Inside the black box: The role and composition of compensation peer groups ☆

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ABSTRACT

This paper considers the features of the newly disclosed compensation peer groups and demonstrates their significant role in explaining variations in chief executive officer (CEO) compensation beyond that of other benchmarks such as the industry-size peers. After controlling for industry, size, visibility, CEO responsibility, and talent flows, we find that firms appear to select highly paid peers to justify their CEO compensation and this effect is stronger in firms where the compensation peer group is smaller, where the CEO is the chairman of the board of directors, where the CEO has longer tenure, and where directors are busier serving on multiple boards.

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1. Introduction

Recent growth in chief executive officer (CEO) compensation, especially the dramatic increase for top-paid CEOs, has led many to question whether CEOs have too much influence over their own compensation. The $187 million pay package for former New York Stock Exchange chairman Richard Grasso generated notable press coverage, leading researchers to examine carefully who sets CEO pay and what process is used to arrive at both its

level and composition. During Grasso's tenure at NYSE (1995–2003), NYSE benchmarked their executive compensation against a set of peer companies that included financial institutions many times larger than NYSE, but none of the other stock exchanges or nonprofit organizations.[2] Even Hewitt, the compensation consultant for NYSE, acknowledged that the peer group that the compensation committee selected ignored the conventional factors that are used to develop appropriate peer groups. However, one might argue that the selection of NYSE's compensation peers was consistent with the committee's goal to "attract and retain world class executive talents" because the skills and talents necessary to run NYSE are fairly similar to those necessary to run large financial institutions, as evidenced by the talent flows between NYSE and several large financial institutions.[3]

The academic literature on executive compensation is proliferating, but it has not reached a consensus on why CEO pay has increased so substantially over the last couple decades. Many view the pay increases as a sign of corporate governance failure and CEOs' abuse of power (see Bebchuk and Fried, 2003, 2004; Bertrand and Mullainathan, 2001), but others argue that the compensation simply reflects market equilibrium in which the board of directors (BOD) optimally structures CEO pay to motivate and retain CEOs (see Murphy and Zabojnik, 2004; Oyer, 2004; Baranchuk, MacDonald, and Yang, 2006; Gabaix and Landier, 2008; Edmans, Gabaix, and Landier, 2009; Kaplan and Rauh, 2009). In addition, Hayes and Schaefer (2009) offer a model of the "Lake Wobegon effect" in which firms distort CEO pay upward in an attempt to affect market perceptions of firm value. DiPrete, Eirich, and Pittinsky (2010) show the effects of leapfrogging potentially explain a considerable fraction of the overall upward movement of executive compensation over a recent 15 year period. The objective of this paper is to shed further light on the CEO pay-setting process by examining compensation peer groups such as the one used at NYSE. How much do they explain observed variation in CEO compensation and what determines the composition of these groups?

Theoretically, the pay-setting process is transparent in the US. For a publicly traded firm, the initial pay recommendations typically come from the firm's human resources department. These recommendations are then reviewed and amended by the compensation committee of the BOD, frequently working with outside compensation consultants (see, for example, Murphy and Sandino,

2009; Armstrong, Ittner, and Larcker, 2008). One common practice of the compensation committee is to benchmark pay levels against other companies with whom the firm competes for talent (Bizjak, Lemmon, and Naveen, 2008). The recommendation of the compensation committee is then passed to the full board for approval. This process likely provides CEOs with opportunities to influence their pay.[4] Even with the governance rules put in place by the exchanges to empower the BOD and independent directors who "approach their jobs with diligence, intelligence, and integrity," board actions likely favor CEOs given a range of market data on competitive pay levels (Murphy, 1999; Holmstrom, 2005).[5]

To further enable compensation transparency, the Securities and Exchange Commission (SEC) issued a new disclosure requirement that came into effect for fiscal years ending on or after December 15, 2006 according to which firms must state:

> Whether the registrant engaged in any benchmarking of total compensation, or any material element of compensation, identifying the benchmark and, if applicable, its components (*including component companies* [emphasis added]).—SEC final rules 33-8732a, Item 402(b)(2)(xiv), August 29, 2006

This study is the first to collect and examine the list of compensation peer companies used by the Standard & Poor's (S&P) 500 firms and S&P MidCap 400 firms in their first fiscal year ending after the compliance date of December 15, 2006. We find that the median compensation of the peer group generates significant incremental explanatory power in understanding cross-sectional variation in the observed CEO compensation among disclosing firms even after including controls for CEO labor market conditions. Our results complement those of Bizjak, Lemmon, and Naveen (2008), who find that CEOs whose pay was below the median pay level of their counterparts in companies of similar size and in the same industry receive pay raises that are larger in both percentage and dollar terms. In contrast, having actual compensation peer group membership enables us to demonstrate that peer companies outside the firm's industry and size group also have a significant influence on executive compensation.

In light of this economically significant role that compensation peer groups play, our next goal is to document the characteristics of the peer groups. One would expect that firms select companies in the same industry, of similar size, and with a history of observed talent flows between them to be members of their

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[2] The list of the NYSE's peer companies had been relatively stable during 1995–2002. The one used in 2002 contained Citigroup, Federal Home Loan Bank, FleetBoston Financial, Mellon Financial, Wells Fargo, American Express, Freddie Mac, Fannie Mae, GE Capital, GMAC, Merrill Lynch, Allstate, Chubb Corp., Aetna Inc., AIG, and CIGNA. Source: *Report to the New York Stock Exchange on Investigation Relating to the Compensation of Richard A. Grasso* by Dan K. Webb, Winston & Strawn LLP, December 15, 2003.

[3] Grasso's predecessor, William H. Donaldson, became CEO of Aetna, and Grasso's successor was Citicorp's CEO John Reed. In November 2007 NYSE CEO John Thain became CEO of Merrill Lynch, and ex-Goldman executive Duncan L. Niederauer replaced John Thain at the NYSE.

[4] The empirical evidence on whether CEOs influence their pay setting is somewhat mixed. Focusing on the role of compensation committees, O'Reilly et al. (1988), Main et al. (1995), and Newman and Mozes (1999) suggest the existence of the influence, while Anderson and Bizjak (2003) suggest the opposite.

[5] Lewellen et al. (1996) find self-dealing behavior in firms' selection of performance peer groups. In particular, they show that the industry and peer-company stock return benchmarks, and broader market indices, chosen by management for those comparisons are downward biased, thereby overstating relative reporting-firm performance.

compensation peer groups.[6] We confirm that this is the case. More important, we ask whether other factors explain peer group membership, and thereby also influence overall managerial compensation. Using both multivariate probit models and a propensity score matching (PSM) approach, we show that the level of CEO compensation at a potential peer company is statistically significant in determining its likelihood of being chosen as a compensation peer, after controlling for industry, size, visibility, talent flows, and CEO characteristics. In other words, compensation committees seem to be endorsing compensation peer groups that include companies with higher CEO compensation, everything else equal, possibly because such peer companies enable justification of the high level of their CEO pay.

One interpretation of our results is that entrenched CEOs in firms with weak corporate governance are likely to have more power to influence their own compensation. An alternative interpretation of our findings is that higher CEO compensation (for more complex firms) is likely to be an equilibrium result in a well-functioning labor market. To distinguish between these two theories, we examine the variation in pay differences between selected and unselected peers across measures of corporate governance. We find that highly paid potential peers are more likely to be chosen as compensation peers by firms where the peer group is smaller, where the CEO is the chairman of the BOD, where the CEO has been in the post longer, and where directors are busier serving on multiple boards.

