Do Incentivized Managers Pay Their Workers Less?

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Abstract

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 pays and model settings. Using a novel instrumental-variable strategy based on a tax policy change, we provide evidence that an increase in the CEO's 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.

Keywords: wage, corporate governance, executive compensation, product market competition

JEL Classification:

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1 Introduction

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 CEOs 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 pays, 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 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 2, so far there is no empirical study on the effect of managerial incentive compensation structure on workers wages in the U.S. economy.

[1] See, 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.

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

[3] Although 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.

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 managers 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 pays divided by the total compensation) or *Equity Ratio* (equity-based pays divided by salary), consistently associates with lower wages. The effect persists even when the equity-based pay is decomposed into stock awards and 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 pays, 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-pays-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 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.

1.2 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 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

[4] Most 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).

[5] This 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.

[6] In 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.

(cash-flow rights, measured by the fraction of firms 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 rent trend to focus on the causal effect 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 governance and always push managers for 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

[7] Please see the results in Section 3.3.2.

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

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

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 been focusing 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; Gutirrez & Philippon, 2016), massive layoffs and outsourcing (Jung, 2015 & 2016; Dial & Murphy, 1995). This 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 2 develops a simple two-tiered principal-agent model to clarify the main argument and prediction. Section 3 describes the data and methods, presents our baseline results, and reports results from a set of robustness tests. Section 4 explains the institutional background and the construct of instrument, and presents evidence for causality based on the IV estimation. Section 5 looks closer at the effects of market competition on the relationship between the CEO's equity pay and workers' wages. Section 6 concludes. Details of data sources, variable measurements, and the results of robustness tests are reported in the Appendices.

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

2.1 The argument and key features

The main argument of the model is that by increasing equity-based pays, 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 payments, i.e., private benefits.[10] However, most collusion models start from analyzing the

[10] The 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

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 question[11] 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 later 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, as implied in the first feature, 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.

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 pays 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).

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

and the manager in controlling the firm.

[11] Therefore, 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.

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 pays, 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.

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:

$$m(w - \bar{w}) \geq c, \tag{1}$$

and the wage eliciting the worker's effort is

$$w = \bar{w} + \frac{c}{m}. \tag{2}$$

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

$$\Pi = y_H - w - s, \tag{3}$$

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

$$p = p(\Pi(m)). \tag{4}$$

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

$$p_L = p_H(1 - \lambda), \tag{5}$$

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]

[12] The 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 5 where we analyze whether and how is the effect of equity pay on wages affected by competition.

[13] This 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).

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:

$$G = s + \alpha p, \tag{6}$$

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

$$U = G(m)b(m), \tag{7}$$

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, 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

$$\begin{cases} U_H = G(m_H)b(m_H) = s + \alpha p_H = G_H; \\ U_L = G(m_L)b(m_L) = (s + \alpha p_L)b = (G_H - \alpha p_H \lambda)b. \end{cases} \tag{8}$$

Put Equation (2), (7) and (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. One 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

$$G_H \geq \bar{G}, \tag{9}$$

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

$$G_H \geq (G_H - \alpha p_H \lambda)b. \tag{10}$$

[14] Whether 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.

By rearranging the conditions we obtain

$$\alpha p_H \geq G_H \beta, \tag{11}$$

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.

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 (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:

$$m = \begin{cases} m_L & \text{if } \frac{\alpha p_H}{G_H} = \beta^F < \beta; \\ m_H & \text{if } \frac{\alpha p_H}{G_H} = \beta^F \geq \beta. \end{cases} \tag{12}$$

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 pays, 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

$$\beta^R = \frac{\alpha p_H}{s} = \frac{\beta^F}{(1 - \beta^F)}, \tag{13}$$

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

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

[16] Ordover & 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.

3 Basic Evidence on the Effects of Equity-Based Pays on Wages

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

3.1.1 The dependent variable: wage

Throughout the firm-level analyses, the dependent variable is log(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 (Compuststst 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.

[17] The 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.

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

To capture the relative importance of equity-based pays 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 2, a higher *Equity Fraction* or *Equity Ratio*, and therefore a heavier weight of equity-based pays 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 pays, 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 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 pays 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 pays 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 pays, bonus, and long-term incentive pay, while the later excludes equity-based pays.

