack of discipline from the market for corporate control in privately-held firms should make their CEO pay more closely linked to accounting performance than public firms do, which is opposite to our findings.

Third, compared to public firms, privately-held firms have more limited options in the types of objective performance measures available to align CEO incentives with shareholders. For example, privately-held firms do not have market-determined performance measures such as stock returns or have limited usage of stock option grants. As pointed out by Ke et al. (1999), these differences should, however, make CEO pay in privately-held firms be more sensitive to accounting performance measures than CEO pay in public firms, which again is opposite to our findings. Thus, the difference in the availability of performance measures is unlikely to explain our results.

Finally, the job responsibilities of CEOs (or the degree to which financial performance measures reflect managerial effort) may differ across these two groups of firms. In addition to managing a firm's day-to-day operation, public firm CEOs have to exert considerable effort in taking on many other responsibilities associated with being a public firm, such as dealing with analysts, activist institutional investors, the financial press, and regulators. Although those aspects of managerial effort are important for a firm in the long turn, they may not have much direct impact on the firm's short-term financial performance. The optimal contracting theory (see, for example, Feltham and Xie (1994) and Holmström and Milgrom (1991)) predicts that when an agent has multiple tasks to perform, his compensation should not be based on a limited number of financial performance measures. Based on this argument, the sensitivity of CEO pay to firm operating performance should be weaker in public firms than in privately-held firms, which is opposite to our findings. In other words, the different skill sets and job responsibilities involved in running a privately-held firm versus a public firm are unlikely to drive our findings of the differential in CEO pay–performance sensitivity in these two groups of firms.

In summary, although privately-held and public firms differ along a number of dimensions that might potentially impact CEO performance-based pay, none of them explains our main findings (see Appendix 4 for a summary of the private–public differences and their implications for CEO pay–performance sensitivity). We conclude that the difference in ownership concentration is the key driver of the observed difference in CEO pay–performance sensitivity.

6. Dealing with self-selection

To address firms' self-selection into staying privately-held versus being public when comparing these two groups of firms in CEO contract design, we take a multi-pronged approach: 1) using a transition sample where privately-held firms go through IPOs to become publicly listed; 2) implementing propensity score-matching based on observable firm and CEO characteristics; and 3) running the 2SLS regression with an IV.[21]

6.1. The transition sample

We examine changes in CEO pay–performance sensitivity for a set of firms that undergo a change in listing status.[22] Using the transition sample allows us to compare the same firm as both a privately-held and public firm, and thus to control for the time-invariant unobservable firm characteristics.

We identify 1130 firms during our sample period 1999–2011 that transition from privately-held to publicly-listed. To clearly compare CEO performance-based pay in privately-held firms with that in public firms, we remove observations of CEO pay in the IPO year from the regression. Table 5 presents the results. The dependent variable is the natural logarithm of CEO total pay. *Pre-IPO* is an indicator variable that takes the value of one for the pre-IPO period, and zero otherwise. The key variable of interest is the interaction term, *Pre-IPO* × *ROA*, which captures the difference in pay–performance sensitivity between the pre-IPO period and the post-IPO period.

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[21] See Li and Prabhala (2007) for an overview of self-selection in corporate decisions.

[22] It is very difficult to get information on CEO compensation for firms owned by private equity firms, or transitioning from public to private ownership. Based on a sample of twenty LBO deals, Cronqvist and Fahlenbrach (2013) show that private equity sponsors tend to re-design CEO compensation contracts after going-private transactions. Due to data limitations, we do not examine CEO pay at firms moving from public to private ownership.

Table 5
The transition sample.
The sample consists of 1130 IPO deals from 1999–2011. The dependent variable is the natural logarithm of CEO total pay. Definitions of the variables are provided in Appendix 3. All dollar values are in 2011 dollars. All continuous variables are winsorized at the 1st and 99th percentiles. Column (1) is based on the period from year -2 to year $+2$ around the IPO year (year 0). Column (2) is based on the period from year -3 to year $+3$ around the IPO year. Column (3) is based on all available firm-year observations around the IPO year. CEO and year fixed effects (FEs) are included in the regressions and the heteroskedasticity-consistent standard errors (in brackets) account for possible correlation within a firm cluster.

