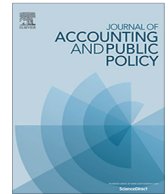


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journal homepage: www.elsevier.com/locate/jaccpubpolHedge fund activism, CEO turnover and compensation[☆]Wonik Choi^{*}, James Jianxin Gong

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ABSTRACT

This paper examines the governance role of hedge fund activists by analyzing the impact of these activists on CEO turnover, CEO pay, and CEO pay-performance link in targeted companies. Using the difference-in-difference approach, we first find significantly higher CEO turnover following hedge fund activism. After we split target companies into the CEO-turnover and non-CEO-turnover sub-samples, we find that only *new* CEOs in targeted companies get more compensation following hedge fund activism while *incumbent* CEO pay does not significantly change. The relationship between CEO bonuses and return on assets following hedge fund activism also differs across the subsamples split by CEO turnover. Pay-performance relationship is enhanced by hedge fund activism for new CEOs, but not for incumbent CEOs. In additional analyses, we document that CEO turnover is positively associated with Tobin's Q and shareholder votes on Say on Pay in target companies after hedge fund activism.

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1. Introduction

While shareholder activism is not new (Gillan and Starks, 2007; Denes et al., 2017), activist hedge funds have recently emerged as a new and critical factor in both corporate governance and market for corporate control (Kahan and Rock, 2007; Brav et al., 2008a; Bebchuk et al., 2015a). There is significant disagreement among researchers, investors, and regulators about whether hedge fund activism contributes to the improvement of board effectiveness and firm performance (e.g., Bebchuk et al., 2015a 2015b; Cremers et al., 2016; deHaan et al., 2019). To shed light on the debate, we focus on the corporate governance role of hedge fund activism, specifically, its effect on CEO turnover, CEO compensation, and pay for performance. The most severe consequence for a CEO is to lose the job (Dikolli et al., 2014), and the next is to receive lower pay (Murphy, 1999; Core et al., 2003). In fact, shareholder proposals related to executive compensation have become an increasingly important subject at the annual meetings of public companies (Brandes et al., 2008). Some hedge fund activists specifically target CEO compensation and incentives in such companies as Applebee's, CSX, and Home Depot (e.g., Duhigg, 2007).

We start our research with a sample consisting of hedge funds' Schedule 13D filings with the SEC between 1995 and 2015. After we merge the sample with ExecuComp, Compustat, and CRSP, our final sample includes 604 target companies. We match our sample with a control group of similar companies in the same industry and year that have never been subject to hedge fund activism.¹

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¹ Our propensity score matching characteristics include firm-specific characteristics, stock performance, CEO characteristics, and CEO compensation. See section 3.1 for detailed explanation of the matching procedure.

Dikolli et al. (2014) document that poorly performed CEOs are most likely to be replaced. Also, if hedge fund activists have a different view with CEOs of corporate strategies and how to create shareholder value, they will replace the current CEOs (Bebchuk et al., 2020). Consistent with this prediction, we find that CEO turnover in companies targeted by activist hedge funds during the two-year period after the hedge fund investment (39.4%) is higher than that in control firms over the same period (27.8%). Our multivariate regression results suggest that hedge fund activism (HFA) significantly increases the likelihood of CEO turnover in the post-HFA period. But there is no significant difference in the turnover-performance relationship between targeted companies and the control sample.

Since we observe high CEO turnover after hedge fund intervention, we next investigate target companies' CEO turnover as a moderating variable on the effect of hedge fund activism on CEO compensation. We find that the increase in CEO pay is not evenly distributed across CEOs. Activist hedge funds increase *newly hired* CEOs' compensation level significantly while they keep *incumbent* CEOs' pay nearly unchanged. Furthermore, the CEO compensation increase is mostly due to CEO bonus growth. This suggests that activist hedge funds tend to remove poorly performing CEOs and then hire new CEOs and provide them with higher bonuses when they achieve performance goals. At the same time, they retain the well-performing CEOs and do not change the pay packages for them. We do not find significant changes in the dollar value of equity compensation nor the ratio of equity compensation to total compensation after the hedge fund intervention. Our explanation is that boards of directors probably consider that more performance-based annual bonuses provide sufficient incentives for performance improvement in the targeted companies. Thus there is no need for a rise in equity compensation. This is consistent with the argument in Murphy (2013) that the incentive effects of bonus plans might be stronger than equity compensation because the link between executives' actions and the performance metrics in bonus plans is often more direct than the link between actions and stock price changes.

As for the CEO pay-performance relationship, we document that the relationship between CEO bonuses and operating performance is enhanced in the post-HFA period; and the enhancement of the relationship is more significant for *new* CEOs than *incumbent* CEOs. Considering the earlier finding that hedge fund activism is associated with the *new* CEOs' higher bonuses, we conclude that hedge fund activists enhance cash incentives to CEOs for performance improvement and compensate them with higher bonuses due to performance achievement. On the other hand, the association between equity compensation and firm performance for both *new* and *incumbent* CEOs does not change after hedge fund activism. This is consistent with our earlier finding that activist hedge funds do not change equity compensation arrangements for both new and incumbent CEOs.

In addition, we find that CEO turnover in targeted companies is associated with higher shareholder value creation measured by Tobin's Q and three-year cumulative abnormal returns after hedge fund activism. This result confirms prior studies' finding that hedge fund activism improves firm performance (e.g., Brav et al., 2008a, Bebchuk et al., 2015a). Combining this set of findings with earlier results, we conclude that activist hedge funds remove CEOs with different views on corporate strategy and operational tactics, design appropriate compensation packages, and ultimately contribute to the creation of shareholder value.

In additional analyses, we examine equity incentives as measured by Delta (pay-performance sensitivity) and Vega (pay-risk sensitivity) in the CEO's equity holding and equity compensation. We do not find significant differences before and after hedge fund activism. Again, this is probably due to boards of directors' perception that annual bonuses provide sufficient incentives to CEOs.

One way to test the overall efficacy of executive compensation is by examining whether stockholders approve the compensation arrangement. Therefore, we also examine Say on Pay votes in the post-HFA period. We find that shareholder votes for executive compensation in Say on Pay significantly increase after hedge fund intervention. We interpret this result as another piece of evidence that HFA improves the design of the system of incentive compensation.

This study contributes to the growing literature on the hedge fund activism by studying the effects of hedge fund activism on a series of related variables, including CEO turnover, CEO pay setting, and the relationship between CEO pay and performance. Existing evidence is inconclusive on whether activist hedge funds improve the governance practices (Cremers et al., 2017; deHaan et al., 2019). We show that activist hedge funds provide beneficial effects on corporate governance by replacing some CEOs, providing appropriate compensation to CEOs, and enhancing the bonus-performance relationship. We find that CEO turnover in the post-HFA period is positively related to Tobin's Q and three-year cumulative abnormal returns. Overall, these benefits of hedge fund activism are in contrast to the "myopic-activists" claim held by critics of hedge fund activists. The "myopic-activists" claim plays a central role in support for government regulation of hedge fund activists. Our findings suggest that policymakers would be better off to be cautious in setting new regulations to constrain hedge fund activism.

This paper also contributes to the area of CEO compensation. Using our full hedge fund activism sample, we initially find that CEO compensation level increases following hedge fund activism (untabulated), which seems to be in contrast with beneficial governance roles of activist hedge funds. However, after we split the sample into incumbent and new CEOs, we find that only *new* CEOs appointed after hedge fund activism receive higher compensation, and the increase in pay is concentrated in the form of bonuses. Our results highlight the importance of controlling for CEO turnover in the analysis of hedge fund activism and CEO compensation. In addition, we show that the relationship between bonuses and performance is enhanced only for new CEOs. Furthermore, shareholder approval of executive compensation increases after hedge fund intervention. This suggests that market forces, such as activist hedge funds, can design workable CEO compensation and incentive plans.

Our paper is related to but different from a couple of concurrent studies. Our analysis shows that CEO compensation increases following hedge fund activism. This finding is closely related to a concurrent working paper by [Keusch \(2017\)](#), who also find that CEO pay increases after hedge fund activism. Our study is different from [Keusch \(2017\)](#) in that we split the sample based on CEO turnover and show that only new CEOs' compensation increases while incumbent CEOs' pay remains unchanged. Our results highlight the importance of controlling for CEO turnover in the analysis of hedge fund activism and CEO compensation. Our paper also has some overlap with [Fidrmuc and Kanoria \(2017\)](#), which documents a decline in target CEO pay after hedge fund activism. Our paper is different from their paper in sample selection, research design, and results. Our sample covers more extended periods (1995–2015 vs. their 2009–2011) and has more observations (601 vs. 241). We also use the log-transformed CEO pay measure because the CEO pay distribution is highly skewed. The different samples and research design may explain different empirical findings. Therefore, the results in our study are not comparable to those in [Fidrmuc and Kanoria \(2017\)](#).²

The remainder of the paper is organized as follows: [Section 2](#) reviews related literature and develops hypotheses; [Section 3](#) describes our sample and matching procedure; [Section 4](#) presents the main empirical results; [Section 5](#) reports additional results; and [Section 6](#) concludes the paper.

2. Literature review and hypothesis development

2.1. Background

Since the beginning of the 21st century, we have witnessed the dramatic rise of shareholder attempts to influence management and the board ([Gillan and Starks 2007](#)). Hedge funds are the most active in this round of shareholder activism movement. Following [Brav et al. \(2008a\)](#), we define hedge fund activism as attempts and interventions by a hedge fund to influence the board, top management, and company strategy after the fund acquires a non-controlling interest in a target company (typically more than 5% of outstanding shares). According to a Government Accountability Office report ([Government Accountability Office, 2008](#)), the number of hedge funds grew from approximately 3,000 to 9,000 from 1998 to 2007, and assets under management grew from \$200 billion to more than \$2 trillion globally. An estimated \$1.5 trillion of these assets is managed by U.S. hedge fund advisers. A significant portion of these hedge funds are activist investors.

Activist hedge funds are different from other institutional investors in their organizational form, regulatory environment, and the incentives that they face ([Brav et al., 2008a](#)). For instance, fund managers (partners) have significant incentives to improve portfolio companies' performance due to their payout structure (usually 20% of portfolio gains). Also, multiple hedge funds often work together to form "wolf packs," attacking target firms together to assure the target companies' management meet their demands with a small percentage of shareholding ([Coffee and Palia, 2016](#)). At the same time, mutual funds and pension funds are supporting hedge funds' efforts to improve corporate management and enhance shareholder returns. [Brav et al. \(2015b\)](#) conclude that hedge funds have become better-informed monitors of directors and officers in companies than other institutional shareholders.

While executive compensation was proposed as a solution to the agency problems due to separation of ownership and control, executive compensation itself has become an agency problem as boards captured by powerful CEOs set the compensation level too high ([Bebchuk and Fried, 2004](#); [Jensen and Murphy, 2004](#)). Some companies like Applebee's and Home Depot became targets of hedge fund activism because they have a lack of pay for performance [Duhigg \(2007\)](#). Activist hedge funds targeted other companies like Outerwall and Medifast because of poor performance caused by misaligned incentives ([Ferracone and Welling, 2013](#)). In addition, hedge fund activists often seek to boost shareholder value by demanding stock buybacks, expense cuts, divestitures, and other efforts to focus operations through spin-offs and unit sales ([Brav et al., 2008a](#)). To motivate CEOs to implement these strategic, financial, and operational changes, boards of directors under the influence of hedge fund activists have to reset executive compensation and incentives. In sum, as hedge fund activists intervene, they naturally will consider replacing CEOs if necessary and then focus on target companies' executive compensation policies as one of the steps to achieve their ultimate goal of value creation. For instance, hedge fund activists criticized Home Depot for its misaligned executive incentives that rewarded empire-building through borrowing, and then the company redesigned its CEO compensation plan ([Duhigg, 2007](#)).

2.2. Hedge fund activism and CEO turnover

Corporate CEOs tend to engage in empire building ([Shleifer and Vishny, 1989](#)) or entrench themselves in their positions, which makes it difficult to oust them when they perform poorly ([Bebchuk and Fried, 2004](#)). Entrenched CEOs of publicly listed companies can protect themselves from replacement either through their connections with directors or through their political influence within the company. It is no surprise that activist hedge funds will play a disciplinary role by removing

² As a robustness check, we performed a 2009–2011 sub-period test to evaluate the comparability with [Fidrmuc and Kanoria \(2017, hereafter FK\)](#). Similar to FK, using 2009–2011 hedge fund activism data, we find that total compensation is reduced after HFA regardless of CEO turnover. Excluding the 2009–2011 hedge fund activism data, however, the results are consistent (even stronger) with our main findings – i.e., increase in the new CEO's compensation after HFA. These results remain unchanged when we use non-log-transformed total compensation.

CEOs who cause agency problems or CEOs who are entrenched so as to appoint more competent executives as the CEOs of these companies.