The rest of the paper is organized as follows. Section 2 details the data used throughout the paper. The role of compensation peer groups in explaining observed CEO pay is examined in Section 3. Section 4 discusses the factors determining the composition of these peer groups and analyzes pay differences for selected and unselected peers across various measures of corporate governance. Section 5 concludes.

2. Data

Our primary data set is the companies included in the compensation peer groups for the S&P 500 and the S&P MidCap 400 firms (henceforth referred to as the S&P 900 firms, of which we found available data on Compustat for 896). The compliance deadline for peer disclosure was December 15, 2006. While some firms voluntarily disclosed their compensation peer groups prior to the compliance date, to avoid potential selection issues, we confine our analysis to the fiscal years ending December 2006 through November 2007, the first fiscal year after the compliance date. The compensation peer group members are typically stated in the Compensation Discussion and Analysis section in firm SEC DEF-14A

filings that are available on EDGAR. We identify 657 firms that disclosed an explicit list of compensation peers and had all necessary data in Compustat and ExecuComp. Of these disclosing firms, 395 are of the S&P 500 firms and 262 are of the S&P MidCap 400 firms. As an example of such disclosure, Pfizer Inc. stated:

- The Committee sets midpoint salaries, target bonus levels and target annual long-term incentive award values at the median of a peer group of pharmaceutical companies and a general industry comparator group of Fortune 100 companies, based on available survey data. Where appropriate, the target position is adjusted to reflect Pfizer's scale and scope. For salary and cash bonus levels, these adjustments, if any, are generally based on differences in revenues and relative market capitalization.
- The companies that comprised our pharmaceutical peer group in 2006 are Abbott Laboratories, Amgen, AstraZeneca, Bristol-Myers Squibb Company, Eli Lilly and Company, GlaxoSmithKline, Johnson & Johnson, Merck and Co., Inc., Schering-Plough Corporation, and Wyeth.
- The Committee also uses a general industry comparator group consisting of about one half of the Fortune-100 companies that best align with our sales volume, cash flow and market capitalization, as well as with the nature of our business and workforce, in determining the competitive positioning of pay… The peer group is Alcoa, Allstate, Altria Group, American Express, AIG, Bank of America, Boeing, Cardinal Health, Caterpillar, ChevronTexaco, Cisco, Citigroup, Coca-Cola, Comcast, ConocoPhillips, Dell, Dow Chemical, DuPont, Exxon-Mobil, Fannie Mae, FedEx, Ford Motor, General Electric, General Motors, Hewlett-Packard, Honeywell, Intel, International Paper, IBM, J.P. Morgan Chase, Lockheed Martin, Merrill Lynch, MetLife, Microsoft, Motorola, PepsiCo, Procter & Gamble, TimeWarner, United Parcel Service, United Technologies, UnitedHealth Group, Verizon, Viacom, Wachovia, Walt Disney, and Wells Fargo.

Among the 239 firms for which we were not able to identify explicit compensation peer groups, five of them stated that they did not use peers for benchmarking compensation while most of the others gave information that was too vague to identify the members of the peer group. For example, New York Times Co. stated that their executive compensation was benchmarked against "comparable executive positions at a cross-industry selection of 80 US companies with revenues comparable to ours in the prior fiscal year" and Baxter International Inc. identified its compensation peer group as "135 companies, including 35 in the healthcare industry." A few remaining firms did not disclose any information on compensation peers.[7]

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[6] For example, Heinz (H J) Co. stated that its "peer group is composed of sixteen companies, including those in the TSR Peer Group, plus the following highly regarded consumer products companies against which the Company competes to attract and retain talent: The Clorox Company, The Coca-Cola Company, Colgate-Palmolive Company, Johnson & Johnson, Kimberly-Clark Corporation, PepsiCo, Inc., and The Procter & Gamble Company."

[7] We are unable to distinguish the following scenarios: firms did not use compensation peer groups, the usage of such groups did not have a material impact on executive compensation, or firms did not comply with this recently implemented SEC rule.

Given that the firm's compensation committee is unlikely to have the contemporaneous or future compensation amounts of their peer CEOs at the time it selects compensation peers, we extract peer group compensation data for the fiscal year ending between 12 and 23 months before the fiscal year-end of the sample firm.[8] For example, a firm with its fiscal year ending in December 2006 typically selected its peers in the first 90 days of 2006. At that time, the most recent financial and compensation data on a potential peer with a December fiscal year-end should be from fiscal year 2005 (typically becoming available to the public by March 2006), so 2005 is the data year for the potential peer that we use for this firm-peer pair. In cases in which compensation peers are not in the ExecuComp database, we hand-collect their relevant compensation data from their DEF-14A or 10-K filings via EDGAR. We were able to obtain the CEO compensation levels for 276 of the non-ExecuComp peer companies (corresponding to 782 observations), while the remaining peer companies are private, foreign, subsidiaries, or went through mergers and acquisitions in 2006 or 2007.

We supplement our hand-collected data with measures of firm and peer compensation, firm size, industry, performance measures, leverage ratio, market-to-book ratio, whether the CEO is the chairman of the board, and CEO tenure provided in the ExecuComp and Compustat databases. Summary statistics of CEO compensation and firm characteristics are provided in Table 1 for the combined Panel of observations. The median CEO earned a salary of $0.92 million, with the mean being slightly higher. Salary and bonuses has much greater variation with a median of $2.276 million and a mean of $3.007 million.[9] Total (direct) compensation has a median of $6.085 million and a mean of $8.383 million.[10] Because our analysis of variation in CEO pay is for the S&P 900 firms, our sample is made up of relatively large, strong performing, and reasonably low volatility firms when compared with the entire Compustat universe.

Looking at the structure of the compensation peer groups, as provided in Panel B of Table 1, the average peer group has about 18 companies. We tabulate the median ratios of peer CEO compensation to CEO pay at the corresponding firm. Not surprisingly, the medians of these median ratios are rather close to one, while the means are higher. Among the chosen peers, on average 45.8% (with a

median of 43.5%) share the same two-digit standard industrial classification (SIC) code and 32.6% (with a median of 25%) share the same three-digit SIC code with the disclosing firm. Approximately 40–50% of the chosen peers are within 50% and 200% of the firm in terms of size, as measured by sales, assets, and market capitalization.[11] Because size and industry have previously been shown to predict compensation, and theoretically the outside opportunity for a CEO would likely be a CEO position in a firm of similar size in the same industry, it is not surprising to see that these are important elements to examine when evaluating the make-up of the compensation peer groups.

Beyond size and industry, companies appear to choose compensation peers with similar visibility, as measured by matches of the Dow 30 and matches of the S&P indices, and similar CEO responsibilities, as captured by whether the CEO is or is not the chairman of the BOD at both the firm and its peer. A company could also be a relevant compensation peer of a firm if each has hired top executives from the other. The talent flow variable takes a value of one if at least one of the top five executives moved between a firm and its peer over the previous 14 years (1992–2005, starting from the earliest year in the ExecuComp database) and zero otherwise. About 1.5% of the selected peers had flows of top executives with the corresponding firm.