	Year -2 to $+2$	Year -3 to $+3$	All firm-years around IPO
	(1)	(2)	(3)
Pre-IPO	-0.112	-0.148^{***}	-0.179^{***}
	[0.074]	[0.056]	[0.033]
ROA	0.518^{***}	0.478^{***}	0.356^{***}
	[0.127]	[0.111]	[0.080]
Pre-IPO $\times$ ROA	-0.258^{**}	-0.265^{***}	-0.262^{***}
	[0.114]	[0.103]	[0.085]
Ln(total assets)	0.269^{***}	0.286^{***}	0.321^{***}
	[0.037]	[0.031]	[0.020]
CF volatility	2.120^{***}	2.076^{***}	1.318^{***}
	[0.629]	[0.527]	[0.378]
Leverage	-0.084	-0.015	-0.023
	[0.093]	[0.080]	[0.059]
CEO ownership	-0.170	-0.086	-0.126
	[0.286]	[0.235]	[0.168]
Constant	8.907^{***}	8.485^{***}	7.777^{***}
	[0.773]	[0.633]	[0.418]
CEO and year FEs	Yes	Yes	Yes
Observations	3312	4190	6662
Adj R^2	24%	25%	25%

*** Denotes statistical significance at 1% level.
** Denotes statistical significance at 5% level.
* Denotes statistical significance at 10% level.

In column (1), we restrict the sample period from two years prior to two years after the IPO. The coefficient on *Pre-IPO $\times$ ROA* is negative and significant, indicating that pre-IPO firms have significantly weaker pay–performance sensitivity compared to the same firms after IPOs. We obtain the same results when employing a sample period from three years prior to three years after the IPO in column (2), or when using all available firm-year observations around the IPO in column (3).[23]

Overall, the results in Table 5 suggest a significant permanent increase in CEO pay–performance sensitivity as firms transition from privately-held to publicly-listed, consistent with our main findings based on cross-sectional evidence.

6.2. The propensity score-matched sample

One might argue that IPO firms do not represent the general population of public and privately-held firms well. To mitigate this concern, we employ a matching technique to examine differences in CEO pay–performance sensitivity between privately-held and public firms in general. The matching procedure controls for selection based on observable firm and CEO characteristics. Our data is well suited to the matching approach, given that we have a much larger pool of potential matches (the public firm sample), compared to the treatment group (the privately-held firm sample), which increases the likelihood of finding close matches for the privately-held firms among the public firms.

The matching procedure that we employ is a one-to-one nearest neighbor matching with replacement (Heckman et al. (1997)). The matching starts with a probit regression, using three different specifications to better capture the choice between being a private-held or public firm: 1) ln(total assets) and industry and year fixed effects; 2) ln(total assets), ROA, cash flow volatility, leverage, CEO ownership, and industry and year fixed effects; and 3) the same set of explanatory variables used in column (4) of Table 3, and the *Private* indicator variable as the dependent variable. Then using the predicted probabilities—propensity scores—from the estimated probit regressions, we match to each private firm-year observation a public firm-year observation that minimizes the absolute value of the difference between propensity scores.

Table 6 presents differences in CEO pay–performance sensitivity in privately-held firms and their matched public firms using the three different matching criteria discussed above. We find that the pay–performance link is significantly weaker in privately-held firms than that in public firms, consistent with our main findings based on cross-sectional evidence.

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[23] In untabulated analyses, we limit the IPO sample to firms having the same CEO both before and after the IPO, and show that our main findings remain unchanged.