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

[18] As 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.

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.

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 (weather the firm receives any foreign incomes or pays foreign taxes), since the literature has shown that firms engaged in exports and foreign investments are systematically different from those who don't in may 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 3 and 4 we simply control for product market competition, rather than addressing the issue whether competition reduces the effects of equity-based pays on wages. The latter issue will be examined in Section 5.

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, 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 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 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 pays to employees, with a large standard deviation, 66,509 dollars (in 2010 value).[20]

Table 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

[19] The 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).

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

Table 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 pays, 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
Manager's compensation structure					
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
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

(continued)

(continued)

Variable	Definition	Mean	S.D.	Min	Max
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
Manager's characteristics					
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
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 CEOs 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	Firm-averaged Non-CEOs shareholdings fraction	0.004	0.01	0	0.17
female Non-CEO	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.	0.068	0.136	0	1
Firm and industry characteristics					
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

(continued)

(continued)

Variable	Definition	Mean	S.D.	Min	Max
Foreign Activity	1 if the firm receives any foreign incomes or pays 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
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 ($\leq$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

3.1.5 Model Specification

We estimate a standard fixed effect model as follows:

$$log(w_{kjsct}) = \alpha_{kjsct} + \beta \boldsymbol{X}_{kjst} + \gamma \boldsymbol{M}_{kjst} + \delta \boldsymbol{I}_{kjst} + \phi \boldsymbol{V}_{jt} + \mu \boldsymbol{F}_{jsct} + \varepsilon_{kjsct}, \qquad (14)$$

where w is the yearly total wage, so $log(w_{kjst})$ 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}. $\boldsymbol{X}_{kjsct}$ denotes managerial compensation structures including *Equity Fraction*, *Equity Ratio*, etc. $\boldsymbol{M}_{kjst}$ includes other manager characteristics and three variables of managerial controlling power. $\boldsymbol{I}_{kjst}$ includes firm characteristics, and $\boldsymbol{V}_{jt}$ includes ten workers' characteristics at the industry level. $\boldsymbol{F}_{jsct}$ 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.

3.2 Results from basic correlation analyses

Table 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 pays into stock awards and stock options to check whether their effects on wages are the same. In Table 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 pays 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 3.3.3.

Table 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 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.

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 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 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 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 3.3.3).

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. 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 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 (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 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.

[21] These 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).

[22] With 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.

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 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 pays 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 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 8 Column (7) and (8), controlling for managerial shareholding does not change our baseline results.

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

[23] Since 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.

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 11 column (1) and (2), the effects of the equity-based pay on wages are all negative and statistically significant. All else equal, an increase in CEO *Equity Fraction* by one standard deviation (12.4%) is associated with 0.46% lower wages, and an inrease in CEO *Eqyuity Ratio* by one standrad 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 pays 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 12, the directions of the coefficients of most variables are the same as in the firm-level analyses (Table 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, consisting 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

pays.

4 Identification Strategy

The analyses in the previous sections show that workers' wages are lower as managers receive more equity-based pays. 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 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 4.1 explains the institutional background and the choice of my instrumental variable. Section 4.2 presents the model specification and estimation results.

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 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 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 became more equity-based and more sensitive to firms' (stock market) performances (Perry & Zenner, 2001; Balsam & Ryan, 2007).

As shown in Figure 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 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.