3. Role of peer compensation on CEO pay

Our first objective is to understand the effect of compensation peer groups on the observed level of CEO pay, so we begin with a baseline estimation of the level of compensation for CEOs among the firms for which we have peer group information. We regress CEO compensation on firm and CEO characteristics previously shown in the literature (see, for example, Core, Holthausen, and Larcker, 1999) to explain the observed variation in CEO compensation using the following specification:

$$Ln(CEO\ Compensation_{i,t})$$
$$= a + \beta_1 Ln(Sales_{i,t-1}) + \beta_2 ROA_{i,t} + \beta_3 ROA_{i,t-1}$$
$$+ \beta_4 (Stock\ return_{i,t}) + \beta_5 (Stock\ return_{i,t-1})$$
$$+ \beta_6 Volatility_{i,t-1} + \beta_7 Leverage_{i,t-1}$$
$$+ \beta_8 Market\text{-}to\text{-}book_{i,t-1} + \beta_9 Dummy(CEO\ is\ chair_{i,t})$$
$$+ \beta_{10}(CEO\ tenure_{i,t}) + \varepsilon_{i,t}. \qquad (1)$$

Our measures of compensation are salary, salary and bonuses, and total (direct) compensation (TDC1). We use the lag of some financial variables to capture the fact that when compensation (such as salary and the bonus payment formula) was determined, the contemporaneous financial results of the firm would not yet be available to the compensation committee. As a measure of the size of the firm, we use the firm's lagged sales, as typically done in the literature. We further include measures of the firm's profitability (ROA) and stock performance (TRS1YR)

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[8] The external compensation consultants compiling peer group data for disclosing firms routinely have information earlier than public disclosure. Our results are robust to using peer compensation data in the previous fiscal year.

[9] Beginning in December 2006, ExecuComp modified the definition of some compensation variables. By construction of sample, our sample firms include only those reporting under the new rules and our peer companies (except Applied Materials, Family Dollar, and Whole Foods) include only those reporting under the old rules. *Salary and bonuses* is defined as *salary* plus *bonus* plus long-term incentive pay (*LTIP*) before 2006 and *salary* plus *bonus* plus nonequity incentive pay afterward.

[10] We use TDC1 in ExecuComp. Prior to December 2006, *TDC1* was *Salary+Bonus+Other Annual+LTIP Payouts+Restricted Stock Grants+Value of Options Granted+All Other*. After December 2006, *TDC1* was *Salary+Bonus+Non-Equity Incentive Plan Compensation+Grant-Date Fair Value of Stock Awards+Value of Options Granted+Other Compensation*.

[11] The proximity of size (50–200%) between a disclosing firm and its selected peers was often mentioned in the Compensation Discussion and Analysis of the firm's DEF-14A filings.

Table 1

Descriptive statistics. In Panel A, *Salary and bonuses* is *Salary+Bonus+LTIP* before December 15, 2006 and *Salary+Bonus+Noneq Incent* afterward. *Total pay* is *TDC1* in the ExecuComp database. Firm characteristic variables are *Sales*, *ROA*, *Stock return*, and *Volatility* (*BS Volatility* from ExecuComp), *Market-to-book value*, and *Leverage* (debt-to-market value of assets). *Dummy* (*CEO is chair*) is one if the chief executive officer (CEO) is the chairman of the board. *CEO tenure* is the number of years the CEO has been in the post. In Panel B, *Median* (*peer/firm pay*) is the median ratio of peer pay (*Salary*, *Salary and bonuses*, and *Total pay*) in the matching year to firm pay. *Number of peers* is the number of chosen compensation peers. *Match* (*two-digit industry*) and *Match* (*three-digit industry*) are one if a chosen peer is in the same two-digit and three-digit industry of the firm and zero otherwise, respectively. *Dummy* (*Size within 50–200%*) is one if the sizes (*Sales*, *Assets*, and *Market capitalization*) of the firm and peer are within 50–200% of each other and zero otherwise. *Chair* is the chairman of the board of directors. *Dummy* (*Talent flows*) is one if at least one of the top five executives moved between the firm and its peer during 1992–2005. S&P=Standard & Poor's.

Compensation and firm characteristics	Mean	Median	Standard deviation	Number of observations
Panel A: Descriptive statistics of disclosing firms				
Salary (millions of dollars)	0.932	0.920	0.345	657
Salary and bonuses (millions of dollars)	3.007	2.276	2.776	657
Total pay (*TDC1*, millions of dollars)	8.383	6.085	7.640	657
Lagged sales (billions of dollars)	11.82	3.767	27.06	657
ROA (percent)	6.012	5.372	6.832	657
Lagged ROA (percent)	6.190	5.429	6.289	657
Stock return	0.154	0.131	0.254	657
Lagged stock return	0.129	0.082	0.278	657
Lagged volatility	0.332	0.293	0.152	657
Lagged market-to-book value	2.057	1.648	1.291	657
Lagged leverage	0.149	0.115	0.134	657
Dummy (CEO is chair)	0.591	1.000	0.492	657
CEO tenure	7.244	5.500	6.771	657
Panel B: Descriptive statistics of disclosing firms and selected peers				
Median (Peer/firm salary)	1.035	0.982	0.390	653
Median (Peer/firm salary and bonuses)	1.368	0.990	1.807	654
Median (Peer/firm total pay)	1.354	0.939	1.663	657
Number of peers	18.25	16.00	11.66	657
Match (two-digit industry)	0.458	0.435	0.297	657
Match (three-digit industry)	0.326	0.250	0.292	657
Dummy (Sales within 50–200%)	0.494	0.500	0.207	657
Dummy (Assets within 50–200%)	0.448	0.455	0.190	657
Dummy (Market Cap within 50–200%)	0.408	0.412	0.189	657
Peer is Dow 30 if firm is Dow 30	0.468	0.500	0.215	27
Peer is Dow 30 if firm is not Dow 30	0.048	0.000	0.107	630
Peer is S&P 500 if firm is S&P 500	0.895	0.938	0.131	395
Peer is S&P MidCap 400 if firm is S&P MidCap 400	0.292	0.268	0.160	262
Peer CEO is chair if firm CEO is chair	0.708	0.730	0.145	388
Peer CEO is not chair if firm CEO is not chair	0.316	0.294	0.151	269
Dummy (Talent flows)	0.015	0.000	0.036	657

in both the contemporaneous and previous years, as well as the lagged volatility of the firm's stock over the previous 60 months (BS_VOLAT), leverage ratio (the total debt value over the market value of assets), and market-to-book value of firm assets. Finally, we include whether the CEO is the chairman of the board of directors and the number of years the CEO has been in the post. To mitigate the skew in the data, we winsorize all compensation variables at the 1st and 99th percentiles and follow Murphy (1999) to use Ln(CEO compensation) as the dependent variable. In addition, we transform Sales to Ln(Sales) in our regressions.

As shown by the results located in Columns 1, 3, and 5 of Table 2, CEOs have higher pay at firms that are larger, have better performance (when looking at salary and bonuses as well as total compensation), and have CEOs serving as the chairmen of the boards of directors, consistent with results previously shown in the literature. Higher market-to-book values correspond to lower salary and bonuses (Columns 1 and 3) but higher total pay (Column 5), consistent with higher equity-based pay at such firms.

To determine the effects of peer group compensation, we add the median CEO pay of the compensation peer group in the matching year to regression specification Eq. (1). One could argue that compensation of the peers is not itself influencing CEO compensation but is reflecting CEO labor market conditions not captured in the baseline specification. To address that concern, we simultaneously add the median CEO pay of companies that are in the firm's two-digit industry and fall within 50% and 200% of the firm's sales as a proxy for CEO labor market conditions.