Table 6

Propensity score matching

The sample consists of 7168 private firm-year observations and their propensity score-matched public firm-year observations, using the nearest neighbor matching. The dependent variable is the natural logarithm of CEO total pay. Definitions of the variables are provided in Appendix 3. All dollar values are in 2011 dollars. All continuous variables are winsorized at the 1st and 99th percentiles. In column (1), the variables we use in matching are ln(total assets) and industry and year fixed effects. In column (2), the variables we use in matching are ln(total assets), ROA, cash flow volatility, leverage, CEO ownership, and industry and year fixed effects. In column (3), the variables we use in matching are the full set of firm and CEO characteristics used in column (4) of Table 3. CEO and year fixed effects (FEs) are included in the regressions and the heteroskedasticity-consistent standard errors (in brackets) account for possible correlation within a firm cluster.

	(1)	(2)	(3)
Private	−0.190***	−0.030	−0.029
	[0.062]	[0.076]	[0.091]
ROA	0.647***	0.817***	0.654***
	[0.105]	[0.090]	[0.096]
Private × ROA	−0.394***	−0.605***	−0.403***
	[0.144]	[0.133]	[0.139]
Ln(total assets)	0.242***	0.232***	0.221***
	[0.016]	[0.016]	[0.016]
CF volatility	1.129***	0.586*	0.350
	[0.334]	[0.308]	[0.296]
Leverage	−0.093**	−0.112***	−0.136***
	[0.045]	[0.043]	[0.044]
CEO ownership	−0.481***	−0.366***	−0.262***
	[0.064]	[0.059]	[0.059]
Constant	9.068***	9.154***	9.298***
	[0.330]	[0.316]	[0.326]
CEO and year FEs	Yes	Yes	Yes
Observations	14,336	14,336	14,336
Adj R^2	46%	42%	41%

*** Denotes statistical significance at 1% level.
 ** Denotes statistical significance at 5% level.
  * Denotes statistical significance at 10% level.

6.3. The 2SLS regression

Under the 2SLS regression approach, in the first stage we run a linear probability regression to predict a firm's listing status, which is the *Private* indicator variable.[24] In the second stage, we use the predicted listing status as the independent variable and examine how it influences CEO pay–performance sensitivity. For the purpose of identification, we need an IV that affects a firm's propensity of staying privately-held, but does not affect its CEO pay directly, other than through the effect of being privately-held.

Our instrumental variable is the state-level household stock market participation rate. This variable is motivated by the widely-documented fact that households tend to hold stocks of local public firms (see Coval and Moskowitz (1999) for example). Due to this home bias, households participate more in the stock market if there are a large number of local public firms (Brown et al. (2008)). For this reason, we expect local households' stock market participation to be positively associated with the prevalence of local public firms (satisfying the relevance condition).

We construct the state-level household stock market participation rate as the number of households who make non-zero stock investments divided by the total number of households in a state. The information on households' stock ownership is obtained from the Panel Study of Income Dynamics (PSID) database, which is a survey of representative US individuals and families compiled by the University of Michigan. We use the survey data in 1984, which is the earliest year with available information on household stock holdings. There is about a 20-year gap between 1984 when our instrumental variable is measured and our sample period 1999–2011 when CEO compensation is examined, and thus the stock market participation rate in 1984 is unlikely to directly influence CEO compensation almost 20 years later (other than through the channel of being privately held, satisfying the exclusion condition).

Table 7 presents the results. The negative coefficient on the IV indicates that a privately-held firm is more likely to stay private if local households are less likely to invest in the stock market. Column (2) shows that after controlling for self-selection into staying privately-held, there remains a weaker pay–performance link in privately-held firms compared to public firms.

In summary, controlling for self-selection, our main findings on the weaker pay–performance link in privately-held firms compared to public firms remain qualitatively unchanged, supporting the shareholder monitoring hypothesis (H1).

7. Conclusions

In this paper, we take advantage of a unique dataset on CEO pay in large privately-held and public firms to help understand CEO contract design in relation to ownership structure. Using a large sample of privately-held and public firms over the period 1999–2011, we first show that CEOs in public firms are paid 30% more than CEOs in comparable privately-held firms. We further

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[24] We use a linear probability model instead of a logit or probit model because in the context of 2SLS, only the former yields consistent second-stage estimates (Angrist, 2001; Angrist and Krueger, 2001).

Table 7

The two-stage least squares regression.