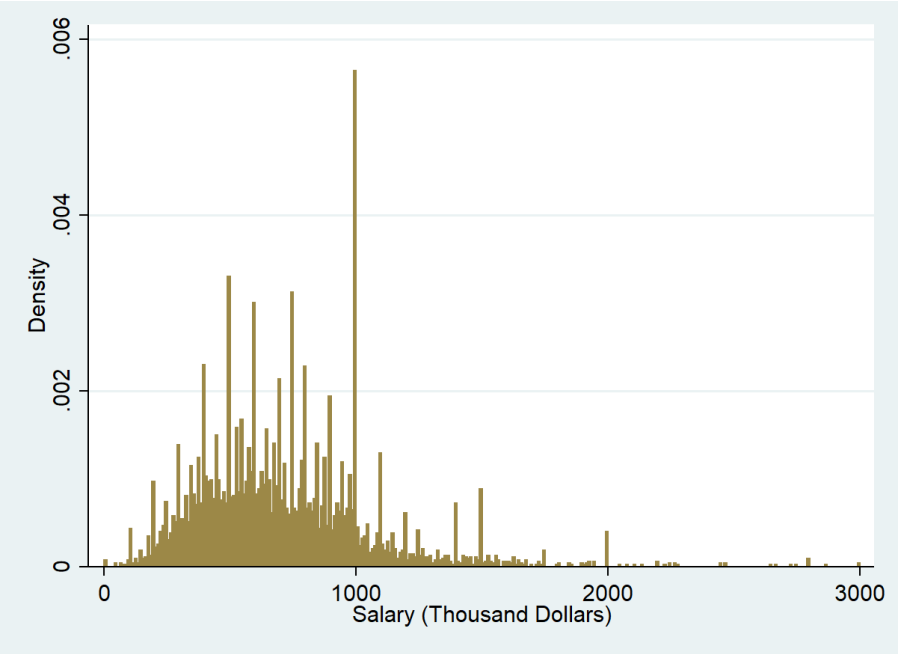

Figure 1: The bunching distribution of firms by CEO's salary, whole-sample period (1992-2016)

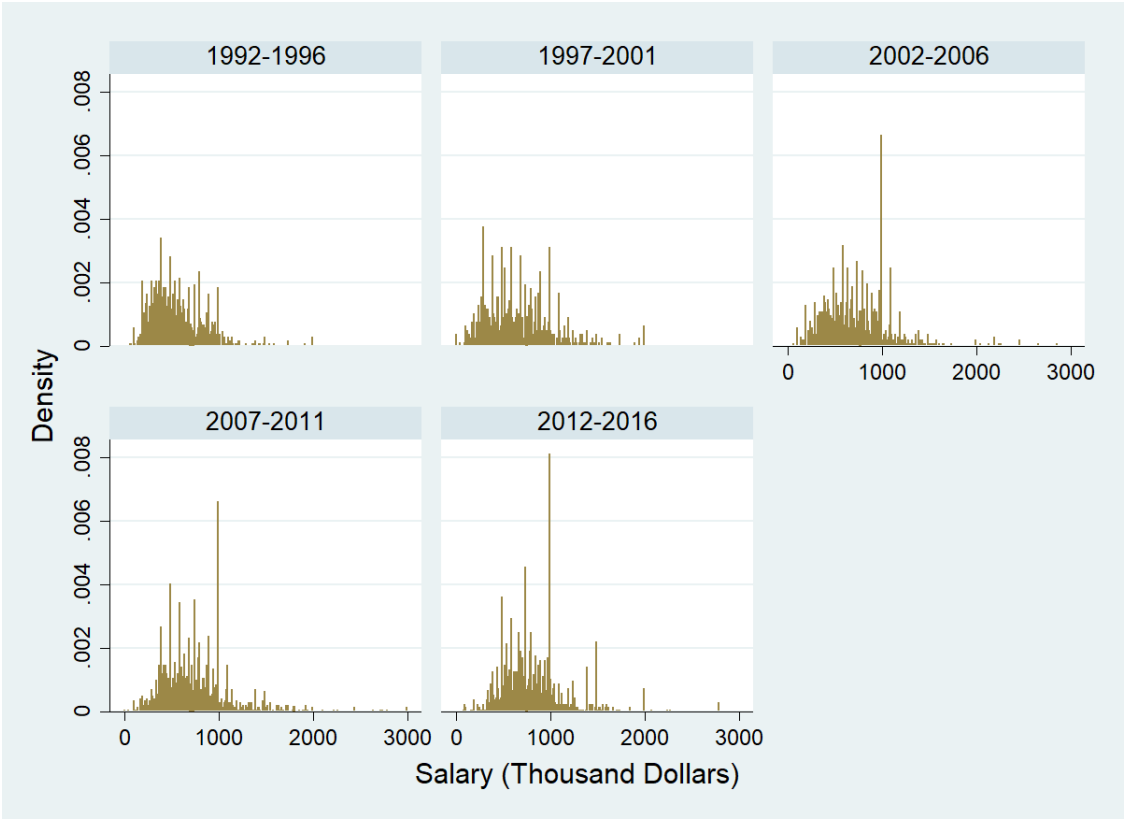

Figure 2: The bunching distribution of firms by CEO's salary, five-year periods

A few issues need to be dealt with before we can utilize the legislation as an instrument for estimation. First, 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.