The results located in Columns 2, 4, and 6 show that peer compensation is an important consideration in understanding the level of CEO compensation. The coefficient is statistically significant at better than 1%. However, the labor market proxy is not statistically significant. This finding suggests that factors beyond industry, size, performance, risk, and CEO labor market conditions affect the observed CEO pay. Economically, as shown in Column 6, the CEO of the corresponding firm earns an extra 0.581% for each 1% increase in the median total pay among its compensation peers, all else equal. In

Table 2

Effect of chief executive officer (CEO) compensation at peers on CEO compensation at disclosing firms. The dependent variables are firm *Salary* in Columns 1 and 2, *Salary and bonuses* in Columns 3 and 4, and *Total pay* in Columns 5 and 6. *Median peer pay* is the median CEO pay of compensation peer companies. *Median pay of industry-size peers* is the median CEO pay of companies in the firm's two-digit industry and of sales within 50–200% of the firm's. Firm *Sales*, *ROA*, *Stock return*, and *Volatility* (BS volatility) are from ExecuComp. *Leverage* is *total debt/(total debt+market capitalization)*. *Market-to-book value* is the ratio of market value to book value of assets. *Dummy* (*CEO is chair*) is one when the CEO of the firm serves as the chairman of the board, and *CEO tenure* is number of years the CEO has been in the post. We winsorize compensation variables at the 1st and 99th percentiles, and we apply log transformation to compensation variables and sales to overcome the skewness in the data. Standard errors are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Independent variables	Dependent variable: CEO compensation at a disclosing firm					
	(1)	(2)	(3)	(4)	(5)	(6)
Ln(Median peer salary)		0.697***				
		(0.091)				
Ln(Median salary of industry-size peers)		0.071				
		(0.082)				
Ln(Median peer salary and bonuses)				0.459***		
				(0.071)		
Ln(Median salary and bonuses of industry-size peers)				0.018		
				(0.068)		
Ln(Median peer total pay)						0.581***
						(0.070)
Ln(Median total pay of industry-size peers)						0.044
						(0.067)
Ln(Lagged sales)	0.136***	0.022	0.254***	0.099***	0.368***	0.150***
	(0.012)	(0.019)	(0.021)	(0.031)	(0.023)	(0.033)
ROA	0.004	0.005	0.016***	0.019***	−0.001	0.005
	(0.003)	(0.003)	(0.006)	(0.005)	(0.006)	(0.006)
Lagged ROA	0.000	0.001	−0.006	−0.009	−0.009	−0.007
	(0.004)	(0.004)	(0.006)	(0.006)	(0.007)	(0.007)
Stock return	−0.070	−0.066	0.442***	0.470***	0.034	0.185*
	(0.062)	(0.060)	(0.105)	(0.101)	(0.116)	(0.112)
Lagged stock return	−0.062	−0.008	0.354***	0.308***	0.219**	0.204**
	(0.056)	(0.054)	(0.095)	(0.091)	(0.105)	(0.100)
Lagged volatility	−0.153	−0.056	−0.243	−0.050	0.117	−0.073
	(0.107)	(0.103)	(0.181)	(0.175)	(0.200)	(0.190)
Lagged leverage	−0.278**	−0.209*	−0.022	−0.123	0.215	0.197
	(0.130)	(0.125)	(0.221)	(0.214)	(0.245)	(0.231)
Lagged market-to-book value	−0.047***	−0.056***	−0.060**	−0.053**	0.061**	0.024
	(0.016)	(0.015)	(0.028)	(0.026)	(0.030)	(0.029)
Dummy (CEO is chair)	0.029	0.012	0.123**	0.118**	0.133**	0.123**
	(0.032)	(0.031)	(0.054)	(0.052)	(0.060)	(0.057)
CEO tenure	0.003	0.005**	0.003	0.003	0.002	−0.001
	(0.002)	(0.002)	(0.004)	(0.004)	(0.004)	(0.004)
Intercept	−1.145***	−0.616	−1.379***	−0.677	−1.564***	−1.052**
	(0.127)	(0.522)	(0.214)	(0.458)	(0.238)	(0.475)
Number of observations	657	630	657	630	657	631
Adjusted r^2	0.228	0.321	0.306	0.370	0.325	0.409

addition, the adjusted r^2 of the regression increases significantly for all three measures of compensation and the coefficient on size, the most important determinant of CEO pay in the baseline specification, has fallen in magnitude by 59–84%.[12]

These results are robust to adding the median pay of the firm's two-digit industry peers as well as adding the lagged CEO compensation at the firm. They are also robust to adding two-digit industry fixed effects, which effectively allows for the existence of variation in the pay level across different industries. Overall, our results indicate that CEO compensation of the compensation peers

explains CEO compensation at the sample firm beyond traditional pay determinants and proxies for CEO labor market conditions.[13]

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[12] Because we lose observations when we add the median pay of the industry-size peers, the adjusted r^2 values are not perfectly comparable. In untabulated regressions with the same observations, the increases in adjusted r^2 by adding peer compensation are 9.1%, 6.0%, and 9.1% for the three pay measures, respectively.

[13] While the increase in explanatory power arising from inclusion of measures of compensation peer group pay is impressive, one might question why even greater statistical significance does not result. There are several potential reasons. First, while some firms specifically state that they target compensation at the peer group median, some merely use it as a benchmark and adjust up or down based on other factors, such as stock or accounting performance. Others state that they use alternative percentiles or percentile ranges in determining pay, an effect that adds noise to our estimation. Second, some of the firms that are listed as peers are foreign or private firms or firms that have merged and therefore do not publicly disclose their compensation, even though the corresponding firm could have that information through its compensation consultant. Our estimate of the medians is for the subset of peers for which we were able to identify CEO compensation via the ExecuComp database and hand-collection from the proxy statements of the chosen non-ExecuComp peers. Third, because firms disclose the list of peers, but

4. Selection of compensation peer groups

Given the large impact of peer compensation, the important economic question is: Which factors determine whether or not a company is included in the peer compensation group? If a firm intends to grant high compensation to its CEO, but still be able to justify that the CEO is making a reasonable percentile of its peers, one solution is to select peers that have relatively high compensation themselves. To test this, it requires having not only the list of companies chosen as compensation peer group members but also the list of potential peer companies that are not chosen. While more than five thousand companies listed on Compustat in 2006 and 2007 are arguably potential peers, we limit the set of potential peers to companies in the S&P 500 and S&P 400 MidCap indices (the S&P 900) because they are of similar size and visibility as disclosing firms. In other words, the potential peers for a disclosing firm in our specifications consist only of the other 899 companies in the S&P 900, which cover about 80% of the frequency of chosen peers for our sample.

We caution that one should interpret our results as showing which of the S&P 900 companies are or are not selected as peers. The estimated coefficients explain variations in the selection of the S&P 900 companies. Peer companies outside the S&P 900 are omitted because if we include the chosen non-S&P 900 peers, we should also include potential peers outside the S&P 900 that are not chosen so that we do not induce a bias in our selection analysis. Were we to expand the potential peers to the entire Compustat universe, we would include a few hundred more chosen small peers (with low compensation), but we would also include several thousand more potential small peers (with lower compensation) that are not chosen. We would expect to find stronger selection biases toward highly paid potential peers than what we present below.[14]

Our analysis of peer group composition begins with univariate results for CEO compensation and firm characteristics of the S&P 900 companies that are chosen to be in the compensation peer group relative to those that are not chosen. Next, we conduct probit regression analysis generating estimates of the choice of peer group members, focusing on the importance of the pay levels of CEOs at potential peers. We follow this with a propensity score matching approach to demonstrate that selected peers have higher pay than unselected similar companies. Having established the role of peer compensation on peer group composition, we examine the variation of the peer pay effect across different corporate governance measures, in the hope of enlightening the debate on the effect of corporate governance on the pay-setting process.

4.1. Univariate analysis

To get a preliminary assessment of which companies are chosen as members of the compensation peer group, we break up potential peer companies into four categories based on two measures: whether or not a potential peer is selected for the compensation peer group and whether or not the potential peer has the same three-digit SIC code as the firm. As demonstrated by the results in Panel A of Table 3, we examine 594,102 potential firm-peer pairs. Because there are nearly 900 potential peers in the sample and the average peer group has 18 companies, 98.5% of the potential peers are not selected as peers. Consistent with the earlier results, a large fraction of the companies chosen, 30.0% (2,640/(2,640+6,175)), is in the firm's three-digit industry.

