



University of
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THREE ESSAYS ON THE ECONOMICS OF CORPORATE GOVERNANCE

Item Type	Dissertation (Open Access)
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DOI	10.7275/19290389
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Download date	2026-04-13 18:15:04
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Link to Item	https://hdl.handle.net/20.500.14394/18311

**THREE ESSAYS ON THE ECONOMICS OF
CORPORATE GOVERNANCE**

A Dissertation Presented

by

KUO CHIH HUANG

Submitted to the Graduate School of the
University of Massachusetts Amherst in partial fulfillment
of the requirements for the degree of

DOCTOR OF PHILOSOPHY

September 2020

Economics

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DEDICATION

To Jung

ACKNOWLEDGMENTS

I would like to thank my advisor, Gerald Epstein, and other members of my committee – Ina Ganguli, Peter Skott, and Kevin Young. Without their help, this work would have been impossible. Jerry generously supported me on everything, from intellectual to emotional, a graduate student needs and guided me through the whole process. Ina gave me insightful comments and suggestions at every step of empirical analysis. Peter never failed to point out anything unclear or suspect in my analysis and helped me to improve. Kevin provided stimulating comments and has always been there when I needed him. I thank the Political Economy Research Institute (PERI) for providing me with financial resources during the time I wrote this dissertation. I am particularly indebted to Weikai Chen for his incredible help at every stage of my study and everyday life at Amherst. Finally, I express my deepest gratitude and love to my wife and my parents.

ABSTRACT

THREE ESSAYS ON THE ECONOMICS OF CORPORATE GOVERNANCE

SEPTEMBER 2020

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The Great Recession and the revival attention on inequality have cast doubts on various aspects of the governance of Corporate America. Not only the specific design of corporate governance institutions, but also the very purpose of the firm have become hotly debated issues.

The first essay investigates the effect of the CEO's equity-based pay on workers' wages and whether the effect is amplified by product market competition. Since the 1980s, Chief Executive Officers' (CEO) pay has exploded, largely in the form of equity-based incentive compensation such as stock awards and options. Using a two-tiered principal-agent model, we show that aligning managers' incentives with shareholder interests through equity-based pay can lower workers' wages. Analyzing a sample that matches firm, manager, and worker information in the U.S. economy

over the period 1992-2016, we show that higher equity-based pay is associated with lower average wages across various measures of pay and model settings. Using a novel instrumental-variable strategy based on a tax policy change, we provide evidence that an increase in the CEO equity-to-salary ratio by one unit, say, from 1:1 to 2:1, leads to a 4% decline in the average wage. We also find that while firms under all degrees of competition raise equity pay in response to the policy change, the negative impact on wages is stronger when the degree of competition is high, suggesting that competition does not substitute for executive compensation but amplifies its effect.

The second essay analyzes the effect of CEOs' equity-based pays on firms' investment herding. Firms, like individual investors, may herd on investments resulting in the co-movement in firms' and the industry's investments. Will the CEO's equity-based compensation increase or decrease the investment herding? Economic theories disagree. The information-based theory suggests that more equity-based pay can reduce managers' herd behaviors, while the compensation-based theory argues the opposite. This paper provides a rare opportunity to examine the conflicting predictions of two major theories. Applying a novel instrumental-variable strategy to analyze a CEO-firm matched sample of the U.S. firms over the period 1992-2016, we find that an increase in the CEO's equity-to-salary ratio leads to a decrease in investment herding.

The third essay discusses the role of the labor-affiliated shareholder in the reform of the purpose of the firm. Shareholder primacy may help to halt corporate misconduct when shareholders have pro-social preferences and concern about externalities. A shareholder democracy in which ethical shareholders push the manager to maximize shareholders' welfare rather than wealth can lead to better social outcomes. However, my analyses show that, given the heterogeneity among shareholders and realistic institutional conditions, the balance still tilts heavily toward profit maximization such that ethical shareholders will become extinct and good social outcomes are not

sustainable without the participation of union and public pension funds. This is consistent with the evidence that most social proposals have been coming from labor-affiliated shareholders, implying that a shareholder democracy cannot sustain itself without the involvement of stakeholders or the “special interest” shareholders that its proponents try to dismiss.

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CHAPTER 1

DO INCENTIVIZED MANAGERS PAY THEIR WORKERS LESS?

1.1 Introduction

1.1.1 The equity-based compensation structure

Since the 1980s, as the wages of most workers have stagnated in the U.S., Chief Executive Officer (CEO) pay has exploded, largely in the form of equity-based incentive compensation such as stock awards and options. Although the change in the CEO's compensation structure and the CEO-worker income gap have attracted a lot of attention, the literature usually analyzes the causes of patterns of CEO compensation and workers' wages separately; while the increase of CEO's compensation is attributed to the competition for talent, managerial rent-seeking, tax policies and the need to provide incentives for managers' efforts under shareholders' pressures,¹ the stagnation of workers' wages is attributed to technological changes, globalization, declining union density, etc. A critical issue has been largely omitted: does the change in CEOs' compensation structures make workers' wages stagnate or decline? Specifically, do CEOs' stock-based pay, which have been the biggest part in the CEO's compensation package since the 1980s, induce managers to cut workers' wages?

The omission of empirical study on this issue is conspicuous against the theoretical literature. Focusing on the conflicting incentives of "principals" (shareholders) and their "agents" (managers), agency theory, which has been the major framework in

¹See, for example, Piketty & Saez (2003), Burkhauser, et al. (2012), and Bakija, Cole & Heim (2012) for the US case, and Bell & Van Reenen (2013) for the UK case.

the literature,² claims that stock-based compensation helps to align the interests of shareholders and managers, such that managers are less likely to take the “easy road”, paying high wages as a comfortable way of minimizing conflicts; their energetic pursuit of self-interest motivates them to cut wage costs and increase firm efficiency (Jensen and Meckling 1976; Jensen & Murphy, 1990; Pagano & Volpin, 2005).³ In spite of the plausible prediction, which we formalize in a simple model in Section 1.2, so far there is no empirical study on the effect of managerial incentive compensation structure on workers wages in the U.S. economy.

To fill the gap, this paper investigates the following question: Does equity-based compensation incentivize managers to pay workers less? We first develop a simple two-tier principal-agent model to show that because profit and therefore stock price are influenced by the manager’s choice of monitor level, as long as the equity ratio is high enough, the equity income may be sufficient to offset the cost of giving up the peaceful life, such that the manager is willing to exercise high monitoring and reduce workers’ wages.

Next, we implement a set of analyses and a novel instrumental-variable strategy using a tax policy change, finding that a higher equity-based pay, measured by *Equity Fraction* (equity-based pay divided by the total compensation) or *Equity Ratio* (equity-based pay divided by salary), consistently associates with lower wages. The effect persists even when the equity-based pay is decomposed into stock awards and

²See Shleifer & Vishny (1997), Murphy (2013), and Edmans, et al. (2017b) for reviews of the literature.

³Although a detailed analysis of the theoretical debates around the determinants of CEO compensation is beyond the scope of the present study, it’s interesting to mention that a variant of agency theory, managerial rent-seeking theory (Bebchuk and Fried 2006), is based on the same principal-agent framework and shareholder primacy, but argues that excessive stock-based pay is actually a result of managerial power, allowing managers to maximize their own interests at the expense of shareholder value. This theory proposes a better-designed incentive compensation and a stronger shareholder activism to discipline managers. Following this logic, however, we are not sure whether a rent-seeking manager under stock-based compensation has an incentive to reduce wages or not. The proponents of the theory have been silent on this issue.

stock options, and also when being combined into the performance pay as a whole. Evidence from our IV estimation suggests that an one-unit increase in the CEO's equity-to-salary ratio, say, from 1:1 to 2:1, will lead to a 4% reduction in the average wage. In addition to this baseline result, we further show that this negative effect is more significant when the degree of competition is high than low, implying that competition does not substitute compensation, but amplifies its effect by enlarging the gap between rewards under different profit outcomes.

A major advance of this paper is the identification strategy based on a tax policy change. The motivation of this effort is to identify causality beyond correlation, since several omitted factors might affect both managers' compensation structures and workers' wages and make them correlated. For example, a technology change may affect the dynamics of both workers' and managers' labor markets, such that the firm can reduce ordinary workers' wages while needing to provide more incentives to attract talented managers. Alternatively, a firm with a worrisome business outlook may pay workers less, and yet at the same time try to adopt new strategies by giving managers more equity incentives. This paper addresses the issue by utilizing a change in the corporate-tax deductibility of CEO's salary brought by Section 162(m) of Internal Revenue Code in 1993. Under this legislation, non-performance pay, mainly salaries, paid to top-five managers above \$1 million will be subjected to a 60% federal surtax. As a consequence, firms switch to forms of performance pay, especially equity-based ones, to compensate their managers while keeping salaries at or below the \$1 million threshold. We use whether the CEO's salary falls into the treatment range around (and above) the threshold, and the amount of salary, as instruments for changes in the CEO compensation structure measured by the equity-based-pay-to-salary ratio. While this legislation and its effects on CEO compensation structures had been studied by many, this paper is the first to transform it into an instrument and identify the causal effects of compensation structure on firm outcomes.

An important obstacle to any study on this issue in the U.S. economy is the lack of micro-data that links the information of CEO compensation, firm characteristics and workers' wages precisely.⁴ To alleviate the obstacle, we focus on the average wage of individual firm, and construct a firm-level sample by matching firms' average wages and other information (source: Compustat) with CEOs' compensation structure (source: Execucomp). We then link the data with workers' characteristics calculated as the weighted averages at the 2-digit industry level (sources: Current Population Survey (CPS)). This results in a firm-level panel data set of the U.S. economy covering the period 1992-2016, with variables of worker characteristics measured at the industry level.⁵ Supplementing to our baseline analyses, we also use other data in a set of robustness tests (Section 1.3.3) to address several potential concerns, including the low report rate of wage information in Compustat, composition changes due to offshoring, heterogeneity between non-financial and financial sectors, and the industry-year-specific shocks.

1.1.2 Related literature and contributions of the paper

By showing that equity-based pay does induce managers to reduce workers' wages in the U.S., this paper makes several contributions to the following literature. First, this paper is the first to study this question in the U.S. economy. To the best of our

⁴Most linked employer-employee data sets are merged at the establishment level using identifiers such as Employer Identification Number (EIN). But a firm may have multiple establishments at various levels and use multiple EINs for different purposes. To the best of our knowledge, there is yet no simple way to find all establishments for a given firm and merge the establishment-level data with firm's balance sheet and CEO compensation data (Handwerker & Mason, 2013; 2014).

⁵This approach of sample building is similar to many studies utilizing heterogeneities across industries and using industry-level variables as their main explanatory variables and individual variables as outcomes, such as the literature on inter-industry wage structure since Krueger & Summers (1988). Other examples include: Leonardi (2007) link individual data from CPS to firm data from Compustat at the industry level, to study the effects of industrial capital-labor ratio (capital per employee) on individual wage dispersion; Lin & Tomaskovic-Devey (2013) match firm data from Compustat with individual data from tax reports at the industry level, to study the effects of increasing dependence on financial income at the industry level on earnings dispersion among individual workers.

knowledge, this issue had been addressed only partially by Cronqvist et al. (2009) for the Swedish economy.⁶ In their analysis of Swedish data over the period 1995-2002, they find that while CEOs with more voting rights pay their workers more, CEOs' financial incentives (cash-flow rights, measured by the fraction of firm's shares owned by the CEO) mitigate such effects, putting downward pressures on workers' wages. While their results are generally in line with ours, however, in an one-share-one-vote system that is common in the U.S., a high managerial shareholding implies both strong controlling power and strong financial incentives, which are predicted to have conflicting effects on wages. This may cause ambiguities and hinder interpretations if we apply their measurement to the U.S. case. Instead, this paper uses *Equity Fraction* and *Equity Ratio* as the main explanatory variables to avoid the problem. In our analyses, the negative effects of *Equity Fraction* and *Equity Ratio* on wages persist after controlling for managerial shareholdings.⁷ Moving beyond their analyses, we further examine the effects of various parts of executive compensation in detail, including stock award, stock option, performance pay as a whole, and non-equity performance pay, and our examination include other high-ranking managers' compensations as well.

Second, due to the complexity in the process of determining executive compensation, the empirical literature on the effects of executive compensation had been experiencing difficulty in identifying causality, and just starts to overcome it in few recent studies.⁸ This paper joins in the recent trend to focus on the causal effect

⁶In the broader literature of corporate governance, for the U.S. economy, Bertrand & Mullainathan (1999; 2003) provide evidence over the period 1976-1995 showing that firms that face lower takeover threats due to anti-takeover legislation (and therefore managers are more entrenched) tend to pay their workers higher wages. Unfortunately they didn't take into account the effects of managers' compensations.

⁷Please see the results in Section 1.3.3.2.

⁸See Edmans, et al. (2017b) for a review of empirical literature on the effects of executive compensations.

of executive compensation structure on wages, using a novel identification strategy based on the IRC 162(m).

Third, a literature argues that changes in corporate governance do not matter in competitive industries, because competition substitutes for governance and always pushes toward managers efficiency. This thesis is supported by Giroud & Mueller (2010), in which they find that changes in the anti-takeover regulation have no effect on firms' performances when competition is strong. However, we find a completely reversed pattern: the negative impact of CEO equity pay is stronger when competition is strong, suggesting that competition enlarges the gap between rewards under different outcomes and does not substitute the effect of compensation but amplifies it.

Fourth, starting from Jensen & Meckling (1976), most theoretical literature on incentive compensation focus on the managerial shareholding in the one-tier principal-agent relationship between shareholders and managers.⁹ We argue that the effect of managerial shareholding on wages is ambiguous, and focus on the compensation structure which connects closely to our empirical analyses. In addition, in our two-tier principal-agent model, we analyze the effect of compensation structure change using a multiplicative specification similar to Edmans, Gabaix & Landier (2008), rather than the additive one typical in the literature, of CEO utility.

Fifth, in recent years, the increasing skepticism of equity-based pay, and of shareholder primacy in general, have on other detrimental consequences: excessive risk-taking (Coles, et al., 2006; Chen, et al., 2006; Pathan, 2009; Bolton, et al., 2015), increased stock buybacks at the expense of real investment and employment (Lazonick, 2014; Almeida, et al., 2016; Edmans, et al., 2017a; Gutiérrez & Philippon, 2016), massive layoffs and outsourcing (Jung, 2015 & 2016; Dial & Murphy, 1995). This

⁹The collusion model literature (Tirole, 1986; Pagano & Volpin, 2005) developed two-tier principal-agent models, but did not move beyond the focus of managerial shareholding.

paper contributes to this literature by providing the first evidence for the negative effects of the incentive compensation on wages.

The rest of this paper is organized as follows. Section 1.2 develops a simple two-tiered principal-agent model to clarify the main argument and prediction. Section 1.3 describes the data and methods, presents our baseline results, and reports results from a set of robustness tests. Section 1.4 explains the institutional background and the construct of instrument, and presents evidence for causality based on the IV estimation. Section 1.5 looks closer at the effects of market competition on the relationship between the CEO's equity pay and workers' wages. Section 1.6 concludes. Details of data sources, variable measurements, and the results of robustness tests are reported in the Appendices.

1.2 A simple model of the effect of equity-based compensation structure on wages

1.2.1 The argument and key features

The main argument of the model is that by increasing equity-based pay, measured by *Equity Fraction* and *Equity Ratio*, the manager will be incentivized to reduce workers' wages. In putting forward a tractable prediction, this section develops a simple two-tier principal-agent model that first, specifies the manager's incentives and the interactions between the manager and the worker; and second, derives the measures of compensation structures and analyzes the effects of changes in compensation structures on wages.

Three features distinguish the model from the literature. First, in analyzing the interaction between the manager and the worker, this paper adopts a collusion model following Tirole (1986) in which agents can make monetary or non-monetary side pay-

ments, i.e., private benefits.¹⁰ However, most collusion models start from analyzing the factors determining compensation, and aim to design an optimal contract from the principal's perspective. In contrast, this paper focuses on the consequence of the CEO's compensation structure, rather than the causes of it. In addition, as Tirole (1986) had also warned that the model itself does not suggest whether the exchanges among agents are welfare-enhancing (cooperation) or not (collusion), a discussion of the welfare outcome requires a comprehensive general equilibrium model and a cost-benefit analysis which go beyond the scope of this paper. This paper takes a more neutral and moderate view, abstracting from the optimality question¹¹ and focusing on the empirical prediction to facilitate the empirical analysis.

The second feature of the model is the focus on the manager's compensation structure, rather than his shareholding of the firm. The latter has been the main measure of executive incentives in the literature. For example, in Pagano & Volpin (2005), which develops a model closest to mine, worker's wages will be lower if the manager's shareholding is higher. An important reason for their focus on shareholding is to analyze the conflict between the shareholder and the manager in controlling the firm, which is also the typical concern of agency theory. In contrast, this paper deviates from the overwhelming concern of shareholder interest and the shareholder-manager conflict. In addition, the shareholding measure may be inappropriate for our empirical study, as it conflates controlling power and financial incentive in the one-share-one-vote system, as explained in Section 1.2.

¹⁰The side payment (private benefit) and its effect on wages have been studied previously in the context of (anti-)takeover strategy used by the incumbent manager (Shleifer & Summers (1988); Pagano & Volpin (2005); Bertrand & Mullainathan (1999; 2003)). In contrast to the (anti-)takeover literature, in the model we abstract from the question of control, i.e., the power conflict between the shareholder and the manager in controlling the firm.

¹¹Therefore, for example, the simple model in this section does not explicitly specify the shareholder's utility function. The model also abstracts from some typical focuses of the literature on optimal compensation design like the uncertainty in measuring the manager's effort.

The third feature of the model is a multiplicative specification of CEO utility, rather than the additive one typical in the literature. With multiplicative preferences, the utility from private benefit is proportional to the CEO's total compensation, and influences naturally the fraction of equity-based pay needed to incentivize the manager to cut wages. This specification is used in the macroeconomics literature on labor supply choice, and is introduced into an analysis of CEO incentives by Edmans, Gabaix & Landier (2008).

1.2.2 The model

The scenario of the model goes as follows. In a simple model of labor extraction and collusion, the worker chooses the level of effort, and whether to give the manager a side payment or not, depending on the level of monitoring chosen by the manager. The manager chooses the level of monitoring, which relates directly to the worker's wage level, accounting for the worker's behaviors and the incentive compensation structure designed by the shareholder. With the incidence of side payment depends on the level of monitoring, the manager therefore faces a trade-off between the private benefit from the side payment, and the value of the incremental reward brought by the choice of a higher level of monitoring and regulated by the amount of equity in his compensation package. The compensation structure measures how much the equity-based pay is needed for the manager to offset the loss of private benefit. The model shows that with more equity-based pay, measured by *Equity Fraction* and *Equity Ratio*, the manager will more likely give up the private benefit and choose a higher level of monitoring, resulting in a lower wage for the worker.

The presentation of the model proceeds in three steps. First, we solve the labor extraction game to derive the wage function, and then specify the relation of the wage/monitoring to the firm's surplus and stock price. Second, we specify the payoff and utility functions of the manager, and analyze his utility maximization by

incorporating the participation and incentive-compatibility constraints, which naturally relate to a threshold of equity-based compensation structure needed for inducing high monitoring. Finally, we analyze the possible choice of compensation structure by shareholders and its effect on workers' wages, and explain the connection between two measures, *Equity Fraction* and *Equity Ratio*, that will be used in the following empirical analyses.

1.2.2.1 Wage setting, the firm's surplus, and stock price

In a simple model of labor extraction/monitoring, the worker can choose contributing effort or not. If the worker contributes effort, his utility is $w - c$, and $m\bar{w} + (1 - m)w$ otherwise, where w is the wage, \bar{w} is the reservation wage, c is the cost of effort, m reflects the strength or probability of monitoring. Therefore, the worker's incentive compatibility constraint is:

$$m(w - \bar{w}) \geq c, \tag{1.1}$$

and the wage eliciting the worker's effort is

$$w = \bar{w} + \frac{c}{m}. \tag{1.2}$$

There are two levels of output, y_H and y_L , corresponding to the worker's effort and no effort. Assume $y_H - y_L > \frac{c}{m}$, i.e., the increase in output is bigger than the cost of eliciting effort by the wage, such that the manager and the shareholder will always want to elicit effort. In this case, it is always the case that $w = \bar{w} + \frac{c}{m}$, and the worker always put effort and produce y_H , while the manager can choose different levels of m and pay different levels of w . Here we assume no link between monitor and outputs. This should be treated as a conservative, "lower-bound" scenario, because should a higher monitor level give rise to higher outputs and therefore higher profits, the

manager's opportunity cost of having a peaceful life will be higher, and the manager would be more hostile at all levels of equity ratio. For simplicity and focusing on the effect on the average wage, we also assume the manager's choices do not affect the number of workers and normalize the number to one.

As we focus on the works of the manager and the worker, and abstract from other production factors, the firm's surplus, Π , is determined as

$$\Pi = y_H - w - s, \tag{1.3}$$

where s is the fixed salary for the manager. Specifically, denote Π_H and Π_L as the surpluses produced when the manager chooses high and low levels of monitoring respectively such that

$$\begin{cases} \Pi_L = y_H - (\bar{w} + \frac{c}{m_L}) - s & \text{if } m = m_L; \\ \Pi_H = y_H - (\bar{w} + \frac{c}{m_H}) - s & \text{if } m = m_H. \end{cases}$$

Market then evaluates the firm's surplus and projects onto a market price of the firm's stock as

$$p = p(\Pi(m)). \tag{1.4}$$

For simplicity, we ignore here the complex and often imperfect process of stock market evaluation, and assume that market can identify the effect of a manager's action in the sense that the function is monotonically increasing with Π . Without loss of generality, the gap between p_L and p_H , which correspond to Π_L and Π_H , can be simplified as

$$p_L = p_H(1 - \lambda), \tag{1.5}$$

where $0 < \lambda < 1$. With this simple representation, the change in the firm's stock price is regulated by λ , which is an indicator of price-to-surplus sensitivity created

by the manager's monitoring. The more effective is the monitoring, the larger the indicator, and therefore the larger difference between p_L and p_H .¹² The value of the equity-based pay is therefore regulated directly by the market evaluation of firm's stocks which is linked with the manager's monitoring. While the manager can choose between high and low levels of monitoring, the consequences of his choice to the firm's surplus and stock price are public knowledge and known beforehand.¹³

1.2.2.2 The manager's payoff and utility maximization

The total compensation of the manager, G , consists of two components, a fixed salary and an equity-based pay that relates to the market evaluation of firm's stocks:

$$G = s + \alpha p, \tag{1.6}$$

where α is the amount of stocks/options awarded to the manager.

In addition to the monetary compensation, a non-monetary side payment, b , plays an important role. Let U be the utility of the manager, and

$$U = G(m)b(m), \tag{1.7}$$

in which G is the total compensation of the manager, and $m \in \{m_L, m_H\}$ is the manager's choice of monitoring level. If he chooses the low level of monitoring, m_L , then $b = b(m_L) > 1$. In contrast, if the manager chooses the high level of monitoring,

¹²The price-to-surplus sensitivity can also vary with competition such that λ is larger under strong competition and smaller under weak competition. This interpretation is introduced in Section 1.5 where we analyze whether and how is the effect of equity pay on wages affected by competition.

¹³This setting abstracts from the uncertainty in measuring the manager's effort which has been a focus of the literature on optimal contract design. For recent theories incorporating this uncertainty in analyzing the CEO's overpay and rent extraction problem, please see Skott & Guy (2013) and Bénabou & Tirole (2016).

m_H , then $b = 1$. Denote the manager's utility as U_L when choosing m_L , and U_H when choosing m_H , we have

$$\begin{cases} U_H = G(m_H)b(m_H) = s + \alpha p_H = G_H; \\ U_L = G(m_L)b(m_L) = (s + \alpha p_L)b = (G_H - \alpha p_H \lambda)b. \end{cases} \quad (1.8)$$

Put Equation (1.2), (1.7) and (1.8) together, one can see that the manager and workers are in a two-way stick-and-carrot relationship. On the one side of the relationship, the manager can choose between high monitoring and high wage policies, and consequently faces the trade-off between a higher total compensation and the private benefit. On the other side, workers may either receive lower wages and refuse to give private benefit to the manager, or receive higher wages and keep a peaceful relationship with the manager.

From the shareholder's point of view, to elicit high level of monitoring to increase surplus and stock price, the optimal contract should satisfy both the participation constraint

$$G_H \geq \bar{G}, \quad (1.9)$$

where \bar{G} is the manager's outside option,¹⁴ and the incentive-compatibility constraint such that

$$G_H \geq (G_H - \alpha p_H \lambda)b. \quad (1.10)$$

By rearranging the conditions we obtain

$$\alpha p_H \geq G_H \beta, \quad (1.11)$$

¹⁴Whether the participation constraint is binding or not, the analyses of this simple model remain intact. It's conceivable that several factors that are left out of this simple model may cause the participation constraint unbinding, such as increases in firm-level volatility (Skott & Guy, 2013), CEO may be paid for luck (Bertrand & Mullainathan, 2001), or CEO may capture the pay-setting process (Bebchuk & Fried, 2006). These are all related to the issue of optimal design of compensation which is not the focus of this paper.

where $\beta = (1 - \frac{1}{b})\frac{1}{\lambda}$ denotes the equity-based pay fraction.¹⁵ Note that $\beta = \beta(b, \lambda)$, and $\beta_b > 0$, that is, β needs to be higher if the private benefit b is larger, to induce the manager to give up the private benefit and to choose high-level monitoring. In contrast, $\beta_\lambda < 0$, i.e., β can be lower and still generates enough rewards to the manager, if the increase in the firm's stock price brought by the manager's monitoring effort being larger.