4.2 IV estimations

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

$$X_{kjsct} = \alpha_1 + \eta \boldsymbol{Z}_{kt} + \gamma \boldsymbol{M}_{kjst} + \delta \boldsymbol{I}_{kjst} + \phi \boldsymbol{V}_{jt} + \mu \boldsymbol{F}_{jsct} + \varepsilon_{kjsct}; \tag{15}$$

and the second stage is:

$$log(w_{kjsct}) = \alpha_2 + \beta \widehat{\boldsymbol{X}}_{kjst} + \gamma \boldsymbol{M}_{kjst} + \delta \boldsymbol{I}_{kjst} + \phi \boldsymbol{V}_{jt} + \mu \boldsymbol{F}_{jsct} + \varepsilon_{kjsct}. \tag{16}$$

where X_{kjsct} is the CEO *Equity Ratio*, $\boldsymbol{Z_{kt}}$ 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). The coefficient $\boldsymbol{\beta}$ 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 pays enjoying tax deductions. In responding to the policy change, firms may increase not only equity-based performance pays but also the non-equity ones. Moreover, as shown in Section 3.2 Table 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 out 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 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 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.

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

Table 5: Evidence on Causality, IV Estimation (LIML Estimator)

Treatment range ($Salary, thousand dollars; year $\geq$ 1994)	750- (1)	850- (2)	950- (3)	1000- (4)
First Stage	Dependent Variable: CEO equity/salary ratio			
Treatment range dummy	0.684**	0.886***	0.936***	0.536
	(0.314)	(0.302)	(0.323)	(0.33)
Salary	-0.002***	-0.002***	-0.002***	-0.002***
	(0.001)	(0.001)	(0.001)	(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
Second Stage	Dependent Variable: Log(Yearly Average Wage)			
CEO equity/salary ratio	-0.047*	-0.041*	-0.039*	
	(0.025)	(0.022)	(0.022)	
CLR test p-value (H_0: $\beta = 0$)		0.023	0.029	
CLR 95% conf. sets		[-.111, -.006]	[-.1, -.004]	
Controlling Variables				
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 pays. 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 5 are based on the Limited Information Maximum Likelihood (LIML) estimator[25] 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 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 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.

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

[25] The original 2SLS results are very similar.

[26] Please 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

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 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 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

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.

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 2 Equation (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 (11). According to Equation (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).

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 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:

$$\begin{aligned} X_{kjsct} = \alpha_{kjsct} &+ \eta_{11}\boldsymbol{Z}_{kt} + \eta_{12}\boldsymbol{Z}_{kt}H(2)_{jt} + \eta_{13}\boldsymbol{Z}_{kt}H(3)_{jt} \\ &+ \eta_{14}H(2)_{jt} + \eta_{15}H(3)_{jt} + \eta_{16}\boldsymbol{Control}_{kjsct} + \epsilon_{kjsct}; \end{aligned} \tag{17}$$

$$\begin{aligned} X_{kjsct}H(2)_{jt} = \alpha_{kjsct} &+ \eta_{21}\boldsymbol{Z}_{kt} + \eta_{22}\boldsymbol{Z}_{kt}H(2)_{jt} + \eta_{23}\boldsymbol{Z}_{kt}H(3)_{jt} \\ &+ \eta_{24}H(2)_{jt} + \eta_{25}H(3)_{jt} + \eta_{26}\boldsymbol{Control}_{kjsct} + \epsilon_{kjsct}; \end{aligned} \tag{18}$$

$$\begin{aligned} X_{kjsct}H(3)_{jt} = \alpha_{kjsct} &+ \eta_{31}\boldsymbol{Z}_{kt} + \eta_{32}\boldsymbol{Z}_{kt}H(2)_{jt} + \eta_{33}\boldsymbol{Z}_{kt}H(3)_{jt} \\ &+ \eta_{34}H(2)_{jt} + \eta_{35}H(3)_{jt} + \eta_{36}\boldsymbol{Control}_{kjsct} + \epsilon_{kjsct}. \end{aligned} \tag{19}$$