Aside from the industry breakdown, some interesting patterns emerge with regard to the compensation at the potential peers. The table provides the median CEO salary at the potential peer and the median ratio of CEO salary at the potential peer to the lagged CEO salary at the firm for each of the four categories in Panel A, for salary and bonuses in Panel B, and for total compensation in Panel C. If we look at the potential peers outside of the firm's industry that are selected as peers (upper left quadrant), these companies have high compensation when measured in both dollar and percentage terms. In contrast, companies in the same industry that were not selected as peers (lower right quadrant) have the lowest salary, salary and bonuses, and total compensation of the four categories, in both dollar and percentage terms. Differences in medians for selected and unselected potential peers are significantly different from each other, both statistically and economically, for all three measures of compensation regardless of whether we look within or outside of the firm's industry.[15] In other words, at least based upon univariate analysis, the selection of compensation peers seems to favor higher paid companies over lower paid companies.

4.2. Multivariate probit regressions

Characteristics other than peer pay could potentially explain peer group selection. If correlated with peer pay, those other characteristics may explain the univariate findings shown above. So, to determine whether there is a selection bias of compensation peers, we conduct

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(*footnote continued*)

not from which fiscal year they are using peer pay information, we could be inducing measurement error using peer pay in the matching year. Our matching algorithm ensures the availability of peer pay information at the time peers were chosen, but some firms might have learned about or inferred peer CEO pay prior to the public via their compensation consultants.

[14] In unreported regressions, we include all S&P 1500 companies as potential peers for the 657 disclosing firms to examine whether our results are robust to expanding the set of potential peers to a larger group including potential (selected and unselected) peer companies with lower CEO pay. Not surprisingly, our results are strengthened. The selection sensitivity to peer pay is slightly higher than what we show using the S&P 900 companies as the universe of potential peers.

[15] The statistical significance of median differences is estimated by running median regressions that minimize the sum of the absolute residuals. The results are more striking when we compare the mean pay difference between selected and unselected potential peers.

Table 3

Peer selection bias, univariate analysis. *Same industry* is determined by whether a firm and its potential peer share the same three-digit standard industrial classification code. *Salary* is salary payment to the chief executive officer (CEO) at a potential peer company, and *Salary and bonuses* is *Salary+Bonus+LTIP* (fiscal years ended before December 15, 2006). *Total Pay* is the total compensation (*TDC1* in the ExecuComp database). *Ratio to lagged firm pay* is the ratio of CEO pay at a potential peer to the lagged CEO pay at the firm. All pay variables are measured in millions of dollars and are winsorized at the 1st and 99th percentiles. Compensation levels for potential peers are measured in the matching year. The results are based on median differences. Observation statistics are listed based on the corresponding numbers for which we have potential peer compensation data. The observation numbers are slightly smaller for the pay ratios due to missing lagged compensation data for some firms.

	Peer (A)	Non-Peer (B)	Difference (A–B)
Panel A: Descriptive statistics on salary payment of peer versus non-peer companies			
Different industry (C)			
Potential peer pay (millions of dollars)	0.995	0.825	0.170***
Ratio to lagged firm pay	101.7%	95.3%	6.5% ***
Number of observations	6,175	578,897	
Same industry (D)			
Potential peer pay (millions of dollars)	0.900	0.750	0.150***
Ratio to lagged firm pay	101.8%	92.9%	8.9% ***
Number of observations	2,640	6,390	
Difference (C–D)			
Potential peer pay (millions of dollars)	0.095***	0.075***	
Ratio to lagged firm pay	−0.1%	2.4% ***	
Panel B: Descriptive statistics on salary and bonuses of peer versus non-peer companies			
Different industry (C)			
Potential peer pay (millions of dollars)	2.846	1.985	0.861***
Ratio to lagged firm pay	108.1%	91.3%	16.8% ***
Number of observations	6,175	578,897	
Same industry (D)			
Potential peer pay (millions of dollars)	2.238	1.625	0.613***
Ratio to lagged firm pay	109.1%	85.1%	23.9% ***
Number of observations	2,640	6,390	
Difference (C–D)			
Potential peer pay (millions of dollars)	0.608 ***	0.360***	
Ratio to lagged firm pay	−1.0%	6.2% ***	
Panel C: Descriptive statistics on total pay of peer versus non-peer companies			
Different industry (C)			
Potential peer pay (millions of dollars)	7.204	4.931	2.274***
Ratio to lagged firm pay	110.2%	92.6%	17.5% ***
Number of observations	6,162	576,758	
Same industry (D)			
Potential peer pay (millions of dollars)	6.163	4.464	1.699***
Ratio to lagged firm pay	110.8%	89.0%	21.8% ***
Number of observations	2,635	6,353	
Difference (C–D)			
Potential peer pay (millions of dollars)	1.041 ***	0.466***	
Ratio to lagged firm pay	−0.6%	3.6% *	

multivariate regression analysis controlling for similarities between firms and potential peers along various dimensions. Using a probit model, we regress whether a potential peer is included in the corresponding firm's compensation peer group on a baseline set of factors that have been previously shown to explain cross-sectional variation in CEO compensation. An observation is a pair corresponding to the firm of interest for which we have compensation peer group members and a potential peer company (the other 899 of the S&P 900 companies).

Specifically, we estimate the following discrete choice model:

Chosen as peer$_{ij}$

$$= \Phi[a + \beta_1 \, Match(\textit{two-digit industry}_{ij})$$

$$+ \beta_2 \, Match(\textit{three-digit industry}_{ij})$$

$$+ \beta_3 \, Dummy(\textit{Sales within } 50\text{–}200\%_{ij})$$

$$+ \beta_4 \, Dummy(\textit{Assets within } 50\text{–}200\%_{ij})$$

$+\beta_5\, Dummy(Market\ Cap\ within\ 50-200\%_{ij})$

$+\beta_6\, Match(Dow\ 30_{ij})+\beta_7\, Match(S\&P\ 500_{ij})$

$+\beta_8\, Match(S\&P\ MidCap\ 400_{ij})+\beta_9\, Match(CEO\ is\ chair_{ij})$

$+\beta_{10}\, Match(CEO\ is\ not\ chair_{ij})+\beta_{11}\, Dummy(Talent\ flows_{ij})$

$+\beta_{12}\,(Number\ of\ peers)+\varepsilon_{ij}],$ \hfill (2)

where the dependent variable takes the value one if the potential peer j is chosen to be a member of the compensation peer group of firm i; it takes the value zero otherwise. Independent variables include whether the potential peer has the same two- and three-digit SIC code, respectively, as the firm; whether the potential peer is

within 50% and 200% of the firm along the three size measures of sales, book assets, and market capitalization; whether both the potential peer and the firm are Dow (DJIA) 30 members, S&P 500 index components, and S&P MidCap 400 index components; whether CEOs of both the potential peer and the firm are or are not chairmen of the BODs; and whether any of the top five executives moved between the firm and its potential peer during the time period of 1992–2005. These variables are intended to capture similarities between the firm and its potential peer along the dimensions of industry, size, visibility, CEO responsibility, and competition for talent. In estimating the standard errors, we follow Petersen (2009) and cluster them at both the firm and peer level, arguing that errors in estimating peer group inclusion are likely to be correlated