1.2.2.3 Two measures of compensation structure and the effect on wage

To link the theory with empirical analyses closely, we need to specify the two measures, *Equity Fraction* and *Equity Ratio*, and restate the prediction. In Equation (1.9), by shifting G_H to the left, we can compute *Equity Fraction*, β^F , that incentivizes the manager to give up the private benefit and choose high monitoring:

$$m = \begin{cases} m_L & \text{if } \frac{\alpha p_H}{G_H} = \beta^F < \beta; \\ m_H & \text{if } \frac{\alpha p_H}{G_H} = \beta^F \geq \beta. \end{cases} \quad (1.12)$$

An incentive compensation scheme set by the shareholder will aim to give the manager a $\beta^F > \beta$, which can be achieved by increasing α , given p_H , β , and $\frac{\partial \beta^F}{\partial \alpha} > 0$. A larger α and therefore a larger β^F will be more likely larger than β , such that the wage, w , to be lower since $\frac{c}{m_H} < \frac{c}{m_L}$. That is, more equity-based pay, measured as higher *Equity Fraction*, will leads to lower wages.¹⁶

Finally, it's easy to see that the alternative measure, *Equity Ratio*, β^R , works as a proxy for *Equity Fraction*, since it is defined as

¹⁵Here we restrict $\lambda \geq 1 - \frac{1}{b}$ so that $\beta \leq 1$.

¹⁶Ordover & Shapiro (1984) and Skott & Guy (2007) had analyzed how the improvement of supervision technology may reduce workers' wages, as a process of power-biased technology change, or PBTC, vis-à-vis skill-biased technology change (SBTC). In the context of PBTC, the simple model presented here can be viewed as emphasizing that even after new supervision technology becomes available, a firm's adoption of such technology still hinges on the manager's incentives.

$$\beta^R = \frac{\alpha p_H}{s} = \frac{\beta^F}{(1 - \beta^F)}, \quad (1.13)$$

where $0 \leq \beta^F \leq 1$ such that β^R will move at the same direction as β^F .

1.3 Basic Evidence on the Effects of Equity-Based Pay on Wages

1.3.1 Data Sources and Measurements of Variables

The main dataset for following analyses is the firm-level sample based on the firm information from Compustat, which is matched with CEOs' information from Execucomp, and workers' characteristics from CPS measured at the industry level, over the period 1992-2016.¹⁷

Compustat provides balance sheet and other financial information for publicly-traded firms in the U.S., which are collected from firms' annual reports and other filings to the SEC. Execucomp contains detailed information of top executives' compensations, such as salary, bonus, pension, stock award and stock option, and personal characteristics such as gender and age, that are collected from firms' annual proxy reports (DEF14A SEC form). Current Population Survey (CPS) is a monthly survey of about 60,000 participating households, a sample representing the civilian non-institutional U.S. population, conducted by the U.S. Census Bureau for the U.S. Bureau of Labor Statistics (BLS). We use the Annual Social and Economic Supplement (ASEC), or the "March supplement", of the CPS which contains more demographic details than surveys in other months and has been extensively used in the literature. A set of worker characteristics, such as gender, race, education, union

¹⁷The matched data set begins at 1992 because Execucomp starts at 1992. A data set based on Forbes surveys contains executive compensation data before 1992, but its measurements does not allow the calculation of equity-based fraction of total compensation. Nonetheless we thanks Kevin Murphy for sharing the data with me.

coverage, etc., are calculated as proportions at the 2-digit SIC industry level. The details of matching methods are explained in Appendix 1.

1.3.1.1 The dependent variable: wage

Throughout the firm-level analyses, the dependent variable is $\log(\text{yearly average wage})$ of each firm-year observation. We use the labor and related expense (Compustat item: `xlr`), subtract by the total amount of executive compensation of all top-five managers, divide it by the number of employees (Compustat item: `emp`), and then take natural log. The labor and related expense variable in Compustat includes salary and wage, other benefit plans, payroll taxes, pension costs, profit sharing, and incentive compensation. So this comprehensive measurement is less likely to be biased by the changes in the composition of earning when, say, salary decreases while health insurance increases.

1.3.1.2 Explanatory variables: *Equity Fraction* and *Equity Ratio*

To capture the relative importance of equity-based pay to the manager, explanatory variables consist of two measurements of executive compensation structure, *Equity Fraction* and *Equity Ratio*. The former is measured as the sum of stock awards and stock options values divided by the value of total compensation, and the later is measured as the sum of stock awards and stock options values divided by the value of salary. As explained in Section 1.2, a higher *Equity Fraction* or *Equity Ratio*, and therefore a heavier weight of equity-based pay in the managerial compensation, is expected to align managers' interests closer with shareholders' interests and lead to wage reductions.

In calculating the values of equity-based pay, we generally use the standard Black-Scholes/fair-value measures to represent the *ex ante* evaluations of compensation values at the beginning of a business year when executives plan their work. They

are also more available through the whole period, and widely used in the literature.¹⁸ Please see Appendix 2 for more details.

Many studies investigate the differences between stock awards and stock options regarding risk-taking behaviors. Based on the simple theory in Section 1.2, however, the effects of stock awards and stock options on wages are indistinguishable and both are negative. To check whether that's the case empirically, we decompose equity-based pay into stock awards and stock options, and calculate their fractions and ratios against total compensation and salary respectively.

Although this paper focuses on equity-based pay, researchers and policy makers are also interested in the performance pay in general which include bonus and various non-equity incentives in addition of equity. Besides, it's interesting to explore whether equity-based and non-equity-based pay have different effects on wages. Since bonus and non-equity incentives usually target certain accounting metrics rather than stock performance, it's likely that their effect on wages may be different from equity. We therefore construct two additional variables: total performance pay fraction and ratio, and non-equity performance pay fraction and ratio. The former includes equity-based pay, bonus, and long-term incentive pay, while the later excludes equity-based pay.

Most literature on corporate governance/control focus only on CEOs. In a large firm, however, given the complex process of decision making and division of labor, it's not very clear whether the CEO is the only person, or the most influential one, in determining the wage policy. To investigate this issue, we calculate *Equity Fraction* and *Equity Ratio* for other high-rank managers, and create corresponding non-CEO variables by taking averages across these managers.

¹⁸As reported in Hopkins & Lazonick (2016), the definitions and measurements of several compensation elements in Execucomp database had changed over the period, and some measures are available for shorter periods. In contrast to the Black-Scholes/fair-value measures, for example, the realized-value measures are *ex post* valuations whose values may be relatively uncertain to the executives at the beginning of a year, and they are available only after 2006.

1.3.1.3 Control variables

We control for four groups of factors including manager, firm, and worker characteristics, and a set of fixed effects.

Manager characteristics. Aside from the compensation structures, managers' powers in controlling the firm vis-à-vis shareholders are relevant to the determination of wages, as the theory predicts that a powerful manager tends to collude with workers by paying them higher wages. Together with the compensation structures, they measure the extent and mechanisms of alignment between the interests of executives and shareholders in the context of principal-agent relationship. We include two measurements to proxy for the managers' controlling powers. First, CEO-chair duality. The board of directors is supposed to select and supervise the CEO. If the CEO is also the board chair, the check and balance effect is weakened, giving the CEO more discretionary power, though not necessarily more independence from shareholders. Second, whether the CEO is hired from outside. A CEO promoted through the long ladder within a firm may have more connections and influences among his or her coworkers, while an externally-hired CEO may rely more on the supports of shareholders. A large literature finds that women make economic decisions differently (Croson & Gneezy, 2009), so we include managers' gender as one control variable.

Firm characteristics. At the firm level, we control for firms' capital structure (leverage) and capital expenditure, scale (total assets), and labor productivity (sales per employee). We add firm-specific time trends (firm's age) to control for the growth path of each firm. We also control for the firm's foreign activity (whether the firm receives any foreign incomes or pay foreign taxes), since the literature has shown that firms engaged in exports and foreign investments are systematically different from those who don't in many aspects (Melitz & Redding, 2014; Helpman, 2011).

Worker characteristics. To control for workers' individual characteristics, we include variables of race, gender, age, education, union coverage, experience, part-time

status, urban residence, and marital status. All these individual characteristics are calculated as proportions at the SIC 2-digit industry-year level using CPS data.

Fixed effects. Bertrand & Mullainathan (1999; 2003) find that managers' incentives may be affected by the anti-takeover legislation which vary by state and year, depending on where the firm incorporates. To control for this anti-takeover legislature effect, we include the incorporation state where the firm incorporates and interact it with years. We also control for firm-, state-, industry- and year-fixed effects through the firm-level analyses, and report robust standard errors adjusted for clustering of the observations at the firm level.

Product market competition may affect workers' wages and executive compensation simultaneously. For example, as the intensive product market competition leads to lower wages, firms may feel more (or less) compelled to use high-power compensation to incentivize managers when product market competition intensifies. To control for the effects of product market competition, we include the Herfindahl-Hirschman index (HHI) at the SIC 2-digit industry level based on the complete Compustat database (not just the firms reporting wages). Note that in Section 1.3 and 1.4 we simply control for product market competition, rather than addressing the issue whether competition reduces the effects of equity-based pay on wages. The latter issue will be examined in Section 1.5.

1.3.1.4 Summary Statistics

We require all observations to have all variables discussed above without any missing value. The resulted sample contains 5,579 firm-years and 651 unique firms covering the period of 1992 to 2016. The sample includes many well-known big firms, such as Boeing, General Motors, American Airlines, and MacDonald's in the non-financial sector, and Bank of America, Citigroup, Morgan Stanley, and Goldman Sachs in the financial sector.

Note that about 44% of firms in this sample belong to the “F.I.R.E.” sector, i.e., the finance, insurance, and real estate sector, as shown in Table 1.1, but they account for just about 21% of total employment. This raises a concern of heterogeneity among sectors, especially between non-financial and financial sectors, and whether this biases our analyses based on the whole sample. We address this concern in Section 1.3.3 where we find the effects are similar between non-financial and financial sectors and remain unaffected after controlling for industry-year fixed effects.

Table 1.2 reports definitions and summary statistics of our variables. The primary focus is on managers’ *Equity Fraction* and *Equity Ratio*, and workers’ wages. First, the incentive measure of most interest is the equity-based pay (stock award and stock option) fractions (divided by total compensation) and ratios (divided by salary) for CEOs and non-CEOs. We find that the magnitudes are substantial, and non-CEOs generally have less incentive compensation than CEOs but not far behind. On average, *Equity Fraction* is 36.7% for CEOs, and 29.8% for non-CEOs. *Equity Ratio* is 3.26 for CEOs and 2.3 for non-CEOs. Next, aside from the equity, non-equity performance pay is also important. For CEO, the non-equity performance pay constitutes 22.7% of CEOs’ total compensations, and 21.2% for non-CEOs. Measured against salary, the non-equity performance pay to salary ratio is 1.69 for CEOs and 1.29 for non-CEOs. In terms of the CEO’s controlling power of the firm, on average the probability of a CEO also serving as the board chair is 54.9%.¹⁹ On average, the CEO owns 2.4% of the firm’s total shares. Finally, the average yearly wage is 83,749 dollars, which include various benefits and incentive pay to employees, with a large standard deviation, 66,509 dollars (in 2010 value).²⁰

¹⁹The U.S. has a particularly high probability of CEO-chair duality comparing to other countries. It is declining in the recent decades thanks to the shareholder movements, including working-class shareholders (Webber 2018: 112-113).

²⁰In our sample, low-average wage (< 25 thousand dollars) and normal/high-wage observations co-exist in many industries, but Eating And Drinking Places industry (SIC 58) contains about 70% of all low-wage observations and no high-wage observation. Nonetheless, our results remain intact

Table 1.1. Distributions of firms across major industries (%), the firm-level sample

Sector (1-digit SIC, division)	Firms	Employments
Mining and Construction	1.52	1.37
Manufacturing 1: Food, Textile, Chemicals, etc.	8.28	7.23
Manufacturing 2: Rubber, Machinery, Electronics, etc.	5.52	16.27
Transportation, Communications, Electric, etc.	19.29	21.51
Wholesale Trade & Retail Trade	8.75	17.84
Finance, Insurance, and Real Estate	44.27	21.37
Services 1: Hotel, Personal Business, Motion Picture, etc.	5.47	4.88
Services 2: Health, Legal, Education, Social, etc.	6.9	9.54

when dropping all the SIC-58 observations, and we consistently control for industry-fixed effects throughout analyses.

Table 1.2: Variables Definitions and Summary Statistics, Firm-Level Sample

Variable	Definition	Mean	S.D.	Min	Max
Manager and Firm Characteristics at the firm-year level. ($N=5,579$)					
Wage	Yearly total labor and related expenses (including incentive pay, benefit plans, payroll taxes, pension costs, profit sharing, salaries and wages, and employer's contribution to health insurance), subtracted by executive compensation, divided by the total number of employees (in 2010 year thousand dollar).	83.749	66.506	2.921	741.02
Log(yearly wage)	Yearly wage in logarithms.	4.179	0.742	1.072	6.608
<i>Manager's compensation structure</i>					
CEO equity-based pay fraction	The CEO's equity-based pay (stock awards + stock options) fraction of the total compensation.	0.367	0.259	0	1
CEO stock award fraction	The CEO's stock awards fraction of the total compensation.	0.186	0.221	0	1
CEO stock option fraction	The CEO's stock option fraction of the total compensation.	0.181	0.225	0	0.971
CEO performance pay fraction	CEO's bonus + long-term incentive pay + equity-based pay, till 2005; CEO's non-equity incentive pay + equity-based pay, since 2006. Divided by the total compensation.	0.583	0.27	0	1
CEO non-equity performance pay fraction	The CEO's non-equity performance pay (bonus + long-term incentive pay till 2005, non-equity incentive pay since 2006) fraction of the total compensation.	0.217	0.2	0	0.984
CEO equity-based pay to salary ratio	The CEO's equity-based pay (stock awards + stock options) divided by salary.	3.259	5.959	0	99.787
CEO stock award to salary ratio	The CEO's stock awards divided by salary.	1.699	4.064	0	95.4

(continued)

(continued)

Variable	Definition	Mean	S.D.	Min	Max
CEO stock option to salary ratio	The CEO's stock options divided by salary.	1.560	3.921	0	84.736
CEO performance pay to salary ratio	CEO's bonus + long-term incentive pay + equity-based pay, till 2005; CEO's non-equity incentive pay + equity-based pay, since 2006. Divided by salary.	4.95	8.555	0	156.165
CEO non-equity performance pay to salary ratio	The CEO's non-equity performance pay (bonus + long-term incentive pay till 2005, non-equity incentive pay since 2006) divided by salary.	1.691	4.309	0	71.429
Non-CEO equity-based pay fraction	Firm-averaged Non-CEO equity-based pay fraction.	0.298	0.192	0	0.905
Non-CEO stock award fraction	Firm-averaged Non-CEO stock awards fraction.	0.159	0.174	0	0.874
Non-CEO stock option fraction	Firm-averaged Non-CEO stock options fraction.	0.156	0.182	0	0.96
Non-CEO performance pay fraction	Firm-averaged Non-CEO performance pay fraction.	0.51	0.229	0	0.982
Non-CEO non-equity performance pay fraction	The Non-CEO executives' non-equity performance pay (bonus + long-term incentive pay) fraction of the total compensation.	0.212	0.178	0	0.965
Non-CEO equity-based pay to salary ratio	Firm-average Non-CEO equity-based pay ratio.	2.304	11.042	0	645.877
Non-CEO stock award to salary ratio	Firm-average Non-CEO stock awards ratio.	1.298	6.33	0	357.280
Non-CEO stock option to salary ratio	Firm-average Non-CEO stock options ratio.	1.115	7.617	0	538.459
Non-CEO performance pay to salary ratio	Firm-average Non-CEO performance pay ratio.	3.596	12.087	0	647.477
Non-CEO non-equity performance pay to salary ratio	Firm-average Non-CEO non-equity performance pay ratio.	1.292	3.259	0	53.73
<i>Manager's characteristics</i>					
CEO total current compensation	CEO's salary plus bonus.	1,331.807	1,715.937	0.001	28,333.105
CEO-chair duality	1 if the CEO is also the board chair, and 0 otherwise.	0.549	0.498	0	1

(continued)

(continued)

Variable	Definition	Mean	S.D.	Min	Max
external CEO	1 if becomes CEO within 3 years of joining the firm, and 0 otherwise.	0.145	0.352	0	1
CEO shareholding	The CEO's shareholding fraction of the firm's total shares.	0.024	0.056	0	0.566
female CEO	1 if the CEO's gender is female, and 0 otherwise.	0.024	0.154	0	1
Non-CEO shareholding female Non-CEO	Firm-averaged Non-CEO's shareholdings fraction 1 if the Non-CEO manager's gender is female, and 0 otherwise. Then take the average within the firm-year to calculate the probability of a non-CEO manager being female.	0.004 0.068	0.01 0.136	0 0	0.17 1
<i>Firm and industry characteristics</i>					
Sale per employee	The value of total sale divided by the number of employees (in million dollar).	498.849	2,529.419	4.782	95,373.172
Total assets	The value of total assets (in million dollar).	43,347.987	192,067.434	4.91	3,221,972
Leverage	Total long-term debts and debts in current liabilities, divided by total assets.	0.234	0.199	0	1.94
Foreign Activity	1 if the firm receives any foreign incomes or pay foreign taxes, 0 otherwise.	0.357	0.479	0	1
Capital expenditures by assets	The funds used for additions to property, plant, and equipment, excluding amounts arising from acquisitions, divided by total assets. In Millions of dollars.	0.047	0.062	-0.001	0.597
Firm-specific time trends	The years since the firm first appears in the Compustat database (1970-2016).	18.851	11.247	1	47
HHI	The Herfindahl-Hirschman index at the 2-digit SIC-year level, based on Compustat data set. A higher HHI indicates a higher degree of sale concentration in the industry.	882.902	611.282	76.918	6,185.75

(continued)

(continued)

Variable	Definition	Mean	S.D.	Min	Max
Workers' characteristics at the 2-digit SIC-year level ($N = 776$)					
Proportion Age 1		0.136	0.108	0	0.597
Proportion Age 2		0.251	0.055	0.087	0.475
Proportion Age 3		0.263	0.058	0.098	0.441
Proportion Age 4		0.223	0.066	0.042	0.472
Proportion Age 5		0.109	0.046	0.004	0.314
Proportion Age 6		0.019	0.016	0	0.103
Proportion Female	1 if the worker's gender is female, 0 otherwise.	0.374	0.182	0.01	0.807
Proportion Years of education 9	1 if highest level of education is 9th degree (≤ 9 years), 0 otherwise	0.034	0.033	0	0.173
Proportion Years of education 10	1 if highest level of education is 10th grade, 0 otherwise	0.018	0.018	0	0.112
Proportion Years of education 11	1 if highest level of education is 11th grade, 0 otherwise	0.035	0.029	0	0.161
Proportion Years of education 12	1 if highest level of education is 12th grade/high school graduate, 0 otherwise	0.32	0.109	0.067	0.622
Proportion Years of education 13	1 if highest level of education is some college, 0 otherwise	0.202	0.047	0.067	0.375
Proportion Years of education 14	1 if highest level of education is associate degree, 0 otherwise	0.094	0.034	0.028	0.22
Proportion Years of education 16	1 if highest level of education is bachelor's degree, 0 otherwise	0.219	0.109	0.029	0.584
Proportion Years of education 18	1 if highest level of education is master's degree, 0 otherwise	0.063	0.05	0	0.242
Proportion Years of education 19	1 if highest level of education is professional degree, 0 otherwise	0.007	0.008	0	0.043
Proportion Years of education 23	1 if highest level of education is doctorate degree, 0 otherwise	0.009	0.014	0	0.104
Proportion Experience 1		0.26	0.118	0.034	0.704
Proportion Experience 2		0.256	0.051	0.107	0.419

(continued)

(continued)

Variable	Definition	Mean	S.D.	Min	Max
Proportion Experience 3		0.248	0.06	0.072	0.472
Proportion Experience 4		0.174	0.066	0.02	0.434
Proportion Experience 5		0.062	0.031	0	0.209
Part-time	Full/part-time status, 1 if the worker is a part-time worker, 0 otherwise.	0.1	0.112	0	0.499
Non-white race	1 if the worker's race is non-white, 0 otherwise.	0.184	0.057	0.023	0.456
Proportion Union coverage	1 if covered by union or collective agreement, 0 otherwise.	0.165	0.166	0	0.859
Proportion Urban residence 1	1 if not identifiable or not in metro area;	0.152	0.116	0.01	0.69
Proportion Urban residence 2	1 if central city, 0 otherwise	0.249	0.079	0	0.523
Proportion Urban residence 3	1 if outside central city, 0 otherwise	0.458	0.087	0.148	0.674
Proportion Urban residence 4	1 if central city status unknown, 0 otherwise	0.134	0.037	0.032	0.314
Proportion Marital status 1	1 if married, spouse present, 0 otherwise	0.582	0.11	0.198	0.86
Proportion Marital status 2	1 if married, spouse absent, 0 otherwise	0.012	0.008	0	0.069
Proportion Marital status 3	1 if separated, 0 otherwise	0.023	0.012	0	0.09
Proportion Marital status 4	1 if divorced, 0 otherwise	0.108	0.027	0.01	0.192
Proportion Marital status 5	1 if widowed, 0 otherwise	0.014	0.009	0	0.092
Proportion Marital status 6	1 if never married/single, 0 otherwise	0.261	0.114	0.042	0.695

1.3.1.5 Model Specification

We estimate a standard fixed effect model as follows:

$$\log(w_{kjsct}) = \alpha_{kjsct} + \beta \mathbf{X}_{kjsct} + \gamma \mathbf{M}_{kjsct} + \delta \mathbf{I}_{kjsct} + \phi \mathbf{V}_{jt} + \mu \mathbf{F}_{jsct} + \varepsilon_{kjsct}, \quad (1.14)$$

where w is the yearly total wage, so $\log(w_{kjsct})$ is the log wage of firm k in industry j in state s and incorporation state c at year t . The firm-fixed effects are included in α_{kjsct} . \mathbf{X}_{kjsct} denotes managerial compensation structures including *Equity Fraction*, *Equity Ratio*, etc. \mathbf{M}_{kjsct} includes other manager characteristics and three variables of managerial controlling power. \mathbf{I}_{kjsct} includes firm characteristics, and \mathbf{V}_{jt} includes ten workers' characteristics at the industry level. \mathbf{F}_{jsct} are industry-, state-, year-, and incorporation-state-year fixed effects, and HHI by industry-year. The robust standard errors are clustered at the firm level. The estimations of β is of particular interest in the following analyses.

1.3.2 Results from basic correlation analyses

Table 1.3 reports basic results of estimation. Consistent with the theoretical prediction, column (1) and (2) show that all else equal, an increase in CEO *Equity Fraction* by one standard deviation (25.9%) is associated with 1.5% lower wages. An increase in *Equity Ratio* is also negatively associated with wages, although not statistically significant at the 10% level. The effect of non-CEO *Equity Fraction* in column (3) is stronger than the result of CEO *Equity Fraction*, while the effect of non-CEO *Equity Ratio* (column (4)) is also weaker and statistically insignificant.

Next, we decompose the equity-based pay into stock awards and stock options to check whether their effects on wages are the same. In Table 1.4, column (1) and (2) show the effects of *Stock Fraction* (stock awards divided by the total compensation) and *Option Fraction* (Stock options divided by the total compensation), while column (5) and (6) shows the effects of *Stock Ratio* (stock awards divided by salary) and *Option Ratio* (stock options divided by salary). Except *Stock Ratio* which is statistically insignificant, the coefficients of all other three measures show clear negative effects on wages. These findings strengthen the theoretical prediction that more equity-based pay, be it stock or option, correlates with lower wages.

We further test the effects of the performance pay as a whole, and the effects of non-equity performance pay in particular. The results of column (3) and (7) show that performance pay as a whole tends to have negative effects on wages. This is

not surprising given the fact that most of the performance pay are equity-based. In contrast, while also being parts of the performance pay, the results of column (4) and (8) show that non-equity elements have positive effects on wages. This interesting result appears again in our robustness tests based on an individual-level sample in Section 1.3.3.3.

Table 1.3. Effects of Equity-Fraction and Equity-Ratio on Wages, Baseline Results

Dependent Variable: Log(Yearly Average Wage)				
	(1)	(2)	(3)	(4)
CEO equity-based pay fraction	-0.058*** (0.021)			
CEO equity/salary ratio		-0.002 (0.001)		
Non-CEO equity-based pay fraction			-0.114*** (0.034)	
Non-CEO equity/salary ratio				-0.001 (0.001)
Manager characteristics by firm-year	Yes	Yes	Yes	Yes
Firm characteristics by firm-year	Yes	Yes	Yes	Yes
Worker characteristics by industry-year	Yes	Yes	Yes	Yes
HHI by industry-year	Yes	Yes	Yes	Yes
Firm-, industry-, state-, and year-fixed effects	Yes	Yes	Yes	Yes
Incorporation state-year-fixed effects	Yes	Yes	Yes	Yes
R-squared	0.307	0.305	0.309	0.304
Observations	5,579	5,579	5,579	5,579
Number of firms	651	651	651	651

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Notes. Equity based pay fraction is defined as the fraction of stock award and stock option in the executive total compensation. Equity/salary ratio is defined as the value of stock award plus stock option divided by the value of salary. Manager characteristics include: gender, total amount of current compensations (salary + bonus), CEO-chair duality, externally-hired CEO, non-CEO's gender. Firm characteristics includes: foreign activity dummy, sales per employee, total assets, leverage ratio, capital expenditure divided by total assets, and firm's age. Worker characteristics include: gender, race, age, education, experience, union coverage, full/part-time status, urban residence, and marital status, all calculated as proportions at the 2-SIC digit-year level. Robust standard errors are adjusted for clustering at the firm level.