The dependent variable is the natural logarithm of CEO total pay. Definitions of the variables are provided in Appendix 3. All dollar values are in 2011 dollars. All continuous variables are winsorized at the 1st and 99th percentiles. The sample consists of 7168 private firm-year observations and 45,730 public firm-year observations from 1999–2011. In the first stage, we run a linear probability regression to predict the *Private* indicator variable, using the state-level household stock market participation rate in 1984 as the instrumental variable. In the second stage, we replace the *Private* indicator variable by its predicted value from the first stage. CEO and year fixed effects (FEs) are included in the second-stage regressions and the heteroskedasticity-consistent standard errors (in brackets) account for possible correlation within a firm cluster.

	First-stage predicting *Private* (1)	Second-stage explaining CEO pay (2)
Private		−0.845***
		[0.248]
Private × ROA		−0.936***
		[0.097]
ROA	−0.045***	0.732***
	[0.011]	[0.041]
Ln(total assets)	−0.033***	0.313***
	[0.001]	[0.011]
CF volatility	−0.641***	1.018***
	[0.061]	[0.239]
Leverage	0.451***	0.155
	[0.008]	[0.114]
CEO ownership	0.383***	−0.123
	[0.014]	[0.106]
State-level stock market participation rate (IV)	−0.073***	
	[0.017]	
Constant	0.719***	7.835***
	[0.024]	[0.217]
Industry and Year FEs	Yes	
CEO and Year FEs		Yes
Observations	52,898	52,898
Adj R²	20%	44%
F-statistic of the test: IV = 0	17.41***	

*** Denotes statistical significance at 1% level.
** Denotes statistical significance at 5% level.
* Denotes statistical significance at 10% level.

show that both private and public firm CEO pays are positively and significantly related to firm accounting performance, and that the pay–performance link is much weaker in privately-held firms. We then show that this difference in pay–performance link is not explained by firms' self-selection into different listing status, nor by some other private–public differences, such as CEO ownership, employee stock ownership, stock liquidity, discipline from the takeover market, and the availability of different performance measures. Our results support the view that concentrated ownership structure substitutes for CEO performance-based compensation contracts.

We expect that the study of CEO contract design in privately-held firms is likely to be a fruitful area for further research. For example, considering the controversy associated with generous severance pay for public firm CEOs, it is important to ask: How do private firms design their CEOs' severance packages? Relatedly, do private firm CEOs extract as much perquisites as their counterparts in public firms do? To the extent that the Sarbanes–Oxley Act of 2002 (SOX) greatly increases the liabilities and penalties faced by public firm executives, does the SOX make public firms less competitive than privately-held firms in the market for managerial talent?

Appendix 1. Computing CEO pay in privately-held firms

Mr. Daniel Thomas is the CEO of Concentra Operating Corp. The company, based in Addison, Texas, was founded in 1979, and operates in the healthcare industry. In 2004, Mr. Thomas received $568,654 as salary, $850,000 as bonus, $1,636,500 as a restricted stock grant, 200,000 shares of option grant, and $18,146 as other compensation, consisting of his life insurance policy and medical expenses.

With respect to the restricted stock grant, the footnote of the 10-K filings stated, "Because there is no active trading market for Concentra's common stock, we rely on the Compensation Committee to determine in good faith the fair value of securities underlying awards at the time they are granted …"

The firm's 10-K filings also provided relevant information about the option grant: It expires in 10 years and has a strike price of $15. We apply the Black–Scholes formula with the following input:

Strike price: 15
Volatility: 0.931 (the return volatility of a public firm that is in the healthcare industry and has the closest cash flow volatility to that of Concentra Operating Corp. in the year 2004)

Grant-date price: 15 (assuming that the options are granted at-the-money)

Dividend yield: zero (the firm's dividend payment is zero in the previous year)

Time to maturity: 70% × 10 = 7 years (following the ExecuComp's method, we apply 70% of the stated time to maturity)

Risk-free rate: 3.94% (the 7-year Treasury bond yield prevailing on the grant date)

In the end, we obtain a value of $2,431,975 for his option grant.