Table 4

Peer selection bias, probit regressions. The dependent variable is one if a potential peer [Standard & Poor's (S&P) 500 and S&P MidCap 400] is chosen as a compensation peer by a disclosing firm and zero otherwise. *Peer salary*, *Peer salary and bonuses*, and *Peer total pay* are from the matching year and are measured in millions of dollars. We winsorize peer pay at the 1st and 99th percentiles and use Ln(peer pay) in the regression. *Number of peers* is the number of compensation peers chosen by the firm. *Match* (*two-digit industry*) and *Match* (*three-digit industry*) are one if a potential peer is in the firm's two-digit and three-digit industry, respectively, and zero otherwise. *Dummy* (*Size within 50–200%*) is one if the sizes (*Sales*, *Assets*, and *Market cap*) of the firm and the potential peer are within 50–200% of each other and zero otherwise. *Match* (*Dow 30 membership*), *Match* (*S&P 500 membership*), and *Match* (*S&P 400 MidCap membership*) are one when both the firm and its potential peer are Dow 30 members, S&P 500 index components, and S&P MidCap 400 index components, respectively, and zero otherwise. *Match* (*CEO is chair*) is one when CEOs of both the firm and its potential peer are chairmen of the board of directors; and *Match* (*CEO is not chair*) is one when both CEOs are not chairmen. Dummy (Talent *flows*) is one if at least one of the top five executives moved between the firm and its potential peer during 1992–2005. Standard errors are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Independent variables	Dependent variable: whether a potential peer is chosen as a compensation peer by a disclosing firm				
	(1)	(2)	(3)	(4)	(5)
Ln(Peer salary)		0.045*			−0.017
		(0.023)			(0.021)
Ln(Peer salary and bonuses)			0.105***		0.056***
			(0.020)		(0.022)
Ln(Peer total pay)				0.142***	0.108***
				(0.015)	(0.019)
Number of peers	0.011***	0.011***	0.011***	0.011***	0.011***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Match (two-digit industry)	1.156***	1.156***	1.162***	1.171***	1.171***
	(0.030)	(0.030)	(0.030)	(0.031)	(0.031)
Match (three-digit industry)	0.813***	0.818***	0.825***	0.815***	0.820***
	(0.036)	(0.037)	(0.036)	(0.036)	(0.036)
Dummy (Sales within 50–200%)	0.414***	0.415***	0.417***	0.423***	0.423***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Dummy (Assets within 50–200%)	0.293***	0.291***	0.298***	0.299***	0.301***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Dummy (Market cap within 50–200%)	0.119***	0.118***	0.119***	0.123***	0.122***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Match (Dow 30 membership)	1.744***	1.721***	1.671***	1.675***	1.661***
	(0.081)	(0.081)	(0.082)	(0.083)	(0.083)
Match (S&P 500 membership)	0.444***	0.443***	0.417***	0.391***	0.391***
	(0.024)	(0.024)	(0.025)	(0.023)	(0.023)
Match (S&P MidCap 400 membership)	0.048**	0.054**	0.074***	0.094***	0.094***
	(0.023)	(0.023)	(0.023)	(0.024)	(0.024)
Match (CEO is chair)	0.114***	0.113***	0.095***	0.093***	0.089***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.017)
Match (CEO is not chair)	−0.052**	−0.048**	−0.030	−0.029	−0.024
	(0.023)	(0.022)	(0.022)	(0.022)	(0.022)
Dummy (Talent flows)	1.137***	1.135***	1.137***	1.125***	1.126***
	(0.082)	(0.082)	(0.082)	(0.082)	(0.082)
Intercept	−3.236***	−3.223***	−3.315***	−3.477***	−3.467***
	(0.022)	(0.023)	(0.027)	(0.036)	(0.036)
Number of observations	596,965	594,102	594,102	591,908	591,908
Pseudo-r^2	0.2901	0.2914	0.2945	0.2963	0.2968

for a particular firm as well as for a particular peer. The results are presented in Table 4.

Companies in the same industry (using both the two- and three-digit SIC code) and of similar size are the ones most likely to be chosen for the peer compensation group. We estimate a 0.66% likelihood of being chosen as a peer when both the potential peer and the firm are in the S&P 500 index and the CEOs of both are chairmen of the BODs, but when the potential peer is outside 50–200% of the firm's three size measures and not in the same two-digit industry as the firm. An otherwise identical potential peer that is in the firm's two-digit but not its three-digit industry has an estimated likelihood of being chosen of 9.28% and, for the potential peer in the firm's three-digit industry, the estimated likelihood being chosen rises to 30.47%. When the potential peer is within the three size thresholds but outside the firm's two-digit industry, the likelihood of selection is 4.91%, whereas when the potential peer is in the firm's two-digit industry but not its three-digit industry, the likelihood of selection rises to 30.92%. A potential peer that is within the three size thresholds and in the same three-digit industry as the corresponding firm has an estimated likelihood of selection of 62.36%. These dramatic differences highlight the significant roles that industry and size play in the construction of compensation peer groups.

In untabulated regressions, we allow the peer selection sensitivity to size to be different for larger and smaller potential peers, i.e., using an indicator variable denoting that a potential peer is 50–100% of firm size and a separate indicator variable indicating that the potential peer is 100–200% of firm size. We find that the coefficients on the two indicator variables are not statistically different from each other under any of the three size measures. Essentially, a firm chooses companies of similar size as its compensation peers, similarly rejecting companies that are much larger and much smaller than itself. In other words, it is the proximity of size that matters. Moreover, this symmetric result holds when the size difference is measured in raw dollar values.

Dow 30 companies are more likely to be chosen by other Dow 30 firms as peers because they are of similar visibility and operational complexity even though they might not be in the same industry. The frequent statements by firms that they choose certain compensation peers with whom they compete for managerial talent truly apply here: Market leaders comprising the Dow 30 are more likely to look for CEOs at other market leaders rather than at smaller companies in their industry. Similarly, S&P 500 companies are more likely to be chosen by S&P 500 firms as compensation peers, and so are S&P MidCap 400 companies by S&P MidCap 400 firms. In addition, companies with CEOs serving as the chairmen of the BODs are more likely to be chosen to be compensation peers by firms with chairman CEOs, but companies with separate CEOs and chairmen are less likely to be chosen by firms with separate CEOs and chairmen. Not surprisingly, potential peers are more likely to be chosen by firms with larger compensation peer groups.

Firms often claim in their proxy statements that "they choose peer companies against which they compete for talent." Talent flows between a firm and its potential peer significantly increase the likelihood of the potential peer being chosen. Economically, for a potential peer of similar size to the firm but outside the firm's two-digit industry, the likelihood of selection increases from 4.91% to 30.26% if at least one of the top five executives moved between the firm and the potential peer during 1992–2005. We acknowledge that the observed talent flows are the lower bound of all potential talent flows. In untabulated regressions, we measure talent flows by whether at least one of the top five executives moved between a disclosing firm and companies in the four-digit industry of its potential peer during 1992–2005.[16] Economically, for a potential peer of similar size to the firm but outside the firm's two-digit industry, the likelihood of selection increases from 4.91% when there is no flow of talent between the firm and the potential peer's four-digit industry to 13.86% when such talent flow has taken place. Our results are also robust when talent flows are measured during a shorter time period: 2001–2005.

To explore the possibility of gaming in the peer selection process, we add CEO compensation at potential peers in the matching year to the estimation of Eq. (2). The null hypothesis in this specification is that CEO pay at the potential peer has no influence on the likelihood of it being selected as a compensation peer after controlling for industry, size, visibility, CEO responsibility, and talent flows. If the coefficients corresponding to the peer compensation variables are found to be significantly positive, it would suggest that some peers are chosen because they would raise the pay level for the peer group, enabling the firm to more easily justify its high CEO compensation.[17]

The results from adding these peer compensation variables, contained in Columns 2 through 4 of Table 4, indicate that higher CEO compensation at a potential peer company is associated with a greater likelihood of the company being chosen as a compensation peer. Economically, if a potential peer (both the potential peer and the firm are in the S&P 500 index, both CEOs are chairs, and the two are similar in size) is in the firm's three-digit industry, an increase from one standard deviation below the mean to one standard deviation above the mean in the natural log of CEO total compensation at a potential peer increases its likelihood of peer membership from 55.1% to 65.5%. Meanwhile, the same increase in potential peer pay increases its likelihood of peer membership from 3.06% to 5.62% if the potential peer is otherwise identical but outside the firm's two-digit industry.