The hedge fund lists the purpose for its acquisition in Item 4 of Schedule 13D filings with SEC filings. We read about 1,000 such filings and manually code the filers' (hedge funds') stated purposes of investments.³ Consistent with [Brav et al. \(2008a\)](#), we find that 64.1% of the hedge fund activists list shareholder wealth maximization as a stated purpose, and 25.0% include improvement of governance as one of their purposes. To achieve their purposes, activist hedge funds often demand memberships on the board and a change in CEO. Anecdotal evidence suggests that hedge funds often fire a CEO after they intervene. For instance, hedge fund activists demanded DuPont CEO Ellen Kullman, to step down soon after their intervention, and the CEO quits after a lengthy proxy battle ([Bunge, 2015](#)). As another example, Arconic CEO, Klaus Kleinfeld, was forced out as chairman and CEO following heavy pressure from activist investor Elliott Management ([Benoit and Tita, 2017](#)). [Brav et al. \(2008a\)](#) and [Bebchuk et al. \(2020\)](#) provide descriptive statistics on CEO turnover and show higher CEO turnover in HFA targeted firms than a control sample. Therefore, we state our first hypothesis in the alternative form as follows:

- H1: The likelihood of CEO turnover in companies targeted by activist hedge funds will become higher after hedge fund activism.

2.3. Hedge fund activism and CEO compensation level and structure

CEO turnover has a significant effect on executive compensation because new CEOs, especially when they are hired from outside the company, often get paid more than their predecessors ([Murphy and Zábojník, 2004](#)). Therefore, we need to consider the CEO turnover after hedge fund activism as we develop hypotheses on the effect of hedge fund activism on CEO compensation. We will discuss the compensation change for incumbent CEOs first, followed by the new CEO compensation change.

There are two competing but non-mutually-exclusive theories for predicting incumbent CEO pay change after HFA: efficient contracting theory and managerial power hypothesis ([Murphy, 2013](#)). Managerial power hypothesis ([Bebchuk and Fried, 2004](#)) argues that powerful CEOs often influence how boards of directors set executive pay and cause widespread distortions in pay arrangements. Both efficient contracting theory and managerial power hypothesis will predict that hedge fund activists will retain well-performing incumbent CEOs and do not change (or increase) the pay package. For poorly performing incumbent CEOs, the efficient contracting theory will predict lower CEO compensation, while managerial power hypothesis predicts that target firms won't be able to lower the CEO compensation level for the staying CEOs, who are most likely powerful. [Cremers et al. \(2017\)](#) find that hedge fund activism has no significant impact on CEO pay. However, after activist hedge funds intervene, CEOs often lose power ([Kahan and Rock, 2007](#)) even if they are able to keep the job. Also, more members representing activist hedge funds will be voted onto the board, and thus the board will be more independent. In addition, there is a widespread belief that CEOs in poorly performing companies are overpaid (e.g., [Fuhrmans, 2018](#)). Since hedge funds often target these companies, we expect that the CEO pay level will decline following hedge fund activism. In reality, occasionally, hedge funds name executive compensation as the reason for investing in a target. Prior studies, such as [Brav et al. \(2008a\)](#), document that the excessive CEO pay decreases one year after hedge fund activism. In sum, efficient contracting theory predicts no change or increase in pay for well-performing incumbent CEOs and a decrease in pay for poorly performing incumbent CEOs. Managerial power hypothesis predicts no change or increase in pay for both types of CEOs regardless of past performance. Therefore, we state our hypothesis on incumbent CEO compensation in the null form as follows:

- H2a: Compensation of incumbent CEOs in companies targeted by activist hedge funds will not change after hedge fund activism.

On the other hand, new CEOs hired after hedge fund activist intervention will be different from their predecessors and peers in non-targeted firms for a few reasons. First, [Murphy and Zábojník \(2004\)](#) document that new CEOs are paid higher than their predecessors. Second, working for a hedge fund activist target company poses a high risk of losing the job. Therefore, CEOs will demand a risk premium to the average compensation level. Third, the board needs to provide incentives for performance improvement. For instance, the board may want to motivate CEOs for a turnaround and offer him/her with performance-contingent cash incentives. These incentives are at risk, and this additional risk borne by executives has to be compensated through higher pay to achieve the risk-reward balance. Thus, our hypothesis on compensation for newly hired CEOs after hedge fund activism is as follows.

- H2b: Compensation of new CEOs in companies targeted by activist hedge funds will become higher after hedge fund activism.

Besides the compensation level, another important dimension of executive compensation is compensation structure ([Murphy, 1999](#)). Most CEO pay packages include salary, bonus, non-equity incentives, restricted stocks, performance shares, stock options, pensions, perks, and other compensation. Salary, bonus and non-equity incentives are cash compensation

³ See Panel C of [Table 1](#) for the summary of events by hedge funds' stated purposes.

while restricted stocks, performance shares, and stock options are equity compensation. Cash compensation is either fixed (salary) or primarily based on current year performance (bonus). Equity compensation takes time to vest, and its realized value is dependent upon future stock prices. Existing literature on executive compensation (e.g., [Core and Guay, 1999](#); [Murphy, 1999](#)) suggests that cash compensation, especially bonus, provides short-term incentives while equity compensation, especially stock options, provides powerful long-term incentives. There is an unsettled debate on whether hedge fund activists are short-term oriented or long-term oriented ([Kahan and Rock, 2007](#); [Bebchuk et al., 2015a](#); [Cremers et al., 2016](#)). Therefore, we do not provide a directional prediction on how hedge fund activism affects the structure of CEO compensation. Our hypothesis on the compensation structure in the null form is as follows.

- H2c: Compensation structure of incumbent CEOs in companies targeted by activist hedge funds will not change after hedge fund activism.
- H2d: Compensation structure of new CEOs in companies targeted by activist hedge funds will not change after hedge fund activism.

2.4. Hedge fund activism and pay-performance relationship

Pay for performance is one of the most critical principles in setting CEO pay. Academic researchers, investors, and regulators are interested in the link between CEO compensation and firm's stock performance. There seems to be a disconnection between CEO compensation and firm performance when the board of directors is less independent, CEOs are powerful, and large shareholders are not present ([Core and Guay, 1999](#); [Bebchuk and Fried, 2004](#)). If activist hedge funds intervene and can improve the CEO compensation contract, we expect that the relationship between incumbent CEO pay and performance will be enhanced. On the other hand, if CEOs are powerful and hedge funds are not able to change CEO compensation, we expect that the relationship between incumbent CEO pay and performance will be unclear. Our hypothesis on the pay-performance relationship in the null form is as follows:

- H3a: For incumbent CEOs in companies targeted by activist hedge funds, the pay-performance relationship will not change after hedge fund activism.

If activist hedge funds intervene and can replace the CEO, we expect that they will improve the CEO compensation design, particularly pay for performance mechanisms. In addition, boards of directors under the influence of hedge fund activists have the opportunity to re-contract with new CEOs. For instance, they can change the performance measures in incentive plans to motivate CEOs to work toward hedge fund activist goals. Therefore, the observed pay-for-performance link will be stronger for new CEOs after hedge fund intervention.

- H3b: For new CEOs in companies targeted by activist hedge funds, the pay-performance relationship becomes stronger after hedge fund activism.

3. Sample selection and propensity score matching

3.1. Hedge fund data collection

We collect data on hedge fund activism from two sources. We first obtain hedge funds and their acquisitions of target firms from 1995 to 2011 based on a comprehensive list of activist hedge funds used in [Brav et al. \(2008a\)](#).⁴ We additionally collect intervention events using all Schedule 13D and 13D/A filings from 2005 to 2015.⁵ From these filings, we match these filers with the list of activist hedge funds used in [Brav et al. \(2008a\)](#) to identify Schedule 13D and 13D/A filings that are filed by hedge funds. We collect the filing dates, the acquisition dates, and the names of filers and targets. We also manually code target firm identifiers (i.e., gvkey, cusip) to merge with other databases. The number of initial sample hedge fund activism events is 2,922.

We then select firms at the intersection of our hand-collected sample, the ExecuComp, Compustat, and CRSP databases. We remove all firm-years that miss ExecuComp, Compustat, or CRSP data items required to calculate the variables used in our empirical analysis. Consistent with prior literature, we eliminate utility and financial firms (SIC codes 4900–4999 and 6000–6999) because these firms often have different regulations and objectives. Our final hedge fund activism sample with available data for propensity score matching includes 601 events.⁶ Panel A of [Table 1](#) summarizes the sample construction

⁴ We thank Dr. Alon Brav and his coauthors for sharing an updated list of activist hedge funds.

⁵ The investor who acquires more than 5% of the outstanding share of a company and intends to influence management is required to file Schedule 13D with the SEC within ten days of cross the 5% beneficial ownership threshold.

⁶ The biggest reduction in the sample number is due to the compensation data.

Table 1
Sample Description.

Panel A. Sample construction			
Total Hedge fund activism (1995–2015)			2,922
Less: Compustat, CRSP, IBES, compensation data available			–2,321
Sample activism events with available data for propensity matching			601
Panel B. Hedge fund activist events across years			
Calendar Year	N	Calendar Year	N
1995	6	2006	67
1996	12	2007	87
1997	13	2008	58
1998	10	2009	21
1999	13	2010	39
2000	14	2011	47
2001	15	2012	25
2002	17	2013	28
2003	17	2014	34
2004	25	2015	4
2005	49		
Panel C. Summary of events by hedge funds' stated objectives			
		N	%
Shareholder value maximization		385	64.1
Capital Structure		71	11.8
Business Strategy		177	29.5
Sale of Target		55	9.2
Governance		150	25.0

process. In Panel B, we find that the number of events is higher in the 2005–2011 period relative to the years before and after that period.⁷ We obtain CEO turnover and compensation data from both ExecuComp and ISS, accounting data from COMPUSTAT, stock price data from CRSP, analyst forecast data from IBES.

3.2. Propensity score matching

Following prior literature (e.g., Cheng et al., 2012, 2015; Chen and Jung, 2016), we create a propensity score-matched control sample. The main objective of the propensity score matching is to compare any change in target firms (e.g., CEO turnover, CEO pay, CEO pay for performance) after HFA with that in control firms that have similar characteristics. We estimate a logistic regression in which the dependent variable is an indicator for whether a target firm has experienced hedge fund intervention in year t and the independent variables include CEO compensation, CEO characteristics as well as firm and market-based characteristics measured in year $t - 1$. We follow Brav et al. (2008b), Cheng et al. (2012, 2015), and Chen and Jung (2016) for the determinant of being a target of activist hedge funds. We also add CEO compensation, CEO age, and CEO tenure variables because any difference in CEO compensation and characteristics could jointly determine the choice of target firms and CEO turnover at those firms.⁸

$$\begin{aligned}
 HFA = & \alpha + \beta_1 \text{Size}_{t-1} + \beta_2 \text{TobinQ}_{t-1} + \beta_3 \text{SALEGROWTH}_{t-1} + \beta_4 \text{ROA}_{t-1} + \beta_5 \text{LEV}_{t-1} + \beta_6 \text{DIVIDEND}_{t-1} \\
 & + \beta_7 \text{R\&D}_{t-1} + \beta_8 \text{HHI}_{t-1} + \beta_9 \text{ANALYSTS}_{t-1} + \beta_{10} \text{BHAR}(-12, -1) + \beta_{11} \text{CEOAGE}_{t-1} + \beta_{12} \text{CEOTENURE}_{t-1} \\
 & + \beta_{13} \text{TotalComp}_{t-1} + \text{Industry\&YearDummies} + \varepsilon
 \end{aligned} \quad (1)$$

where HFA is the dummy variable that equals one if the hedge fund acquires more than 5% of shares of the firms in year t , and zero otherwise. $Size$ is the natural logarithm of market capitalization, $TobinQ$ is Tobin's Q , $SALEGROWTH$ is the growth rate of sales over the previous year, ROA is operating income scaled by total asset, LEV is long-term debt scaled by total asset, $DIVIDEND$ is the dividend per share, $R\&D$ is research and development expense scaled by total asset, HHI is Herfindahl-Hirschman index of sales in different business segments, $ANALYSTS$ is the number of analysts following, $BHAR(-12, -1)$ is

⁷ Hedge fund intervention sample during the 2005–2011 period is first obtained by Alon Brav (76% of our full sample) and then augmented by our collection (24%) using all Schedule 13D and 13D/A filings. Consistent with other studies (e.g., Chen and Jung 2016), we report higher number of hedge fund activism during the 2005–2011 period but this is not because of multiple data sources in this specific period. We carefully exclude additional intervention events if they are overlapped with Brav's data.

⁸ As a robustness check, we constructed the propensity score matched control sample without the CEO compensation and characteristics variables ($CEOAGE$, $CEOTENURE$, $TotalComp$). This is to follow Cheng et al. (2012, 2015), Chen and Jung (2016) which examine the effect of hedge fund activism on tax, accounting conservatism, and voluntary disclosure. The benefit of the model without CEO compensation and characteristics is higher number of observations in the logistic regression ($N = 109,835$ vs. $N = 35,096$) and the higher number of treatment-control pairs ($N = 821$ vs. $N = 601$). Since the main interest of this paper is CEO compensation and CEO turnover, we include the CEO compensation and characteristics in the logistic regression at the cost of reduced number of sample pairs. The alternative logistic regression model does not change our main results.

Table 2
Propensity Score Matching.