Table 1.4. Effects of Four Components of Compensation, Firm-Level Sample

	Dependent Variable: Log(Yearly Wage)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CEO stock award fraction	-0.044*							
	(0.027)							
CEO stock option fraction		-0.045*						
		(0.024)						
CEO performance pay fraction			-0.036					
			(0.023)					
CEO non-equity perf. pay fraction				0.051**				
				(0.025)				
CEO stocks award ratio					0.000			
					(0.002)			
CEO stock options ratio						-0.003**		
						(0.002)		
CEO performance pay ratio							-0.001	
							(0.001)	
CEO non-equity perf. pay								0.003
								(0.002)
Managers' characteristics by firm-year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Worker characteristics by industry-year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm characteristics by firm-year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
HHI by industry-year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-, industry-, state-, and year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Incorporation state-year-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.305	0.305	0.305	0.305	0.304	0.306	0.304	0.305
Observations	5,579	5,579	5,579	5,579	5,579	5,579	5,579	5,579
Number of firms	651	651	651	651	651	651	651	651

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Notes. Performance pay fraction is defined as the fraction of bonus + long-term incentive pay + equity-based pay, till 2005; CEO's non-equity incentive pay + equity-based pay, since 2006, in the executive total compensation. Stock award and stock option fractions are defined as the value of stock award and stock option divided by the value of the executive total compensation. Stock award/salary ratio and stock option/salary ratio are defined as the value of stock award and stock option divided by the value of salary. Non-equity performance pay fraction is defined as the fraction of bonus + long-term incentive pay till 2005, non-equity incentive pay since 2006, in the executive total compensation. Manager characteristics include: gender, total amount of current compensations (salary + bonus), CEO-chair duality, externally-hired CEO, non-CEO's gender. Firm characteristics includes: foreign activity dummy, sales per employee, total assets, leverage ratio, capital expenditure divided by total assets, and firm's age. Worker characteristics include: gender, race, age, education, experience, union coverage, full/part-time status, urban residence, and marital status, all calculated as proportions at the 2-SIC digit-year level. Robust standard errors are adjusted for clustering at the firm level.

1.3.3 Robustness tests

To address several potential concerns regarding our baseline results based on the firm-level sample, in this section we report results from a set of robustness tests. First, a sample selection bias may occur because only about 20% of the firms in Compustat report labor expenses. To deal with this concern, we estimate the Heckman bias

correction model and find similar results (Section 1.3.3.1). We further estimate the same model using the individual-level sample which does not suffer from the problem, and still find consistent results (Section 1.3.3.3).²¹

Second, we examine if our baseline results are biased due to the over-representation of financial firms in the firm-level sample, or omitting the industry-year specific shocks. The results suggest that our baseline results are reliable. The literature on managerial incentives typically focuses on the managerial shareholding. We find that controlling for managerial shareholdings does not change our baseline results (Section 1.3.3.2).

Third, another concern is composition changes, which refers to the problem that, due to business offshoring, the labor expenses reported by firms include wages paid to employees hired in foreign countries. If the wages of the foreign employees are different from the ones in the U.S., a lower mean wage of the firm may reflect either a composition change, a true wage reduction for all workers, or a mix of both. My analyses based on the individual-level sample which includes only workers in the U.S., verify that the negative effects remain statistically significant (Section 1.3.3.3).

1.3.3.1 Sample selection bias

Because firms have not been required to disclose workers' wages under the U.S. Generally Accepted Accounting Principles (GAAP) until very recently,²² only about 20% of firms have reported wages, and they tend to be larger and concentrate in especially the financial sector, as shown in Table 1.1. This raises a concern of sample selection bias.

To address the concern of selection bias, we estimate Heckman's (1976) two-step correction model and report the results in Appendix 3, Table 1.7. Following the approach of Shin (2014), we estimate a series of probit models to identify variables that predict the probability of reporting labor cost, and then find out which ones do not affect the wage level by running a set of regressions with all explanatory variables. The diagnostics suggest that firms reporting selling, general, and administrative expenses

²¹These results are consistent with recent studies using the same average wage data based on Compustat, such as Chemmanur, Cheng, & Zhang (2013) and Faleye, Reis & Venkateswaran (2013).

²²With the implementation of the Dodd-Frank Wall Street Reform and Consumer Protection Act, U.S. firms will need to disclose the median employee compensation, the CEO's compensation, and the ratio of the two, starting at 2018.

(Compustat item: `xsga`) are unlikely to disclose labor costs due to some accounting practices that are unrelated to the wage level. Therefore we use a binary variable indicating whether the firm reports selling, general, and administrative expenses as the selection variable in the Heckman models. As shown in Table 1.7 (Appendix 3), the results from Heckman models are similar with the baseline results in Table 3 and confirm the negative correlation between managerial equity-based pay and workers' wages.

1.3.3.2 Non-finance vs. finance, industry-year-fixed effects, and managerial shareholding

We further perform two other robustness tests and report the results in Appendix 4. First, since about 44% of the firms in the sample concentrate in the financial sector, there is a concern whether the heterogeneity across different industries biases the estimation. We divide the sample into non-financial and financial sectors and estimate the same model. As shown in Appendix 4 Table 1.8 from Column (1) to (4), non-financial firms show the same effects as the whole sample. Although the statistical significance of the CEO *Equity Fraction* or *Equity Ratio* in financial sector is weaker, the results are still consistent and show negative associations of equity-based pay on wages.

Second, it's possible that a temporary shock specific to one industry-year may lead the firms of the industry-year to increase executive equity-based pay and hire more temporary, low-wage workers. To address this issue, we add industry-year-fixed effects in to the model to control for potential shocks specific to an industry-year. As shown in Appendix 4 Table 1.8 Column (5) and (6), the results remain similar with our baseline results.

Third, to compare with the literature that focus on the effect of managerial shareholding, we include the CEO's shareholding fraction in controlling variables, measured by the percentage of the firm's stocks owned by the CEO. As shown in Appendix 4 Table 1.8 Column (7) and (8), controlling for managerial shareholding does not change our baseline results.

1.3.3.3 Sample selection bias, and composition changes by offshoring: tests using the individual-level sample

A concern of the firm-level sample is that a lower mean wage of the firm may reflect firms' offshorings to low-wage countries rather than direct wage reductions. One way to address this concern is to construct a sample containing only workers in the U.S. economy for analysis. We use individual U.S. workers' data (CPS) who are hired in big firms (employing 500 workers and more), and then match them with CEO's compensation structure and firms' information, also limiting to big firms, calculated at the 2-digit industry level.²³ This produces a multi-year, cross-sectional data set with the basic unit being an U.S. worker. Compared to the firm-level sample in which we have individual firms' and managers' information with workers' characteristics at the industry level, here we have an individual worker-level sample with firms' and managers' characteristics at the industry level. Since the information of firm and manager covered in this sample is not constrained by whether the firm reports labor expenses, this sample is comprehensive and does not suffer from the concern of sample selection bias. Details of the sample, summary statistics, model specification, and the regression tables are reported in Appendix 5.

With the individual-level sample, we estimate a cross-section model in which the log hourly wage of individual workers is the dependent variable, and the industry-level CEO *Equity Fraction* or *Equity Ratio*, is the explanatory variable, controlling for a rich set of individual-level characteristics including occupation which is not feasible in the firm-level sample. We further test whether the results vary with two different measures of wages: one includes and the other excludes the amount of employer's contribution for health insurance, since the accuracy of reports of the contributions may be a concern.

Across these settings, results from this individual-level sample are similar with our baseline results. As shown in Appendix 5 Table 1.11 column (1) and (2), the effects of the equity-based pay on wages are all negative and statistically significant.

²³Since CPS contains significant amount of employees who work in small firms, while the Compustat and Execucomp data tend to be reported by big firms, we require individual workers, firms, and managers in the matched data set all to be in big firms, defined as a firm hired at least 500 employees. In this way although we can't link individual workers precisely to their firms, and many workers not employed in the firms in the Compustat-Execucomp linked database are inevitably included in, the workers in the sample should overlap largely with our targeted firms' employees.

All else equal, an increase in CEO *Equity Fraction* by one standard deviation (12.4%) is associated with 0.46% lower wages, and an increase in CEO *Equity Ratio* by one standard deviation (3.959) is associated with 0.15% lower wages. Column (3) and (4) show that the results are not affected if we exclude the employer’s contribution for health insurance from the measure of wage. These results are consistent with the theoretical prediction, and verify that at least parts of the negative effects of equity-based pay on wages in previous sections are not driven by offshorings. They also suggest that the concern of sample selection bias may not be too serious.

Next, as in the analyses of the firm-level sample, We decompose the equity-based pay into stocks and options, and also compute variables for performance pay and non-equity performance pay. As shown in Table 1.12, the directions of the coefficients of most variables are the same as in the firm-level analyses (Table 1.4), although the magnitudes are smaller. On the one hand, more stock awards and stock options also associate with lower wages, and so do performance pay, consistent with our theoretical prediction. On the other hand, non-equity performance pay associates with higher wages both in the firm-level and the individual-level samples. This interesting result, however, should be treated with caution, because there is no clear theory to rigorously guide our estimation and prediction, and the designs of non-equity performance pay (bonuses and long-term incentives) are likely to be more complex and diverse among firms than equity-based pay.

1.4 Identification Strategy

The analyses in the previous sections show that workers’ wages are lower as managers receive more equity-based pay. However, the correlation may not mean causality. There might be unobserved factors, such as a technology change and a worrisome business outlook, affecting both managers’ compensation structures and workers’ wages and creating the negative correlation we saw in Section 1.3. To test whether the effect is causal or not, we need to identify a change in the managerial compensation structure that is unrelated to these unobserved factors. In this section, we utilize a change in the corporate tax policy as an instrumental variable for the CEO’s compensation structure and implement the IV estimation. Section 1.4.1 explains the institutional background and the choice of my instrumental variable. Section 1.4.2 presents the model specification and estimation results.

1.4.1 Internal Revenue Code 162(m) and the construction of IV

Enacted by Congress in 1993, section 162(m) of the Internal Revenue Code limits the deductibility of top five executives' non-performance-related compensations over \$1 million, and imposes a 60% federal surtax on salaries above \$1 million. In this way, the legislation encourages firms to increase the use of performance pay rather than fixed salary while leaving open the total amounts of compensations. Responding to the legislation, several studies found that firms originally paying higher salaries reduced salaries to \$1 million, and firms originally paying lower raised salaries over time but didn't go above \$1 million (Perry & Zenner, 2001; Rose & Wolfram, 2002). At the same time, the growth of the total amounts of executive compensation has been unaffected by the legislation. Firms simply switched from salary to other forms of compensations such that the structure of executive compensation has become more equity-based and more sensitive to firms' (stock market) performance (Perry & Zenner, 2001; Balsam & Ryan, 2007).

As shown in Figure 1.1, in my firm-level sample there is indeed a significant, abnormal bunch of firms paying CEOs' salaries right at the tax deductibility threshold, one million dollars. Further, in Figure 1.2, by graphing the distribution separately in every five-years period, we can see clearly that this bunch grows higher and higher over each period. This implies that many firms indeed are affected by legislation and freeze CEOs' salaries at the threshold, and the amount of firms affected grows over time. In this case, if the firms want to pay their CEOs more, they are more likely raise performance pay especially the equity-based pay, and we will see a change in the compensation structure as a result.

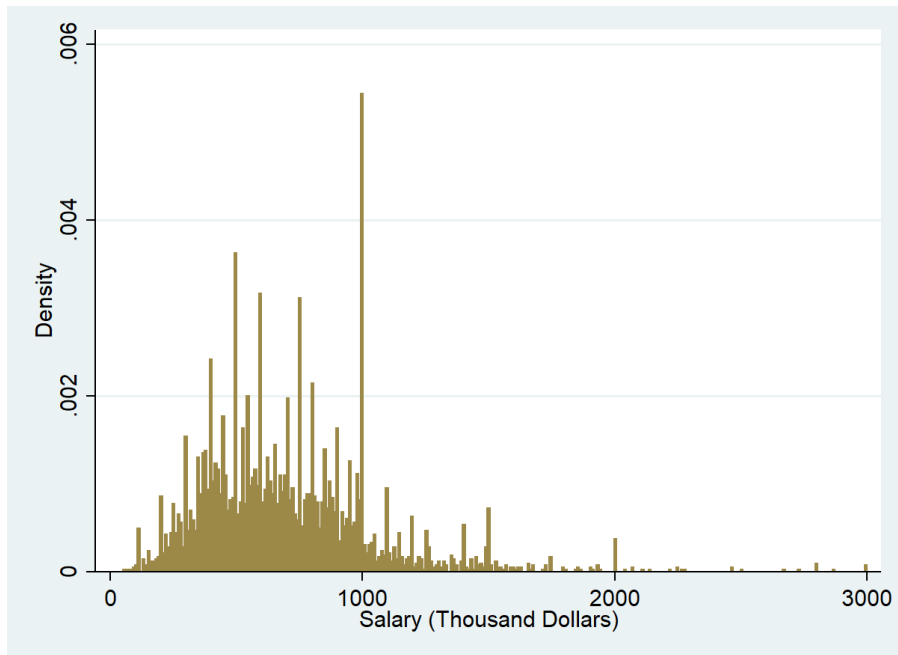


Figure 1.1. The bunching distribution of firms by CEO's salary, whole-sample period (1992-2016)

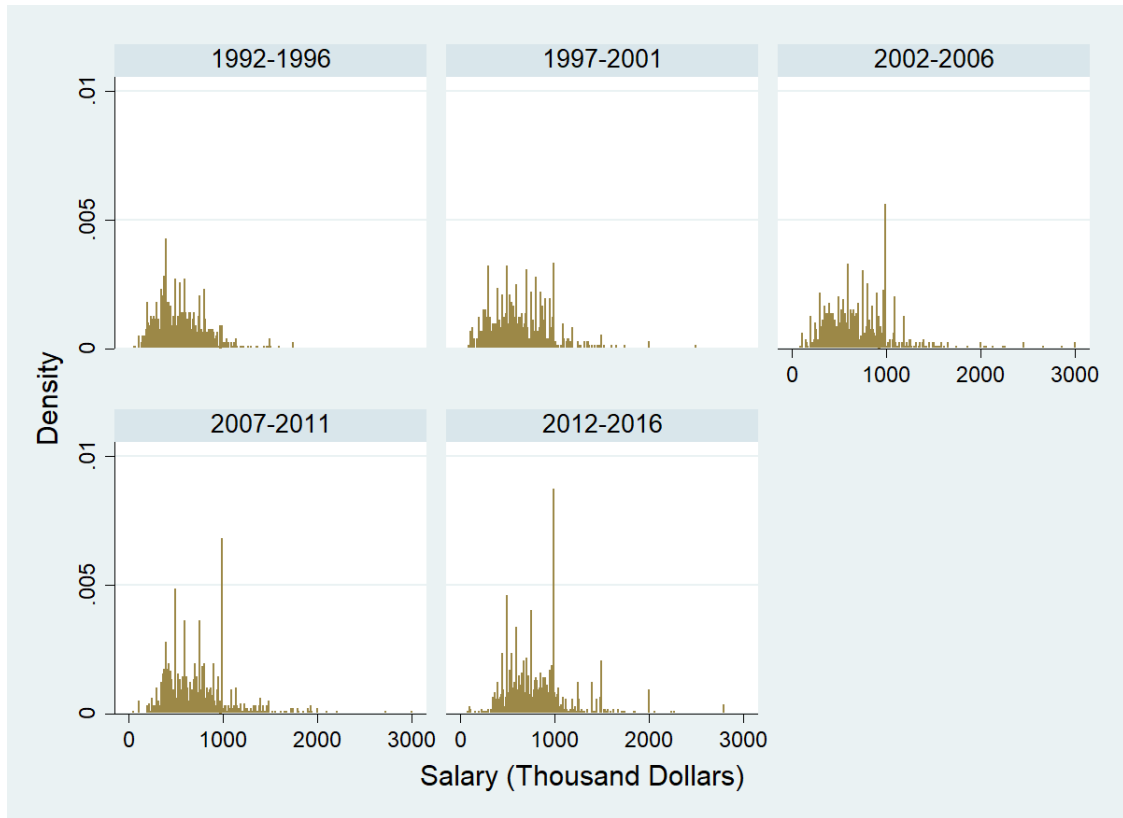


Figure 1.2. The bunching distribution of firms by CEO’s salary, five-year periods

A few issues need to be dealt with before we can utilize the legislation as an instrument for estimation. First, is the choice of measurement. The key compensation item this legislation aimed to limit is salary, so the effect of the legislation on compensation structure would be captured more precisely by a measurement of equity-based pay relative to salary, rather than the shareholding as commonly used in the literature. Two measurements of CEO equity-based compensation, *Equity-Fraction* and *Equity-Ratio*, are used in the previous analyses. The former is expected to be too noisy in measuring and interpreting the change, because it uses total compensation as the denominator which includes salary, bonus, equity, non-equity incentives, etc, and many of them may also change as equity increases, and the effects can be complex. Therefore, to capture the policy change more precisely, a natural choice of measurement seems to be the equity-based pay-to-salary ratio. To pin down the interpretation, we further focus on the CEO in the following analyses but continue controlling for variables of non-CEO managers’ controlling powers.

Second, to analyze the causal effect, we need to identify the treatment imposed on firms. While CEOs' compensation structures may change, which firms were really affected by the legislature is not completely clear. Intuitively, the treatment effect of Section 162(m) on firms' decisions works in a way of a probability over a certain range of CEOs' salaries rather than a sharp discontinuity starting at \$1 million dollars. Besides, since CEOs' salaries would likely move toward the threshold over time from both sides, the area around the threshold is definitely the center of the range of treatment and will be our main focus, but what the lower and upper bounds of the range are remain uncertain. We therefore try different treatment ranges in the following analyses.

Based on the above considerations, We use two variables as our instrument for the change in CEO's *Equity Ratio*: a dummy variable indicating whether the CEO's salary falls into the treatment range since 1994, and the CEO's salary level controlling for the simple arithmetic relationship between the amount of salary and the ratio. Since the legislature and whether a CEO's salary falls into the treatment range are exogenously determined and orthogonal to workers' wages, we argue that the first variable satisfies the exclusion restriction of instrumental variable. The second variable might be of some concern to firms that want to keep the gap between CEOs' total compensation and the average wages within certain ranges. Fortunately, since salary is a relatively small part of CEO's total compensation and determined in a process separately from the determination of the mean wage, and we also control for the sum of salary plus bonus to control for the possible relationship between the CEO's total compensation and workers' wages, we argue that the concern is not serious and the IV satisfies the requirement.

1.4.2 IV estimations

We estimate a two-stage-least-square model in which the first stage is:

$$X_{kjsct} = \alpha_1 + \eta \mathbf{Z}_{kt} + \gamma \mathbf{M}_{kfst} + \delta \mathbf{I}_{kfst} + \phi \mathbf{V}_{jt} + \mu \mathbf{F}_{jsct} + \varepsilon_{kjsct}; \quad (1.15)$$

and the second stage is:

$$\log(w_{kjsct}) = \alpha_2 + \beta \widehat{\mathbf{X}}_{kfst} + \gamma \mathbf{M}_{kfst} + \delta \mathbf{I}_{kfst} + \phi \mathbf{V}_{jt} + \mu \mathbf{F}_{jsct} + \varepsilon_{kjsct}. \quad (1.16)$$

where X_{kjsct} is the CEO *Equity Ratio*, \mathbf{Z}_{kt} is our instruments including a treatment range dummy and the level of salary. The definitions of other variables are the same as in Equation (1.14). The coefficient β is our main focus in the following analyses.

In terms of the controlling variables, one difference between the IV and the previous OLS estimations is that we include the CEO's non-equity performance pay ratio in the IV estimation. Because our instrument, the tax policy change, allows all types of performance pay enjoying tax deductions. In responding to the policy change, firms may increase not only equity-based performance pay but also the non-equity ones. Moreover, as shown in Section 1.3.2 Table 1.4, the CEO's non-equity performance pay does associate with higher wages. In this case, if we omit the non-equity performance pay, the effect of our instrument on wages will likely go through this omitted variable, and violate the exclusion restriction.²⁴

Another difference is the control of firm-fixed effects (or CEO-fixed effects). While we control for firm-fixed effects in previous estimations, doing so will understandably invalidate the instrument, particularly the treatment range dummy, since firms do not switch in and out of the treatment frequently, there is not enough variation of the treatment within firms. In spite of this limitation, we had compared the CEO's *Equity Ratio* effects before and after controlling for the firm-fixed effects (using the model in column (2) of Table 1.3), and found that the sign of the coefficients remains the same while the magnitudes are very similar. This suggests that the concern of leaving out firm-fixed effects would be moderate.

The results of IV estimation are reported in Table 1.5. Due to the uncertainty of the treatment range of the legislation, columns (1) to (4) try various bounds of the treatment range which all include the bunching center, \$1 million dollars. For example, column (1) shows the results from using a treatment range covering salaries starting at 750 thousand dollars.

²⁴The results are very similar if we include non-equity performance pay in the baseline analyses.

Table 1.5. Evidence on Causality, IV Estimation (LIML Estimator)

Treatment range (\$Salary, thousand dollars; year \geq 1994)	750- (1)	850- (2)	950- (3)	1000- (4)
<i>First Stage</i>				
	Dependent Variable: CEO equity/salary ratio			
Treatment range dummy	0.684** (0.314)	0.886*** (0.302)	0.936*** (0.323)	0.536 (0.33)
Salary	-0.002*** (0.001)	-0.002*** (0.001)	-0.002*** (0.001)	-0.002*** (0.001)
1st-stage F of IV	8.69	9.51	9.82	5
MOP effective F	5.82	6.91	6.83	5.48
<i>Second Stage</i>				
	Dependent Variable: Log(Yearly Average Wage)			
CEO equity/salary ratio	-0.047* (0.025)	-0.041* (0.022)	-0.039* (0.022)	
CLR test p-value ($H_0: \beta = 0$)		0.023	0.029	
CLR 95% conf. sets		[-.111, -.006]	[-.1, -.004]	
<i>Controlling Variables</i>				
Manager characteristics by firm-year	Yes	Yes	Yes	Yes
Firm characteristics by firm-year	Yes	Yes	Yes	Yes
Worker characteristics by industry-year	Yes	Yes	Yes	Yes
HHI by industry-year	Yes	Yes	Yes	Yes
State-, industry-, and year-fixed effects	Yes	Yes	Yes	Yes
Incorporation state-year-fixed effects	Yes	Yes	Yes	Yes
Observations	5,579	5,579	5,579	5,579
Number of firms	651	651	651	651

Robust S.E. in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Clustered at firms.

Notes. Column (1) to (4) are results using treatment ranges of 750/850/950/1000 thousand dollars and above. Equity based pay/salary ratio is defined as the value of stock award plus stock option divided by the value of salary. Manager characteristics include: gender, total amount of current compensations (salary + bonus), CEO-chair duality, externally-hired CEO, non-CEO's gender, the CEO's and non-CEO's non-equity performance pay ratios. Firm characteristics includes: foreign activity dummy, sales per employee, total assets, leverage ratio, capital expenditure divided by total assets, and firm's age. Worker characteristics include: gender, race, age, education, experience, union coverage, full/part-time status, urban residence, and marital status, all calculated as proportions at the 2-SIC digit-year level. All controlling variables are the same as in correlation analyses except the non-equity performance pay ratio and firm-fixed effects. Robust standard errors are adjusted for clustering at the firm level. MOP effective F and CLR test p-value and confidence sets are reported following the recommendations by Andrews, Stock, and Sun (2018).

The results from the first stage estimation suggest that our instruments are valid in general, and the directions are also consistent with our prediction, i.e., the IRC 162(m) legislation increases the use of equity based pay. The results are robust across various choices of treatment ranges as long as the area around the threshold is included. Otherwise, as shown in column (4), the dummy variable of the treatment fails to capture the variation of CEO equity/salary ratio at 10% statistically significant level. This is consistent with the implication that the estimated results are driven by the

policy-induced change in the compensation structure around the threshold, rather than unobservable factors varied with CEOs' salaries.

The F- and Montiel Olea-Pflueger (MOP) effective F-statistics, however, are all smaller than the rule-of-thumb value, 10, suggesting that our instruments are weak. To deal with this issue, the results reported in Table 1.5 are based on the Limited Information Maximum Likelihood (LIML) estimator²⁵ which is more nearly centered at the true value of the estimand (Stock & Watson, 2003: 467). In addition, we adopt the weak-IV robust inference method suggested by Andrews, Stock & Sun (2018) and report the results from Conditional Likelihood Ratio (CLR) tests using the treatment ranges of 850- and 950-. As shown in the column (2) and (3) in Table 1.5, the p -values the CLR tests suggest that we can reject the null hypothesis that true value of the estimand is zero, and the confidence sets do not include zero or the non-IV estimates from our baseline results (-0.002), implying that our estimation is still reliable in spite of weak instruments.

Based on the results of the second stage estimation, our IV estimation largely agrees with our baseline OLS estimation: given the validity of the instrumental variables, the effect of CEO equity/salary ratio on wages is clearly negative, and the coefficients in Column (2) and (3) are around -0.04 which are much stronger and significant compared to the previous result in Table 1.3 column (2) (-0.002). This evidence therefore indicates that one unit increase in the CEO's equity-to-salary ratio, say, from 1:1 to 2:1, will lead to about a 4% reduction in the average wage, all else equal. Put it in another way, an increase in the CEO's equity-to-salary ratio by one standard deviation (4.06) will lead to 16.24% lower wages.

1.5 Whether and how is the effect of CEO equity Pay on Wages affected by competition?

In previous analyses, we hold the degree of market competition constant by consistently controlling for HHI. In this section, we move beyond the average results

²⁵The original 2SLS results are very similar.

and analyze whether and how is the effect of CEO equity pay on wages affected by different degrees of market competition.²⁶

1.5.1 Theory

A theory argues that corporate governance doesn't matter in competitive markets, because competition constantly forces managers to reduce any slack or waste for surviving, with or without a good governance institution. Therefore, a change in the governance institution should make little difference for firms' performances when competition is strong. Supporting this theory, Giroud & Mueller (2010) show that an exogenous change in the anti-takeover regulation, which makes managers less likely to be punished for shirking, has no impact on performances when the degree of competition is at the high level, comparing to when competition degree is low.