The total compensation for Mr. Thomas in year 2004 is thus $5,505,275 ($568,654 + $850,000 + $1,636,500 + $2,431,975 + $18,146).

Capital IQ covers Concentra Operating Corp. up to 2006. Over the coverage period, the CEO, Mr. Thomas, did not exercise this option or sell any of his stock holdings. We do observe that one VP sold his share holdings back to Concentra upon his resignation.

Appendix 2. Comparing compensation data from Capital IQ and ExecuComp

The sample consists of 19,089 public firm-year observations that are included in both Capital IQ and ExecuComp from 1999–2011. Definitions of the variables are provided in Appendix 3. All dollar values are in 2011 dollars. The corresponding data items in ExecuComp are *TDC1* for Totalpay, *RSTKGRNT* for Stock, and *OPTION_AWARDS_BLK_VALUE* for Option (ExecuComp stops reporting *RSTKGRNT* and *OPTION_AWARDS_BLK_VALUE* after 2005; therefore the comparison of *Stock* and *Option* is for the period 1999–2005).

	Capital IQ		ExecuComp		
	Mean	Median	Mean	Median	Correlation coefficient
Totalpay ($K)	5517	3313	4996	2992	0.94
Salary ($K)	809	754	813	760	0.98
Bonus ($K)	1133	635	1278	666	0.92
Stock ($K)	665	0	672	0	0.96
Options ($K)	3017	1006	3007	1020	0.95
Sales ($M)	5158	1457	5295	1506	0.99
Total Assets ($M)	10,817	2022	10,854	2045	0.99

Appendix 3. Variable definitions

Variable	Definition
Private	An indicator variable that takes the value of one if a firm is a privately-held firm, and zero otherwise.
Pre-IPO	An indicator variable that takes the value of one if a sample year is prior to an IPO, and zero otherwise.
Top1 ownership	The number of shares owned by the single largest outside shareholder normalized by the total number of shares outstanding.
Top5 ownership	The number of shares owned by the five largest outside shareholders normalized by the total number of shares outstanding.
Cashpay	The sum of salary and bonus.
Stock	When privately-held and public firms in our sample pay their CEOs with restricted stock, we take the value of restricted stock as reported by the firm.
Options	For public firms, we calculate the dollar value of each option grant, based on the ExecuComp's modified Black–Scholes approach. To compute the value of an option grant, ExecuComp assumes: (1) the volatility is the annualized standard deviation of stock returns during the 60 months prior to the grant date; (2) the risk-free rate is the seven-year Treasury bond yield prevailing on the grant date; (3) the grant-date stock price is the exercise price (the option is granted at-the-money), unless the company specifies otherwise; (4) the dividend yield is the average of dividend yields over a three-year period prior to the grant; and (5) the time to maturity is equal to 70% of the stated maturity.
	With respect to the value of option grants for private firm CEOs, we hand collect relevant information and make the following assumptions to compute the value: (1) the volatility is the return volatility of a public firm in the same industry and year with the closest cash flow volatility; (2) the risk-free rate is the seven-year Treasury bond yield prevailing on the grant date; (3) the grant-date stock price is the exercise price (the option is granted at-the-money); (4) the dividend yield is the ratio of the dividend paid out in the last year to the exercise price; and (5) the time to maturity is 70% of the stated maturity.
Equity-based pay	The sum of the grant-date value of restricted stock awards (Stock) and the Black–Scholes value of granted options (Options).
Otherpay	Other CEO annual compensation, such as premiums for insurance policies and medical expenses.
Totalpay	The sum of a CEO's salary, bonus, the grant-date value of restricted stock awards (Stock), the Black–Scholes value of granted options (Options), and other pay (Otherpay).
Cashpay/Totalpay	The sum of salary and bonus as a percentage of totalpay.
Equity-based pay/Totalpay	The equity-based pay as a percentage of totalpay.
Stock/Totalpay	The value of restricted stock awards as a percentage of totalpay.
Options/Totalpay	The Black–Scholes value of granted options as a percentage of totalpay.
MBA	An indicator variable that takes the value of one if a CEO holds an MBA degree, and zero otherwise.
Male CEO	An indicator variable that takes the value of one if a CEO is a male, and zero otherwise.