Panel A. Logistic regression in which the dependent variable is an indicator of investment by activist hedge funds				
Dependent Variable:			Pred. Sign	HFA = 1
Size _{t-1}			-	-0.202*** (-4.15)
TobinQ _{t-1}			-	-0.380*** (-5.59)
SALEGROWTH _{t-1}			-	-0.028 (-0.68)
ROA _{t-1}			+	0.271 (0.55)
LEV _{t-1}			?	0.547** (2.19)
DIVIDEND _{t-1}			-	-0.320*** (-2.82)
R&D _{t-1}			?	1.175 (1.31)
HHI _{t-1}			-	0.075 (0.40)
ANALYSTS _{t-1}			+	-0.002 (-0.20)
BHAR (-12, -1)			+	-0.288*** (-3.19)
CEOAGE			?	0.006 (0.94)
TENURE			?	-0.016** (-2.44)
TotalComp			?	0.010 (0.16)
Constant				-3.803*** (-3.64)
Industry & Year FE				YES
N				34,633
Pseudo R2				0.089
Panel B: Covariate Balance	(1) Control (N=601)	(2) HFA (N=601)	(1)-(2)	P-value
Size _{t-1}	6.738	6.780	-0.043	(0.59)
TobinQ _{t-1}	1.568	1.567	0.001	(0.98)
SALEGROWTH _{t-1}	0.088	0.135	-0.046	(0.13)
ROA _{t-1}	0.100	0.107	-0.007	(0.26)
LEV _{t-1}	0.184	0.203	-0.018*	(0.08)
DIVIDEND _{t-1}	0.225	0.239	-0.014	(0.58)
R&D _{t-1}	0.028	0.032	-0.004	(0.24)
HHI _{t-1}	0.841	0.830	0.011	(0.46)
ANALYSTS _{t-1}	6.000	5.810	0.190	(0.60)
BHAR (-12, -1)	0.006	-0.022	0.028	(0.36)
CEOAGE _{t-1}	54.388	55.168	-0.780	(0.17)
CEOTENURE _{t-1}	5.744	5.837	-0.093	(0.81)
TotalComp _{t-1}	7.737	7.808	-0.071	(0.19)

Panel A presents the results of the Logistic regression of the incidence of hedge fund activism (HFA). T-statistics are reported in parentheses. Panel B presents the average values of variables at year $t - 1$ used in the logistic regression for the control and HFA groups. Differences in mean and p-value are reported in the right two columns. All variables are described in the Appendix. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

market-adjusted buy-and-hold abnormal return during the $(-12, -1)$ month period relative to the month of hedge fund investment on target firm, *CEOAGE* is the CEO age, *CEOTENURE* is the CEO tenure, and *TotalComp* is the natural logarithm of CEO total compensation. Definitions of all variables are also described in the Appendix.

Panel A of Table 2 presents the results of this logistic regression analysis. Consistent with prior literature, firms are more likely to be targeted by hedge fund activists when they are smaller (*Size*), poor market valuation (*TobinQ*), higher leverage (*LEV*), lower dividend pay (*DIVIDEND*), poor previous abnormal returns (*BHAR(-12, -1)*), and smaller CEO tenure (*CEOTENURE*). Next, for each firm in our sample with available data ($n = 601$), we match a non-target control firm ($n = 601$) with the closest propensity score in the same industry and year without replacement.⁹ We also require that the differences in size and CEO total compensation between an HFA firm and the matched control firm to be less than 20%. To assess the effectiveness of the matching procedure, we evaluate the covariate balance between the two samples. Panel B of Table 2 shows the mean values from each sample and tests for differences using a two-tailed *t*-test for means. Except that the difference in means for leverage (*LEV*) is significant at the 10% level, the two groups are fairly matched along with all other variables.

⁹ We use Fama and French (1997) 48-industry classification.

4. Empirical results

Panel A of Table 3 reports descriptive statistics of the main dependent variables used in the following sections. They are compensation variables (*TotalComp*, *Bonus*, *EquityComp*, *EquityRatio*), shareholder support (*SayOnPay*), and firm performance (*TobinQ*) during pre ($t - 3$, $t - 2$, $t - 1$) and post ($t + 1$, $t + 2$, $t + 3$) periods relative to hedge fund activism year (t), and CEO turnover (*CEOTO*) during the post (t , $t + 1$, $t + 2$) periods. Comparing the mean of variables between the hedge fund's target sample (HFA) and control, we find that the HFA group has higher CEO compensation and a higher likelihood of CEO turnover. The differences in mean are statistically significant at least at the 5% level. Although we report similarities in control variables at year $t - 1$ between HFA and control groups (covariate balance), they have different CEO compensation level and CEO compensation structure during the six years ($t - 3$, $t - 2$, $t - 1$, $t + 1$, $t + 2$, $t + 3$) surrounding the hedge fund activism event; and the likelihood of CEO turnover after the hedge fund activism. Therefore, to examine the effect of hedge fund activism on CEO turnover and CEO compensation, we need to control for the difference in those dimensions by using the difference-in-difference research design. Panel B of Table 3 presents pairwise correlations between variables used in the regression models.

4.1. Hedge fund activism and CEO turnover (H1)

Fig. 1 shows the trend of CEO turnover and different CEO compensation measures during the seven years surrounding HFA. To explore the effect of HFA on CEO turnover and compensation, we compare the patterns between the HFA sample and a control group. In Panel A, we find that the likelihood of CEO turnover for the HFA firms increases after hedge fund activism, while that for the control firms is generally decreasing over time. Thus, we further split the sample based on CEO turnover to examine whether HFA influences *new* and *incumbent* CEO's compensation in different manners.

Target companies' CEO compensation level (*TotalComp*) is generally higher than that of control firms as shown in Panel B. However, we do not observe remarkable increases in total compensation, salary, and equity compensation level after hedge fund activism for HFA sample relative to control sample (Panel B, C, E). In Panel D, we find that bonuses for *new* CEOs increase more dramatically for the HFA sample compared to the control group. Panel F shows an unstable pattern in the ratio of equity-based compensation for *new* CEOs in the HFA sample. Although CEO turnover appears to be an important variable to gain a complete picture of how HFA affects CEO compensation, simple trends shown in Fig. 1 should be interpreted with caution. Therefore, in the remaining part of the paper, we test our hypotheses using subsamples split based on CEO turnover in the multivariate regressions.

If hedge fund managers have different views with the current CEOs on the way of improving shareholder value, they may replace the CEOs. As observed in Panel A of Fig. 1, we first predict that the likelihood of CEO turnover is higher for the HFA sample compared to the control group. Panel A of Table 4 presents the frequency of CEO turnover in each subsample. The results are consistent with the prediction. During the first three fiscal years after the hedge fund's investment on target firms, 47.4% of target firms experience CEO turnover, while 38.6% of control firms have CEO turnover during the matched placebo years.¹⁰ In addition, the proportion of forced turnover (i.e., replaced CEO's age is less than 64) in HFA target firms is 83.9%, while that in control firms is 68.5%. In Panel B, we provide two-by-two tables to report the average value of the firm-year level CEO turnover variable (*CEOTO*, *CEOTO_Force*) in the pre- and post-HFA period for the HFA and the control firms. The difference-in-difference result shows that the mean *CEOTO* for the HFA sample is increased from 0.124 to 0.165 after hedge fund activism. We find that the difference (0.042) is statistically significant (p -value = 0.001) and that the change is significantly greater than the change in the control sample (diff-in-diff = 0.082). Similarly, the mean *CEOTO_Force* for HFA sample increases more significantly than that for the control sample (diff-in-diff = 0.030).

Next, we include the control variables and examine the effect of HFA on the CEO turnover in a multivariate framework. We run the following logistic regression model:

$$CEOTO_t = \alpha + \beta_1 HFA*PostHFA + \beta_2 PostHFA + \beta_3 HFA + Controls (RET_{t-1}, Size_{t-1}, ROA_{t-1}, LEV_{t-1}, MTB_{t-1}, CEOAGE_{t-1}, CEOTENURE_{t-1}, ANALYSTS_{t-1}, INSTOWN_{t-1}) + Industry\&YearDummies + \varepsilon \quad (2)$$

CEOTO_t is the dummy variable that equals one if the CEO is changed in year t . *PostHFA* is the dummy variable that equals 1 for the year t , $t + 1$, $t + 2$, and $t + 3$, and 0 for the year $t - 1$, $t - 2$, and $t - 3$ relative to hedge fund activism in year t .¹¹ Thus, the baseline period (captured in the intercept term) is the period of ($t - 3$, $t - 2$, $t - 1$). Definitions of all other variables are described in the Appendix. The coefficient β_1 on the interaction term *HFA*PostHFA* is our primary variable of interest because it captures whether the change of the likelihood of CEO turnover in target firms after HFA is different from that in control firms. In Panel C of Table 4, Column (1) presents the empirical results estimating the logistic regression model specified in Eq. (2). The coefficient on β_1 is positive and statistically significant at the 1% level, indicating that there is a higher likelihood of CEO turnover in the target firm during the three years after the hedge fund's investment, consistent with H1.

¹⁰ The "matched placebo year t " of a control firm is the year of hedge fund activism for the matched target firm.

¹¹ The year t is the matched placebo year for control firms. From the next section (Section 4.2), we exclude the year t in the definition of *Post* to clearly capture the period with hedge fund's influence. We do not exclude year t in this section assuming that hedge funds might affect the CEO turnover during a short period (e.g., a month) before their actual investment on the target firms. The exclusion of year t in this analysis does not alter the main finding.

Table 3
Descriptive Statistics.

Panel A: Mean differences of main variables between treatment and control group														
Variable	Control		HFA		Difference in Mean									
	N	(1) Mean	N	(2) Mean	(1) - (2)									
TotalComp	3177	7.634	3025	7.711	-0.078***									
Bonus	3217	5.152	3017	5.052	0.100									
EquityComp	3217	5.738	3019	5.774	-0.036									
EquityRatio	3207	0.401	2997	0.417	-0.015**									
SayOnPay	669	0.876	566	0.865	0.011									
CEOTO(t, t + 2)	3207	0.304	3026	0.368	-0.065***									
TobinQ	3404	1.637	3230	1.637	-0.000									
Panel B. Correlations														
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) TotalComp	1	0.50	0.69	0.61	-0.07	-0.15	0.09	0.65	0.20	0.19	0.08	0.01	0.02	-0.05
(2) Bonus		1	0.26	0.06	-0.13	-0.01	0.07	0.41	0.24	0.11	0.07	0.03	0.03	-0.02
(3) EquityComp			1	0.88	-0.08	-0.07	0.08	0.41	0.08	0.04	0.09	-0.03	-0.06	-0.09
(4) EquityRatio				1	-0.05	-0.05	0.14	0.34	0.04	0.02	0.11	-0.04	-0.12	-0.10
(5) CEOTO(t,t+2)					1	-0.02	-0.03	-0.06	-0.04	-0.02	-0.02	0.02	0.01	-0.19
(6) SayOnPay						1	0.08	0.08	0.05	-0.10	0.10	0.03	0.02	-0.03
(7) TobinQ							1	0.22	0.20	-0.05	0.53	0.00	-0.05	0.01
(8) Size								1	0.32	0.10	0.17	0.00	0.04	-0.03
(9) ROA									1	0.09	0.13	0.00	0.00	0.01
(10) LEV										1	0.04	0.00	0.03	0.00
(11) MTB											1	0.00	-0.04	-0.01
(12) RET												1	0.00	-0.01
(13) CEOAGE													1	0.40
(14) CEOTENURE														1

Panel A presents the number of observations and the average values of main test variables (CEO compensation, CEO turnover, Say-on-pay, and Tobin's Q) at years from $t-3$ to $t+3$ for the control and HFA groups. Differences in mean are reported in the rightmost columns. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively. Panel B presents Pearson correlations among the main test variables and control variables. Correlations in bold are significantly different from zero at the 5% level. All variables are described in the Appendix.

In addition, we investigate whether the target firm's poor performance mainly drives the relation between hedge fund activism and CEO turnover. After hedge funds' investment, they might affect the governance on target firm management (e.g., CEO) in order to maximize shareholder value. For a CEO with bad performance, the severest punishment is to force him/her to lose the job. To test this hypothesis, we examine the target firm's CEO turnover-for-performance surrounding the hedge fund's investment using the following logistic regression model:

$$\begin{aligned}
 CEOTO_t = & \alpha + \beta_1 HFA * PostHFA + \beta_2 HFA * RET_{t-1} * PostHFA + \beta_3 HFA * RET_{t-1} + \beta_4 RET_{t-1} * PostHFA + \beta_5 PostHFA \\
 & + \beta_6 HFA + Controls(RET_{t-1}, Size_{t-1}, ROA_{t-1}, LEV_{t-1}, MTB_{t-1}, CEOAGE_{t-1}, CEOTENURE_{t-1}, ANALYSTS_{t-1}, INSTOWN_{t-1}) \quad (3) \\
 & + Industry \& Year Dummies + \varepsilon
 \end{aligned}$$

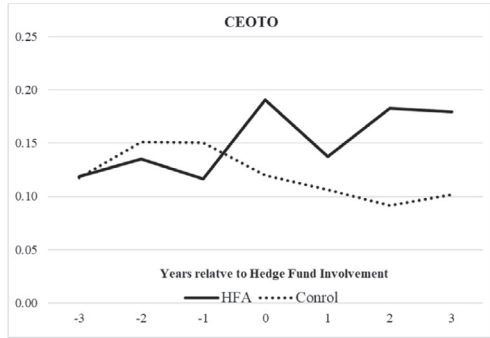
Similar to the model (2), β_1 captures the general effect of hedge fund activism on CEO turnover. In addition, to examine whether hedge fund activism increases the turnover-for-performance, we focus on the coefficient of the variable of interest, β_2 . However, as reported in Column (2), β_2 is not statistically significant, which does not support that hedge funds oust CEOs more for the reason of poor past firm performance than other companies. One explanation for this finding is that hedge fund activists might not be able to replace poorly performing CEOs due to the power of the incumbent CEO, consistent with the managerial power hypothesis (Bebchuk and Fried, 2004). For an empirical test of this possible explanation, we compare corporate governance features and performance of the 'replaced CEOs' and the 'staying CEOs' in the pre-HFA period (untabulated). We find that older, poor performing CEOs are more likely to be replaced after hedge fund activism. Board size and CEO-chair duality are not related to CEO turnover. These findings do not support the managerial power hypothesis; instead, these are more consistent with the efficient contracting theory.