Does this apply to the negative impact of CEO equity pay on wages as well? We suspect not. Regarding the relationship with competition, a key difference between other governance institutions and compensation is: other governance institutions are designed to replicate the discipline of competition particularly when competition is weak. Hence, it's quite natural that governance makes little difference when competition is strong. In contrast, compensation is designed to translate market valuation into the manager's reward assuming that competition and market valuation work well. Therefore the effect of compensation should be larger when competition is strong, but may not function well when competition is weak.

More specifically, under strong competition, market valuation is more sensitive to the change in firm performances, such that the same gap in performance can generate a larger difference in stock prices, comparing to the case under weak competition. Since equity-based compensation ties the manager's reward to the stock price, a

²⁶Please note that we keep focusing on the consequence of CEO compensation structure in this section, rather than the cause of it. Regarding the later question, there is a large literature on the product market competition effect on managerial incentive provisions, but the direction remains indeterminate. For example, theoretically, while Hart (1983) suggests competition reduces the managerial slacks implying less need for managerial incentive provisions, Scharfstein (1988), Hermalin (1992), Schmidt (1997), and Raith (2003) argue that the effects vary with various conditions, and the results can be ambiguous. Empirically, Cuñat & Guadalupe (2009) find that more competition increases managerial incentive provisions and the sensitivity of pay to performance, but Fernandes, Ferreira & Winters (2018) find opposite results. To investigate this question, one needs to identify an exogenous change in the degree of competition, which is beyond the scope of this paper. In this section, we simply show that *Equity Ratio* goes up with all three degrees of competition in our first-stage estimation, and then keep focusing on the marginal effects.

larger difference in prices means a larger difference in the manager’s monetary income between keeping the peaceful labor relation or choosing high-level monitoring and reducing wages. Therefore, at any given equity ratio, the opportunity cost for the manager to keep the peaceful labor relation is higher under strong competition than weak competition, such that the manager will more likely choose high-level monitoring and reduce wages.

We can use the model presented in Section 1.2 to pin down the idea. In that model, even under the assumption that a higher monitor level does not bring higher outputs (y), because surplus (Π) is still affected by the manager’s choice of monitor level, the manager may still be willing to exercise high-level monitoring and trade off the private benefit from a peaceful life for equity income, as long as the equity ratio is high enough. There, we implicitly assume that the sensitivity of stock price to surplus is identical across industries, which may be more legitimate when analyzing the average pattern. Now, if we are to analyze the possibly different impacts on wages under different degrees of competition, we would let the price-to-surplus sensitivity vary with the degree of competition. In addition, we would expect the price-to-surplus sensitivity to be larger when competition level is high, where a small improvement in efficiency can lead to a bigger reward, and a failure of doing so invites punishments easily.

Let’s reinterpret λ in the stock market evaluation function (Section 1.2 Equation (1.5)) as the indicator of the price-to-surplus sensitivity, and let λ to be larger in cases of high competition. Since λ determines the gap in stock prices between high- and low-surplus firms, a larger λ implies that market rewards a high surplus more and also punishes a low surplus more. Then a larger λ translates into a smaller β in Equation (1.11). According to Equation (1.12), this means that β^F is more likely to be larger than the small β under strong competition, such that the manager would more likely choose high-level monitoring and reduce wages in those industries, all else equal. If that’s the case, we would expect to see the negative impact of equity ratio on wages to be larger when the degree of competition is high, which is a completely reversed pattern of Giroud & Mueller (2010).

1.5.2 Model specification

To proceed, we utilize interaction terms following Giroud & Mueller (2010)’s approach. We first rank all Herfindahl-Hirschman Index (HHI) at the same year from

small to large and group them into 3 levels, in which 3 denotes the largest, 2 the medium, and 1 the smallest. HHI=1 represents the high degree of competition, and HHI=3 the low degree of competition. Then we add two interaction terms between competition and *Equity Ratio* into our model in Section 1.4.2. Specifically, we fit the following model on the firm-level sample we used in previous sections, in which the first-stage estimate equations are:

$$\begin{aligned} X_{kjsct} = & \alpha_{kjsct} + \eta_{11}\mathbf{Z}_{kt} + \eta_{12}\mathbf{Z}_{kt}H(2)_{jt} + \eta_{13}\mathbf{Z}_{kt}H(3)_{jt} \\ & + \eta_{14}H(2)_{jt} + \eta_{15}H(3)_{jt} + \eta_{16}\mathbf{Control}_{kjsct} + \epsilon_{kjsct}; \end{aligned} \quad (1.17)$$

$$\begin{aligned} X_{kjsct}H(2)_{jt} = & \alpha_{kjsct} + \eta_{21}\mathbf{Z}_{kt} + \eta_{22}\mathbf{Z}_{kt}H(2)_{jt} + \eta_{23}\mathbf{Z}_{kt}H(3)_{jt} \\ & + \eta_{24}H(2)_{jt} + \eta_{25}H(3)_{jt} + \eta_{26}\mathbf{Control}_{kjsct} + \epsilon_{kjsct}; \end{aligned} \quad (1.18)$$

$$\begin{aligned} X_{kjsct}H(3)_{jt} = & \alpha_{kjsct} + \eta_{31}\mathbf{Z}_{kt} + \eta_{32}\mathbf{Z}_{kt}H(2)_{jt} + \eta_{33}\mathbf{Z}_{kt}H(3)_{jt} \\ & + \eta_{34}H(2)_{jt} + \eta_{35}H(3)_{jt} + \eta_{36}\mathbf{Control}_{kjsct} + \epsilon_{kjsct}. \end{aligned} \quad (1.19)$$

With the three instrumented variables, \widehat{X}_{kjsct} , $X_{kjsct}\widehat{H}(2)_{jt}$, and $X_{kjsct}\widehat{H}(3)_{jt}$, we then estimate the following model at the second stage:

$$\begin{aligned} \log(w_{kjsct}) = & \alpha_{kjsct} + \beta_0\widehat{X}_{kjsct} + \beta_1X_{kjsct}\widehat{H}(2)_{jt} + \beta_2X_{kjsct}\widehat{H}(3)_{jt} \\ & + \beta_3H(2)_{jt} + \beta_4H(3)_{jt} + \beta_5\mathbf{Control}_{kjsct} + \varepsilon_{kjsct}, \end{aligned} \quad (1.20)$$

where \mathbf{Z}_{kt} is our instruments including a treatment range dummy (salary \geq 850 thousand dollars and year \geq 1994) and the amount of salary. $H(2)_{jt}$ and $H(3)_{jt}$ are binary variables indicating the HHI of level 2 (medium competition) and 3 (low competition). $\mathbf{Control}_{kjsct}$ is the vector of all controlling variables we consistently used in the previous sections. The coefficients β_0 , β_1 , and β_2 are our focuses in the following analyses.

1.5.3 Marginal effects vary with the degree of competition

We report the results in Table 1.6 where Column (1) to (3) contain results from the first-stage estimation, and Column (4) the second-stage.²⁷ In spite of the weak instruments, we conclude the concern to be moderate based on the results of Angrist-Pischke tests, and the similarity between LIML and 2SLS results. Column (1) and (3) show signs indicating that the CEO equity ratio increases with the treatment no

²⁷The results reported here are based on the LIML estimator. 2SLS results are very similar.

matter competition is strong or weak, while Column (2) shows the increase when competition level being medium is statistically insignificant.

With the clear signs of increases in the equity ratio particularly under high-degree and low-degree of competition, our second-stage results show that their impacts on wages are quite different. Interestingly, consistent with our theory, the impact is the strongest when interacting with the high degree of competition. The coefficient, -0.096 , implies that an unit increase in CEO equity ratio, say, from 1:1 to 2:1, leads to a 9.6% decline in the average wage when competition is strong, which is stronger than our baseline average effect (4%). The magnitude of the impact tends to decrease when interacting with lower degrees of competition. When interacting with weak competition, the negative impact of CEO equity ratio on wages is the smallest, where a unit increase in equity ratio leads to just 1.2% decline in the average wage.

Figure 1.3 plots the three marginal effects of CEO equity ratio on wages when interacting with three levels of competition, and shows the negative impact to be larger when interacting with higher degree of competition. The confidence intervals show that while the effect under medium-level competition is often indistinguishable from the effects under other competition levels, the effect under weak competition is clearly different from, and smaller than, the effect under strong competition.

Table 1.6. Marginal effects vary with the degree of competition: IV Estimation (LIML)

	<i>First Stage</i>			<i>Second Stage</i>	
	Equity ratio (1)	Equity ratio × HHI(2) (2)	Equity ratio × HHI(3) (3)		Log(Wage) (4)
Treatment dummy	1.626** (0.737)	0.082 (0.318)	-0.017 (0.323)	Equity ratio	-0.096*** (0.036)
Salary	-0.004** (0.002)	-0.002*** (0.001)	-0.003*** (0.001)	Equity ratio × HHI(2)	0.026 (0.055)
Treatment dummy × HHI(2)	-0.666 (0.986)	0.974 (0.907)	0.033 (0.473)	Equity ratio × HHI(3)	0.084** (0.04)
Treatment dummy × HHI(3)	-0.728 (0.83)	-0.376 (0.371)	1.185** (0.533)	HHI(2)	-0.104 (0.231)
Salary × HHI(2)	0.000 (0.002)	-0.000 (0.002)	0.001 (0.001)	HHI(3)	-0.37** (0.18)
Salary × HHI(3)	0.002 (0.002)	0.001** (0.001)	0.001 (0.001)		
Angrist-Pischke F-statistic	3.384	6.455	8.428		
Angrist-Pischke F-test p-value	0.009	4.26e-5	1.24e-6		
<i>Controlling Variables</i>					
Manager characteristics by firm-year	Yes	Yes	Yes		Yes
Firm characteristics by firm-year	Yes	Yes	Yes		Yes
Worker characteristics by industry-year	Yes	Yes	Yes		Yes
State-, industry-, and year-fixed effects	Yes	Yes	Yes		Yes
Incorporation state- year-fixed effects	Yes	Yes	Yes		Yes
Observations	5,579	5,579	5,579		5,579
Number of firms	651	651	651		651

Robust S.E. in parentheses: *** p<0.01, ** p<0.05, * p<0.1. Clustered at firms.

Notes. Column (1) to (3) report the first-stage results for three endogenous variables. Column (4) reports the second-stage results using the instrumented variables. Treatment dummy is define as 1 if the CEO's salary \geq 850 thousand dollars at year \geq 1994. HHI(2) is a dummy indicating if the industry is at the second level of concentration (a medium-competition industry). HHI(3) is a dummy indicating if the industry is at the third level of concentration (a low-competition industry). Equity based pay/salary ratio is defined as the value of stock award plus stock option divided by the value of salary. Manager characteristics include: gender, total amount of current compensations (salary + bonus), CEO-chair duality, externally-hired CEO, non-CEO's gender, the CEO's and non-CEO's non-equity performance pay ratios. Firm characteristics includes: foreign activity dummy, sales per employee, total assets, leverage ratio, and firm's age. Worker characteristics include: gender, race, age, education, experience, union coverage, full/part-time status, urban residence, and marital status, all calculated as proportions at the 2-SIC digit-year level. All controlling variables are the same as in correlation analyses except the non-equity performance pay ratio and firm-fixed effects. Robust standard errors are adjusted for clustering at the firm level. Angrist-Pischke F statistics and tests are designed for inference when using multiple instruments (Angrist & Pischke, 2008).

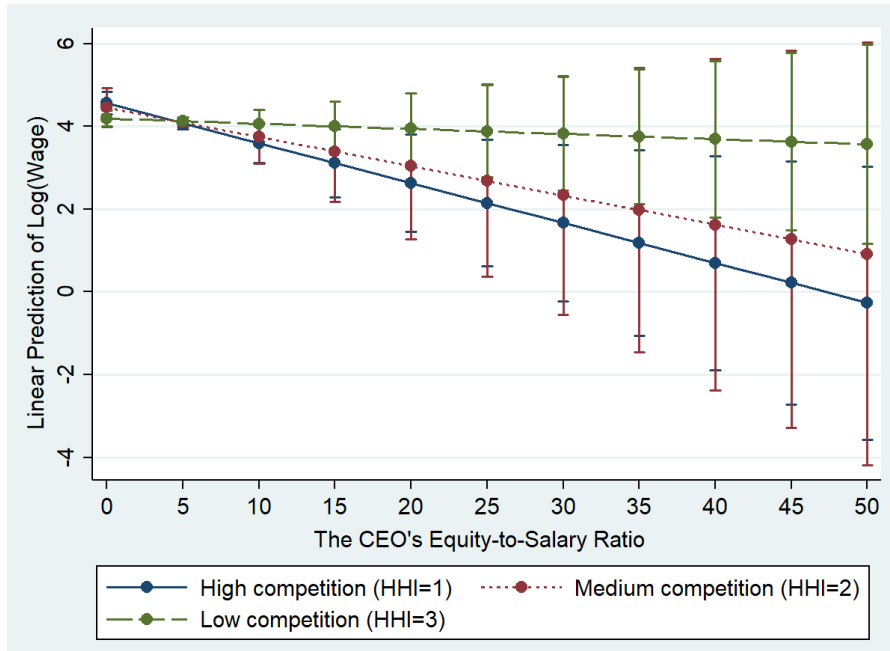


Figure 1.3. Marginal effects of equity ratio on wages, interacting with three levels of competition

1.6 Conclusion

Does equity-based compensation, such as stock awards and stock options, incentivize managers to pay their workers less? Evidence reported in this paper suggests it does. Analyzing a sample that matches firm, manager, and worker information in the U.S. economy over the period 1992-2016, we find that wages are negatively associated with the CEO's equity-based pay across various measures and model settings. Using the change in corporate tax policy in 1993, IRC 162(m), as an exogenous factor increasing the CEO compensation structure, we identify that a one unit increase in the CEO's equity-to-salary ratio, say, from 1:1 to 2:1, will lead to a 4% decline in average wages.

Does intense product market competition reduce this negative effect? Our finding suggests the opposite. A literature finds that when the degree of competition is high, changes in corporate governance institutions have little effect on firms' performances. In contrast, we show that the negative effect of equity pay on wages is stronger under strong competition than weak competition. A unit increase in the CEO's equity-to-salary ratio (from 1:1 to 2:1) will decrease the average wage by 9.6% under strong

competition, but only by 1.2% under weak competition. Our finding highlights a critical feature of equity-based compensation regarding its relationship to competition: equity-based compensation is designed to make the manager's reward sensitive to market valuation, assuming that market competition and valuation work well.

These results have several implications. First, researchers interested in causal effects of executive compensation may benefit from the identification strategy used in this paper. Second, if we count executive compensation as an institution of corporate governance, our finding implies that some corporate governance institutions may still matter in competitive markets, and the relationships between competition and various corporate institutions may be heterogeneous and deserve more investigations. Third, supplementing the current literature on monopsony and monopoly in the product and labor markets, this paper suggests that the power relationship within firms has important effects on wage outcomes as well. Fourth, in terms of policy, this paper sheds light on a dark side of shareholder primacy in which shareholders' wealth may be at the cost of workers' welfare. Public policy debates on executive compensation, and on corporate governance in general, can be advanced by accounting for our findings and giving a role to workers' voices.

CHAPTER 2

DOES EQUITY-BASED PAY AMPLIFY CORPORATE INVESTMENT HERDING?

2.1 Introduction

2.1.1 The research question: the effect of equity-based pay on herd behavior

In 1907, the pioneer statistician Francis Galton went to the West of England Fat Stock and Poultry Exhibition held in Plymouth, where people were participating in a contest of guessing the actual weight of an ox, and those coming closest would win. After reading guesses on 787 entries, Galton found that the median guess was 1,207, just 9 pounds over the actual weight, 1,198, and the average guess is even closer: 1,197 (Galton, 1907; Jackson, 2019). This wisdom of the crowd is perhaps why Keynes observed that when facing fundamental uncertainty about the future, people tend to follow others' moves as an easy guide, substituting for their own judgements (Keynes, 1937). Interestingly, possibly inspired by his own experience as an investor, Keynes emphasized more that people may herd as well when their compensations and careers depend on others' perceptions, such as the money manager depends on investors, or the corporate executive depends on shareholders, for the manager know that "it's better for reputation to fail conventionally than to succeed unconventionally" (Keynes, 1936). Compared with these two views, one can not help but ask: how would the herd behavior changes if we bring the compensation factor into the first scenario?

After Keynes, the literature of the effect of compensation on herd behaviors developed two theories, in line with the above two views.¹ The information-based theory

¹I thanks Gerald Epstein's insight that both views can be found in Keynes' writings. There are other theories of herding beyond the scope of this paper, like the behavioral theory (Shiller, 2015), because its mechanisms are independent of the managerial compensation structure.

(Banerjee, 1992; Bikhchandani, Hirshleifer & Welch, 1992; Devenow & Welch, 1996) suggests that the cause of herd behavior is managerial shirking from acquiring and utilizing firm-specific information. Instead of working hard on his/her own to examine firm-specific information, as the ox weight speculators did a century ago, the manager relies on the information of other firms in analyzing market conditions and designing strategies. In this case, a more equity-based compensation can align the manager's incentive with shareholders' interests such that he/she would invest more efforts in firm-specific information and reduce herd behaviors.

In contrast, the compensation-based theory (Scharfstein & Stein, 1990; Brandenburger & Polak, 1996; Bikhchandani, Hirshleifer & Welch, 1998; Holmström, 1999)² suggests that herd behavior comes from the financial incentive of the manager, particularly when his/her compensation is tied to stock price. Since shareholders do not obtain firm-specific information as the manager does, and stock price often reflects shareholders' general sentiment (and herding sometimes), a manager under equity-based compensation scheme can receive higher financial rewards by adopting the strategy that fits with shareholders' perceptions, rather than following the firm-specific information known only to him/herself. In this case, a more equity-based compensation will amplify the herd behavior.³

With opposite predictions from two well-articulated theories, it's interesting to see which one fits better with empirical evidence. Moreover, as Chief Executive Officers and money managers received ever higher equity-based pays in the recent decades, especially in the U.S., the significance of this question is anything but trivial.

²Scharfstein & Stein (1990) and Holmström (1999) emphasize more on the reputation, but in terms of prediction, the reputation-based theory is consistent with other the compensation-based theories in the sense that more equity-based pay makes the manager more concerned of shareholders' evaluations which affect his/her career, and therefore becomes more enthusiastic in delivering what market wants. Holmström (2016) recently express this view again in the context of the recent financial crisis.

³An alternative, shareholder-view interpretation can be as follows: Typically the CEO seeks private benefits by engaging in "empire building" such that the firm deviates from industry norm. By raising the CEO's equity pays, he/she would reduce "empire building" and convert to the norm.

Surprisingly, the empirical studies on this question are still scarce,⁴ the few results are mixed, and none of them addresses the endogeneity issue.

This paper examines these two theories by empirically investigating the relationship between the Chief Executive Officer (CEO)'s stock-based compensation and corporate herding (co-movement) in investment. Specifically, I define investment herding as the co-movement or correlation between industry-median investment changes and firms' investment changes, and examine whether higher equity-based pays increase or decrease the industry-firm investment co-movement, using a CEO-firm matched sample covering non-financial firms in the U.S. economy over the period 1992-2016. We find that more equity-based pay leads to less investment co-movement, and therefore provide evidence for the information-based theory.

Several factors can affect both the firm's investment decisions and the determination of the CEO's compensation structure, and make the observed correlation between them non-causal. For example, an within-industry idiosyncratic change in technology which occurs to some firms rather than others may reduce the investment co-movement, and affects the CEO's compensation by changing the requirements of managerial skills. Alternatively, a firm facing a worrisome business outlook may decide to try somethings innovative, therefore reducing the co-movement, while at the same time paying the CEO more equity incentives.

To deal with these concerns and to identify the causal effect of the equity-based pays on the co-movement, a major advance of this paper is to utilize a tax policy change (IRC 162(m)) as the instrument for the CEO's compensation structure. The Section 162(m) of Internal Revenue Code in 1993 changed the corporate-tax deductibility of CEO's salary. Under this legislation, non-performance pay, mainly salaries, paid to top-five managers above \$1 million will be subjected to a 60% federal surtax. As a consequence, firms switch to forms of performance pay, especially equity-based ones, to compensate their managers while keeping salaries at or below the \$1 million threshold. We use whether the CEO's salary falls into the treatment range around (and above) the threshold, and the amount of salary, as instruments

⁴Several extensive reviews of the executive compensation literature mention no study on this issue, including Edmans, Gabaix & Jenter (2017), Murphy (2013), Aggarwal (2008), and Core, Guay & Larcker (2003). Most literature on firms' or individual investor's herd behaviors omit this issue as well. Please see Bikhchandani & Sharma (2000), Hirshleifer & Hong Teoh (2003), and Spyrou (2013) for literature reviews.

for changes in the CEO compensation structure measured by the equity-based-pay-to-salary ratio.⁵

2.1.2 Related literature and contributions

As mentioned above, empirical studies of this issue are rare. The one closest to this paper is Knyazeva, et al. (2008). They analyze the effects of a set of managerial incentive and corporate governance institutions on the co-movement of non-financial firm's investments using samples of U.S. and non-U.S. non-financial firms. Their U.S. firm sample contains about 8,000 firm-year observations over the period of 1995-2004. They define co-movement as the influence of the industry-wide investment change on the firm's investment change, and find that managerial equity incentives relate to more co-movement but remain statistically insignificant through various settings.⁶

In the management literature on business strategy, two studies, Carpenter (2000) and Tang, et al. (2011), construct special deviation indices to measure the extent of conformity of a firm's strategy toward the average business strategy in the industry. Carpenter (2000) finds that long-term pay structure associates positively with deviation from the industry norm of business strategy (less herding). Tang, et al. (2011) test the effect of the CEO's and top management team's stock options, but the signs are not stable and coefficients remain statistically insignificant. However, these two studies employ relatively small samples⁷, and their indices contain various factors in complex ways, making them difficult to interpret and compare.⁸ More importantly, their indices are designed to measure how different the firm (or the CEO) is from the industry norm, while the framework of Knyazeva, et al. (2008) is to measure the direction and magnitude of the firm's change in response to the change of industry

⁵While this legislation and its effects on CEO compensation structures had been studied by many, this paper is the first to transform it into an instrument and identify the causal effects of compensation structure on firm outcomes.

⁶They also find that strong corporate governance, such as more activist shareholder (public pension fund) ownership and more independent directors on the board, relates to less investment co-movement, which is consistent with the broader prediction of information-based theory.

⁷Tang, et al. (2011) contain only 51 U.S. firms in computer industry during the period of 1997-2003.

⁸Please see details in Appendix A.3 where we create indices following their methods and replicate their results using our sample.

norm, which is closer to the issue at hand. Therefore we decide to follow the empirical framework of Knyazeva, et al. (2008).

This paper makes two important contributions to the literature. First, this paper contributes to the literature on firms' herding behaviors⁹ by specifically investigating whether equity-based compensation strengthens or weakens investment herding in the non-financial sector. Second, the information-based and compensation-based theories are usually discussed separately. As emphasized by Bikhchandani & Sharma (2000), it's very difficult to distinguish between their effects by testing on their predictions. By focusing on the effect of equity-based pay on investment herding, this paper provides a rare test on this issue that can help to distinguish the two major theories on herding. Third, compared to Knyazeva, et al. (2008), this paper utilizes the tax policy IRC 162(m) to identify the causal effect of the equity-based pay on the investment co-movement. While our initial OLS estimation produces similar results that equity incentives correlate to investment co-movement positively, our IV estimation deals with the problem of endogeneity and finds the opposite, providing the first causal information on this issue.

2.2 The definition of investment herding, model specification, and interpretation

2.2.1 Defining investment herding

Empirically, the herd behavior, or co-movement, among a group of firms can be defined as a correlation between individual firms' behaviors and the group pattern. Specifically, this study defines investment herding as the co-movement or correlation between the industry-level investment changes and firms' investment changes.

There are several motivations for this choice. First, firms, like individuals, can herd on many behaviors other than investment, but the economic implication of investment herding is significant and widely discussed, which connects our study to a broader literature. More importantly, as mentioned before, theories have contradictory predictions regarding the relationship between the CEO's equity compensation and investment herding. Our choice provides a rare opportunity to test the theories.

⁹For example, Badertscher, et al. (2013), Kaustia & Rantala (2015), Leary & Roberts (2014), and Grundy & Li (2010).

Second, unfortunately, theories do not suggest a unique definition or measure of investment herding, and different definitions can have diverse interpretations and implications.¹⁰ We choose to focus on the co-movement between firm and industry investment changes, because we want to capture the responsiveness of the individual firm to the industry-level pattern, which reflects an essentially dynamic aspect of herding. We argue that herding means different firms follow others' behaviors in a dynamic sense (as you increase investments, I increase investment too), rather than different firms become the same type at a steady state (like we all invest at the same amount). In contrast, some studies employ measures of the differences between individual firms and the industry, or the degree of uniformity/diversity among firms, which are more the results of the processes rather than the firm-industry interactions that we want to understand.

Third, we measure the investment change by computing the change in the capital expenditure-to-total assets ratios of two successive years.¹¹ We do not argue that our measure is the only nor the best one for investment herding. Besides, while this ratio is conventional and widely used in the literature, different types of investments (like financial or non-financial) and various shocks on asset values can affect the ratio in complex ways. A further decomposition is possible but beyond the scope of this paper.

2.2.2 Model specification and interpretation

To investigate the influence, I specify an econometric model in which a set of variables interacting with the industry-level investment change:

$$\begin{aligned} \Delta I_{kfst} = & \alpha_k + \beta_0 \Delta \mathbf{I}(\mathbf{k})_{jt} + \beta_1 \Delta \mathbf{I}(\mathbf{k})_{jt} X_{kfst} + \beta_2 X_{kfst} \\ & + \beta_3 \Delta \mathbf{I}(\mathbf{k})_{jt} V_{kfst} + \beta_4 V_{kfst} + \beta_5 \mathbf{F}_{jst} + \gamma \Delta I_{kfs,t-1} + \varepsilon_{kfst}, \end{aligned} \tag{2.1}$$

¹⁰This is partly a reason why studies find different effects of the CEO's equity compensation on herd behaviors.