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[16] For example, if firm XYZ Corp. hired its Chief Financial Officer (during 1992–2005) who served as a top executive for Goldman Sachs Group Inc., then we assign a value one to the pairs of XYZ Corp. and the following 12 potential peers from SIC 6211: Edwards (A G) Inc., Jefferies Group Inc., Merrill Lynch & Co Inc., Raymond James Financial Corp., Bear Stearns Companies Inc., Morgan Stanley, Schwab (Charles) Corp., Lehman Brothers Holdings Inc., E Trade Financial Corp., Waddell & Reed Financial Inc., Goldman Sachs Group Inc., and Ameriprise Financial Inc. We consider only talent flows between XYZ Corp. and potential peers in SIC 6211. We do not consider all other firms in XYZ Corp.'s industry to have had talent flow between them and companies in SIC 6211 (unless the firm itself hired top executives from or lost top executives to companies in SIC 6211). In our sample, 9.5% of firms have talent flows with their peers' four-digit industries.

[17] We use Ln(*peer pay*) in the regression. Our results are robust to using the raw value of peer pay.

Table 5

Peer selection bias, propensity score matching approach. This table contains median differences between the selected peers and the propensity score matched unselected companies in each of *Salary*, *Salary and bonuses*, and *Total compensation*. In Columns 1 and 2, the differences are expressed in thousands of dollars, and in Columns 3 and 4, they are expressed as percentages of the compensation at the best-matched unselected company. To calculate these differences, we first calculate the difference for each selected-propensity score matched pair (pay at the selected peer minus pay at the propensity score matched unselected peer) and then take the median difference for each firm. The table provides the mean and median across firms for those firm-level median pay differences (mean of the medians in Columns 1 and 3, median of the medians in Columns 2 and 4). In Column 5, we tabulate the percentage of sample firms in which the median pay difference of the selected-propensity score matched pair (pay at the selected peer minus pay at the best-matched unselected peer) is negative. Column 6 contains the percentage of firms in which 50% of chosen peers have higher compensation and the other 50% of them have lower compensation than the best-matched unselected peers. Column 7 contains the percentage of firms in which the median pay difference of the selected-propensity score matched pair is positive. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

CEO compensation	Mean of dollar pay difference (thousands of dollars)	Median of dollar pay difference (thousands of dollars)	Mean of percentage pay difference	Median of percentage pay difference	Firms with negative median pay difference (percent)	Firms with exactly 50% of chosen peers with pay greater than or equal to matched companies (percent)	Firms with positive median pay difference (percent)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Salary	26.52***	21.28***	3.43***	2.03***	36.67	8.54	54.79
Salary and bonuses	527.86***	136.72***	25.44***	6.11***	38.29	8.39	53.32
Total compensation	1191.02***	470.48***	29.31***	10.73***	35.35	9.57	55.08

Because of the high degree of multicollinearity between salary, salary and bonuses, and total compensation, it is as yet unclear which compensation component is driving peer selection. To address this issue, we include all three pay measures in one specification and find salary and bonuses as well as total compensation to be statistically significant (Column 5), indicating that firms find bonuses and stock-based compensation, i.e., the sources of the differences between the three pay measures, to be relevant when choosing their compensation peers.

These results are highly robust to a number of alternative specifications. We adopt alternative industry definitions, using the Fama and French 49 industry classification, the number of overlapping business segments (defined by the three-digit SIC code) of the potential peer and the firm as disclosed in the Compustat segments database, and the difference of the number of business segments between the potential peer and the firm. In each of these specifications, we find a similar effect of CEO pay at a potential peer on its peer group membership. In addition, our results hold when the analyses are done using logistic regressions, using peer CEO compensation amounts in the previous fiscal year, restricting the analysis to just the S&P 500 disclosing firms, and adding whether the potential peer is in the firm's performance peer group.[18] We also estimate the role of peer pay using residual peer compensation, after removing the effect of size and industry, finding results that are economically similar but

statistically weaker. Overall, the evidence confirms that a highly paid potential peer is more likely to be chosen as a compensation peer, all else equal.

4.3. Propensity score matching approach

A multivariate probit approach potentially suffers from mulitcollinearity concerns if peer compensation is correlated with other peer characteristics. To more specifically identify the incremental effect of peer compensation on peer group membership, we employ the propensity score matching approach (see Rosenbaum and Rubin, 1983; Armstrong, Ittner, and Larcker, 2008). We match selected peers with unselected potential peers by industry, size, visibility, CEO responsibility, and talent flows (but not peer compensation). Using the regression estimates from Column 1 of Table 4, we estimate the probability of each potential peer being chosen as a peer (its propensity score) given its characteristics relative to the corresponding firm. Then, for each chosen peer of a firm, we identify the unselected potential peer that has the closest (in absolute terms) propensity score and has not already been matched to another chosen peer for that firm. So for each chosen peer in our data set, this approach identifies a best-matched unselected potential peer.[19]

Using this matched sample, we calculate the differences in CEO compensation between the chosen peers and the best-matched unselected companies in both dollar terms and as a percentage of the best-matched company's compensation. We then calculate the median of those differences for each firm for which we have compensation peer groups and tabulate the results in Table 5. We focus on the median pay difference because, among the 429

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[18] The performance peer information is typically disclosed around the performance graph in the 10-K or DEF 14A filings. We complemented the data by checking the annual reports posted at company websites and contacting the investor relation of about 40 companies. Most of performance peers are components of industry-wide indexes. The performance peer list is longer than the compensation peer list. On average, firms have 31 performance peers even after leaving out firms with more than two hundred performance peers. In the final sample, we use 333 of the S&P 500 firms that also have compensation peer information disclosed.

[19] We identify matches without replacement so an unselected potential peer could be the counterpart for only one chosen peer for a given firm. The results are robust to the sequence in which we identify best-matches.

firms that disclose pay benchmarks, the percentages of firms that benchmark salary, salary and bonuses, and total pay at or above the median CEO pay at peer companies are 96.93%, 98.81%, and 98.00%, respectively. In particular, 77.46%, 72.21%, and 58.21% of firms benchmark at the median of peer salary, salary and bonuses, and total pay, respectively.

Chosen peers received significantly higher compensation than the best-matched unselected potential peers under all three pay measures. For the average firm in our sample, the median salary payment is $26,520 higher, salary and bonuses is $527,860 higher, and there is a difference in total compensation of $1,191,020. Given the positive skew in the data, we also tabulate the median of the median pay difference between chosen peers and the best-matched unselected potential peers. For the median firm in our sample, the median salary payment is higher by $21,280, salary and bonuses is higher by $136,720, and total compensation is higher by $470,480. The percentage pay differences are 3.43%, 25.44%, and 29.31%, respectively, when calculated at the mean, while the medians of the percentage pay differences are 2.03%, 6.11%, and 10.73%, respectively, for the three pay measures.

In addition to calculating the sample means and medians, we tabulate the percentage of sample firms for which the majority of the firm's selected peers made less than the best-matched companies, the majority of selected peers made more, and when exactly half of the selected peers made more than the best-matched companies. For total compensation, this distribution was 35.35%, 55.08%, and 9.57%, respectively. In other words, the median pay difference between selected peers and the

best-matched companies is positive roughly 20% more often than it is negative, consistent with firms biasing their peer groups toward highly paid companies.