Another alternative explanation is that hedge fund activists may replace the target firms' CEOs when they have different views with the CEOs regardless of the firm performance. In Columns (3) and (4), we report the regression results using the forced CEO turnover (*CEOTO_Force*) as the dependent variable. The main finding from this additional analysis is similar. Overall, we find that there are more frequent CEO turnovers, in general, after hedge fund activism; thus, we need to examine the effect of hedge fund activism on *new* and *incumbent* CEOs' compensation separately.

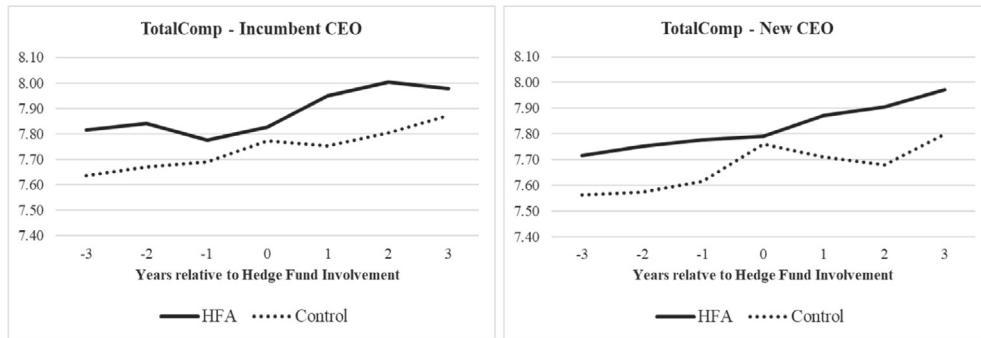
4.2. Hedge fund activism and CEO compensation level (H2)

To test whether investment by activist hedge funds affects target firms' CEO compensation controlling for other factors, we execute the difference-in-difference research design and run the following regression model on two types of subsamples: firms with CEO turnover and those without CEO turnover.

Panel A. CEO Turnover



Panel B. Total Compensation



Panel C. Salary

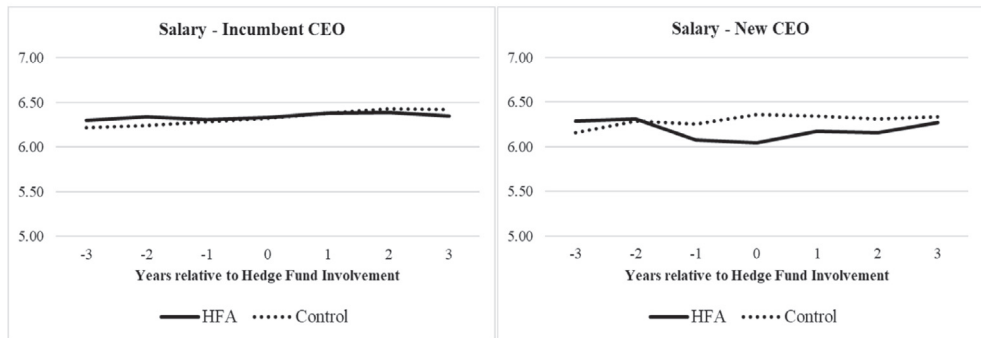


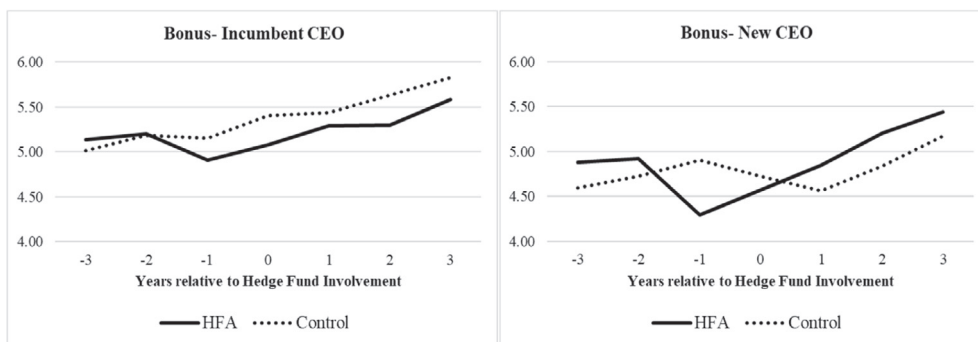
Fig. 1. CEO Compensation around Hedge Fund Activism. Presents the average CEO turnover and CEO compensation measures during the seven-year period surrounding the hedge fund activism. Each sub-sample (HFA, control) is further divided into “incumbent CEO” and “new CEO” based on the CEO turnover during (t, t + 2) relative to the hedge fund activism year t.

$$\begin{aligned}
 CEOPay_t = & \alpha + \beta_1 HFA * PostHFA \text{ (or PostCEOTO)} + \beta_2 PostHFA \text{ (or PostCEOTO)} \\
 & + \beta_3 HFA + Controls(Size_t, ROA_t, LEV_t, MTB_t, RET_t, CEOAGE_t, CEOTENURE_t) + Industry \& Year Dummies + \varepsilon
 \end{aligned}
 \tag{4}$$

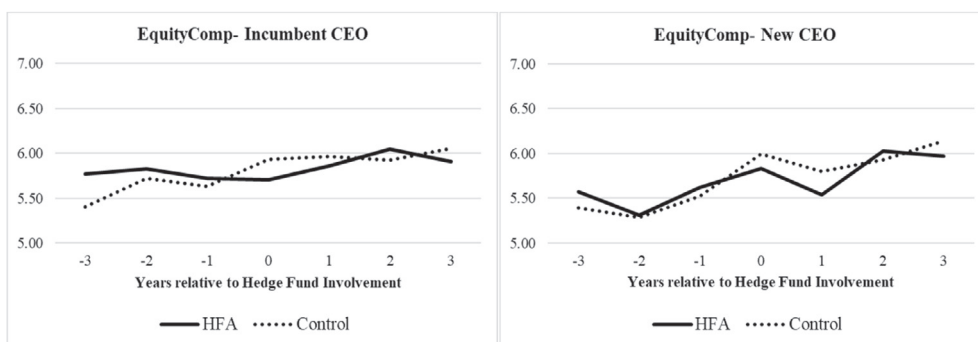
where the dependent variables are measures of CEO compensation level (*TotalComp*, *Bonus*, *EquityComp*) and structure (*EquityRatio*).¹² For the non-CEO turnover sample, *PostCEOTO* is the dummy variable that equals 1 for the year t + 1, t + 2, and t + 3 relative to hedge fund activism year t; while for the CEO turnover sample, *PostHFA* is the dummy variable that equals 1 for the year and after the CEO turnover. Note that we exclude the observations in year t to ensure that Post captures the period

¹² We exclude Salary for our main analysis because Fig. 1 shows that there is apparently no significant change (pre vs post) and differences (HFA vs control) in the average value of Salary.

Panel D. Bonus



Panel E. Equity Compensation



Panel F. Ratio of Equity-based Compensation to Total Compensation

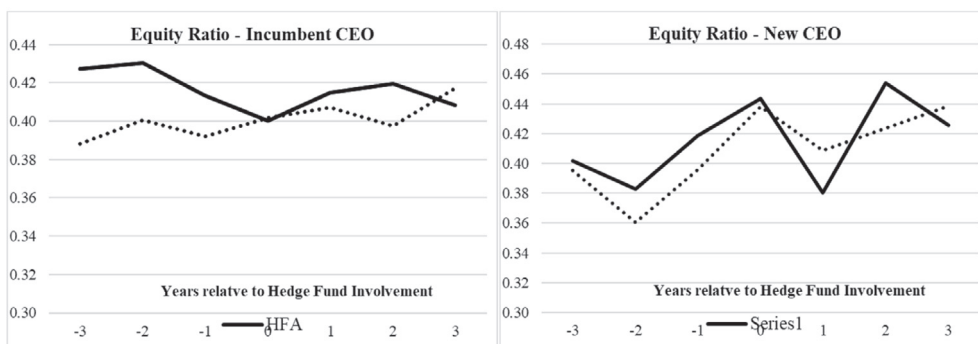


Fig. 1 (continued)

under the hedge fund's influence. The coefficient β_1 on the interaction term $HFA * PostHFA$ (or $PostCEOTO$) is the primary variable of interest because it captures whether the change in CEO pay of target firms after the event is different from the change in CEO pay of control firms.

In Panel A of Table 5, we first report the average of the CEO compensation variables in the pre- and post-HFA periods for the HFA and the control firms. The difference-in-difference results show that the increase in total compensation (*TotalComp*) for the HFA sample is not significantly different from that for the control sample. To provide a more intuitive comparison, we also calculate the average dollar value of compensation variables.¹³ For example, when new CEO is appointed ($CEOTO = 1$), the dollar value increase in average total compensation for HFA sample is \$346,920 (from \$3,894,235 to \$4,241,155), while that for control sample is \$341,765 (from \$3,443,463 to \$3,785,228). More importantly, we find that there is a higher increase in bonus (*Bonus*) after hedge fund activism compared to control firms when the new CEO is appointed (diff-in-diff = 0.440), which is statistically significant at the 5% level. The increase in new CEO's average bonus in HFA sample is \$119,463 (from \$718,872 to

¹³ For our main analysis, we use the natural logarithm of compensation variables (*TotalComp*, *Bonus*, *EquityComp*) to address the skewness issue.

Table 4
Hedge Fund Activism and CEO Turnover.

Panel A. CEO turnover after hedge fund activism for HFA and control sample					
HFA	N	%		N	%
CEO turnover	285	47.4	CEO turnover with replaced CEO Age < 63	239	83.9
			CEO turnover with replaced CEO Age ≥ 63	46	16.1
No CEO turnover	316	52.6			
Control	N	%		N	%
CEO turnover	232	38.6	CEO turnover with replaced CEO Age < 63	159	68.5
			CEO turnover with replaced CEO Age ≥ 63	73	31.5
No CEO turnover	369	61.4			
Panel B. Difference-in-difference – Univariate analysis					
Variable: CEOTO	(1) Pre	(2) PostHFA	Difference in Mean (2)-(1)		P-value
HFA	0.124	0.165	(3)	0.042	0.001
Control	0.141	0.100	(4)	-0.041	0.001
			Diff-in-Diff (3)-(4)	0.082	0.000
Variable: CEOTO_Force	(1) Pre	(2) PostHFA	Difference in Mean (2)-(1)		P-value
HFA	0.089	0.109	(3)	0.020	0.008
Control	0.085	0.074	(4)	-0.010	0.079
			Diff-in-Diff (3)-(4)	0.030	0.001
Panel C. Regression of CEO Turnover					
Dependent Variable:	CEO Turnover		Forced CEO Turnover		
	(1)	(2)	(3)	(4)	
HFA*PostHFA	0.587*** (2.63)	0.570** (2.53)	0.672* (1.87)	0.722** (1.97)	
HFA*RET _{t-1} *PostHFA		0.409 (1.20)		-0.730 (-1.41)	
HFA*RET _{t-1}		-0.333 (-1.15)		-0.063 (-0.17)	
RET _{t-1} *PostHFA		0.039 (0.19)		0.309 (1.15)	
PostHFA	-0.413** (-2.54)	-0.421** (-2.55)	-0.682** (-2.40)	-0.729** (-2.51)	
HFA	-0.231 (-1.44)	-0.226 (-1.39)	0.076 (0.31)	0.075 (0.30)	
RET _{t-1}	-0.021 (-0.57)	-0.098 (-0.84)	-0.170 (-1.25)	-0.137 (-0.73)	
Size _{t-1}	-0.085 (-1.37)	-0.083 (-1.33)	0.043 (0.44)	0.048 (0.49)	
ROA _{t-1}	-2.053*** (-3.47)	-2.033*** (-3.43)	-1.961** (-2.26)	-1.905** (-2.18)	
LEV _{t-1}	0.151 (0.42)	0.132 (0.37)	0.470 (0.87)	0.530 (0.98)	
MTB _{t-1}	0.009 (0.50)	0.011 (0.61)	0.019 (0.77)	0.020 (0.84)	
CEOAGE _{t-1}	-0.023*** (-2.63)	-0.023*** (-2.62)	-0.025* (-1.87)	-0.027** (-1.96)	
CEOTENURE _{t-1}	-0.490*** (-18.45)	-0.488*** (-18.36)	-0.314*** (-11.75)	-0.319*** (-11.79)	
ANALYSTS _{t-1}	-0.016 (-1.18)	-0.017 (-1.23)	-0.012 (-0.57)	-0.012 (-0.57)	
INSTOWN _{t-1}	0.932*** (2.73)	0.926*** (2.70)	0.241 (0.45)	0.287 (0.54)	
Constant	1.624* (1.87)	1.615* (1.85)	-0.813 (-0.71)	-0.762 (-0.67)	
Industry & Year FE	YES	YES	YES	YES	
N	4,091	4,091	3,955	3,955	
Pseudo R2	0.3003	0.3016	0.2115	0.2146	

Panel A presents the number of treatment and control sample firms with CEO turnover from year t to year $t + 2$ after hedge fund activism. Year t represents the hedge fund activism years for the HFA group and the matched placebo years for the control group. Panel B presents the results of the diff-in-diff t – test of the incidence of CEO turnover in year t using the sample period from year $t - 3$ to $t + 3$. Panel C presents the results of the logistic regression of the incidence of CEO turnover using the sample period from year $t - 3$ to $t + 3$. HFA is the dummy variable that equals one if the hedge fund acquires more than 5% of the shares of the firms in year t . PostHFA is the dummy variable that equals 1 for the year t , $t + 1$, $t + 2$, and $t + 3$, and 0 for the year $t - 1$, $t - 2$, and $t - 3$ relative to hedge fund activism in year t . All control variables are measured at one year prior to the CEO turnover. All variables are described in the Appendix. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively. T-statistics are reported in parentheses.