¹¹Capital expenditure includes the funds used for additions to property, plant, and equipment, excluding amounts arising from acquisitions (for example, fixed assets of purchased companies). This includes property and equipment expenditures. Total assets include current assets plus net property, plant, and equipment plus other non-current assets (including intangible assets, deferred charges, and investments and advances).

where ΔI_{kfst} is the change in the investment-to-asset ratio of firm k in industry j in state s at year t , and $\Delta \mathbf{I}_{jt}$ is the industry change in investment ratio in industry j at year t , excluding firm k . The lagged term of the firm’s investment change, $\Delta I_{kfs,t-1}$, is also included. The firm-fixed effects are included in α_k . X_{kfst} denotes managerial compensation structures measured by the equity-to-salary ratio (*Equity Ratio*). V_{kfst} denotes all other factors that might affect the extent of herding, including the CEO-chair duality, externally-hired CEO, the firm’s age, tangible asset ratio, analyst forecast coverage, and the Herfindahl-Hirschman Index (HHI). \mathbf{F}_{jst} are industry-, state-, year-, and incorporation-state-year fixed effects. Robust standard errors are clustered at the firm level.

The focus of this study is not on the impact of the CEO’s equity pay on the firm’s investment, nor on the industry-firm correlation *per se*, but on the influence of CEO equity pay on the industry-firm correlation, i.e., does the extent of herding increase or decrease as the CEO receives more equity-based pay.¹² To illustrate, we can take a partial derivative with respect to $\Delta \mathbf{I}_{jt}$, such that

$$\frac{\partial \Delta I_{kfst}}{\partial \Delta \mathbf{I}_{(k)jt}} = \beta_0 + \beta_1 X_{kfst} + \beta_3 V_{kfst}, \quad (2.2)$$

in which the main effect of the industry’s investments on an individual firm’s investment, β_0 , is adjusted by $\beta_1 X_{kfst}$ and $\beta_3 V_{kfst}$. In the following analyses, the estimation of β_1 is of particular interest, indicating the impact of equity-based pay on the co-movement or herd relationship between ΔI_{kfst} of the firm and $\Delta \mathbf{I}_{jt}$ of the industry. The result can be counted as evidence for the information-based (compensation-based) hypothesis, if the coefficient β_1 is significant and negative (positive).

2.3 Data, variables, and summary statistics

2.3.1 Data sources

In the following analyses, I collect data of firms’ investments and other information from CRSP-Compustat Merged database (Compustat). Compustat provides balance sheet and other financial information for publicly-traded firms in the U.S., which are collected from firms’ annual reports and other filings to the SEC. The data is then

¹²This framework also helps to resolve the so-called “spurious herding” issue, i.e., the difficulty in distinguishing between the common condition-driven herding and the firm-specific factor-driven herding (Bikhchandani & Sharma, 2000).

matched with CEOs' information collected from Execucomp, which contains detailed information of top executives' compensations, such as salary, bonus, pension, stock award and stock option, and personal characteristics such as gender and age, that are collected from firms' annual proxy reports (DEF14A SEC form). The information of analysts' coverage is collected from the Thomson Reuters IBES database and matched with the CEO-firm data set. The final sample contains 2,689 firms and 32,520 firm-year observations, covering publicly traded firms in the U.S. economy over the period 1992-2016.

2.3.2 Measurements of variables and summary statistics

The outcome variable is the change in the investment-to-asset ratio of the firm, ΔI^F for simplicity. Investment is measured by the sum of tangible (capital expenditure) and intangible (R&D) investments divided by total assets. A lagged term of the firm's investment change, ΔI_{t-1}^F , is included to control for the autocorrelation between the firm's investments in successive periods.

Due to the uncertainty about the precise target for each firm, this study computes three industry-level investment changes, the industry-median, the industry-average, and the industry-leader, and investigate which one correlates more strongly with firms' investment changes. The industry-median investment change is defined as the median investment change within the industry-year, calculated excluding the focal firm. The industry-average investment change is defined as the average investment change within the industry-year, calculated excluding the focal firm. The industry-leader investment change is defined as the average investment changes of the top tercile of firms (by sales share) in the industry-year. These top-tercile firms are excluded when running regressions using the industry-leader investment change as ΔI^{Ind} . All three industry-level investment-to-asset ratios are defined at the three-digit SIC level. Investment herding is then captured by the correlation between ΔI^F and ΔI^{Ind} .

To capture the relative importance of equity-based pay to the manager, I measure CEO's compensation structure by the equity-to-salary ratio, *Equity Ratio*, which is

defined as the sum of stock awards and stock options values divided by the value of salary.¹³

The relationship between CEO compensation structure and the firm-industry investment co-movement is likely to be influenced by many other factors. Based on the theory and the empirical literature, this study controls for *CEO-chair duality*, *External CEO*, *Analyst forecast coverage*, *Tangible asset ratio*, *Herfindahl-Hirschman index*, and *Firm's age*, by generating respective interaction terms with the industry-level investment change, ΔI^{Ind} .

Aside from the compensation structures, previous studies based on the principal-agent framework suggested that managers' powers in controlling firms vis-à-vis shareholders are relevant to the firm-industry investment co-movements (Knyazeva, et al., 2008) and strategy choices (Carpenter, 2000; Tang, et al., 2011). I include two binary variables to proxy for the managers' controlling powers: *CEO-chair duality* and the *External CEO*. If the CEO is also the board chair, the check and balance functions of the board is weakened, giving the CEO more discretionary power. The externally hired CEO indicates to whether the CEO is hired from outside three years before he/she becomes the CEO. An internally-promoted CEO may have more connections and influences among his or her coworkers, while an externally-hired CEO may rely more on shareholders' supports.

Analyst forecast coverage is measured as the log of the number of one-year-ahead analyst EPS forecasts, using the data from the Thomson Reuters IBES database. Knyazeva, et al. (2008) find that when a firm receives more financial analysts' earnings-per-share (EPS) forecasts, the firm tends to herd less. They suggest that analysts' forecasts provide information about the market and the firm, which reduces the asymmetric information problem between shareholders and the manager, and therefore less room for managerial shirking.

Tangible asset ratio is defined as property, plants and equipment divided by total assets. Knyazeva, et al. (2008) find that firms with more tangible assets tend to herd more, but the underlying cause is hard to pin down.

¹³In calculating the values of equity-based pays, I use the standard Black-Scholes/fair-value measures to represent the *ex ante* evaluations of compensation values at the beginning of a business year when executives plan their work. They are also more available through the whole period, and widely used in the literature.

Firm's age is measured as the years the firm existed in Compustat database. Older firms should accumulate more firm-specific information from experiences and have stable growth paths, and therefore herd less.

As competition intensifies, firms need to study more firm-specific information to survive, and therefore may reduce the firm-industry co-movement. To measure the extent of market competition, I compute *Herfindahl-Hirschman index* (HHI) at the SIC 3-digit industry level based on Compustat database. A higher HHI implies higher-level of concentration and lower-level of competition.

In addition to these variables that interact with the industry-level investment change, this paper includes a set of controlling variables and fixed effects controlling for other factors. We include the number of employees controlling for the firm's size, and the lagged term of the return on assets for the firm's profitability. We control for firm-, state-, industry- and year-fixed effects throughout the firm-level analyses. We also include the incorporation state where the firm incorporates and interact it with years, controlling for the variation of regulations like anti-takeover acts (Bertrand & Mullainathan, 1999 & 2003). This paper reports robust standard errors adjusted for clustering of the observations at the firm level.

2.3.3 Summary statistics

Table 2.1: Variables Definitions and Summary Statistics, U.S. Non-financial Firms (1992-2016).

Variable	Definition	Mean	S.D.	Min	Max
Number of firm-year observations: 32,520; Number of firms: 2,689.					
<i>Manager</i>					
CEO equity-based pay to salary ratio	The CEO's equity-based pay (stock awards + stock options) divided by salary.	3.321	4.601	0	53.711
CEO stock award to salary ratio	The CEO's stock awards divided by salary.	1.181	2.091	0	14.803
CEO stock option to salary ratio	The CEO's stock options divided by salary.	2.026	3.977	0	52.8
CEO-chair duality	1 if the CEO is also the board chair, and 0 otherwise.	0.498	0.5	0	1
External CEO	1 if becomes CEO within 3 years of joining the firm, and 0 otherwise.	0.215	0.411	0	1
<i>Firm</i>					
Firm-level investment change	The change in the firm-level investment ratio (measured by the sum of capital expenditure and R&D divided by assets) from the last year.	-0.002	0.141	-15.034	13.475
Tangible asset ratio	Property, plant, and equipment investment, divided by assets. In Millions of dollars.	0.539	0.419	0	11.497
Analyst forecast coverage	Log of the number of one-year-ahead analyst EPS forecasts of each firm	42.576	47.374	0	480
Firm's age	The years since the firm first appears in the Compustat database (1970-2016).	25.379	16.518	2	67
Employees	The number of employees hired by a firm, in thousand people.	19.909	64.489	0	2300
Return on asset ratio last year	The firm's earnings before interest and taxes (EBITDA) divided by the value of total asset, in the last year	0.133	0.597	-100	1.388
<i>Industry</i>					
Industry-median change	The median investment change within the firm's industry, calculated excluding the focal firm	-0.001	0.011	-0.278	0.479
Industry-average change	The average investment change within the firm's industry, calculated excluding the focal firm	-0.007	0.698	-19.739	21.633

(continued)

(continued)

Variable	Definition	Mean	S.D.	Min	Max
Industry-leader change	investment share) in the industry.	-0.002	0.02	-0.76	0.6
HHI	The Herfindahl-Hirschman index at the 3-digit SIC-year level, based on Compustat data set.	1555.69	1230.287	271.068	6302.258

2.3.4 OLS results

We first compare among three industry-level targets to see which one relates to firms' investments more. We estimate a simplified version of Equation (2.1) which includes the main explanatory variable, CEO equity-based pay ratio, and controls for basic characteristics of the sample, including the firm's investment change last year, return on assets last year, the number of the firm's employees, and four fixed effects. Table 2.2 reports the results, in which Column (1), (2), and (3) are the results using, respectively, the industry-median, the industry-average, and the industry-leader investment changes as the ΔI^{Ind} . The effect of the industry-median is stronger than the other two in Table 1, and the gap becomes wider after including other controlling variables, as shown in Table 2.6 in Appendix A.1.¹⁴ Based on these results, we use the industry-median investment change as the ΔI^{Ind} in the following analyses.

¹⁴The comparison reveals that firms' herding targets are not random but affected by certain structures. However, the investigation of these structures is beyond the scope of this paper.

Table 2.2. Effects of Equity-Based Pay on Investment Herding (Non-Financial Firms): Comparing Three Targets

	Dependent Variable: Firm's Investment Change (ΔI^F)		
	Industry-Median	Industry-Average	Industry-Leader
	(1)	(2)	(3)
Industry investment change (ΔI^{Ind})	0.439*** (0.112)	-0.000 (0.000)	0.090*** (0.029)
CEO equity-based pay ratio $\times \Delta I^{Ind}$	0.033** (0.019)	0.000 (0.000)	0.008 (0.006)
CEO equity-based pay ratio	-0.000* (0.000)	-0.000** (0.000)	-0.000* (0.000)
Manager characteristics and interactions	No	No	No
Firm characteristics and interactions	No	No	No
Herfindahl-Hirschman index and interactions	No	No	No
ΔI_{t-1}^F	Yes	Yes	Yes
Return on assets last year	Yes	Yes	Yes
Number of employees	Yes	Yes	Yes
Firm-, industry-, and year-fixed effects	Yes	Yes	Yes
Incorporation-state-year-fixed effects	Yes	Yes	Yes
Adjusted R-squared	0.305	0.303	0.305
Observations	32,520	32,520	29,261
Number of firms	2,689	2,689	2,640

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Notes. The sample includes the firms in CRSP-Compustat Merged Database, matching with the CEO compensation data from Execucomp database, covers the period from 1992 to 2016, and excludes firms in financial and utilities industries (SIC codes 6000-6999 and 4949-4999). Investment changes are measured by the difference between the investment ratio (total capital expenditures divided by assets) of this period and of the last period. In Column (1), the industry investment change is industry-median investment change calculated excluding the focal firm. In Column (2), the industry investment change is industry-average investment change calculated excluding the focal firm. In Column (3), the industry investment change is industry-leader investment change, which is defined as the average investment changes of top tercile of firms (by sales share) in the industry. These top-tercile firms are excluded from regressions in Column (3). Industry is defined at the 3-digit SIC level. Equity based pay ratio is defined as the value of stock award plus stock option divided by the value of salary. Robust standard errors are adjusted for clustering at the firm level.

After identifying the co-movement between the industry-median and the firms' investments changes, we focus on the effect of equity-based pay on the industry-firm investment co-movement. In Table 2.3 Column (1), we repeat the basic findings in Table 2.2 Column (1). Then we include other variables that might also affect the industry-firm investment co-movement in three steps. In Column (2), we include two

variables controlling for managerial characteristics: whether the CEO is also the chair of the board (CEO-chair duality), and whether the CEO joins the firm within three years before becoming the CEO (External CEO). In Column (3), we include variables controlling for firm and industry characteristics: tangible asset ratio, analyst forecast coverage, firm's age, and Herfindahl-Hirschman index (HHI). Finally, in Column (4), we include all controlling variables.

Before discussing the effect of equity-based pay on the industry-firm investment co-movement, we first look at the co-movement itself, which is shown in the coefficient of the industry-median investment change (ΔI^{Ind}). In Table 2.3, the coefficients are consistently positive and statistically significant through Column (1) to (4), while the magnitude increases when including more variables. The results in Column (4) implies that an increase in the industry-median investment change by one unit is associated with one unit increase in the firm's investment change, all else equal.

Next, we focus on the effects of equity-based pay. From Column (1) to (4), the coefficient of the interaction term between CEO equity-based pay ratio and the industry-median investment change remains positive and statistically significant, and the magnitude ranges between 0.032 and 0.036. This implies that, at the average level of equity-based pay ratio, 3.321, the extent of industry-firm investment co-movement will be strengthened by 0.1 unit, which is about 10% of the co-movement magnitude in Column (4). This economically sizeable effect is in line with the prediction of the compensation-based theory.

Several variables that might affect the co-movement also show significant effects. Based on the results in Column (4), if the CEO is also the board chair, the industry-firm co-movement will reduce by 36%. Interestingly, this seems different from the finding of Knyazeva, et al. (2008) in which more entrenched the CEO is, the lower propensity of the firm to co-move. In contrast, if the tangible asset ratio is at its average level, 0.539, the co-movement will increase by 41%, which is in line with Knyazeva, et al. (2008). Column (4) also shows that in line with our predictions, if HHI is at its average level, the co-movement will decrease by 33%; and if the firm's age is at its average level, 25, the co-movement will decrease by 28%.

Table 2.3. Effects of Equity-Based Pay on Investment Herding (Non-Financial Firms)

	Outcome Variable: Firm's Investment Ratio Change (ΔI^F)			
	(1)	(2)	(3)	(4)
Industry-median investment change (ΔI^{Ind})	0.439*** (0.112)	0.542*** (0.123)	0.935** (0.367)	1.008*** (0.365)
CEO equity-based pay ratio $\times \Delta I^{Ind}$	0.033* (0.019)	0.036** (0.018)	0.033* (0.018)	0.032* (0.018)
CEO-chair duality $\times \Delta I^{Ind}$		-0.462** (0.182)		-0.358** (0.156)
External CEO $\times \Delta I^{Ind}$		0.612 (0.416)		0.460 (0.361)
Tangible asset ratio $\times \Delta I^{Ind}$			0.842*** (0.208)	0.765*** (0.187)
Analyst forecast coverage $\times \Delta I^{Ind}$			-0.003 (0.003)	-0.003 (0.002)
Herfindahl-Hirschman index $\times \Delta I^{Ind}$			-0.00022*** (0.00005)	-0.00021*** (0.00005)
Firm's age $\times \Delta I^{Ind}$			-0.012*** (0.004)	-0.011** (0.004)
CEO equity-based pay ratio	-0.000* (0.000)	-0.000* (0.000)	-0.000 (0.000)	-0.000 (0.000)
CEO-chair duality		-0.001 (0.001)		-0.000 (0.001)
External CEO		0.001 (0.002)		0.001 (0.002)
Tangible asset ratio			-0.001 (0.023)	-0.002 (0.023)
Analyst forecast coverage			-0.000 (0.000)	-0.000 (0.000)
Herfindahl-Hirschman index			-0.000 (0.000)	-0.000 (0.000)
Firm's age			0.001 (0.001)	0.001 (0.001)
ΔI_{t-1}^F	-0.659*** (0.174)	-0.658*** (0.174)	-0.655*** (0.168)	-0.655*** (0.168)
Return on assets last year	0.027 (0.028)	0.027 (0.028)	0.027 (0.028)	0.027 (0.028)
Number of employees	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Firm-, industry-, and year-fixed effects	Yes	Yes	Yes	Yes
Incorporation-state-year-fixed effects	Yes	Yes	Yes	Yes
Adjusted R-squared	0.305	0.305	0.307	0.308
Observations	32,520	32,520	32,520	32,520
Number of firms	2,689	2,689	2,689	2,689

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Notes. The sample includes the firms in CRSP/Compustat Merged Database, matching with the CEO compensation data from Execucomp database, covers the period from 1992 to 2016, and excludes firms in financial and utilities industries (SIC codes 6000-6999 and 4949-4999). *Firm's investment changes* (ΔI^F) are measured by the difference between the investment ratio (total capital expenditures divided by assets) of this period and of the last period. *Industry-median investment change* (ΔI^{Ind}) is measured by the median investment change in the industry excluding the focal firm. Industry is defined at the 3-digit SIC level. *CEO Equity based-pay ratio* is defined as the value of stock award plus stock option divided by the value of salary. *CEO-chair* is a binary variable indicating whether the CEO is also the chair of the board. *External CEO* is a binary variable indicating whether the CEO joins the firm within three years before becoming the CEO. *Tangible asset ratio* is property, plants and equipment divided by total assets. *Analyst forecast coverage* is log of the number of one-year-ahead analyst EPS forecasts. *Herfindahl-Hirschman index* is computed at the 3-digit SIC level. *Firm's age* is the number of years the firm entered in Compustat. *Return on assets last year* is one-year lag of earnings before interest, taxes, depreciation and amortization (EBITDA) divided by total assets. Robust standard errors are adjusted for clustering at the firm level.

2.4 Identification strategy

In the OLS analyses, an endogeneity concern can arise because, for example, the firm planning to follow certain investment fashions may need to provide more incentives for the incumbent manager. Or, a technological change may affect both the firm's investments and the CEO's compensation structure. It's also likely that the firms herding on investments may herd on other corporate policies as well, including the CEO's compensation structure.¹⁵ To examine whether the correlation means causation, we need to identify a change in the managerial compensation structure that is unrelated to the industry-firm investment change.

2.4.1 Identification strategy: Internal Revenue Code 162(m)

A corporate tax policy change seems to be the natural candidate for the needed instrument. Enacted by Congress in 1993, section 162(m) of the Internal Revenue Code limits the deductibility of top five executives' non-performance-related compensations over \$1 million, and imposes a 60% federal surtax on salaries above \$1 million. In this way, the legislation encourages firms to increase the use of performance pay rather than fixed salary while leaving open the total amounts of compensations. Responding to the legislation, several studies had found that firms originally paying higher salaries reduce salaries to \$1 million, and firms originally paying lower raise salaries over time but don't go above \$1 million (Perry & Zenner, 2001; Rose & Wolfram, 2002). At the same time, the growth of the total amounts of CEO compensation has been unaffected. Firms increase other forms of compensations instead of salary, such that the structure of executive compensation has become more equity-based (Perry & Zenner, 2001; Balsam & Ryan, 2007).

Given these findings, if we range firms by their CEOs' salaries, we would expect to see firms crowding around the tax deductibility threshold, one million dollars. In addition, as the total compensation keeps growing, the number of firms crowded around the threshold should increase over time. As shown in Figure 2.1, there is indeed a significant, abnormal bunch of firms paying CEOs' salaries right at the threshold, implying that many firms are affected by the legislation and freeze CEOs' salaries at the threshold. Figure 2.2 shows that the bunch grows higher over time

¹⁵Please see Clifford (2017) for real-world observations that boards indeed herd in determining CEOs' compensations.

as the whole distribution gradually shifts rightward, suggesting that more and more firms freeze CEO's salaries around the threshold. In this case, as firms try to pay their CEOs more over time, they are more likely to do so by raising performance pay especially the equity-based pay, and we should see an increase in the equity-to-salary ratio as a result.

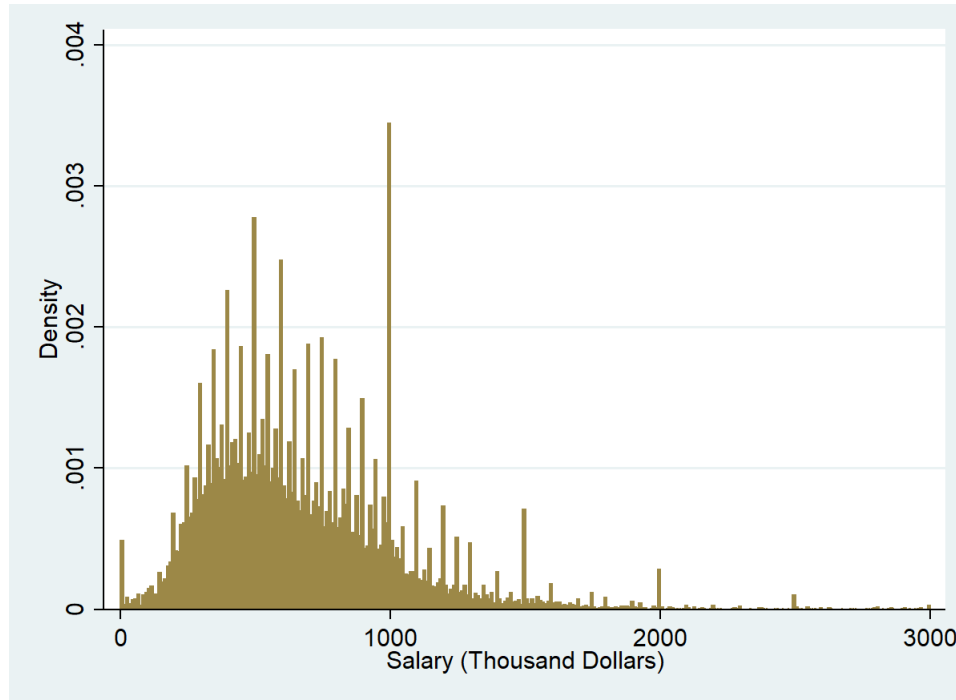


Figure 2.1. The bunching distribution of firms by CEO's salary, whole sample period (1992-2016)

However, the IRC Section 162(m) is not a strict ban, and firms can choose how or whether to respond. In this case, the treatment effect of Section 162(m) on firms' decisions is not a sharp discontinuity at the \$1 million dollars salary threshold, but works more in the way of a probability over a certain range of CEOs' salaries and leads to the bunching of firms around the threshold. As this policy was enacted in 1993, on the one hand, all firms originally above the \$1 million salary threshold would be affected. They are likely to reduce the salaries to the threshold or at least stop salaries from growing. On the other hand, firms originally below the threshold could be affected as well such that they might freeze salaries before hitting the threshold. We therefore expect that both firms close to and above the threshold are affected. In addition, while the center of bunching is clear, the lower bound of the treatment

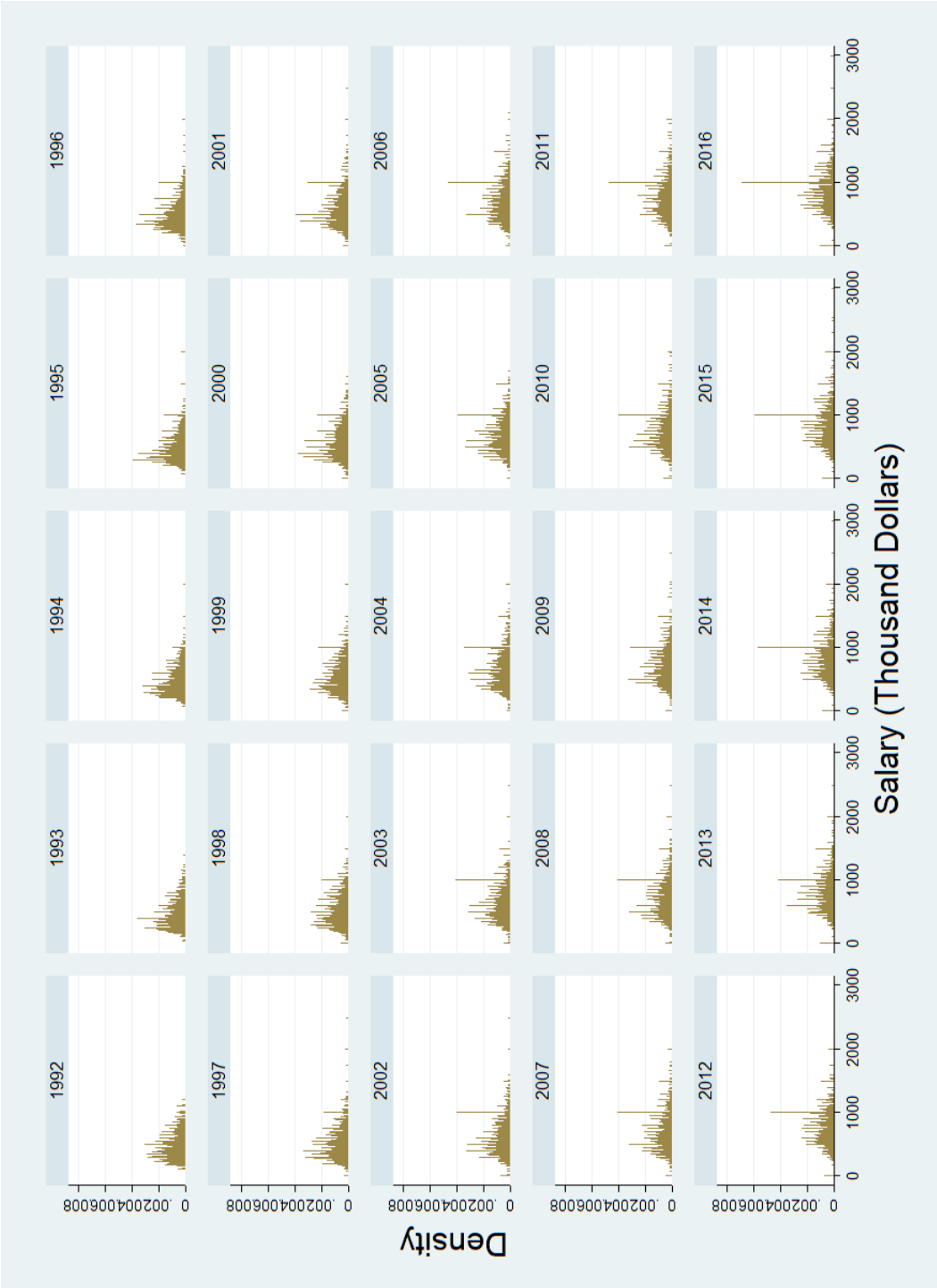


Figure 2.2. The bunching distribution of firms' by CEO's salary, each year (1992-2016)

remains uncertain. We therefore try different treatment bounds in the following analyses.