4.4. Variation in peer selection biases

Having shown the role of peer CEO compensation in the construction of compensation peer groups, we next analyze at which firms the pay differences between selected peers and best-matched companies are more dramatic. Because peer group size itself is endogenous, we examine whether pay differences are significantly different across firms with small and large peer groups. In addition, if powerful, self-serving CEOs can influence the selection of peer group members to justify their own pay, we would expect it to most likely be the case where CEOs are most entrenched. To test this hypothesis, we examine governance measures commonly used in the literature (see, for example Core, Holthausen, and Larcker, 1999): whether the CEO serves as the chairman of the board of directors, CEO tenure, and whether the board is busy (measured by the number of other boards that firm directors serve on). The results of these analyses are in Table 6.

The median salary and bonuses difference and the median total pay difference between selected peers and best-matched unselected companies in firms with small peer groups (16 or fewer peers, i.e., the sample median) are significantly higher than those differences in firms with large peer groups. These results hold for both dollar values and percentage pay measures. Economically, the median difference is $859.86 thousand (18.9%) for small peer groups but

Table 6
Variation in peer selection biases. This table contains median differences of *Salary*, *Salary and bonuses*, and *Total compensation* for selected peers and the propensity score matched unselected companies. The sample is divided into two subsamples based on the firm characteristics of whether the compensation peer group contains fewer than or equal to 16 companies (the sample median), whether the chief executive officer (CEO) is the chairman of the board of directors (BOD), whether the CEO has been in the post for more than 5.5 years (the sample median), and whether the average member of the BOD serves on more than 0.9 other BODs (the sample median). In Columns 1–3, the differences are expressed in thousands of dollars, and in Columns 4–6, they are expressed as percentages of the compensation at the propensity score matched unselected company. Columns 3 and 6 are the differences of the medians between the two subsamples. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Peer group and corporate governance characteristics	Median of dollar pay difference (thousands of dollars)			Median of percentage pay differences		
	Yes (1)	No (2)	Difference (3)	Yes (4)	No (5)	Difference (6)
Peer group is small						
Salary	19.61*	21.58**	− 1.98	1.58	2.27**	− 0.69
Salary and bonuses	214.52***	57.47	157.05*	9.69***	2.47	7.22*
Total compensation	859.86***	162.49	697.37***	18.92***	5.65**	13.26***
CEO is chair						
Salary	31.52***	7.61	23.91**	3.23***	0.00	3.23**
Salary and bonuses	194.78***	15.38	179.40*	9.48***	1.39	8.09**
Total compensation	452.52***	525.62***	-73.10	11.43***	10.47***	0.96
CEO has long tenure						
Salary	19.08*	24.06***	− 4.98	2.05*	2.31**	− 0.26
Salary and bonuses	143.04**	134.30**	8.74	7.53**	5.21	2.32
Total compensation	776.46***	130.20	646.27***	16.34***	4.36	11.98***
Board is busy						
Salary	29.85***	7.61	22.24**	2.89***	0.49	2.40*
Salary and bonuses	207.11***	31.32	175.79*	9.69***	1.83	7.86*
Total compensation	776.46***	248.19*	528.28***	13.62***	6.61*	7.01

only $162.49 thousand (5.65%) when the peer groups are large. These results are potentially explained by firms finding it more difficult to justify a long list of highly paid companies in their compensation peer groups. If firms want to justify high compensation by increasing median peer pay, fewer highly paid peers are required when peer groups are smaller.

Moving to our corporate governance measures, the salary difference and salary and bonuses difference between the chosen peers and best-matched unselected companies are significantly higher when CEOs are chairmen of the BODs than when they are not. In addition, CEOs who have long been the chief executive are more likely to be entrenched. These veteran CEOs (in the post for more than 5.5 years, the sample median) are estimated to have richly paid peers. The estimated total pay difference is significantly positive. It has also been argued by Core, Holthausen, and Larcker (1999) and Fich and Shivdasani (2006) that busier boards engage in less oversight of the firms and CEOs could therefore be relatively more powerful at such firms. We define a board of directors as busy if the average number of other boards that its directors serve on is greater than 0.9 (the sample median). We find that the pay difference is significantly higher for all three compensation measures in firms with busy boards.

The median pay difference between chosen peers and best-matched unselected companies at the median firm is positive for all subsamples of corporate governance measures, most of them statistically significant. This suggests that there could be some gaming of compensation peer selections at both types of firms: those with weak governance and those with strong governance. However, when pay differences between selected peers and unselected best-matched companies are statistically different, the pay differences are always greater in firms with weak corporate governance than in firms with strong corporate governance. Such results suggest that the gaming of compensation peer groups is more prevalent at firms with weak corporate governance.

The result that firms with weak corporate governance have more selection bias toward highly paid peers is robust to different specifications. In untabulated probit regressions, we add interaction terms of peer pay with the four corporate governance variables above, one at a time, into the baseline regressions reported in Table 4. As an example, a positive and significant coefficient on the interaction term of the busy board dummy with peer pay would indicate that firms with busy boards are more likely to choose peer companies with higher CEO compensation than firms with less busy boards. In these robustness specifications, we confirm the results discussed above from using the propensity score matching approach: Firms with small peer groups, chairman CEOs, long-tenured CEOs, and busy boards are more likely to choose peers with higher compensation, everything else equal.

5. Conclusion

Numerous firms have stated that they follow a process of basing CEO compensation on an analysis of similar companies, but only recently this process has become more transparent with greater disclosure of compensation peer group members. Our work is the first to show that the composition of the actual compensation peer groups does play an important role in explaining the variation in observed CEO compensation. We show a number of summary statistics regarding compensation peer groups and analyze the determinants of peer group composition. We find that while industry and size are important in explaining the composition of these compensation peer groups, the level of compensation at potential peer companies also plays a significant role. Firms tend to choose highly paid peers to justify their high CEO compensation. This effect is particularly strong in firms where the peer group is smaller, where the CEO is the chairman of the board of directors, where the CEO has longer tenure, and where directors are busier serving on multiple boards.

The propensity score matching approach shows that the median firm in our sample chose a median peer with $470 thousand higher total pay than its best-matched unselected peer. To put it into perspective, this difference is 5.6% of the mean ($8.383 million) and 7.7% of the median ($6.085 million) CEO total pay in our sample. This estimated pay difference for the median peer implies an annual increase of 3.3–4.5% in CEO pay at the firm (given the estimate from Table 2 that CEO pay increases 0.581% for every 1% increase in median peer pay). Thus, the selection bias toward highly paid companies in the compensation peer groups appears to contribute to the ratcheting of CEO pay over time.

Moreover, given a list of strategically selected compensation peers, firms could further boost CEO pay by setting benchmarks higher than can be justified by the firm's size ranking among its peers. For example, for a firm ranked in the bottom quartile of the size distribution of its selected peers, benchmarking against the median pay of its peer companies could boost its CEO pay. Taking into account the effect of selected peers for whom we do not have size or pay data (approximately 6% of selected peers), we fail to find a systematic bias in setting pay benchmarks in the subsample of 429 firms that disclosed the benchmarking information. Combined, our results suggest that the CEO pay-setting process is neither as well justified as claimed by Kaplan and Rauh (2009) and Gabaix and Landier (2008), among others, nor as manipulated as argued by Bebchuk and Fried (2004), among others.

The increased transparency should lead to greater analysis by shareholders, as well as other firm stakeholders, on how potential peer companies are selected as members of the compensation peer group. It will be interesting to observe whether this additional scrutiny will alter the patterns that we have shown here.

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