Table 5
Hedge Fund Activism and CEO Compensation.

Panel A. Difference-in-difference – Univariate analysis										
CEOTO = 0					CEOTO = 1					
Total Comp	(1) Pre	(2) PostHFA	Difference in Mean (2)-(1)	P-value	Total Comp	(1) Pre	(2) PostCEOTO	Difference in Mean (2)-(1)	P-value	
HFA	7.809	7.976	(3) 0.167	0.00	HFA	7.758	7.925	(3) 0.167	0.00	
Control	7.617	7.887	(4) 0.270	0.00	Control	7.590	7.682	(4) 0.092	0.05	
			Diff-in-Diff (3)-(4)	0.10				Diff-in-Diff (3)-(4)	0.075	0.28
Bonus	(1) Pre	(2) PostHFA	Difference in Mean (2)-(1)	P-value	Bonus	(1) Pre	(2) PostCEOTO	Difference in Mean (2)-(1)	P-value	
HFA	5.075	5.383	(3) 0.308	0.03	HFA	4.662	5.145	(3) 0.483	0.00	
Control	5.120	5.625	(4) 0.505	0.00	Control	4.747	4.790	(4) 0.043	0.78	
			Diff-in-Diff (3)-(4)	0.26				Diff-in-Diff (3)-(4)	0.440	0.04
EquityComp	(1) Pre	(2) PostHFA	Difference in Mean (2)-(1)	P-value	EquityComp	(1) Pre	(2) PostCEOTO	Difference in Mean (2)-(1)	P-value	
HFA	5.772	5.936	(3) 0.164	0.31	HFA	5.556	5.868	(3) 0.312	0.07	
Control	5.593	5.980	(4) 0.387	0.00	Control	5.406	5.877	(4) 0.471	0.00	
			Diff-in-Diff (3)-(4)	0.28				Diff-in-Diff (3)-(4)	-0.159	0.50
EquityRatio	(1) Pre	(2) PostHFA	Difference in Mean (2)-(1)	P-value	EquityRatio	(1) Pre	(2) PostCEOTO	Difference in Mean (2)-(1)	P-value	
HFA	0.424	0.414	(3) -0.010	0.53	HFA	0.404	0.425	(3) 0.021	0.16	
Control	0.394	0.407	(4) 0.013	0.27	Control	0.384	0.420	(4) 0.036	0.01	
			Diff-in-Diff (3)-(4)	0.23				Diff-in-Diff (3)-(4)	-0.015	0.45

Panel B. Regression of CEO compensation												
Dependent Variable:	CEOTO = 0				CEOTO = 1				CEOTO_Forced = 1			
	TotalComp	Bonus	EquityComp	EquityRatio	TotalComp	Bonus	EquityComp	EquityRatio	TotalComp	Bonus	EquityComp	EquityRatio
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
HFA*PostHFA	-0.001	-0.033	0.011	-0.004								
	(-0.02)	(-0.21)	(0.07)	(-0.23)								
PostHFA	0.013	0.231	-0.139	-0.024***								
	(0.48)	(1.55)	(-1.43)	(-3.05)								
HFA*PostCEOTO					0.142***	0.510**	-0.120	-0.010	0.131*	0.162	0.126	0.011
					(2.66)	(2.53)	(-0.54)	(-0.46)	(1.73)	(0.92)	(0.35)	(0.42)
PostCEOTO					-0.038	-0.157	0.157	0.004	0.016	0.247*	0.022	-0.008
					(-0.92)	(-1.02)	(0.92)	(0.24)	(0.35)	(1.73)	(0.11)	(-0.50)
HFA	0.030	-0.162	0.105	0.028**	0.039	-0.075	-0.085	-0.009	0.140**	0.113	0.175	0.021
	(1.29)	(-1.51)	(0.86)	(2.51)	(1.00)	(-0.52)	(-0.53)	(-0.61)	(2.74)	(0.73)	(0.77)	(1.07)
Size	0.461***	0.632***	0.901***	0.076***	0.439***	0.717***	0.912***	0.069***	0.471***	0.718***	0.946***	0.080***
	(44.21)	(19.84)	(32.79)	(28.84)	(41.92)	(18.31)	(21.03)	(17.37)	(30.52)	(14.80)	(21.91)	(19.88)
ROA	-0.219*	3.495***	-1.925***	-0.252***	-0.538***	3.246***	-0.504	-0.094*	-0.495***	2.776***	-2.247***	-0.226***
	(-1.78)	(6.63)	(-3.60)	(-4.85)	(-4.04)	(6.51)	(-0.91)	(-1.86)	(-3.32)	(5.38)	(-3.56)	(-4.55)
LEV	0.768***	0.912***	0.532	0.054**	0.381***	0.271	0.013	0.013	0.376***	0.678**	0.484	0.010
	(9.91)	(3.44)	(1.69)	(2.18)	(4.45)	(0.83)	(0.71)	(0.41)	(5.29)	(2.52)	(1.22)	(0.31)
MTB	-0.007	-0.067***	0.017	0.006***	-0.016***	0.009	-0.038**	-0.002	-0.007	-0.054**	-0.012	0.002
	(-1.42)	(-5.32)	(1.25)	(3.97)	(-3.73)	(0.54)	(-2.21)	(-1.35)	(-0.78)	(-2.25)	(-0.40)	(0.74)
RET	-0.000	0.168**	-0.118	-0.015**	0.007	0.096***	-0.005	-0.003	0.005	0.208***	-0.043	-0.006
	(-0.03)	(2.50)	(-1.63)	(-2.28)	(1.10)	(3.44)	(-0.16)	(-0.97)	(0.29)	(3.85)	(-0.47)	(-0.70)
CEOAGE	0.001	0.018***	-0.032***	-0.005***	-0.001	-0.013*	-0.021**	-0.003***	-0.005	-0.017**	-0.020	-0.003***
	(0.27)	(3.26)	(-3.91)	(-6.25)	(-0.71)	(-1.77)	(-2.57)	(-4.05)	(-1.51)	(-2.17)	(-1.64)	(-3.78)

(continued on next page)

Table 5 (continued)

Panel B. Regression of CEO compensation												
Dependent Variable:	CEOTO = 0				CEOTO = 1				CEOTO_Forced = 1			
	TotalComp	Bonus	EquityComp	EquityRatio	TotalComp	Bonus	EquityComp	EquityRatio	TotalComp	Bonus	EquityComp	EquityRatio
CEOTENURE	-0.001 (-0.35)	-0.016** (-2.81)	-0.025*** (-3.38)	-0.001* (-1.97)	-0.002 (-0.88)	0.000 (0.01)	-0.021* (-1.84)	-0.003*** (-3.04)	0.004 (1.36)	0.014* (1.83)	-0.013 (-1.20)	-0.002** (-2.66)
Constant	4.643*** (32.55)	0.262 (0.71)	1.903*** (3.80)	0.182*** (3.80)	4.342*** (23.26)	-0.490 (-0.72)	-0.156 (-0.21)	0.045 (0.64)	4.755*** (21.02)	0.628 (1.22)	0.411 (0.58)	0.089 (1.48)
F-Test												
Coef on HFA*Post + Post	0.012	0.198	-0.128	-0.028	0.104	0.353	0.037	-0.006	0.147	0.409	0.148	0.003
F-test p-val	0.763	0.219	0.357	0.070	0.010	0.020	0.827	0.709	0.011	0.020	0.512	0.889
Industry & Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	3,262	3,277	3,277	3,262	2,627	2,528	2,528	2,518	1,901	1,869	1,869	1,858
Adj R2	0.555	0.241	0.242	0.252	0.490	0.232	0.217	0.185	0.548	0.269	0.230	0.244

Panel A presents the results of the diff-in-diff *t*-test of the CEO compensation variables (TotalComp, Bonus, EquityComp, EquityRatio) using the sample period from year $t - 3$ to $t + 3$, excluding year t . Panel B presents the results of OLS regression. Columns (1), (2), (3), (4) report the results using the HFA and control groups without CEO turnover from year t to year $t + 2$, Columns (5), (6), (7), (8) report the results using the HFA and control groups with CEO turnover from year t to year $t + 2$, and Columns (9), (10), (11), (12) report the results using the HFA and control groups with forced CEO turnover (with CEO age less than 64) from year t to year $t + 2$. HFA is the dummy variable that equals one if the hedge fund acquires more than 5% of the shares of the firms in year t . For the non-CEO turnover sample (Columns (1)-(4)), PostHFA is the dummy variable that equals 1 for the year $t + 1$, $t + 2$, and $t + 3$ relative to hedge fund activism year t . For the CEO turnover sample (Columns (5)-(12)), PostCEOTO is the dummy variable that equals 1 for the year and after the CEO turnover. All other variables are described in the Appendix. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively. T-statistics are reported in parentheses. F-test p-values in bold are significantly different from zero at the 10% level.

\$838,366), while there is \$14,257 decrease in control sample (from \$764,449 to \$750,192). We do not find any significant results in univariate diff-in-diff analyses of other variables (*EquityComp*, *EquityRatio*).

Panel B presents the empirical results estimating the regression model specified in Eq. (4) with the CEO compensation level (*TotalComp*, *Bonus*, *EquityComp*) and compensation structure (*EquityRatio*) as the dependent variable. To gain a complete picture of the effect of hedge fund activism on CEO compensation, we perform the subsample analysis. The first subsample consists of HFA and control firms without CEO turnover. The purpose of this step of analysis is to compare the target firm's *incumbent* CEO's compensation change after the hedge fund activism with the control firm's *incumbent* CEO's compensation change after the matched placebo year. If hedge fund activism affects the target firm's CEO pay, the change in CEO compensation for the target firms should be significantly different from the change in CEO compensation for the control firms. We report the results using the subsample of *incumbent* CEOs in Columns (1)–(4). For the *incumbent* CEOs, we do not find any significant coefficient on the interaction term $HFA * PostHFA$, indicating that there is no change in CEO compensation of the target firm's *incumbent* CEO after HFA compared to the change in control firm's *incumbent* CEO's pay.

The second subsample consists of HFA and control firms with CEO turnover after the hedge fund activism. We compare the changes in compensation from old to *new* CEOs appointed after the hedge fund activism with the changes in compensation from old to *new* CEOs of the control firms appointed after the matched placebo years. While CEO turnover, in general, is driven by broader reasons, a hedge fund may focus on the improvement of corporate governance and performance by removing poor-performing CEOs. In this scenario, we predict that the degree of change in compensation for the target firms' *new* CEO might be more substantial compared to the change in compensation for the control firms' *new* CEO. We document more significant increases in target firm CEO's total compensation when a *new* CEO is hired compared to a similar case in control firms. Column (5) reports a positive coefficient on $HFA * PostCEOTO$, and it is statistically significant at the 1% level. The coefficient in the regression of bonus (Column (6)) is also positive and statistically significant, while the coefficient β_1 in the regression of equity compensation (Column (7)) is not significant. Overall, we find evidence that hedge fund activism leads to increases in the CEO compensation level (total compensation and bonus), especially in the target firms with *new* CEOs compared to the matched control firms. This finding is consistent with H1b predicting that target firms experiencing CEO turnover set higher CEO compensation following hedge fund activism compared to the control group. Next, we report the regression results using *EquityRatio* as the dependent variable. Considering that activist's concern over CEO pay is a multi-fold issue - including pay level, pay structure and pay for performance, we do not have a precise directional prediction on the change in the ratio of equity compensation to total compensation. For the *new* CEO, in Column (8), we report that the coefficient on $HFA * PostCEOTO$ is not significant.

In our sample, on average, the *new* CEO's compensation structure becomes more 'cash-based' after hedge fund activism. This suggests that newly hired CEOs demand more cash-based compensation as the value of equity compensation is more uncertain in the targeted firms. Boards of directors influenced by hedge fund activists seem to be willing to meet the demands of CEOs. At the same time, the boards can include key performance indicators they care about in bonus plans to hold CEOs accountable for performance improvement.