Based on the above considerations, we construct out instrumental variable by including a binary variable indicating whether the CEO's salary falls into the treatment range since 1994, and a variable for the CEO's salary level, together as our instrumental variables to capture the change in CEO's *Equity Ratio*. Since the tax policy and whether a CEO's salary falls into the treatment range are exogenously determined and orthogonal to firm and industry investments, we argue that our binary variable satisfies the exclusion restriction of instrumental variable. In addition, since salary as a non-performance pay is typically disconnected from the firm or industry investments, and remains a relatively small part of a CEO's total compensation, we argue that the salary level variable satisfies the exclusion restriction as well.

2.4.2 Model specification

We estimate a two-stage-least-square model in which the first stage is:

$$\begin{aligned} X_{kfst} = & \alpha + \eta_{11}\mathbf{Z}_{kt} + \eta_{12}\Delta\mathbf{I}_{jt}\mathbf{Z}_{kt} \\ & + \eta_{13}\Delta\mathbf{I}_{jt} + \eta_{14}\Delta\mathbf{I}_{jt}V_{kfst} + \eta_{15}V_{kfst} + \eta_{16}\mathbf{F}_{jst} + \eta_{17}\Delta I_{kjs,t-1} + \epsilon_{kfst}, \end{aligned} \quad (2.3)$$

and

$$\begin{aligned} \Delta\mathbf{I}_{jt}X_{kfst} = & \alpha + \eta_{21}\mathbf{Z}_{kt} + \eta_{22}\Delta\mathbf{I}_{jt}\mathbf{Z}_{kt} \\ & + \eta_{23}\Delta\mathbf{I}_{jt} + \eta_{24}\Delta\mathbf{I}_{jt}V_{kfst} + \eta_{25}V_{kfst} + \eta_{26}\mathbf{F}_{jst} + \eta_{27}\Delta I_{kjs,t-1} + \epsilon_{kfst}, \end{aligned} \quad (2.4)$$

where \mathbf{Z}_{kt} includes the binary variable indicating whether it's after 1994 and above certain lower bounds of the salary, and a salary level variable. The definitions of other variables are the same as in Equation (2.1).

The second stage is:

$$\begin{aligned} \Delta I_{kfst} = & \alpha_k + \beta_0\Delta\mathbf{I}_{jt} + \beta_1\Delta\mathbf{I}_{jt}\widehat{X}_{kfst} + \beta_2\widehat{X}_{kfst} \\ & + \beta_3\Delta\mathbf{I}_{jt}V_{kfst} + \beta_4V_{kfst} + \beta_5\mathbf{F}_{jst} + \gamma\Delta I_{kjs,t-1} + \epsilon_{kfst}, \end{aligned} \quad (2.5)$$

where $\Delta\mathbf{I}_{jt}\widehat{X}_{kfst}$ and \widehat{X}_{kfst} are the fitted values from the first-stage regressions using our instruments.

2.4.3 IV estimation results

The results of IV estimation are reported in Table 2.4 and 2.5.¹⁶ In Table 2.4 and 2.5, we try different lower bounds of salary from Column (1) to (5). For example, Column (1) shows the results using a lower bound of 750 thousand dollars, in which the binary variable indicates whether the observation is after 1994 and has a salary above 750 thousand dollars.

Our instruments show expected signs in the first stage estimation. In terms of the first endogenous variable, the treatment range dummy is associated with a higher CEO equity-to-salary ratio. For the second endogenous variable, the interaction term between CEO equity ratio and the industry-median investment change, the interaction term between the treatment dummy and the industry-median investment change also shows a positive correlation. These results confirm our prior that the IRC 162(m) induced firms to raise equity-to-salary ratio. In addition, the magnitude and statistical significance decrease when the lower bound of treatment moves up, and the effects of our instruments tend to peak around the salary bound of 850 thousand dollars, which verifies our intuition that firms may stop increasing salary before hitting the threshold.

We further check test statistics to diagnose weak instrument issues. In the first stage, we check Angrist-Pischke F-test, which is to test whether one of the endogenous regressors is under- or weakly identified (Angrist & Pischke, 2008). The p-values of Angrist-Pischke F-tests indicate that we can reject the null hypothesis that one of our endogenous variables is weakly identified. In the second stage, we check Cragg-Donald and Kleibergen-Paap tests and comparing the F-statistics with the Stock-Yogo (2005) weak identification test critical values, which are 11.04 at the 5% maximal IV relative bias and 16.87 at the 10% maximal IV size. Based on the tests, we conclude the results in Column (2) to be the most reliable ones.

In the second stage, interestingly, our IV estimation shows that a higher CEO equity ratio will lead to less herding, which is opposite to the finding based on the OLS analyses. Based on the results shown in the Table 2.5 Column (2), while the magnitude of industry-firm investment co-movement is 2.25, i.e., an unit increase in the industry-median investment change is associated with 2.25 unit increase in the

¹⁶We report the results using LIML estimator rather than 2SLS as Table 2.7 in Appendix A.2, which are almost identical to Table 2.4 and 2.5.

firm's investment change, the co-movement magnitude will be reduced by 0.93 unit (about 41%) if the CEO's equity ratio is at the average level. This finding is consistent with the the information-based theory.

Table 2.4. Evidence on Causality: IV Estimation (2SLS), First-Stage Results

Treatment range (\$Salary, thousand dollars)	750- (1)	850- (2)	950- (3)	1050- (4)	1150- (5)
<i>First Stage</i>	Endogenous variable 1: CEO equity ratio				
Treatment range dummy	0.814*** (0.107)	0.973*** (0.107)	0.081*** (0.12)	0.693*** (0.147)	0.419** (0.172)
Salary	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Treatment range dummy $\times \Delta I^{Ind}$	-0.41 (6.421)	8.171 (6.865)	3.793 (7.558)	4.703 (7.891)	5.641 (8.826)
Salary $\times \Delta I^{Ind}$	0.004 (0.009)	-0.005 (0.009)	-0.001 (0.009)	0.005 (0.009)	0.005 (0.009)
Angrist-Pischke F-statistic	20.431	29.341	17.662	9.983	4.26
p-value of Angrist-Pischke F-test	4.34e-13	1.16e-18	2.37e-11	1.53e-06	0.00521
	Endogenous variable 2: CEO equity ratio $\times \Delta I^{Ind}$				
Treatment range dummy	-0.000 (0.001)	0.001 (0.001)	0.001 (0.001)	0.000 (0.001)	0.000 (0.001)
Salary	4.54e-07 (9.09e-07)	-2.53e-07 (9.25e-07)	-2.09e-07 (9.32e-07)	1.25e-07 (9.06e-07)	1.93e-07 (9.20e-07)
Treatment range dummy $\times \Delta I^{Ind}$	0.726** (0.312)	0.626* (0.344)	0.54 (.377)	0.658 (0.433)	0.495 (0.464)
Salary $\times \Delta I^{Ind}$	0.001 (0.001)	0.001* (0.001)	0.001* (0.001)	0.001** (0.001)	0.001** (0.001)
Angrist-Pischke F statistic	6.970	6.481	5.878	5.534	4.859
p-value of Angrist-Pischke F-test	0.00011	0.00023	0.00054	0.00087	0.00225
<i>Controlling Variables</i>					
Manager characteristics and interactions	Yes	Yes	Yes	Yes	Yes
HHI and interactions	Yes	Yes	Yes	Yes	Yes
Firm characteristics and interactions	Yes	Yes	Yes	Yes	Yes
ΔI_{t-1}^F	Yes	Yes	Yes	Yes	Yes
Number of employees	Yes	Yes	Yes	Yes	Yes
Return of assets last year	Yes	Yes	Yes	Yes	Yes
Industry- and year-fixed effects	Yes	Yes	Yes	Yes	Yes
Incorporation state-year-fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	32,520	32,520	32,520	32,520	32,520
Number of firms	2,689	2,689	2,689	2,689	2,689

Robust S.E. in parentheses: *** p<0.01, ** p<0.05, * p<0.1. Clustered at firms.

Notes. The sample includes the firms in CRSP/Compustat Merged Database, matching with the CEO compensation data from Execucomp database, covers the period from 1992 to 2016, and excludes firms in financial and utilities industries (SIC codes 6000-6999 and 4949-4999). *Firm's investment changes* (ΔI^F) are measured by the difference between the investment ratio (total capital expenditures divided by assets) of this period and of the last period. *Industry-median investment change* (ΔI^{Ind}) is measured by the median investment change in the industry excluding the focal firm. Industry is defined at the 3-digit SIC level. *CEO Equity based-pay ratio* is defined as the value of stock award plus stock option divided by the value of salary. From Column (1) to (5), the treatment ranges are 750 and above, 850 and above, 950 and above, 1050 and above, and 1150 and above, in thousand dollars. Manager characteristics include: CEO-chair duality and externally-hired CEO. Firm characteristics includes: tangible asset ratio, analyst forecast coverage, firm's age. All controlling variables are the same as in OLS analyses except the firm-fixed effects. Robust standard errors are adjusted for clustering at the firm level.

Table 2.5. Evidence on Causality: IV Estimation (2SLS), Second-Stage Results

Treatment range (\$Salary, thousand dollars)	750- (1)	850- (2)	950- (3)	1050- (4)	1150- (5)
<i>Second Stage</i>					
	Dependent variable: Firm's investment change (ΔI^F)				
CEO equity ratio $\times \Delta I^{Ind}$	-0.249** (0.115)	-0.281** (0.124)	-0.319** (0.134)	-.307** (0.134)	-0.338** (0.15)
ΔI^{Ind}	2.105*** (0.616)	2.254*** (0.635)	2.409*** (0.685)	2.356*** (0.686)	2.471*** (0.755)
CEO equity ratio	0.000 (0.001)	0.001 (0.001)	0.001 (0.001)	0.000 (0.001)	-0.001 (0.002)
Cragg-Donald F-statistic	33.431	39.8	25.968	16.63	8.585
Kleibergen-Paap F-statistic	15.336	22.346	13.362	7.449	3.165
<i>Controlling Variables</i>					
Manager characteristics and interactions	Yes	Yes	Yes	Yes	Yes
HHI and interactions	Yes	Yes	Yes	Yes	Yes
Firm characteristics and interactions	Yes	Yes	Yes	Yes	Yes
ΔI_{t-1}^F	Yes	Yes	Yes	Yes	Yes
Number of employees	Yes	Yes	Yes	Yes	Yes
Return of assets last year	Yes	Yes	Yes	Yes	Yes
Industry- and year-fixed effects	Yes	Yes	Yes	Yes	Yes
Incorporation state-year-fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	32,520	32,520	32,520	32,520	32,520
Number of firms	2,689	2,689	2,689	2,689	2,689

Robust S.E. in parentheses: *** p<0.01, ** p<0.05, * p<0.1. Clustered at firms.

Notes. The sample includes the firms in CRSP/Compustat Merged Database, matching with the CEO compensation data from Execucomp database, covers the period from 1992 to 2016, and excludes firms in financial and utilities industries (SIC codes 6000-6999 and 4949-4999). *Firm's investment changes* (ΔI^F) are measured by the difference between the investment ratio (total capital expenditures divided by assets) of this period and of the last period. *Industry-median investment change* (ΔI^{Ind}) is measured by the median investment change in the industry excluding the focal firm. Industry is defined at the 3-digit SIC level. *CEO Equity based-pay ratio* is defined as the value of stock award plus stock option divided by the value of salary. From Column (1) to (5), the treatment ranges are 750 and above, 850 and above, 950 and above, 1050 and above, and 1150 and above, in thousand dollars. Manager characteristics include: CEO-chair duality and externally-hired CEO. Firm characteristics includes: tangible asset ratio, analyst forecast coverage, firm's age. All controlling variables are the same as in OLS analyses except the firm-fixed effects. Robust standard errors are adjusted for clustering at the firm level.

2.5 Conclusion

The causes of the herd behaviors when facing uncertainty have been puzzling researchers. Based on the views of Keynes (1936; 1937) and the recent analyses of the effects of the CEO's compensation structure, the information-based theory suggests that more equity-based pay will induce the CEO to concentrate on the firm-specific information and decrease investment herding, while the compensation-based theory suggest that more equity-based pays will make the CEO concern his/her

reputation and stock wealth and increase investment herding. This paper provides a rare opportunity to examine these two theories on the same ground using a sample of the U.S. non-financial firms over the period of 1992-2016. By analyzing the causal effect of the CEO's equity-based pay on investment herding, we find that an increase in the CEO's equity-based pay relative to salary leads to a decrease in the co-movement between the firm's and the industry-median investments.

While our finding is consistent with the information-based theory, this is by no mean the final word that can be said on this issue. Other aspects of the issue, such as the relationship between the reduction in herding and other consequences of equity-based pay, the impact on firm performance, or the potential difference between financial and non-financial sectors, deserve careful investigation in the future.

CHAPTER 3

SHAREHOLDER DEMOCRACY AND ITS DISCONTENTS

3.1 Introduction

3.1.1 From shareholder wealth maximization to welfare maximization

Milton Friedman (1970) famously argued that a corporate executive should serve only shareholders' interests by making as much money as possible, within the limit of law and custom. While this doctrine of shareholder wealth maximization has been dominating the discussion of the purpose of the firm, however, there is a growing discontent with it since studies reveal more and more undesirable consequences.¹

To address the problem while preserving shareholder primacy, Hart & Zingales (2017) present an ambitious proposal. They criticize Friedman (1970) for identifying shareholder welfare with market value. Combining with insights from behavioral and social economics, they argue that shareholders, like ordinary people, have ethical concerns too. These shareholders would like to see the firm they invested in to address externalities of the firm's business, just like consumers would like to buy fair-trade coffee. If the purpose of the firm can be re-defined as shareholder *welfare* maximization, rather than *wealth* maximization, the manager would choose a project consistent with the shareholder's ethical preferences and solve the externality problem. With *ethical* shareholders in place, shareholder primacy ceases to be the problem but becomes a force leading to good social outcomes. In this paper, I will call their theory a Shareholder Democracy (*SD*) model, which is shareholder primacy at its best.

Does this *SD* model work? Two sets of questions, both positive and normative, emerge immediately. While their argument that ordinary shareholders have social

¹Including the pay-for-luck phenomenon (Bertrand & Mullainathan, 2001), reducing capital investment (Lazonick, 2014; Almeida, et al., 2016; Edmans, et al., 2017; Gutierrez & Philippon, 2016), increasing excessive risk-taking (Coles, et al., 2006; Chen, et al., 2006; Pathan, 2009; Bolton, et al., 2015), and mass layoffs (Jung, 2015 & 2016).

and ethical concerns is empirically sound, one would wonder why this preference has not revealed itself more widely in the U.S. economy? After all, even with the hurdle of the wealth maximization doctrine, given the emphasis of shareholder primacy in recent decades, we should have had seen more cases of ethical shareholder activism if the ethical shareholder has always been there. More importantly, instead of the ordinary, anonymous shareholders in their theory, most social proposals have been fought for by union and public pension funds.² This raises an interesting question because these labor-affiliated shareholders are often said to pursue private interests “under the guise of ethical behaviors” and ought to be dismissed. Can the ethical shareholder activism persists if we keep away the labor-affiliated shareholder?

From the normative perspective, when Hart & Zingales (2017) legitimize shareholders’ social preferences, which is a progress in the direction of democracy, they inevitably open the door for all types of private interests which deviate from the abstract law of profit maximization of the firm as social preferences do. After all, social preferences often intertwine with private interests and the distinction between them is far from clear. For example, the environmental concern is fundamentally driven by the interest of self-preservation, and the care about local community may come from the benefits of personal reputation and friendships with your neighbors. Under the framework of shareholder primacy, what’s the basis on which to favor shareholders’ social preferences but dismiss other private interests?

With these questions in mind, this paper investigates the implications and limitations of the *SD* model in Hart & Zingales (2017). I points out that the main difference between Hart & Zingales (2017) and Friedman (1970) is less about whether shareholders have social preferences, but more about whether those social preferences should be a legitimate element of the objective of the firm. By legitimizing the role of social preferences while arbitrarily dismissing “private interests”, Hart & Zingales (2017) open a space for, but fail to establish, a political theory of the firm.

I further argue that their *SD* model ignores the heterogeneity among shareholders and the resulting managerial incentive problem. Once we take these factors into account, my analysis shows that the *SD* model either is ineffective in inducing a

²Renneboog and Szilagyi (2010) report that these two investor types sponsored 38% of all Rule 14a-8 shareholder proposals in the 1996 to 2005 period, while Georgeson (2012) reports that they sponsored 47.2% of shareholder proposals in the 2012 proxy season.

socially good outcome, or can achieve it only through the participation of the type of shareholders that the *SD* model wants to dismiss.

Specifically, besides the *ethical* shareholder, I emphasize that there are at least two other types of shareholders which have been very active in the U.S. economy: the *homo-economicus* shareholder which cares only about financial returns, and the *labor-affiliated* shareholder, represented by union and public pension fund shareholders, who show stronger social and ethical concerns. Each types of shareholders would press the manager to choose a business model it preferred: while the *homo-economicus* shareholder prefers a wealth-maximizing model, the *ethical* and the *labor-affiliated* types prefer a social welfare-maximizing model. The choice of the manager depends on his/her financial rewards from these two business models, where a wealth-maximizing model pays the manager higher than a welfare-maximizing model does, and also on the different disutilities caused by the pressures from different types of shareholders.

My population game analysis shows that once we allow the *homo-economicus* shareholder to co-exist with the *ethical* shareholder within the firm, the manager is likely to choose a wealth-maximizing business model which gives him/her a higher reward, even after accounting for the pressure from the *ethical* shareholder, unless the fraction of the *ethical* shareholder is unrealistically high. This suggests that the *SD* model is not very effective in inducing the manager to choose an ethical business model. Next, once three types of shareholders co-exist as they do in many real-world cases, the pressure from the *labor-affiliated* shareholder will not only increase the likelihood of the manager in choosing an ethical business model, but also marginalize or replace the *ethical* shareholder, since the former gains higher utility from the socially good outcomes than the later. This is consistent with the evidence that most social proposals have been coming from labor-affiliated shareholders, implying that a shareholder democracy cannot sustain itself without the involvement of stakeholders or the “special interest” shareholders that the proponents of the *SD* model try to dismiss.

In sum, my analyses show that the *SD* model, while reflecting a progress beyond Friedman (1970), is either ineffective or self-defeating. The non-special interest, *ethical* shareholders remain mostly absent because they are likely to be either outweighed by the *homo-economicus* ones because the manager prefers a wealth-maximizing model, or to be replaced by the *labor-affiliated* ones because the *labor-affiliated* shareholders would fight for the ethical outcomes more strongly than the

ethical shareholders. Targeting at the *labor-affiliated* shareholders will decrease rather than increase the number and the effectiveness of shareholder social proposals. The effects of several types of policies on the ethical shareholder activism are also discussed.

3.1.2 Relation to literature

This paper relates to several issues in the literature. First, an enduring theme in the corporate governance literature is the principal-principal conflict. Although the literature tends to associate this problem with non-U.S. economies (La Porta, et al., 1999; Young, et al., 2008) or with the stakeholder model³ (Jensen, 2001; Tirole, 2001), shareholder heterogeneity is actually omnipresent.⁴ This paper shows that this problem is also unavoidable in the *SD* model proposed by Hart & Zingales (2017), and it deserves careful considerations by reformists to make a progress.

Second, by introducing the *labor-affiliated* shareholder, this paper relates to the literature on union and public pension funds. After early speculations such as Drucker (1976) and Rifkin & Barber (1978), there is a growing empirical literature documenting the structures and effects of these *labor-affiliated* shareholders, including rich observations by legal scholars and activists.⁵ This paper is a first step to build a more realistic theory consistent with the findings from these empirical studies.

Third, there are several models studying the survival and dynamics of socially concerned firms, such as Kopel et al. (2014), Allen et al. (2015), and Magill et al. (2015). They all treat governance and control of the socially concerned firms as given and do not analyze the within-firm conflicts among different types of shareholders and managers. By explicitly analyzing these aspects, this paper is a complement to this literature.

The remaining sections of this paper are organized as follows. In Section 3.2, I explain the implications of Hart & Zingales (2017) by comparing their proposal to

³For examples of stakeholder theory, see Freeman (1984), Hill & Jones (1992), and Blair & Stout (1999). For a detailed literature review, see Williams (2018).

⁴For example, see Hoskisson, et al. (2002), Gaspar, et al. (2005), Cronqvist & Fahlenbrach (2008), Hayden & Bodie (2008), Deng, et al. (2013), Clifford & Lindsey (2016), Jacob & Michaely (2017), and Chen, et al. (2019).

⁵For example, see Ghilarducci (1992), Fung, et al. (2001), Webber (2018), Jacoby (2020), Agrawal (2012), Andonov, et al. (2018), and Matsusaka, et al. (2019).

Friedman (1970), and connecting their treatment of special interests to the literature. Section 3.3 develops a population game model to analyze the limitations of the *SD* model. Section 3.4 concludes.

3.2 Putting Hart & Zingales (2017) in context

3.2.1 Legitimizing social preferences

The main thrust of Hart & Zingales (2017) is incorporating shareholders' social preferences into the objective of the firm: wherever shareholders want the firm's behaviors to be aligned with their social concerns, the shareholder primacy framework will naturally lead the firm to maximize shareholder welfare rather than wealth. They further argue that this incorporation is necessary to address many negative externality issues, because profit and damage are often inextricably connected, and there may be no efficient way for ethical shareholders to reverse or compensate for the consequences.

While their approach has merit in reforming the shareholder primacy framework from within, one may question if they have successfully moved beyond the dominant paradigm instead of avoiding tough issues. In so far as the dominant paradigm is concerned, the existence of shareholders' social and ethical concerns has been well recognized. Friedman (1970) particularly was fully aware of this fact, but argued against incorporating these concerns into the objective of the firm for a reason only partially addressed by Hart & Zingales (2017). To Friedman (1970), as long as the social concern is not shared by all shareholders and stakeholders, exercising social responsibility is to get "some stockholders (or customers or employees) to contribute against their will to social causes favored by activists". This decision is equivalent to "imposing taxes and spending the proceeds" which are fundamentally political. In the usual democratic process, a political process requires check and balance to function properly. A firm, however, lacks institutions to ensure such checks and balances, and therefore the incorporation of social preferences should be rejected. Apparently, Friedman is willing to sacrifice shareholder primacy to avoid the trouble of corporate governance politics, resorting to the abstract doctrine of wealth maximization.

Upholding the principle of shareholder primacy, Hart and Zingales accepted the political aspect of exercising corporate social responsibility and suggested using shareholder votes to aggregate individual preferences, as in the usual democratic process. In this way, Hart & Zingales (2017) legitimized the role of social preferences. This

is only a partial solution, however, because although voting is naturally associated with aggregating diversified preferences, they still treated voters as having the same preferences and ignored the heterogeneity among shareholders in their model. Their incomplete contract approach has freed them from this omission, but yet they seems to be reluctant to go forward in that direction. In consequence, as will be shown in Section 3.3, the heterogeneity among shareholders introduces a type of principal-principal conflict,⁶ rather than the usual principal-agent conflict, which severely weakens the power of ethical shareholders under realistic conditions.

3.2.2 A strange case of “special interests”

Moreover, this principal-principal conflict involves not only the tension between *ethical* shareholders and *homo-economicus* shareholders, but also the tension between *ethical* shareholders and *labor-affiliated* shareholders which is usually viewed as shareholders of “special interests”.

Interestingly, although widely used in the literature, the meaning of special interests is not clearly defined. To Friedman (1970), as we have seen above, any interest that is not shared by all shareholders is a special interest. Shareholder wealth maximization should be used as a kind of second best choice, since Friedman believed that there is no proper way to deal with the principal-principal conflict within the firm. Many of Friedman’s followers, however, treat this second best choice as the primary criterion and any non-profit maximizing concern as a special interest. A general term, “shareholder value”, is often applied to all shareholders without considering the possibility that profit maximization may not be a goal shared by all shareholders. For example, Agrawal (2012) attacked union shareholders for putting members’ interests above the shareholder value which he defined as the maximum of equity prices. The position of Hart & Zingales (2017) on this issue is ambiguous at best. They challenged Friedman (1970) and his followers by legitimizing social preferences but still insisted to fence off other special-interest behaviors “under the guise of ethical behavior”. This makes the definition of special interests more obscure.