Appendix 3 *(continued)*

Variable	Definition
Founder	An indicator variable that takes the value of one if a CEO is one of the founders, and zero otherwise.
Chairman	An indicator variable that takes the value of one if a CEO is Chairman of the Board, and zero otherwise.
Retiring CEO	An indicator variable that takes the value of one if a CEO is over 60 years old, and zero otherwise.
CEO ownership	The number of shares owned by a CEO normalized by the total number of shares outstanding. For public firms, we first collect the ownership data from ExecuComp, Corporate Library, and IRRC; for firms not covered in those databases, we hand collect the ownership data from annual reports and proxy statements.
	For privately-held firms, we hand collect the ownership data from annual reports and proxy statements.
ROA	Return on assets, computed as EBIT normalized by total assets.
CF	Operating cash flow normalized by total assets.
EBITDA	EBITDA (Earnings Before Interest, Taxes, Depreciation, and Amortization) normalized by total assets.
Two-year ROA	Two-year cumulative ROA.
Stock return	Annual stock return.
CF volatility	The standard deviation of industry-median-adjusted quarterly operating cash flows over the previous eight quarters.
Capex	Capital expenditures normalized by total assets.
Cash	Cash holdings normalized by total assets.
Leverage	The book value of leverage normalized by total assets.
Firm age	The number of years since a firm's incorporation.
Number of segments	The number of segments that a firm operates.
State-level stock market participation rate	The number of households who make non-zero stock investment normalized by the total number of households in a given state in 1984.
ESOP	An indicator variable that takes the value of one if employee stock ownership accounts for more than 5% of the total shares outstanding, and zero otherwise.

Appendix 4. A summary of some other private–public firm differences

Private–public firm differences and/or their implications for CEO pay–performance sensitivity	Results from prior work and/or our findings
Private firms do not use as much stock-based compensation as public firms; stock-based compensation may be a primary contributor to greater pay–performance sensitivity for public firm CEOs.	Even for cash compensation, we show that private firm CEOs still have weaker pay–performance sensitivity than public firm CEOs (see Table 4 Panel A columns (3) and (4)).
Private firm CEOs are more likely to be founders and/or from the founding families and thus do not need a contract with greater pay–performance sensitivity.	Even for CEOs who are least likely to be founders and/or from the founding families, we show that private firm CEOs still have weaker pay–performance sensitivity than public firm CEOs (see Table 4 Panel B columns (2) and (3)).
Private firms have poorer accounting information quality than public firms and thus weaker pay–performance sensitivity given the noise in the performance measure.	All our private firms in our sample have audited financial statements, making their accounting information of reasonably good quality. Moreover, we continue to find weaker pay–performance sensitivity for private firm CEOs even when using alternative performance measures that are less susceptible to earnings manipulation (see Table 4 Panel C columns (1) and (2)).
Private firms have limited stock liquidity.	Jayaraman and Milbourn (2012) find that stock liquidity increases the sensitivity of CEO pay to stock returns but has no impact on the sensitivity of CEO pay to accounting performance.
Private firms face little discipline from the hostile takeover market.	Davila and Penalva (2006) find that firms with greater takeover protection put more weight on accounting-based performance measures (such as ROA) in setting CEO pay.
Private firms have a more limited number of objective performance measures.	Ke et al. (1999) argue that when firms do not have market-determined performance measures such as stock returns or have limited usage of stock option grants, they should rely more on accounting-based compensation.
Public firm CEOs have many other responsibilities associated with being a public firm, such as dealing with analysts, activist institutional investors, the financial press, and regulators, in addition to managing day-to-day operation.	Feltham and Xie (1994) and Holmström and Milgrom (1991) argue that when an agent has multiple tasks to perform, his compensation should not be based on a limited number of financial performance measures.
Private firm CEOs may have different ability or other time-invariant attributes.	The CEO fixed effects in Eq. (2) have controlled for it.

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