From Columns (9) to (12), we further report the regression results using the third subsample of HFA and control firms with forced CEO turnover (i.e., replaced CEO's age is less than 64) after the hedge fund activism. We document that in Column (9), the estimated β_1 is positive and statistically significant at the 10% level. Similar to the results using the second subsample (CEO turnover in general), there is an increase in the new CEO's total compensation. This indicates that the forced CEO turnover, relative to the retirement or voluntary leave, is more related to the hedge fund's strategic purpose of influencing the target firm's governance (Jenter and Kanaan, 2015).

Our main conclusions are based on the difference-in-difference research design. For example, the coefficient on $HFA * PostHFA$ (or $PostCEOTO$) captures whether any change in a dependent variable after hedge fund activism year t for HFA sample is different from the change after the placebo year t for the control sample. To examine whether there is any significant change (increase/decrease) after hedge fund activism year t focusing only on the HFA sample, we also report the F-tests for testing the significance of the sum of the coefficients on $HFA * Post$ and $Post$.¹⁴ In Column (5), (6), (9), (10) of Table 5, the F-test p-values on the sum of the coefficients are between 0.010 and 0.020, indicating that there are significant increases in the new CEO's total compensation and bonus after HFA. In other words, a new CEO in HFA firms receive 11% ($=e^{0.104}-1$) higher total compensation and 42% ($=e^{0.353}-1$) higher bonus compared to the old CEO. In a forced CEO turnover case, a new CEO receives 16% ($=e^{0.147}-1$) higher total compensation and 51% ($=e^{0.409}-1$) higher bonus compared to the old CEO.

4.3. Hedge fund activism and contemporaneous pay-performance relationship (H3)

In this section, we investigate whether hedge fund activism affects the contemporaneous relationship between CEO compensation and the target firm's performance. We test the association between firm performance and two performance-based compensations: bonuses and equity compensation. Equity compensation accounts for about 60% of CEO pay (Murphy, 2013). Bonuses are smaller in size but still economically significant. Murphy (2013) argues that the incentive effects of bonus plans might be stronger than equity compensation because the link between executives' actions and the performance metrics in bonus plans is more direct than the link between actions and stock price changes. For example, an executive might under-

¹⁴ $Post$ is $PostHFA$ for the non-CEO turnover sample, and $PostCEOTO$ for the CEO turnover sample.

stand how the development of a new product affects revenue and earnings, but might be less certain about the new product's effect on the stock price. In the previous section, we document that the increase in CEO compensation after HFA is mostly due to the CEO bonus growth, indicating that activist hedge funds probably consider that more performance-based annual bonuses provide sufficient incentives for performance improvement in the targeted companies.

Following prior research (e.g., Core et al., 1999; Albuquerque et al., 2019), we regress both bonus and equity compensation on contemporaneous annual operating performance and stock return. To test the effect of hedge fund activism on the pay-for-performance sensitivity, we include the interaction terms between the performance and time dummies ($ROA*Post$, $RET*Post$). To simplify our model, we run separate regressions for four sub-groups ($CEOTO = 0$ & HFA, $CEOTO = 0$ & Control, $CEOTO = 1$ & HFA, $CEOTO = 1$ & Control) and perform Chi-square tests to compare the coefficients. We keep the periods of pre ($t - 3, t - 2, t - 1$) and post ($t + 1, t + 2, t + 3$) hedge fund activism year (t) and compare whether there is any change following the activism event. Specifically, we run the following regression model:

$$\begin{aligned} \text{Bonus (or EquityComp)} = & \alpha + \beta_1 \text{ROA*PostHFA (or PostCEOTO)} + \beta_2 \text{RET*PostHFA (or PostCEOTO)} \\ & + \beta_3 \text{PostHFA(orPostCEOTO)} + \beta_4 \text{ROA} + \beta_5 \text{RET} + \text{Controls(Size, LEV, MTB, CEOAGE, CEOTENURE)} \\ & + \text{Industry\&YearDummies} + \varepsilon \end{aligned} \quad (5)$$

The coefficients β_1 and β_2 capture the effect of hedge fund activism on the relationship between compensation (bonus, equity compensation) and performance (ROA and RET). If the pay-performance link is increased in target firms following hedge fund activism compared to the case in control firms, then we predict β_1 and/or β_2 to be positive.

Columns (1)-(4) of Table 6 presents the empirical results estimating the regression model specified in equation (5) using *Bonus* as the dependent variable. As reported in Column (1), when there is no CEO change (*incumbent* CEO) in the HFA sample, the coefficients on the interaction terms, β_1 and β_2 , are not significant. In contrast, Column (2) reports a positive and significant coefficient β_2 in the regression using the control sample. The difference in the coefficient β_2 between Column (1) and (2) is also statistically significant ($\chi^2 = 2.97$, p -value = 0.085). It indicates that it is not HFA firms but control firms that experience an increase in the relation between bonus and annual return when there is no CEO turnover. One explanation for this finding is the managerial power hypothesis. That is, in some HFA targeted firms, the CEO is so powerful that HFA might not be able to change CEO compensation. When we combine the powerful CEOs with non-powerful ones, we cannot find significant differences in the pay-performance relationship for all incumbent CEOs.

On the other hand, when a new CEO is appointed, there is a significant increase in the relationship between bonus and firm ROA , as reported in Column (3). The β_1 is positive and statistically significant at the 1% level, and this is significantly higher than the β_1 in Column (4) ($\chi^2 = 5.93$, p -value = 0.015). It indicates that the relation between the new CEO's bonus and ROA is improved following hedge fund activism compared to the case in the control firms. In other words, the improvement in the pay-performance relationship is concentrated on target firms where a new CEO is hired. Comparing the coefficients β_2 reported in Columns (3) and (4), we find that the relationship between bonus and the annual return is more decreased in the HFA sample compared to the case in the control group. Overall, the results support our hypothesis H2b, predicting a stronger relationship between the target firm's new CEO's compensation (*Bonus*) and operating performance (ROA) after the hedge fund activism. Combining with the earlier finding that hedge fund activism is associated with the new CEOs' higher bonuses, we can conclude that hedge fund activists first enhance cash incentives to CEOs for performance improvement and then compensate them with higher bonuses when the CEOs achieve performance improvement.

In Columns (5)-(8), we also examine the relationship between CEO's equity compensation and performance (ROA and RET). We find a weak relationship between CEO equity compensation and current year's ROA and RET , consistent with prior literature summarized in Balsam (2007). Our interpretation is that equity compensation mainly serves to motivate executives to perform better in the future and thus has a weak relationship with current performance. Furthermore, there is no significant effect of hedge fund activism on the relationship between the new CEO's equity compensation and performance. This is consistent with our earlier finding that activist hedge funds do not change equity compensation arrangements for both new and incumbent CEOs.

5. Additional analysis

5.1. Hedge fund activism, CEO turnover and firm value

Next, we investigate the moderating effect of CEO turnover on the relationship between hedge fund's investment and target firm value. This is essentially to test whether the stock performance of target firms experiencing CEO turnover is improved after the appointment of the new CEO.¹⁵ We run the following regression using the CEO turnover subsample:

$$\begin{aligned} \text{TobinQ (or 3-year CAR)} = & \alpha + \beta_1 \text{HFA*PostHFA (or PostCEOTO)} + \beta_2 \text{HFA} + \beta_3 \text{PostHFA (or PostCEOTO)} \\ & + \text{Controls(Size, ROA, LEV, SALEGROWTH, DIVIDEND, CashFlow, CAPEX, R\&D, MTB)} + \text{Industry\&YearDummies} + \varepsilon \end{aligned} \quad (6)$$

¹⁵ We also test whether hedge fund's investment improves operating performance. When we use ROA as the dependent variable, we find the increase in ROA for HFA sample with CEO turnover is higher than that for control sample with CEO turnover but the result is not statistically significant.

Table 6
Hedge Fund Activism and CEO Pay-Performance Relationship.

Dependent Variable:	Bonus						Equity					
	CEOTO = 0			CEOTO = 1			CEOTO = 0			CEOTO = 1		
	HFA	Control	Chi-square Test	HFA	Control	Chi-square Test	HFA	Control	Chi-square Test	HFA	Control	Chi-square Test
	(1)	(2)	p-value	(3)	(4)	p-value	(5)	(6)	p-value	(7)	(8)	p-value
ROA*PostHFA	-0.602 (-0.51)	-1.479 (-1.62)	$\chi^2 = 0.30$ p-val = 0.586				-0.933 (-0.70)	-2.995*** (-2.72)	$\chi^2 = 1.29$ p-val = 0.257			
RET*PostHFA	-0.217 (-1.55)	0.159* (1.72)	$\chi^2 = 2.97$ p-val = 0.085				0.024 (0.15)	-0.077 (-0.69)	$\chi^2 = 0.23$ p-val = 0.634			
PostHFA	0.350* (1.75)	0.312** (2.07)					-0.253 (-1.13)	0.343* (1.88)				
ROA*PostCEOTO				3.846*** (2.90)	-1.081 (-0.83)	$\chi^2 = 5.93$ p-val = 0.015				2.374 (1.54)	-0.507 (-0.36)	$\chi^2 = 2.03$ p-val = 0.155
RET*PostCEOTO				-1.053*** (-5.41)	-0.234* (-1.88)	$\chi^2 = 10.15$ p-val = 0.001				-0.020 (-0.09)	0.020 (0.15)	$\chi^2 = 0.03$ p-val = 0.856
PostCEOTO				0.112 (0.53)	0.107 (0.48)					-0.060 (-0.24)	0.214 (0.89)	
ROA	5.248*** (5.80)	3.398*** (4.74)		1.619 (1.60)	3.852*** (3.82)		-0.585 (-0.58)	-0.939 (-1.08)		-2.341** (-1.98)	0.960 (0.89)	
RET	0.409*** (3.37)	0.079 (1.37)		1.141*** (5.92)	0.193* (1.78)		-0.170 (-1.25)	-0.044 (-0.63)		0.014 (0.06)	-0.037 (-0.32)	
Size	0.616*** (12.59)	0.647*** (15.94)		0.636*** (12.71)	0.738*** (12.63)		0.967*** (17.61)	0.779*** (15.84)		0.898*** (15.36)	0.810*** (12.94)	
LEV	1.165*** (3.79)	1.679*** (6.07)		0.425 (1.10)	0.418 (0.83)		0.316 (0.92)	0.172 (0.51)		0.307 (0.68)	-1.779*** (-3.29)	
MTB	-0.070*** (-3.58)	-0.061*** (-3.04)		-0.007 (-0.39)	0.018 (0.70)		0.045** (2.04)	0.010 (0.42)		-0.020 (-0.90)	0.020 (0.76)	
CEOAGE	0.005 (0.44)	0.023*** (2.88)		-0.011 (-1.10)	0.001 (0.10)		-0.036*** (-3.09)	-0.023** (-2.39)		-0.000 (-0.00)	-0.047*** (-3.87)	
CEOTENURE	-0.027*** (-2.82)	-0.002 (-0.21)		0.016 (1.17)	-0.018 (-1.04)		-0.012 (-1.06)	-0.034*** (-3.30)		-0.049*** (-2.99)	0.013 (0.70)	
Constant	0.309 (0.35)	-1.576** (-2.31)		-0.772 (-0.83)	-1.223 (-1.19)		0.546 (0.55)	1.175 (1.42)		-0.574 (-0.53)	1.476 (1.34)	
Industry & Year FE	YES	YES		YES	YES		YES	YES		YES	YES	
N	1,437	1,847		1,316	1,090		1,437	1,847		1,316	1,090	
Adj R2	0.209	0.230		0.221	0.195		0.262	0.164		0.181	0.187	

This table presents the results of the OLS regression of the CEO performance-based compensation variables (*Bonus and EquityComp*) using the sample period from year $t - 3$ to $t + 3$, excluding year t . Columns (1), (2), (5), (6) report the results using the HFA and control groups without CEO turnover from year t to year $t + 2$. Columns (3), (4), (7), (8) report the results using the HFA and control groups with CEO turnover from year t to year $t + 2$. HFA is the dummy variable that equals one if the hedge fund acquires more than 5% of the shares of the firms in year t . For the non-CEO turnover sample, PostHFA is the dummy variable that equals 1 for the year $t + 1$, $t + 2$, and $t + 3$ relative to hedge fund activism year t . For the CEO turnover sample, PostCEOTO is the dummy variable that equals 1 for the year and after the CEO turnover. All other variables are described in the Appendix. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively. T-statistics are reported in parentheses. Chi-square (χ^2) test is used to test the null hypothesis that the coefficients in regressions on HFA and control samples are the same. P-values in bold indicates that they are significantly different from zero at the 10% level.

Table 7

Hedge fund activism, CEO turnover and firm value.