One alternative to this problem is to follow a tradition in the legal profession acknowledging that all shareholders, individual or institutional, have special interests,

⁶In the corporate governance literature, the most typical principal-principal conflict is the conflict between controlling shareholders and minority shareholders (La Porta, et al., 1999).

let alone the management. While *homo-exonomicus* shareholders may prefer short-term profit over long-term growth and ignore externalities, *labor-affiliated* shareholders may care more about employees and the community. In fact, due to their willingness to challenge the management, *Labor-affiliated* shareholders have been the very active on many issues of corporate governance reforms that benefit all investors, such as say on pay, enhancing proxy access, fighting accounting frauds, or splitting the CEO / chair of the board of directors roles (Ertimur, et al., 2011; Renneboog and Szilagyi, 2010; Georgeson, 2012; Webber, 2018). According to this tradition, the proper approach is to make investors aware of the diverse interests when dealing with each other, and to maintain the bargaining and coalition building processes working as the usual political competition process (Webber, 2018). Although this alternative is not perfect,⁷ it does point out that there is no reason to discriminate particularly against *labor-affiliated* shareholders whether accepting social preferences or not.

3.3 Shareholder democracy in a representative firm

3.3.1 Overview of the model: a passive shareholder model

The analysis starts at a passive shareholder model in which shareholders are unable to put pressures on the manager. As a result, the manager chooses a business model maximizing his/her utility while generating social or environmental externalities. This in turn deters those socially conscious shareholders from staying in the firm. By assuming that shareholders have no way to influence the manager's decisions, this model resembles the basic agency problem that due to the separation between ownership and control, shareholders are not able to monitor the manager effectively, which then gives rise to various misconducts of the firm.

There are two types of shareholders in this economy: *ethical* (*E*-type) shareholders who care about the social and ecological impacts in addition to financial returns, and the *homo-economicus* (*H*-type) shareholders who care only about financial returns. These shareholders are matched with the manager in a representative firm which then executes a production project. In executing the production project, the manager can choose between two business models: a clean model (*C*) which takes into account the

⁷One possible concern is that this principal-principal conflict makes the manager unaccountable for he/she can use one task against another (Tirole, 2001), which in turn provides a reason of paying the manager fixed wages (Holmström & Milgrom, 1991) to deal with this multi-task problem.

social and environmental externalities, and a dirty model (D) which maximizes profit at all costs. The clean/dirty models here do not confine to projects of environmental impacts, but synonyms for various projects with good/bad economic, social, and environmental externalities. The wage to the manager is w_c under a C model, or w_d under a D model. In principle, the manager is neutral in terms of business models and willing to change when better incentives are provided. Since the C model accounts for externalities while the D model doesn't, however, the C model tends to generate lower earnings than the D model. All else equal, even if both C and D models pay the manager the same fraction of earnings, the manager will be paid more if he/she chooses a D model, i.e., $w_c < w_d$. This is consistent with the fact that it requires extra pressures of shareholders to elicit ethical behaviors from the manager, and is also supported by the empirical studies showing that more socially responsible firms pay their CEOs less (Cai, et al., 2011; Francoeur, et al., 2017).

After executing the production project, shareholders and the manager receive rewards that vary with the chosen business model and players' preferences. As shown in Table 3.1, while the financial return to the H -type shareholders is π_c when the manager chooses a clean business model, or π_d when the manager chooses a dirty one, the E -type shareholders gain or lose an extra amount of utility, x , respectively, in addition to the financial returns. While the empirical relationship between corporate social responsibility activities and the firm's financial accounting performances has been a hotly debated issue,⁸ in this paper I follow Hart & Zingales (2017) to assume a tension between shareholders' financial rewards and social welfare, i.e., $\pi_c \leq \pi_d$,⁹ to compare with their results and to make the analysis interesting.

Table 3.1. The payoff matrix in a passive shareholder democracy

		Manager	
		C	D
Shareholder	E	$\pi_c + x, w_c$	$\pi_d - x, w_d$
	H	π_c, w_c	π_d, w_d

⁸For example, the relationship can vary from positive (Lins, et al., 2017; Edmans, 2012) or negative (Matsusaka, et al., 2019; Krüger, 2015; Wright & Ferris, 1997), to neutral (McWilliams & Siegel, 2000) or non-linear (Von Arx & Ziegler, 2014).

⁹Please note that this is not inconsistent with the studies showing stock prices respond positively to corporate social responsibility activities, because the stock prices in those studies reflect the mixed evaluations of various types of shareholders, rather than the reward paid by the firm to its shareholders.

In this simple model, it's easy to see that while *ethical* shareholders would like to stay in the firm when the probability of the manager choosing C is higher than 50%, the manager will never choose C since $w_c < w_d$. That is, the manager always choose D if shareholders remain passive, and the H -type shareholders can offer a price acceptable to the E -type shareholders to exit such that the H -type shareholders prevail.

3.3.2 An active shareholder democracy

The manager will not care about shareholders' views unless discontented shareholders can put pressures on the manager. In this context, existing studies tend to explain misconduct of a firm by the failure of collective actions of its shareholders, and shareholder primacy is not a problem but rather a solution once *ethical* shareholders can act collectively. Moving beyond this view, in the active shareholder model presented in this and next sections, I follow Hart & Zingales (2017) in assuming no collective action problem for shareholders, to highlight critical limits of shareholder democracy. The analysis of this section shows that, even if the E -type shareholders can act collectively and put pressures on the manager, the effect is severely weakened by the H -type shareholders' counter actions. Furthermore, several institutional conditions tilt the balance toward the H -type shareholders. Therefore, simply resorting to shareholder democracy will not solve the problem of corporate misconducts very much.

Consider a representative firm of active shareholder model, in which there are two types of shareholders, E and H . Different from the passive model in Section 3.3.1, here the E -type shareholders can punish the manager by reducing his/her utility by the amount of α , if the manager chooses a D model. In a similar fashion, the H -type shareholders can punish the manager by the amount of β if a C model is chosen. These settings are consistent with the definition of active shareholders who believe that engagement is more important and effective than divestment to change a firm's behaviors. So the active shareholders will stay in the firm rather than shopping freely from firm to firm, unless someone offers a price higher than the expected utility.

Let p be the fraction of the E -type shareholders in the firm, and q be the probability of the manager choosing a C model. Based on the payoff matrix shown in Table 3.2, the expected payoffs for E -type and H -type shareholders are

Table 3.2. The payoff matrix in an active shareholder democracy

		Manager	
		C	D
Shareholder	E	$\pi_c + x, w_c$	$\pi_d - x, w_d - \alpha$
	H	$\pi_c, w_c - \beta$	π_d, w_d

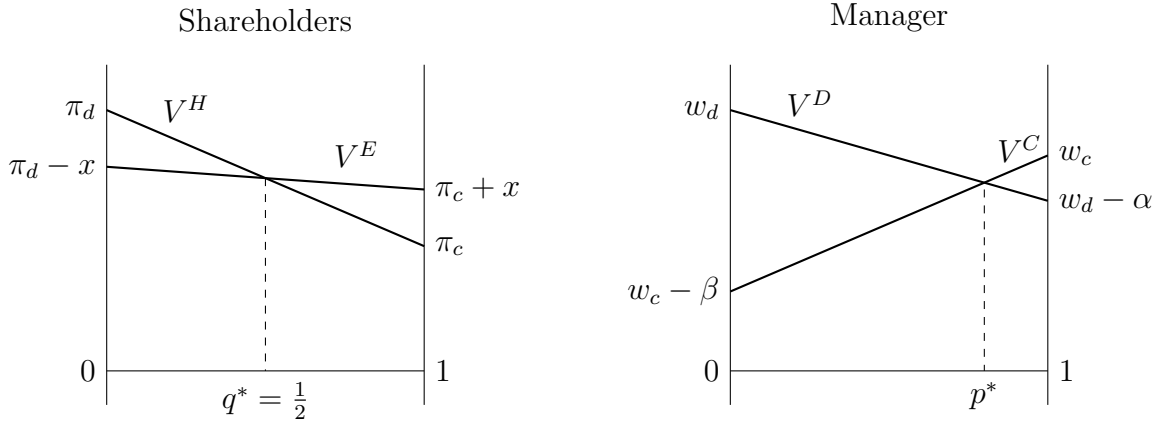
$$\begin{aligned} V^E &= (\pi_c + x)q + (\pi_d - x)(1 - q), \\ V^H &= \pi_c q + \pi_d(1 - q), \end{aligned} \tag{3.1}$$

and the expected payoff for the manager in choosing between C and D models are

$$\begin{aligned} V^C &= w_c p + (w_c - \beta)(1 - p), \\ V^D &= (w_d - \alpha)p + w_d(1 - p). \end{aligned} \tag{3.2}$$

Expected payoffs are further shown in Figure 3.1. For shareholders (right), $V^E = \pi_d - x$ and $V^H = \pi_d$ when $q = 0$, and $V^E = \pi_c + x$ and $V^H = \pi_c$ when $q = 1$. For the manager (right), $V^C = w_c - \beta$ and $V^D = w_d$ when $p = 0$, and $V^C = w_c$ and $V^D = w_d - \alpha$ when $p = 1$.

Figure 3.1. Expected payoffs under an active shareholder democracy to shareholders (*left*) and the manager (*right*)



On the left side of Figure 3.1, the intersection of V^E and V^H identifies the critical value of the probability of the manager choosing C for the E -type shareholder to survive in the firm. It's easy to find that $q^* = \frac{1}{2}$. On the right side of Figure 3.1, the

intersection of V^C and V^D identifies the critical fraction of the E -type shareholders such that C will be the manager's best response. Solve Equations (3.2) for p , we find:

$$p^* = \frac{w_d - w_c + \beta}{\alpha + \beta} = \frac{\Delta w + \beta}{\alpha + \beta}, \quad (3.3)$$

where $0 < \Delta w \leq \alpha$ since $0 \leq p \leq 1$ and $w_d > w_c$.

Compared to the passive shareholder model in the previous section, in this active shareholder model, there are rooms for shareholders to influence the manager's choice of strategy. Therefore, consistent with the shareholder primacy argument, larger the α and hence larger the p^* , easier for the manager to choose C . However, the shareholder primacy argument does not account for the fact that the H -type shareholders can act too, and larger the β , harder for the manager to choose C .

The influence of the E -type shareholders is further constrained by several institutional conditions such that the value of p^* is very likely larger than $\frac{1}{2}$. To see the reasons, we learn from Equation (3.3) that, to have $p^* < \frac{1}{2}$, we need to have $\alpha > 2\Delta w + \beta$. That is, the pressure from the E -type shareholders need to be larger than the pressure from the H -type shareholders *plus* the gap between the manager's compensations from a C and a D models. This is unrealistic because it is likely that $\alpha < \beta$ and $\Delta w > 0$.

The relative strengths of α and β depend on not just the likelihoods of collective actions of the H -type and E -type shareholders, but also on regulation, court decisions, political influences, and the dominant ideology. Even if we assume no problem in the collective actions, since the interpretation of shareholder primacy has been dominated by the proponents of Friedman (1970) in the recent decades, the E -type shareholder is definitely on the weak side in terms of regulation and court decisions. In terms of political influence, compared to the powerful lobbies and campaign contributions from big *homo-economicus* shareholders (Young, 2012; Epstein, 2019), it's very rare to see any meaningful political engagement of ordinary *ethical* shareholders in the forms of protest, lobby or campaign contribution. Actually, one can argue that the *ethical* shareholder is non-political by definition, otherwise it may well become a type of special-interest shareholders.

In terms of the dominant ideology, there are some signs that the current is moving closer to the side of E -type shareholder recently, particularly on the environmental and sweatshop issues accompanying the fair trade movement. But its influence in the corporate world is more a combined product of the actions of *labor-affiliated*

shareholders and consumers, and singling out and attacking the *L*-type shareholder will definitely reduce α .

In terms of Δw , as mentioned earlier, empirical studies find that socially responsible firms pay their CEOs less, suggesting $\Delta w > 0$ (Cai, et al., 2011; Francoeur, et al., 2017). Among different components of the CEO's compensation, these firms also rely less on incentive-based compensation (Francoeur, et al., 2017), which is consistent with the evidence that equity-based pay can lead to various economic and social problems.¹⁰ As the growth of equity-based pay and performance bonuses pushed up the total compensation in the recent decades, the gap between w_d and w_c is far from zero, which suggests that the influence of the *E*-type shareholder is seriously weakened.

3.3.3 When “special interest” shareholders matter

While the institutional conditions discussed above impose serious constraints on the *SD* model, current regulations do not completely rule out the space for shareholders' social proposals or prohibit *ethical* shareholders. Actually, there have been rich records of social proposals in the field of corporate governance. However, we don't see many *ethical* shareholders in reality, and most social proposals have been raised not by the *ethical* shareholders but by the union and public pension funds, or the *labor-affiliated* shareholders (Ertimur, et al., 2011; Renneboog and Szilagyi, 2010; George-son, 2012; Webber, 2018). From a positive rather than a normative point of view, this raises interesting questions about why is this the case and what are its implications to the *SD* model.

The explanation provided in this section is straight-forward: compared to the *ethical* shareholders, union and public pension funds care more about externalities because, by definition, they have more at stake in the game, either because they enjoy some private benefits under a clean model, or because they bear the burden of externalities under a dirty model. In this case, their pressures for a clean model outweigh the pressures from *ethical* shareholders and tend to replace the latter when a clean model is chosen.

Combined with the analyses of previous sections, one interesting result of this section is: the non-special interest, *ethical* shareholders are likely to be squeezed from both sides and to be replaced either by the shareholders who care only about

¹⁰Please see Footnote 1.

financial returns, or by the shareholders who are concerned more about social welfare/externalities more. This explains the absence of *ethical* shareholders and the role of the *labor-affiliated* shareholders in the current shareholder activism. It also implies that the attack on the *labor-affiliated* shareholders will decrease rather than increase social proposals.

In an extended model of active shareholders, there are three types of shareholders, E , H , and L . While E and H are defined as the same as in the previous section, L represents the *labor-affiliated* shareholders including union and public pension funds, as shown in Table 3.3. Due to their roles in the production process and in the community, the L -type shareholders enjoy a private benefit ($+y$) under a C model and suffer from the externality ($-y$) under a D model, which are larger than the extra utility/disutility of the E -type shareholders under the C/D models ($y > x$). As the L -type shareholders have more to gain and to lose, they will protest against the manager harder than the E -type shareholders if the manager chooses a D model. This is shown in the disutility, $-\gamma$, on the manager's return w_d , and $\gamma > \alpha$.

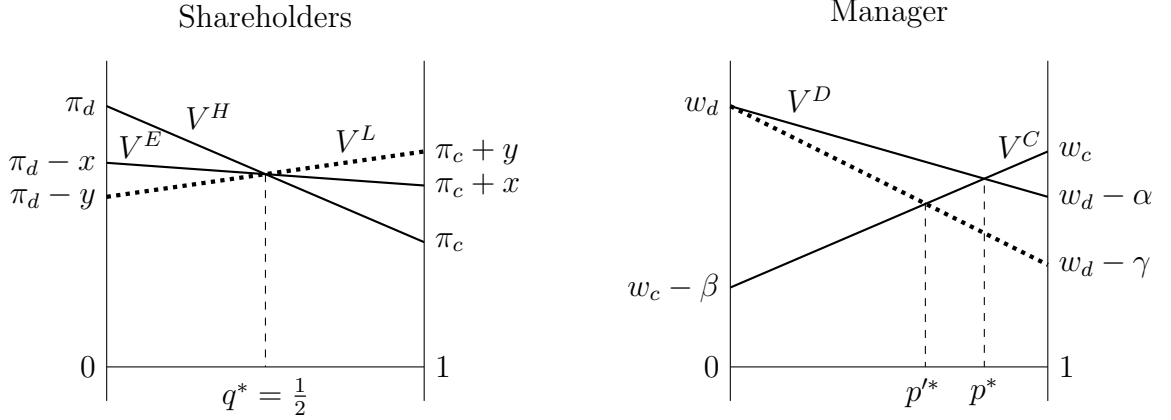
Table 3.3. The payoff matrix in an shareholder democracy with “special-interest” shareholders

		Manager	
		C	D
Shareholder	E	$\pi_c + x, w_c$	$\pi_d - x, w_d - \alpha$
	H	$\pi_c, w_c - \beta$	π_d, w_d
	L	$\pi_c + y, w_c$	$\pi_d - y, w_d - \gamma$

Let q remain the probability of the manager choosing a C model. With the information in Table 3.3, we can depict the expected payoffs of three types of shareholders in the left side of Figure 3.2, where V^H is the expected payoff for the H -type shareholders, V^E for the E -type shareholders, and V^L for the L -type shareholders. It shows that while the critical probability of the manager in choosing C remains $\frac{1}{2}$, the upper envelope of the expected payoff lines is always above V^E except at $q^* = \frac{1}{2}$, implying that the E -type shareholder is going to be replaced not only by the H -type if a D model is chosen, but also by the L -type if a C model is chosen. This result comes from the fact that both the *homo-economicus* and the *labor-affiliated* shareholders have more to gain and lose than the *ethical* shareholders, albeit for different reasons. Once we allow the H -type and the L -type shareholders to co-exist with the E -type shareholders in the model, the E -type shareholders will extinct. It helps

to explain the puzzle why, despite the plausible assumption of the existence of the E -type shareholders, we don't observe them very much in reality.

Figure 3.2. Expected payoffs under an active shareholder democracy to shareholders (*left*) and the manager (*right*)



Next, with the result from the left side of Figure 3.2, we can reduce Table 3.3 to a 2-by-2 matrix by deleting the row of E . Then let p' be the fraction of the L -type shareholders, and $1 - p'$ be the fraction of the H -type shareholders. The manager's expected payoffs in choosing C and D become

$$\begin{aligned} V^C &= (w_c - \beta)(1 - p') + w_c p', \\ V^D &= w_d(1 - p') + (w_d - \gamma)p'. \end{aligned} \quad (3.4)$$

Solve Equations (3.4) for p' , we get

$$p'^* = \frac{\Delta w + \beta}{\gamma + \beta}. \quad (3.5)$$

Compared with Equation (3.3), since $\gamma > \alpha$, we have $p'^* < p^*$ as shown in the right side of Figure 3.2. That is, the critical fraction of the L -type shareholders required to induce the manager to choose a C model is less than that of the E -type shareholders, such that a shareholder democracy led by the *labor-affiliated* shareholders is more likely to succeed in pushing the manager to change for good, all else equal. This is consistent with the existence of social proposals given the institutional constraints, and helps to explain why they mostly come from the union and public pension funds.

3.4 Conclusion

In challenging the dominant theory of the purpose of the firm, Hart & Zingales (2017) propose a *Shareholder Democracy* model in which the doctrine of shareholder *wealth* maximization is replaced by shareholder welfare maximization, and *ethical* shareholders can express their social concerns through voting. While their model represents a big progress beyond Friedman (1970), this paper shows that the model does not immune from the pressures of the *homo-economicus* shareholders. In addition, this model is either problematic or self-defeating by introducing social preferences while fencing off special-interest shareholders, particularly the *labor-affiliated* shareholders, because there is no clear distinction between various social preferences and special interests, and the *labor-affiliated* shareholders have been on the forefront of corporate governance reform and have outweighed the effect of *ethical* shareholders.

Not all private interests are bad. As temporary monopoly rents may stimulate innovations, the private interests of the *labor-affiliated* shareholders may have similar effects in pushing for a more socially inclusive model of corporate governance (Webber, 2018). Such a model is possible if we not only replace wealth maximization with welfare maximization, but also recognize the important role of the *labor-affiliated* shareholders.

APPENDIX A

CHAPTER 1 APPENDICES

A.1 Data Sources and Matching

Compustat (North America) & Execucomp are proprietary databases compiled by Standard & Poors' for firms traded on a U.S. and Canadian Exchange (we keep only firms which have their headquarters in the U.S.) and for S&P 1500, from 1992 to present. We obtain the data from the WRDS platform. **CPS.** The Current Population Survey (CPS) is a monthly survey of about 60,000 participating households, a sample representing the civilian non-institutional U.S. population, conducted by the U.S. Census Bureau for the U.S. Bureau of Labor Statistics (BLS). The data of workers come from the Annual Social and Economic Supplement (ASEC), or the "March supplement", of CPS which is widely used in the literature.

We obtain the data from the IPUMS-CPS program which provides CPS micro-data since 1960s to present in coherent industry and occupation classification codes. We use the data ranging from year 1992 to year 2016, and keep only the wage and salary earners in the private sector. We exclude the executive occupation from the sample.

All nominal values are deflated using the Consumer Price Index (CPI) from BLS. The base year is 2010.

Matching: the firm-level sample. In building the firm-level sample, the merge between Compustat and Execucomp is based on the GVKEY identifier which is unique for each firm in both databases.

To match the CPS data to the Compustat-Execucomp data set, we utilize the Standard Industrial Classification (SIC) code. While each observation in the Execucomp and Compustat databases contain a SIC code following the classification of the U.S. Security and Exchange Commission (SEC), the CPS data set does not contain SIC codes but only the Census 1990 industry code. So we build a crosswalk table to link the Census 1990 code to the SIC code basing on the appendix A of Scopp (2003),

so that each observation in the CPS receives a corresponding SIC code. Due to the changes of categorization over years, the finest level at which the linkage can be made is the 2-digit SIC level.

The ASEC contains more demographic details than surveys in other months. It contains detailed information needed for this study, including gender, race, age, employment status, union membership, education attainment, etc. We calculate the series of proportions of worker characteristics within every industry-year using CPS data. The definition of each variable is presented in the summary statistics tables. The series of proportions are then matched with the Compustat-Execucomp data at the industry-year level.

Since firms in Compustat and Execucomp tend to be big firms, we drop observations from CPS who worked in small firms (less than 100) when calculating worker characteristics. We also drop all conglomerate firms (2-digit SIC = 99) from Compustat-Execucomp data set that are not classifiable to a specific industry.

Matching: the individual-level sample. In building the individual-level sample, we first calculate firms' and managers' compensation structures and other characteristics at the firm-year level, and then take the weighted averages of each at the 2-digit SIC industry level for each industry-year. We use the share of each firm in the total employees in each industry-year as the weight of each firm and each executive.

Then we use the annual wage and salary income to measure the worker's wage. To compute the hourly wage, we divide the annual wage and salary income by the number of hours worked, which is possible only since the 1976 survey. The data of extremely high incomes in CPS are subjected to topcoding procedures and therefore bias downward for confidentiality reasons. To deal with the problem, we multiply top-coded incomes in the period 1992-1995 by 1.75, following the method of Philippon & Reshef (2012).

In the individual-level sample, we require the included individual workers, firms, and managers all to be in big firms, defined as a firm with least 500 employees.

A.2 Measurements of equity-based pay

The information on managerial compensation comes from Execucomp database. Execucomp provides time series data of managerial compensation since 1992.

From 1992 to 2005, the value of stock options is measured by S&P’s Black-Scholes-Merton formula (Execucomp item: `option_awards_blk_value`). The formula calculates the expected value of the option accounting for current stock price, exercise price, discount rate, time to expiration, and the estimated volatility of returns. Since 2006, the values of all equity-based compensations are measured by the estimated fair value of the awards, as required by the SEC. The fair value is often based on Black-Scholes or a similar valuation method, and therefore remains consistent with the evaluation before 2006.

In computing the *Equity Fraction* measure, we use “Total Compensation 1” (Execucomp item: `tdc1`) to measure the value of total compensation of the manager between 1992 and 2005. In the cases of missing variables, we use “Total Compensation 2” (Execucomp item: `tdc2`), and, if still missing, “Total Current Compensation” (Execucomp item: `total_curr`). We use the “Total Compensation as Reported in SEC Filings” (Execucomp item: `total_sec`) since 2006. This measurement uses fair-value measures of stock options and stock awards, and is valued at grant-date stock prices but recorded as compensation expenses only if and when an option or an award vests, i.e., when the manager is allowed to exercise the options and purchase the company’s stock.

Hopkins & Lazonick (2016) point out that the conventional measurements of the value of equity-based pay, using the fair-value or Black-Scholes method, are much smaller comparing to the realized values. However, on the one hand, there are significant uncertainties regarding the magnitudes of realized values when the compensation schemes are determined by the board, so that its incentive effects on executives are ambiguous. On the other hand, the data of realized value become available only since 2006 which will costs us about the half of observations. Therefore, we use conventional measurements in this study.

A.3 Robustness tests: sample selection bias using Heckman correction model (corresp. Section 1.3.3.1)

[This is results from the previous version. Re-estimations are currently underway.]

Table A.1. Evidence on Managerial Incentives and Workers' Wages, Heckman's (1976, 1979) two-step correction model

Dependent Variable: Log(Yearly Average Wage)				
	(1)	(2)	(3)	(4)
CEO equity-based pay	-0.074*** (0.014)	-0.073*** (0.020)		
Non-CEO equity-based pay	-0.083*** (0.022)	-0.093*** (0.023)		
CEO non-equity performance pay			0.060** (0.024)	0.012 (0.000)
Non-CEO non-equity performance pay			0.027 (0.030)	0.028 (0.000)
Incentive-control interaction terms	No	Yes	No	Yes
Managers' shareholdings	Yes	Yes	Yes	Yes
Herfindahl-Hirschman index	Yes	Yes	Yes	Yes
Firm characteristics by firm-year	Yes	Yes	Yes	Yes
Worker characteristics by industry-year	Yes	Yes	Yes	Yes
Firm-, industry-, and year-fixed effects	Yes	Yes	Yes	Yes
Incorporation-state-year-fixed effect	Yes	Yes	Yes	Yes
Observations	9,344	9,344	9,344	9,344

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Notes. Equity pay fraction is defined as the fraction of stock award plus stock option in the executive total compensation. Non-equity performance pay fraction is defined as the fraction of bonus + long-term incentive pay till 2005, non-equity incentive pay since 2006, in the executive total compensation. Firm characteristics includes: foreign activity ratio, log value of sales per employee, log value of asset per employee, leverage ratio. Worker characteristics include: gender, race, age, education, potential experience and its square term, no union coverage, full/part-time status, urban residence, and marital status, all calculated as proportions at the 2-SIC digit-year level.