With the three instrumented variables, $\widehat{X}_{kjsct}$, $\widehat{X_{kjsct}H(2)_{jt}}$, and $\widehat{X_{kjsct}H(3)_{jt}}$, we

then estimate the following model at the second stage:

$$\begin{aligned} log(w_{kjsct}) = \alpha_{kjsct} + \beta_0 \widehat{X}_{kjsct} + \beta_1 X_{kjsct}\widehat{H(2)}_{jt} + \beta_2 X_{kjsct}\widehat{H(3)}_{jt} \\ + \beta_3 H(2)_{jt} + \beta_4 H(3)_{jt} + \beta_5 \boldsymbol{Control}_{kjsct} + \varepsilon_{kjsct}, \end{aligned} \tag{20}$$

where $\boldsymbol{Z_{kt}}$ 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). $\boldsymbol{Control}_{kjsct}$ 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.

5.3 Marginal effects vary with the degree of competition

We report the results in Table 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 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 an unit increase in equity ratio leads to just 1.2% decline in the average wage.

Figure 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.

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

Table 6: Marginal effects vary with the degree of competition: IV Estimation (LIML)

First Stage				*Second Stage*	
	Equity ratio (1)	Equity ratio × HHI(2) (2)	Equity ratio × HHI(3) (3)		Log(Wage) (4)
Treatment dummy	1.626**	0.082	-0.017	Equity ratio	-0.096***
	(0.737)	(0.318)	(0.323)		(0.036)
Salary	-0.004**	-0.002***	-0.003***	Equity ratio	0.026
	(0.002)	(0.001)	(0.001)	× HHI(2)	(0.055)
Treatment dummy	-0.666	0.974	0.033	Equity ratio	0.084**
× HHI(2)	(0.986)	(0.907)	(0.473)	× HHI(3)	(0.04)
Treatment dummy	-0.728	-0.376	1.185**	HHI(2)	-0.104
× HHI(3)	(0.83)	(0.371)	(0.533)		(0.231)
Salary × HHI(2)	0.000	-0.000	0.001	HHI(3)	-0.37**
	(0.002)	(0.002)	(0.001)		(0.18)
Salary × HHI(3)	0.002	0.001**	0.001		
	(0.002)	(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		
Controlling Variables					
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).