Panel A. Panel A. Difference-in-difference – Univariate analysis									
CEOTO = 0					CEOTO = 1				
TobinQ	(1) Pre	(2) PostHFA	Difference in Mean (2)-(1)	P-value	TobinQ	(1) Pre	(2) PostCEOTO	Difference in Mean (2)-(1)	P-value
HFA	1.681	1.643	(3) -0.038	0.44	HFA	1.648	1.703	(3) 0.055	0.28
Control	1.716	1.639	(4) -0.077	0.21	Control	1.603	1.591	(4) -0.012	0.83
		Diff-in-Diff (3)-(4)	0.039	0.64			Diff-in-Diff (3)-(4)	0.067	0.36
CEOTO = 0					CEOTO = 1				
3-year CAR	(1) Pre	(2) PostHFA	Difference in Mean (2)-(1)	P-value	3-year CAR	(1) Pre	(2) PostCEOTO	Difference in Mean (2)-(1)	P-value
HFA	0.080	0.271	(3) 0.191	0.00	HFA	-0.063	0.254	(3) 0.317	0.00
Control	0.204	0.272	(4) 0.068	0.17	Control	0.084	0.300	(4) 0.216	0.00
		Diff-in-Diff (3)-(4)	0.123	0.11			Diff-in-Diff (3)-(4)	0.101	0.31

Panel B. Regression of Tobin's Q						
Dependent Variable:	TobinQ			3-year CAR		
	CEOTO=0	CEOTO=1	CEOTO_Forced=1	CEOTO=0	CEOTO=1	CEOTO_Forced=1
	(1)	(2)	(3)	(4)	(5)	(6)
HFA*PostHFA	0.022 (0.36)			0.074 (0.97)		
PostHFA	-0.002 (-0.05)			0.028 (0.47)		
HFA*PostCEOTO		0.151*** (2.67)	0.224** (2.53)		0.169* (1.74)	0.197* (1.83)
PostCEOTO		0.055 (1.28)	-0.079 (-1.10)		0.106 (1.35)	0.095 (1.05)
HFA	-0.085** (-2.07)	-0.068* (-1.68)	-0.271*** (-4.28)	-0.092* (-1.90)	-0.157** (-2.50)	-0.200*** (-2.85)
Size	0.096*** (7.68)	0.067*** (6.17)	0.088*** (5.16)	-0.113*** (-7.54)	-0.105*** (-6.11)	-0.089*** (-4.84)
ROA	0.833*** (4.25)	2.071*** (10.12)	0.803*** (2.89)	-0.663** (-2.36)	-0.451 (-1.32)	0.057 (0.15)
LEV	-0.417*** (-4.70)	-0.445*** (-4.89)	-0.707*** (-5.26)	0.524*** (5.33)	0.221 (1.61)	0.415*** (2.98)
SALEGROWTH	0.147*** (3.38)	0.171*** (3.99)	0.410*** (5.82)	0.002 (0.04)	-0.102 (-1.57)	-0.158** (-2.23)
DIVIDEND	-0.103*** (-2.68)	-0.045 (-1.26)	-0.039 (-0.75)	0.051 (1.17)	-0.026 (-0.48)	-0.021 (-0.37)
CashFlow	1.103*** (4.37)	0.319 (1.50)	0.938*** (2.70)	0.526 (1.56)	1.027*** (2.92)	0.116 (0.27)
CAPEX	1.543*** (4.32)	1.671*** (4.95)	1.899*** (3.49)	-0.416 (-1.18)	-0.351 (-0.70)	-0.707 (-1.27)
R&D	3.624*** (9.62)	4.408*** (15.47)	3.053*** (6.44)	0.629* (1.69)	0.327 (0.87)	1.042** (2.37)
MTB	0.200*** (38.01)	0.107*** (23.85)	0.200*** (24.87)	0.001 (0.09)	-0.013** (-2.06)	-0.011 (-1.35)
Constant	0.359** (2.10)	0.746*** (4.62)	0.640** (2.43)	0.895*** (8.73)	0.095 (1.42)	0.723*** (5.43)
Industry & Year FE	YES	YES	YES	YES	YES	YES
N	3,614	3,060	2,142	1,872	1,669	1,173
Adj R2	0.500	0.456	0.429	0.129	0.104	0.158

Panel A presents the results of the diff-in-diff *t*-test of Tobin's Q using the sample period from year $t - 3$ to $t + 3$, excluding year t . Panel B presents the results of the OLS regression of Tobin's Q using the sample period from year $t - 3$ to $t + 3$, excluding year t . Columns (1) and (4) report the results using the HFA and control groups without CEO turnover from year t to year $t + 2$, Columns (2), (3), (5), and (6) report the results using the HFA and control groups with CEO turnover and Forced CEO turnover from year t to year $t + 2$. HFA is the dummy variable that equals one if the hedge fund acquires more than 5% of the shares of the firms in year t . For the non-CEO turnover sample, PostHFA is the dummy variable that equals 1 for the year $t + 1$, $t + 2$, and $t + 3$ relative to hedge fund activism year t . For the CEO turnover sample, PostCEOTO is the dummy variable that equals 1 for the year and after the CEO turnover. All variables are described in the Appendix. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively. T-statistics are reported in parentheses.

In Panel A of Table 7, we report the average Tobin's Q and the 3-year cumulative abnormal return in the pre- and the post-HFA periods for the HFA and the control groups. The difference-in-difference results show that the increases in Tobin's Q or 3-year CAR for the HFA sample are neither significantly different from that for the control sample. However, there is only one case that shows an increase, although it is not statistically significant, in Tobin's Q, which is for the HFA sample when a new CEO is hired (from 1.648 to 1.703).

Table 8
Hedge Fund Activism and CEO Incentives.

Panel A. Difference-in-difference – Univariate analysis									
CEOTO = 0					CEOTO = 1				
Delta	(1) Pre	(2) PostHFA	Difference in Mean (2)-(1)	P-value	Delta	(1) Pre	(2) PostCEOTO	Difference in Mean (2)-(1)	P-value
HFA	5.075	5.083	(3) 0.008	0.92	HFA	4.815	4.171	(3) -0.644	0.00
Control	4.777	5.007	(4) 0.230	0.00	Control	4.869	4.434	(4) -0.435	0.00
		Diff-in-Diff (3)-(4)	-0.222	0.03			Diff-in-Diff (3)-(4)	-0.209	0.06
Vega	(1) Pre	(2) PostHFA	Difference in Mean (2)-(1)	P-value	Vega	(1) Pre	(2) PostCEOTO	Difference in Mean (2)-(1)	P-value
HFA	3.794	3.711	(3) -0.083	0.37	HFA	3.778	3.326	(3) -0.452	0.00
Control	3.287	3.267	(4) -0.020	0.88	Control	3.417	3.319	(4) -0.098	0.39
		Diff-in-Diff (3)-(4)	-0.063	0.71			Diff-in-Diff (3)-(4)	-0.354	0.02

Panel B. Regression of CEO Incentives						
Dependent Variable:	CEOTO=0		CEOTO=1		CEOTO_Forced=1	
	Delta	Vega	Delta	Vega	Delta	Vega
	(1)	(2)	(3)	(4)	(5)	(6)
HFA*Post_HFA	-0.059 (-0.85)	0.110 (0.74)				
Post_HFA	0.008 (0.21)	-0.101 (-0.67)				
HFA*Post_CEOTO			-0.079 (-1.07)	-0.169 (-1.35)	-0.065 (-0.72)	0.151 (0.67)
Post_CEOTO			-0.050 (-0.90)	0.102 (1.08)	0.082 (1.16)	-0.132 (-0.61)
HFA	0.005 (0.13)	0.309*** (4.20)	-0.036 (-0.68)	0.237*** (2.69)	-0.005 (-0.09)	0.237*** (3.89)
Size	0.725*** (50.60)	0.774*** (14.05)	0.697*** (48.30)	0.792*** (32.69)	0.705*** (40.90)	0.870*** (19.51)
ROA	0.764*** (4.40)	-0.660 (-1.50)	0.487*** (2.65)	0.059 (0.19)	0.447** (2.28)	-0.675 (-1.60)
LEV	0.038 (0.62)	-0.024 (-0.08)	-0.213* (-1.78)	-0.250 (-1.24)	-0.363** (-2.64)	-0.492** (-2.79)
MTB	0.012 (1.49)	0.012 (1.26)	0.007 (1.05)	-0.021* (-1.92)	-0.006 (-0.42)	-0.027 (-1.70)
RET	-0.000*** (-10.75)	-0.029 (-0.91)	0.026** (2.03)	-0.028 (-1.36)	0.072*** (3.46)	-0.018 (-0.42)
CEOAGE	0.006** (2.40)	0.015* (1.79)	0.000 (0.15)	0.005 (1.13)	0.009** (2.64)	0.022*** (3.01)
CEOTENURE	0.063*** (18.33)	0.007 (1.11)	0.063*** (16.18)	0.018*** (2.63)	0.071*** (13.25)	0.006 (0.92)
Constant	-1.186*** (-5.32)	-2.880*** (-5.18)	-0.342 (-1.37)	-2.704*** (-6.30)	-1.394*** (-6.37)	-3.992*** (-9.31)
Industry & Year FE	YES	YES	YES	YES	YES	YES
N	3,225	2,965	2,447	2,277	1,811	1,690
Adj R2	0.601	0.224	0.629	0.410	0.617	0.366

Panel A presents the results of the diff-in-diff *t*-test of the CEO incentives (Delta, Vega) using the sample period from year $t - 3$ to $t + 3$, excluding year t . Panel B presents the results of the OLS regression of the CEO incentive variables (Delta, Vega) using the sample period from year $t - 3$ to $t + 3$. Columns (1) and (2) report the results using the HFA and control groups without CEO turnover from year t to year $t + 2$, Columns (3) and (4) report the results using the HFA and control groups with CEO turnover from year t to year $t + 2$, and Columns (5) and (6) report the results using the HFA and control groups with Forced CEO turnover from year t to year $t + 2$. Delta is the sensitivity of CEO wealth to stock price. Vega is the sensitivity of CEO wealth to stock volatility. Both are calculated following Guay (1999). HFA is the dummy variable that equals 1 if the hedge fund acquires more than 5% of the shares of the firms in year t . For the non-CEO turnover sample, PostHFA is the dummy variable that equals 1 for the year $t + 1$, $t + 2$, and $t + 3$ relative to hedge fund activism year t . For the CEO turnover sample, PostCEOTO is the dummy variable that equals 1 for the year and after the CEO turnover. All variables are described in the Appendix. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively. *T*-statistics are reported in parentheses.

Panel B presents the empirical results estimating the regression model specified in equation (6). As shown in Columns (2) and (3), the coefficients on the interaction term *HFA*PostCEOTO* are positive and statistically significant when there is a CEO turnover (or forced CEO turnover). This indicates that the improvement in Tobin's *Q* for target firms (relative to control firms) is achieved after the new CEO is appointed. Columns (5) and (6) show that the coefficients on the interaction term *HFA*Post-CEOTO* are positive and statistically significant. This suggests the increase in the long-term shareholder value is significantly higher for target firms that replaced CEOs than the control group. Overall, target companies are more likely to experience significant changes in governance (e.g., CEO turnover) after hedge fund activism, and it supports our motivation to consider CEO turnover as an essential factor in examining the effect of hedge fund activism on CEO compensation.

Table 9
Hedge Fund Activism and Say on Pay.

Panel A. Difference-in-difference – Univariate analysis										
CEOTO = 0					CEOTO = 1					
SOP	(1) Pre	(2) PostHFA	Difference in Mean (2)-(1)		P-value	SOP	(1) Pre	(2) PostCEOTO	Difference in Mean (2)-(1)	
HFA	0.844	0.879	(3)	0.035	0.09	HFA	0.845	0.869	(3)	0.024
Control	0.866	0.883	(4)	0.017	0.34	Control	0.886	0.874	(4)	-0.012
	Diff-in-Diff (3)-(4)			0.018	0.48		Diff-in-Diff (3)-(4)			0.036
Panel B. Regression of Say on Pay										
Dependent Variable:		SOP								
		Full Sample	CEOTO=0	CEOTO=1	CEOTO_Forced=1					
		(1)	(2)	(3)	(4)					
HFA*Post_HFA		0.043**	0.035							
		(2.18)	(1.35)							
Post_HFA		-0.013	-0.004							
		(-0.91)	(-0.23)							
HFA*Post_CEOTO				0.077**	0.082***					
				(2.35)	(2.64)					
Post_CEOTO				-0.037	-0.045*					
				(-1.41)	(-1.83)					
HFA		-0.035**	-0.028	-0.047*	-0.067**					
		(-2.15)	(-1.28)	(-1.67)	(-2.44)					
RET		0.005*	0.026***	0.003	0.002					
		(1.90)	(2.61)	(1.10)	(0.52)					
TotalComp		-0.069***	-0.060***	-0.073***	-0.083***					
		(-8.88)	(-5.58)	(-6.32)	(-6.87)					
Size		0.035***	0.031***	0.040***	0.044***					
		(6.64)	(4.22)	(4.97)	(5.49)					
ROA		0.127***	0.110**	0.150*	0.094*					
		(3.06)	(2.21)	(1.77)	(1.97)					
LEV		0.018	0.037	-0.034	0.071*					
		(0.62)	(0.94)	(-0.73)	(1.67)					
MTB		0.001	0.001	0.001	-0.001					
		(0.68)	(0.46)	(0.48)	(-0.29)					
Constant		1.165***	1.118***	1.185***	1.243***					
		(26.13)	(18.57)	(16.49)	(17.12)					
Industry & Year FE		YES	YES	YES	YES					
Observations		1,152	703	449	369					
Adjusted R-squared		0.146	0.167	0.118	0.230					

Panel A presents the results of the diff-in-diff *t*-test of the Say on Pay using the sample period from year $t - 3$ to $t + 3$, excluding year t . Panel B presents the results of OLS regression of the Say on Pay voting using the sample period from year $t - 3$ to $t + 3$, excluding year t . Column (1) reports the results using the full HFA and control groups, Column (2) reports the results using the HFA and control groups without CEO turnover from year t to year $t + 2$, Column (3) reports the results using the HFA and control groups with CEO turnover from year t to year $t + 2$, and Columns (4) reports the results using the HFA and control groups with Forced CEO turnover from year t to year $t + 2$. SayOnPay is the number of votes cast for SOP scaled by the total number of votes cast. HFA is the dummy variable that equals 1 if the hedge fund acquires more than 5% of the shares of the firms in year t . For the non-CEO turnover sample, PostHFA is the dummy variable that equals 1 for the year $t + 1$, $t + 2$, and $t + 3$ relative to hedge fund activism year t . For the CEO turnover sample, PostCEOTO is the dummy variable that equals 1 for the year and after the CEO turnover. All variables are described in the Appendix. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively. T-statistics are reported in parentheses.