A.4 Robustness Tests: non-finance vs. finance; industry-year-fixed effects; managerial shareholding (corresp. Section 1.3.3.2)

Table A.2. Robustness Tests: Non-financial and financial sectors, industry-Year-Fixed effects, CEO shareholding. Firm-level sample (corresp. Section 1.3.3.2)

	Dependent Variable: Log(Yearly Wage)							
	Non-finance		Finance		Industry-year		Shareholding	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CEO equity-based pay fraction	-0.053** (0.022)		-0.063 (0.045)		-0.057** (0.023)		-0.059*** (0.022)	
CEO equity-based pay/salary ratio		-0.004*** (0.001)		-0.001 (0.002)		-0.002 (0.002)		-0.002 (0.001)
CEO shareholding fraction							-0.127 (0.177)	-0.085 (0.174)
Managers' characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm characteristics by firm-year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year-fixed effects	No	No	No	No	Yes	Yes	No	No
Worker characteristics by industry-year	Yes	Yes	Yes	Yes	No	No	Yes	Yes
HHI by industry-year	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Firm-, industry-, state-, and year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Incorp-state-year-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.402	0.404	0.372	0.369	0.473	0.472	0.307	0.305
Observations	3,109	3,109	2,470	2,470	5,579	5,579	5,579	5,579
Number of firms	368	368	286	286	651	651	651	651

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Notes. Equity based pay fraction is defined as the fraction of stock award and stock option in the executive total compensation. Equity/salary ratio is defined as the value of stock award plus stock option divided by the value of salary. Manager characteristics include: gender, total amount of current compensations (salary + bonus), CEO-chair duality, externally-hired CEO, non-CEO's gender. Firm characteristics includes: foreign activity dummy, sales per employee, total assets, leverage ratio, capital expenditure divided by total assets, and firm's age. Worker characteristics include: gender, race, age, education, experience, union coverage, full/part-time status, urban residence, and marital status, all calculated as proportions at the 2-SIC digit-year level. Robust standard errors are adjusted for clustering at the firm level.

A.5 Robustness tests using the individual-level sample: sample selection bias and composition changes by offshoring (corresp. Section 1.3.3.3)

Data and Variables

Table 1.9 summarizes the distributions of workers, firms and executives across major sectors in the individual-level sample, and Table 1.10 shows summary statistics of all variables. Since we calculated the executive-, firm-, and industry-level variables at the 2-digit SIC level, the discrepancies between the sectoral distributions of workers and firm/executive do not affect matching and measurements. My sample contains 54 industries by 2-digit SIC.

Table A.3. Distributions of workers, firms and executives across major industries (%), the individual-level sample

Sector (1-digit SIC, division)	Workers	Firms	Executives
Mining and Construction	3.62	3.77	2.69
Manufacturing 1: Food, Textile, Chemicals, etc.	8.86	13.16	15.04
Manufacturing 2: Rubber, Machinery, Electronics, etc.	12.09	23.37	18.09
Transportation, Communications, Electric, etc.	10.8	12.3	21.19
Wholesale Trade & Retail Trade	25.35	13.57	8.51
Finance, Insurance, and Real Estate	9.65	12.24	25.91
Services 1: Hotel, Personal Business, Motion Picture, etc.	8.52	15.34	5.07
Services 2: Health, Legal, Education, Social, etc.	21.12	5.89	3.51

In the analyses using the individual-level sample, the dependent variable is the $\log(\text{hourly wage})$, where the hourly wage includes annual wage and salary income¹ plus employer's contribution for health insurance, and divided by total working hours and deflated by CPI to 2010 dollar values. It is therefore a measurement of a worker's total pay, keeping in line with the wage measure in the firm-level sample. (Table 1.11 column (3) and (4) show that the estimation results are similar when excluding employer's contribution for health insurance from the measurement of the dependent variable.)

¹The data of extremely high incomes in CPS are subjected to topcoding procedures and therefore bias downward for confidentiality reason. To deal with the problem, we multiply top-coded incomes in the period 1992-1995 by 1.75, following the method of Philippon & Reshef (2012).

Equity Fraction, *Equity Ratio*, and other manager and firm characteristics are defined in the same ways as in the firm-level sample, but calculated at the industry-year level. We first calculate them for each firm-year, and then take the weighted averages of each at the 2-digit SIC level for each industry-year. We use the share of each firm in the total employees in each industry-year as the weight of each firm and each executive. So the basic unit of my explanatory variables are a ratio in an industry-year. Individual workers are then matched with the executive and firm variables by industry-year.

As in the previous firm-level analyses, we also include industry-, year-, and state-year-fixed effects, and a Herfindahl-Hirschman index (HHI) based on the Compustat dataset. Additionally, we control for occupation-fixed effects which is not feasible with the firm-level sample.

Table A.4: Variables Definitions and Summary Statistics: Individual-Level Analyses

Variable	Definition	Mean	S.D.	Min	Max
Executive and Firm Characteristics, all first calculated at the firm-level, then weighted averaged at the SIC-year level. ($N=1,127$)					
Hourly wage	Annual wage and salary incomes plus employer's contribution to health insurance (in 2010 dollar), divided by total hours worked.	27.298	83.169	4.451	38,354
Log(hourly wage)	Hourly wage in logarithms.	3.055	0.653	1.493	10.555
<i>Manager's compensation structure, by industry-year</i>					
CEO equity-based pay fraction	The CEO's equity-based pay (stock awards + stock options) fraction of the total compensation.	0.442	0.124	0.075	0.749
CEO stock award fraction	The CEO's stock awards fraction of the total compensation.	0.188	0.155	0	0.724
CEO stock option fraction	The CEO's stock options fraction of the total compensation.	0.255	0.134	0.022	0.686
CEO performance pay fraction	CEO's bonus + long-term incentive pay + equity-based pay, till 2005; CEO's non-equity incentive pay + equity-based pay, since 2006.	0.671	0.109	0.188	0.899
CEO non-equity performance pay fraction	The CEO's non-equity performance pay (bonus + long-term incentive pay till 2005, non-equity incentive pay since 2006) fraction of the total compensation.	0.226	0.089	0.013	0.472
CEO equity-based pay to salary ratio	The CEO's equity-based pay (stock awards + stock options) divided by salary.	4.556	3.959	0.178	53.153
CEO stock award to salary ratio	The CEO's stock awards divided by salary.	1.899	2.374	0.000	51.917
CEO stock option to salary ratio	The CEO's stock options divided by salary.	2.599	3.136	0.074	42.833
CEO performance pay to salary ratio	CEO's bonus + long-term incentive pay + equity-based pay, till 2005; CEO's non-equity incentive pay + equity-based pay, since 2006. Divided by salary.	6.396	4.848	0.514	54.805
CEO non-equity performance pay to salary ratio	The CEO's non-equity performance pay (bonus + long-term incentive pay till 2005, non-equity incentive pay since 2006) divided by salary.	1.684	1.253	0.082	13.039
Non-CEO equity-based pay fraction	Firm-averaged Non-CEO equity-based pay fraction.	0.357	0.109	0.000	0.666

(continued)

(continued)

Variable	Definition	Mean	S.D.	Min	Max
Non-CEO stock award fraction	Firm-averaged Non-CEO stock awards fraction.	0.173	0.132	0	0.576
Non-CEO stock option fraction	Firm-averaged Non-CEO stock options fraction.	0.214	0.117	0	0.612
Non-CEO performance pay fraction	Firm-averaged Non-CEO performance pay fraction.	0.586	0.105	0	0.909
Non-CEO non-equity performance pay fraction	The Non-CEO executives' non-equity performance pay (bonus + long-term incentive pay) fraction of the total compensation.	0.227	0.087	0	0.559
<i>Manager's characteristics, by industry-year</i>					
CEO total current compensation	CEO's salary plus bonus.	2,054.854	1,704.088	261.911	26,107.480
CEO-chair duality	1 if the CEO is also the board chair, and 0 otherwise.	0.623	0.235	0	1
external CEO	1 if becomes CEO within 3 years of joining the firm, and 0 otherwise.	0.153	0.161	0	1
CEO shareholding	The CEO's shareholding fraction of the firm's total shares.	0.018	0.025	0	0.229
CEO relative shareholding	1 if the CEO owns more shares than all 5% institutional blockholders together, and 0 otherwise.	0.142	0.246	0	1
female CEO	1 if the CEO's gender is female, and 0 otherwise.	0.02	0.063	0	1
Non-CEO shareholding	Firm-averaged Non-CEO's shareholdings fraction.	0.003	0.006	0	0.127
Non-CEO relative shareholding	1 if the non-CEO managers owns more shares than all 5% institutional blockholders together, and 0 otherwise.	0.117	0.216	0	1
female Non-CEO	1 if the Non-CEO executive's gender is female, and 0 otherwise.	0.064	0.059	0	0.347
<i>Firm and industry characteristics, by industry-year</i>					
Log(sale per employee)	The value of total sale divided by the number of employees (in million dollar). In logarithms.	5.432	0.748	2.564	8.378
Log(asset per employee)	The value of total asset divided by the number of employees (in million dollar). In logarithms.	5.502	1.143	1.620	8.796
Leverage	Total long-term debts and debts in current liabilities, divided by total assets.	0.292	0.115	0.049	0.783
Foreign Activity	1 if the firm receives any foreign incomes or pay foreign taxes, 0 otherwise.	0.672	0.283	0.000	1.000

(continued)

(continued)

Variable	Definition	Mean	S.D.	Min	Max
Capital Expenditures	The funds used for additions to property, plant, and equipment, excluding amounts arising from acquisitions. In Millions of dollars.	1,165.989	2,086.848	8.714	20,526.236
Return on asset	The firm's earnings before interest and taxes divided by the value of total asset.	0.093	0.043	-0.327	0.292
HHI	The Herfindahl-Hirschman index at the 2-digit SIC-year level, based on Compustat data set.	1,066.740	668.541	76.834	3,061.651
Individual Characteristics ($N=564,203$)					
Age		39.489	12.626	15	90
Female	1 if the worker's gender is female, 0 otherwise	0.479	0.5	0	1
Years of Education	No school: 1; 1st-4th grade: 4; 5th-8th grade: 8; 9th grade: 9; 10th grade: 10; 11th grade: 11; 12th grade, no diploma: 11.5; high school graduate: 12; some college, no degree: 13; associate degree: 14; bachelor's degree: 16; master's degree: 18; professional degree: 19; doctorate degree: 23.	13.694	2.585	1	23
Experience	Potential working experience years, calculated as $\min\{age - edu - 6; age - 18\}$ and no less than 0.	19.606	12.538	0	72
Experience ²	Experience squared	541.618	574.12	0	5,184
Part-time	Full/part-time status, 1 if the worker is a part-time worker, 0 otherwise.	0.154	0.361	0	1
Non-white race	1 if the worker's race is non-white, 0 otherwise.	0.195	0.396	0	1
No union proportion	1 if no union coverage, 0 otherwise. This is the no union coverage ratio calculated at the SIC-year level.	0.799	0.117	0.129	1
Urban residence	A categorical variable coded as: 0 if not identifiable; 1 if not in metro area; 2 if central city; 3 if outside central city; 4 if central city status unknown.			0	4
Marital status	A categorical variable coded as: 1 if married, spouse present; 2 if married, spouse absent; 3 if separated; 4 if divorced; 5 if widowed; 6 if never married/single.			1	6

A.5.0.1 Model specification

We fit a series of cross-section regressions in the worker-firm-executive matched sample as follows:

$$\log(w_{ijst}) = \alpha + \beta \mathbf{X}_{jt} + \gamma \mathbf{M}_{jt} + \delta \mathbf{I}_{jt} + \phi \mathbf{V}_{ist} + \mu \mathbf{F}_{ijst} + \varepsilon_{ijst}, \quad (\text{A.1})$$

where w is the hourly total wage, so $\log(w_{ijst})$ is the log wage of individual i in industry j in state s at time t . \mathbf{X}_{jt} denotes CEO compensation structure measures of including equity-based pay, stocks and options, performance pay, non-equity performance pay. \mathbf{M}_{jt} includes other manager characteristics and three variables of managerial controlling power. \mathbf{I}_{jt} includes firm characteristics, and \mathbf{V}_{ist} includes workers' characteristics including occupation. \mathbf{F}_{jst} are industry-, year- and state-year-fixed effects, and HHI by industry and Emp-HHI by state. The robust standard errors are clustered at the industry level. The estimations of β is of particular interest in the following analyses.

Table A.5. Effects of Equity-Based Pay on Wages, Individual-Level Sample

	Dependent Variable: Log(Hourly Wage)			
	with health contrib.		without health contrib.	
	(1)	(2)	(3)	(4)
CEO equity fraction by industry-year	-0.037*** (0.011)		-0.037*** (0.01)	
CEO equity ratio by industry-year		-0.000391** (0.000169)		-0.000403** (0.000179)
Manager characteristics by industry-year	Yes	Yes	Yes	Yes
HHI by industry-year	Yes	Yes	Yes	Yes
Firm characteristics by industry-year	Yes	Yes	Yes	Yes
Worker characteristics	Yes	Yes	Yes	Yes
Occupation-, industry- and year-fixed effects	Yes	Yes	Yes	Yes
State-year-fixed effect	Yes	Yes	Yes	Yes
Observations	564,203	564,203	564,203	564,203
R-squared	0.51	0.51	0.502	0.502

Clustered-robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Notes. Column (1) and (2): worker's wage with employers' contribution for health insurance. Column (3) and (4): worker's wage without employers' contribution for health insurance. Equity fraction is defined as the fraction of stock award and stock option in the executive total compensation. Equity ratio is defined as stock awards plus stock options divided by salary. Manager characteristics include: gender, total amount of current compensations (salary + bonus), CEO-chair duality, CEO's relative shareholdings against all other 5% institutional blockholders, externally-hired CEO, non-CEO's gender, non-CEO's relative shareholdings against all other 5% institutional blockholders. Firm characteristics includes: foreign activity dummy, log value of sales per employee, log value of asset per employee, leverage ratio, numbers of employees, capital expenditure, return on asset, which are all calculated at the 2-SIC digit industry-year level. Worker characteristics include: gender, race, age, education, potential experience and its square term, union coverage, full/part-time status, urban residence, and marital status. Robust standard errors are adjusted for clustering at the industry level.

Table A.6. Effects of Four Compensation Components on Wages, Individual-Level Sample

	Dependent Variable: Log(Hourly Wage)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CEO stock award fraction	-0.047** (0.018)							
CEO stock option fraction		-0.019* (0.01)						
CEO performance pay fraction			-0.028** (0.012)					
CEO non-equity perf. pay fraction				0.03* (0.018)				
CEO stocks award ratio					-0.000892*** (0.000322)			
CEO stock options ratio						-0.000241 (0.000159)		
CEO performance pay ratio							-0.000368** (0.000165)	
CEO non-equity perf. pay Ratio								0.000378 (0.00152)
Manager characteristics by industry-year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
HHI by industry-year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm characteristics by industry-year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Worker characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Occupation-, industry- and year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-year-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	564,203	564,203	564,203	564,203	564,203	564,203	564,203	564,203
R-squared	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Notes. Performance pay fraction is defined as the fraction of bonus + long-term incentive pay + equity-based pay, till 2005; CEO's non-equity incentive pay + equity-based pay, since 2006, in the executive total compensation. Stock award and stock option fractions are defined as the value of stock award and stock option divided by the value of the executive total compensation. Stock award/salary ratio and stock option/salary ratio are defined as the value of stock award and stock option divided by the value of salary. Non-equity performance pay fraction is defined as the fraction of bonus + long-term incentive pay till 2005, non-equity incentive pay since 2006, in the executive total compensation. Manager characteristics include: gender, total amount of current compensations (salary + bonus), CEO-chair duality, CEO's relative shareholdings against all other 5% institutional blockholders, externally-hired CEO, and CEO's non-equity performance pay ratio, non-CEO's gender, non-CEO's relative shareholdings against all other 5% institutional blockholders. Manager characteristics include: gender, total amount of current compensations (salary + bonus), CEO-chair duality, CEO's relative shareholdings against all other 5% institutional blockholders, externally-hired CEO, non-CEO's gender, non-CEO's relative shareholdings against all other 5% institutional blockholders. Firm characteristics includes: foreign activity dummy, log value of sales per employee, log value of asset per employee, leverage ratio, numbers of employees, capital expenditure, return on asset, which are all calculated at the 2-SIC digit industry-year level. Worker characteristics include: gender, race, age, education, potential experience and its square term, union coverage, full/part-time status, urban residence, and marital status. Robust standard errors are adjusted for clustering at the industry level.

APPENDIX B
CHAPTER 2 APPENDICES

B.1 Expanded OLS results

Table B.1. Effects of Equity-Based Pay on Investment Herding (Non-Financial Firms): Comparing Three Targets

Outcome Variable: Firm's Investment Change (ΔI^F)						
	Industry-Median		Industry-Average		Industry-Leader	
	(1)	(2)	(3)	(4)	(5)	(6)
Industry investment change (ΔI^{Ind})	1.008*** (0.365)	0.983*** (0.364)	0.001 (0.002)	0.001 (0.002)	0.061 (0.135)	0.069 (0.134)
CEO equity-based pay ratio $\times \Delta I^{Ind}$	0.032** (0.018)		0.000* (0.000)		0.006 (0.007)	
CEO stock award ratio $\times \Delta I^{Ind}$		-0.039 (0.045)		-0.000 (0.000)		0.020 (0.014)
CEO stock option ratio $\times \Delta I^{Ind}$		0.045** (0.019)		0.000** (0.000)		0.001* (0.008)
CEO equity-based pay ratio	-0.000 (0.000)		-0.000* (0.000)		-0.000 (0.000)	
CEO stock award ratio		0.000 (0.000)		0.000 (0.000)		0.000 (0.001)
CEO stock option ratio		-0.000** (0.000)		-0.001** (0.000)		-0.001** (0.000)
Manager characteristics and interactions	Yes	Yes	Yes	Yes	Yes	Yes
Firm characteristics and interactions	Yes	Yes	Yes	Yes	Yes	Yes
Herfindahl-Hirschman index and interactions	Yes	Yes	Yes	Yes	Yes	Yes
ΔI_{t-1}^F	Yes	Yes	Yes	Yes	Yes	Yes
Firm-, industry-, and year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Incorporation-state-year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.308	0.308	0.303	0.303	0.305	0.305
Observations	32,520	32,520	32,520	32,520	29,261	29,261
Number of firms	2,689	2,689	2,689	2,689	2,640	2,640

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Notes. The sample includes the firms in CRSP/Compustat Merged Database, matching with the CEO compensation data from Execucomp database, covers the period from 1992 to 2016, and excludes firms in financial and utilities industries (SIC codes 6000-6999 and 4949-4999). Investment changes are measured by the difference between the investment ratio (total capital expenditures divided by assets) of this period and of the last period. In Column (1) & (2), the industry investment change is industry-median investment change calculated excluding the focal firm. In Column (3) & (4), the industry investment change is industry-average investment change calculated excluding the focal firm. In Column (5) & (6), the industry investment change is industry-leader investment change, which is defined as the average investment changes of top tercile of firms (by sales share) in the industry. These top-tercile firms are excluded from regressions in Column (5) & (6). Industry is defined at the 3-digit SIC level. Equity based pay ratio is defined as the value of stock award plus stock option divided by the value of salary. Stock award and stock option ratios are defined as the values of stock award and stock option divided by the value of salary. Manager characteristics include: CEO-chair duality and externally hired CEO. Firm characteristics include: tangible asset rate, the numbers of one-year-ahead EPS forecasts, firm's age, the return on firm's assets last year, and the number of employees. Robust standard errors are adjusted for clustering at the firm level.

B.2 Evidence on Causality, IV Estimation (LIML Estimator)

Table B.2. Evidence on Causality, IV Estimation (LIML Estimator)

Treatment range (\$Salary, thousand dollars)	750- (1)	850- (2)	950- (3)	1050- (4)	1150- (5)
First Stage	Endogenous variable 1: CEO equity ratio				
Angrist-Pischke F-statistic	20.431	29.341	17.662	9.983	4.26
p-value of Angrist-Pischke F-statistic	4.34e-13	1.16e-18	2.37e-11	1.53e-06	0.00521
	Endogenous variable 2: CEO equity ratio $\times \Delta I^{Ind}$				
Angrist-Pischke F-statistic	6.970	6.481	5.878	5.534	4.859
p-value of Angrist-Pischke F-statistic	0.00011	0.00023	0.00054	0.00087	0.00225
Second Stage	Dependent variable: Firm's investment change (ΔI^F)				
CEO equity ratio $\times \Delta I^{Ind}$	-0.249** (0.115)	-0.287** (0.126)	-0.323** (0.136)	-.311** (0.136)	-0.342** (0.152)
ΔI^{Ind}	2.105*** (0.616)	2.275*** (0.645)	2.426*** (0.692)	2.373*** (0.686)	2.487*** (0.762)
CEO equity ratio	-0.000 (0.001)	0.001 (0.001)	0.001 (0.001)	0.000 (0.001)	-0.001 (0.003)
Cragg-Donald F-statistic	33.431	39.8	25.968	16.63	8.585
Kleibergen-Paap F-statistic	15.336	22.346	13.362	7.449	3.165
Controlling Variables					
Manager characteristics $\times \Delta I^{Ind}$	Yes	Yes	Yes	Yes	Yes
HHI $\times \Delta I^{Ind}$	Yes	Yes	Yes	Yes	Yes
Firm characteristics $\times \Delta I^{Ind}$	Yes	Yes	Yes	Yes	Yes
ΔI_{t-1}^F	Yes	Yes	Yes	Yes	Yes
Number of employees	Yes	Yes	Yes	Yes	Yes
Return of assets last year	Yes	Yes	Yes	Yes	Yes
Industry- and year-fixed effects	Yes	Yes	Yes	Yes	Yes
Incorporation state-year-fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	32,520	32,520	32,520	32,520	32,520
Number of firms	2,689	2,689	2,689	2,689	2,689

Robust S.E. in parentheses: *** p<0.01, ** p<0.05, * p<0.1. Clustered at firms.

Notes. The sample includes the firms in CRSP/Compustat Merged Database, matching with the CEO compensation data from Execucomp database, covers the period from 1992 to 2016, and excludes firms in financial and utilities industries (SIC codes 6000-6999 and 4949-4999). *Firm's investment changes* (ΔI^F) are measured by the difference between the investment ratio (total capital expenditures divided by assets) of this period and of the last period. *Industry-median investment change* (ΔI^{Ind}) is measured by the median investment change in the industry excluding the focal firm. Industry is defined at the 3-digit SIC level. *CEO Equity based-pay ratio* is defined as the value of stock award plus stock option divided by the value of salary. From Column (1) to (5), the treatment ranges are 750 and above, 850 and above, 950 and above, 1050 and above, and 1150 and above, in thousand dollars. Manager characteristics include: CEO-chair duality and externally-hired CEO. Firm characteristics includes: tangible asset ratio, analyst forecast coverage, firm's age. All controlling variables are the same as in OLS analyses except the firm-fixed effects. Robust standard errors are adjusted for clustering at the firm level.

B.3 Tests using two deviation indices

Table B.3. Effects on Deviation Indices (Non-Financial Firms)

Dependent Variable:	Carpenter (2000)		Tang, et al. (2011)	
	(1)	(2)	(3)	(4)
CEO equity pay ratio	0.008* (0.005)		-0.005 (0.007)	
CEO stock award ratio		0.000 (0.009)		0.019** (0.009)
CEO stock option ratio		0.005 (0.003)		-0.013* (0.007)
Tangible asset rate	0.000 (0.039)	-0.000 (0.039)	-0.145*** (0.028)	-0.144*** (0.028)
Analyst forecast coverage	-0.155*** (0.044)	-0.155*** (0.044)	-0.016 (0.019)	-0.017 (0.019)
HHI	0.013 (0.011)	0.013 (0.011)	-0.067*** (0.020)	-0.066*** (0.020)
CEO-chair duality & external CEO	Yes	Yes	Yes	Yes
Firm characteristics	Yes	Yes	Yes	Yes
Firm-, industry-, and year-fixed effects	Yes	Yes	Yes	Yes
Incorporation-state-year-fixed effects	Yes	Yes	Yes	Yes
Adjusted R-squared	0.100	0.100	0.060	0.061
Observations	25,742	25,742	30,059	30,059
Number of firms	2,362	2,362	2,599	2,599

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Notes. In Column (1) & (2), the outcome variable is the strategic deviation index of *Carpenter (2000)*, which is computed by first calculating six indicators: advertising intensity (advertising expense / sales), plant and equipment upgrades (net plant and equipment / gross plant and equipment), nonproduction overhead (SGA expenses / sales), inventory levels (inventory / sales), financial leverage (debt / equity), and international concern (foreign sales / total sales). Second, calculate the three-year standard deviation of each indicator for each firm. Third, sum up these indicators to form the strategic deviation index. In Column (3) & (4), the outcome variable is the strategic deviation index of *Tang, et al. (2011)*, which is computed by first calculating four indicators: capital intensity (fixed assets / number of employees), plant and equipment upgrades (net plant and equipment / gross plant and equipment), overhead efficiency (selling, general, and administrative expense / sales), and financial leverage (total debt / equity). Second, calculate the standard deviations of each indicator for each firm, and then obtain the absolute value of them. Third, average these indicators to form the strategic deviation index. Industry is defined at the 3-digit SIC level. Equity based pay ratio is defined as the value of stock award plus stock option divided by the value of salary. Stock award and stock option ratios are defined as the values of stock award and stock option divided by the value of salary. Manager characteristics include: gender, shareholding percentage of the firm's stocks, externally hired CEO, and CEO-chair duality. Firm characteristics include log value of sales and log value of asset. In regressions, most explanatory and controlling variables are standardized except two binary variables, *CEO-chair duality* and *external CEO*. Robust standard errors are adjusted for clustering at the firm level.

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