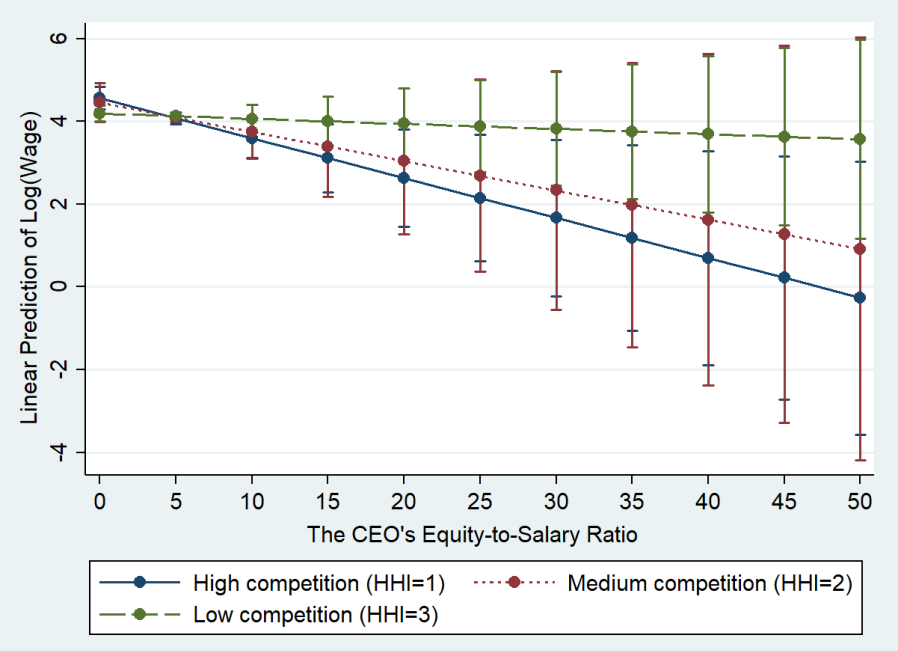

Figure 3: Marginal effects of equity ratio on wages, interacting with three levels of competition

6 Conclusion

Does equity-based compensation, such as stock award and stock option, incentivize managers to pay their workers less? Evidence reported in is 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 an 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. An 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 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 to 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 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.

Appendices

Appendix 1 Data Sources and Matching

Compustat (North America) & Execucomp are proprietary databases compiled by Stansdard & 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 Cunpustat-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.

Appendix 2 Measurements of equity-based pays

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 Fillings" (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-vale 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.

Appendix 3 Robustness tests: sample selection bias using Heckman correction model (corresp. Section 3.3.1)

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

Table 7: 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***	-0.073***		
	(0.014)	(0.020)		
Non-CEO equity-based pay	-0.083***	-0.093***		
	(0.022)	(0.023)		
CEO non-equity performance pay			0.060**	0.012
			(0.024)	(0.000)
Non-CEO non-equity performance pay			0.027	0.028
			(0.030)	(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.

Appendix 4 Robustness Tests: non-finance vs. finance; industry-year-fixed effects; managerial shareholding (corresp. Section 3.3.2)

Table 8: Robustness Tests: Non-financial and financial sectors, industry-Year-Fixed effects, CEO shareholding. Firm-level sample (corresp. Section 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**		-0.063		-0.057**		-0.059***	
	(0.022)		(0.045)		(0.023)		(0.022)	
CEO equity-based pay/salary ratio		-0.004***		-0.001		-0.002		-0.002
		(0.001)		(0.002)		(0.002)		(0.001)
CEO shareholding fraction							-0.127	-0.085
							(0.177)	(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.

Appendix 5 Robustness tests using the individual-level sample: sample selection bias and composition changes by offshoring (corresp. Section 3.3.3)

Data and Variables

Table 8 summarizes the distributions of workers, firms and executives across major sectors in the individual-level sample, and Table 9 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 9: 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(hourly wage), where the hourly wage includes annual wage and salary income[28] 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 5 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.)

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

[28] The 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).

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 10: 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
Manager's compensation structure, by industry-year					
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
Non-CEO stock award fraction	Firm-averaged Non-CEO stock awards fraction.	0.173	0.132	0	0.576

(continued)

(continued)

Variable	Definition	Mean	S.D.	Min	Max
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
Manager's characteristics, by industry-year					
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 CEOs 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-CEOs 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
Firm and industry characteristics, by industry-year					
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 pays 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

Model specification

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

$$log(w_{ijst}) = \alpha + \boldsymbol{\beta X_{jt}} + \boldsymbol{\gamma M_{jt}} + \boldsymbol{\delta I_{jt}} + \boldsymbol{\phi V_{ist}} + \boldsymbol{\mu F_{ijst}} + \varepsilon_{ijst}, \tag{21}$$

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. $\boldsymbol{X_{jt}}$ denotes CEO compensation structure measures of including equity-based pay, stocks and options, performance pay, non-equity performance pay. $\boldsymbol{M_{jt}}$ includes other manager characteristics and three variables of managerial controlling power. $\boldsymbol{I_{jt}}$ includes firm characteristics, and $\boldsymbol{V_{ist}}$ includes workers' characteristics including occupation. $\boldsymbol{F_{jst}}$ 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 $\boldsymbol{\beta}$ is of particular interest in the following analyses.

Table 11: 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***		-0.037***	
	(0.011)		(0.01)	
CEO equity ratio by industry-year		-0.000391**		-0.000403**
		(0.000169)		(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 12: 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.

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