5.2. Hedge fund activism and CEO incentives

Since most hedge funds aim to maximize shareholder value, we also examine whether activist hedge funds provide stronger incentives to CEOs for them to maximize shareholder value. However, since activist hedge funds become more informed monitors of directors and officers in target companies than other institutional shareholders (Brav et al., 2015a), it is also possible that boards of directors may not necessarily provide stronger CEO incentives.¹⁶ In this case, we do not find any improvement in CEO incentives after hedge fund intervention.

We obtain two measures of CEO incentives following previous research (e.g., Core and Guay, 1999, Guay, 1999, Coles et al., 2006): *Delta* and *Vega*. *Delta* is a measure of the sensitivity of CEO wealth to firm performance (stock return), and *Vega* is a measure of the sensitivity of CEO wealth to firm risk (stock return volatility). As reported in Panel A of Table 8, the uni-

¹⁶ Agency theory provides two main corporate governance mechanisms for bringing the managerial behavior in the best interest of shareholders: monitoring the managerial behavior and providing incentives to managers. These two mechanisms may be complements or substitutes to each other (Ward et al. 2009). However, there is not agreement among scholars about the nature of the relationship between monitoring and incentives in controlling agency problems (i.e., as substitutes in Zajac and Westphal 1994 and as complements in Tosi et al. 1997). In accounting literature, Duellman et al. (2013) show that equity incentives have an interest alignment effect over opportunistic financial reporting effect as monitoring intensity increases.

variate difference-in-difference results show that there are more decreases in *Delta* and *Vega* for the HFA sample compared to that for the control sample. However, the regression results estimating the Eq. (4) with *Delta* and *Vega* as the dependent variables show that the estimated coefficients on *HFA*PostHFA* (or *PostCEOTO*) do not statistically differ from zero (Panel B). We do not find support that hedge funds improve the new CEO's incentive contract. Our finding is consistent with that boards of directors consider bonus plans to provide sufficient additional incentives to improve performance, and thus there is not a need to increase wealth-based incentives measured by *Delta* and *Vega*.

5.3. Hedge fund activism and Say on pay

The Dodd-Frank Act, passed in the wake of the financial crisis, introduced advisory Say-on-Pay ("SoP") votes in the U.S. in 2010 and was put into effect by the SEC in early 2011. SoP thus provides shareholders a channel to give feedback to firms about the design of executive compensation through SoP (Kimbro and Xu, 2016). As a supplementary analysis, we examine whether other shareholders agree on hedge funds' intervention in the target firms' CEO compensation contract. To do that, we test whether SoP votes increase after hedge fund activism. We run the following regression model:

$$\begin{aligned} \text{SayOnPay} = & \alpha + \beta_1 \text{HFA} + \beta_2 \text{HFA*PostHFA (or PostCEOTO)} + \beta_3 \text{PostHFA (or PostCEOTO)} \\ & + \text{Controls}(\text{RET}, \text{TotalComp}, \text{Size}, \text{ROA}, \text{LEV}, \text{MTB}) + \text{Industry\&YearDummies} + \varepsilon \end{aligned} \quad (7)$$

where *SayOnPay* is the number of SOP votes supporting executives scaled by the total number of votes (i.e., the sum of votes for, against, and abstained). In Panel A of Table 9, we find that the univariate difference-in-difference results are not significant. However, as reported in Panel B, the regression results show positive and significant coefficients on *HFA*PostCEOTO*, except for when incumbent CEOs stay. In other words, shareholder votes in favor of executive compensation in SOP significantly increase after hedge fund intervention, and a new CEO is appointed. This finding is consistent with that HFA improves the design of the system of executive compensation, especially for new CEOs.

5.4. Robustness test – Change analysis

In previous sections, we implement a difference-in-difference approach using our matched sample to test the effect of hedge fund activism on CEO compensation. To ensure that our conclusions are not influenced by research design choice, we additionally conduct a change analysis. A regression where the variables are measured in change is less prone to a correlated omitted variables problem, eliminates firm fixed effects, and provides a more reliable test of an association (O'Brien and Bhushan, 1990). We run regressions of the change of CEO compensation variables on the dummy variable of HFA and the change of control variables.¹⁷ All change variables are constructed by taking the difference between the mean values during the year $t + 1$, $t + 2$, and $t + 3$ and the mean values during the year $t - 3$, $t - 2$, and $t - 1$. Results (untabulated) are consistent with our findings reported in Table 5. There are significant increases in the new CEO's compensation after hedge fund activism.

5.5. Robustness test – alternative definitions of post period

We acknowledge that there are limitations of our study using our hedge fund activism data obtained from publicly available SEC filings. Since we are not able to observe when hedge funds exactly exit the target firms, it is possible that our Post-HFA period (year $t + 1$, $t + 2$, $t + 3$) includes the years after the exit of hedge funds. However, we believe that this, if any, works against our findings. If our analysis suggests a significant change in the Post-HFA period while there is no more significant stake owned by hedge fund from year $t + 2$, it indicates that the impact of hedge fund's presence in year t and $t + 1$ must have been stronger. Also, Brav et al. (2008b) state, "Analysis of portfolio turnover rates of the funds in our sample suggests holding periods of closer to 20 months." Therefore, we perform robustness tests (untabulated) using the Post-HFA period defined as year $t + 1$, $t + 2$ relative to the hedge fund year t . We find that our results remain unchanged.

5.6. The stated purpose of activist hedge fund activism

The hedge fund lists the purpose for its acquisition in Item 4 of Schedule 13D and 13D/A filings. We find that 25.0% of our sample hedge fund events states that improvement of governance is one of their purposes of investment. Since the objectives are stated and written by the filers (hedge fund), the stated purposes may be ambiguous. Based on our reading of the SEC filings, we find Item 4 contains lots of boilerplates, and more than 60% of filers state that shareholder value maximization is their primary purpose of investment. To examine the relevance of the stated objectives, we examine whether CEO compensation is different when hedge fund states that improvement of governance is their primary purpose of investment (*HFA_Gov* = 1) compared to all other activism events (*HFA_Gov* = 0). We replicate all of the analyses using the new variable (*HFA_Gov*) to examine the effect of stated purposes on our findings. However, we do not find any difference between hedge fund activism stating governance as the main purpose and all other hedge fund activism. This suggests that the hedge funds' stated objectives are not informative in terms of their real effect on the specific aspect of corporate governance.

¹⁷ $\Delta\text{CEOpay} = \alpha + \beta \text{HFA} + \Delta\text{Controls}$.

6. Conclusion

It remains controversial whether activist hedge funds improve board effectiveness and corporate governance (Bebchuk et al., 2015a, 2015b; Cremers et al., 2016). This paper aims to shed light on the debate by examining whether hedge fund activism produces beneficial effects on CEO selection and the compensation setting process. Because a CEO can have a significant influence on a company's success, it is essential to hire the right person and then properly compensate the CEO (Bertrand, 2009). Consistent with prior findings, we find that approximately 47 percent of target companies replace CEOs after hedge fund intervention. Our untabulated evidence shows that companies targeted by activist hedge funds, in general, pay CEOs with higher compensation, which is inconsistent with the notion that hedge fund activism improves corporate governance. However, after we control for CEO turnover, the empirical results show a different pattern. Targeted companies pay higher compensation only to *new* CEOs, while compensation to *incumbent* CEOs remains similar to those of the control group. Further analysis shows that new CEOs are paid more in the form of bonuses, probably as a reward for better performance.

In the next analysis, we do find stronger pay for performance for new CEOs after hedge fund intervention. In addition, shareholder support for executive compensation in Say on Pay votes is higher after hedge fund intervention, which is a signal that post-HFA compensation is more appropriate than before. Finally, we find that CEO turnover in companies targeted by a hedge fund is positively related to Tobin's Q. Overall, our results are consistent with the notion that hedge fund activism improves corporate governance through removing underperforming CEOs, close monitoring, and providing appropriate compensation. This study highlights that CEO turnover is a critical factor to consider when we draw conclusions on the effects of hedge fund activism on CEO pay and the relationship between CEO pay and firm performance.

Our study has two policy implications. First, we shed light on the regulation of hedge fund activists. One widespread criticism of hedge fund activists is that they destroy long term firm value as they focus on short-term returns (see Bebchuk et al., 2015a). We find that hedge fund activism has lasting effects on the corporate provision of management compensation and incentives. Our finding is not consistent with the claim that activists are myopic, which is the basis for tighter regulation on hedge fund activists. To the extent that hedge fund has long term positive effects on corporate governance, we caution against more regulation on hedge fund activists. The second policy implication is related to regulation on executive compensation. We show that although new CEOs hired after hedge fund intervention receive high compensation, their pay for performance is stronger for these CEOs than those in a control group. Shareholder support for executive compensation in Say on Pay is also higher after HFA. Therefore, our results suggest that market forces, like hedge fund activism and adaptive tactics by target companies are well suited to deal with executive compensation issues. More regulation on executive compensation may result in unintended consequences (Edmans et al., 2017).

One limitation of the study is that we do not fully consider the heterogeneity in hedge fund activism. Holding everything else constant, we provide evidence that hedge fund activists improve corporate governance by removing incompetent CEOs and ensuring pay for performance. But everything else is not constant. There is a spectrum of hedge fund activism. Some activist hedge funds are more aggressive than others, and they may initiate a proxy fight with the corporate managers while others are more friendly and collaborative and try to achieve their goals through non-contested channels. In addition, some hedge fund activists focus on socially responsible investing, and their objectives are perhaps hard to define. But, for the sake of simplicity, we implicitly follow standard assumptions of higher shareholder value as objectives of hedge fund activists. As future researchers dig in to better understand the beneficial roles of hedge fund activism, they may consider the broader question of hedge fund's goals. Future studies can also examine whether the aggressiveness of activist hedge funds and CEO power make a difference in the impact on CEO turnover and the effects of CEO turnover on executive compensation.

Appendix: Variable Definitions

Variables	Description
HFA	Dummy variable that equals 1 if hedge fund acquires more than 5% of shares of the firms in year t .
PostHFA	Dummy variable that equals 1 for the year $t + 1$, $t + 2$, and $t + 3$ relative to hedge fund activism year t , which is defined only for the non CEO turnover sample.
PostCEOTO	Dummy variable that equals 1 for the year and after the CEO turnover, which is defined only for the CEO turnover sample.
CEOTO	Dummy variable that equals 1 if CEO is changed from year $t - 1$ to year t .
CEOTO_Forced	Dummy variable that equals 1 if CEO is changed from year $t-1$ to year t , and the replaced CEO's age is less than 64 in year t .
TotalComp	Natural logarithm of CEO total compensation.
Bonus	Natural logarithm of bonus. Consistent with Murphy and Jensen (2018), bonuses include both bonuses and payouts from non-equity incentive plans.
EquityComp	Natural logarithm of equity-based compensation.
EquityRatio	Ratio of equity-based compensation to total CEO compensation.

Appendix (continued)

Variables	Description
SayOnPay	Say on Pay voting. Number of votes cast for SOP scaled by the total number of votes cast, i.e., the sum of votes for, votes against and votes abstained (source: ISS).
TobinQ	Tobin's Q. $(\text{Total assets} + \text{Market equity} - \text{Book equity}) / 0.9 * \text{Total assets} + 0.1 * (\text{Total assets} + \text{Market equity} - \text{Book equity})$
Size	Natural logarithm of market value of equity
ROA	Operating income scaled by total asset
LEV	Long-term debt scaled by total asset
MTB	Market-to-book ratio
RET	Annual return during the fiscal year t
CEOAGE	CEO age
CEOTENURE	CEO tenure
SALEGROWTH	$(\text{Sale}_t - \text{Sale}_{t-1}) / \text{Sale}_{t-1}$
DIVIDEND	Dividend per share
CashFlow	$(\text{Cashflow from operations} - \text{extraordinary items and discontinued operations}) / \text{Total asset}$
CAPEX	Capital expenditure scaled by total asset
R&D	R&D expense scaled by total asset
HHI	Herfindahl-Hirschman index of sales in different business segments
ANALYSTS	Number of analysts following
BHAR (-12, -1)	Market adjusted buy-and-hold abnormal return during the 12 months period before the month of hedge funds' acquisitions of more than 5% of target firm shares.
Delta	Sensitivity of CEO wealth to stock price. It is calculated following Core and Guay (1999) .
Vega	Sensitivity of CEO wealth to stock volatility. It is calculated following Guay (1999) .

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Bios Vol. 39, #6

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