CEO Compensation, Compensation Risk, and Corporate Governance: Evidence from Technology Firms

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Abstract:

Literature suggests that CEOs of technology firms earn higher pay than CEOs of non-technology firms. I investigate whether compensation risk explains the difference in compensation between technology firms and non-technology firms. Controlling for firm size and performance, I find that CEOs in technology firms have higher pay, but also have much higher compensation risk compared to non-technology firms. Compensation risk explains the major part of the difference in CEO pay. My study is consistent with the labor market economics view that CEOs earn competitive risk-adjusted total compensation.

Keywords: Compensation risk, Board structure, Ownership structure, CEO compensation

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1. Introduction

The purpose of this paper is to analyze CEO compensation by comparing the CEO pay in technology firms with CEO pay in non-technology firms. Specifically, I explore whether, and to what extent, compensation risk explains the difference in CEO pay between technology firms and non-technology firms. In addition, I explore whether total compensation is associated with board structure and ownership structure.

Higher CEO pay in technology firms is a well-established result in the literature. Ittner, Lambert, and Larcker (2003, ILL hereafter), for example, conclude that, compared with old economy firms, new economy firms have lower sales, fewer employees, grow more rapidly, and invest more in research and development, but their accounting returns are significantly lower. IIL document that new economy firms grant more stocks and options than old economy firms even if they control for other differences. ILL rely on data from a compensation survey in 1999-2000 by iQuantic, a consulting firm that focuses on the new economy sector. The definition of new economy firms and old economy firms is as same as that of technology firms and non-technology firms. I provide the detail definition in Appendix.

The first explanation of higher CEO pay in technology firms comes from compensation risk literature. Pratt (1964) develops a utility function of money and concludes that higher compensation is associated with higher compensation risk. Conyon et al. (2011) attribute the pay differences between U.S. and U.K. CEOs to risk premiums for bearing incentive risks. Specifically, risky compensation such as stocks and options are higher in the U.S. than in the U.K. CEOs are risk-averse and prefer $1 million salaries to $1 million stock options. The CEOs in U.S. demand risk premiums because they undertake much high compensation risk. I conjecture that the compensation risk for bearing stock-based compensation could explain the pay difference between technology firms and non-technology firms.

Another explanation of higher CEO pay in technology firms comes from the efficient labor market point view. The labor market efficiency hypothesis states that CEOs earn competitive risk-adjusted compensation. Gabaix and Landier (2008) conclude that the labor market could be efficient. According to the arm's length contracting view, CEO pay is only associated with economic determinants such as firm size. Gabaix and Landier (2008) develop a market equilibrium model of CEO compensation. They suggest that the recent rise in CEO compensation is associated with the increase in the market value of firms, rather than resulting from agency issues. Likewise, Murphy and Jan (2007) propose that the increase in pay levels for top executives reflect a change in the relative importance of "managerial ability" (CEO skills transferable across companies). Realizing the importance of the firm size and performance in determining the CEO pay, I control for firm size and performance when I examine the pay difference between technology firms and non-technology firms.

The managerial power approach provides a different perspective. A considerable body of literature reports that the high level of CEO pay in the U.S. may reflect rent extraction by CEOs. Bebchuk et al. (2010), for example, suggest that U.S. CEOs abuse their managerial power to extract excessive compensation. They estimate that the top executive team of Bear Stearns and Lehman Brother earned $1.4 billion and $1 billion individually from cash bonus and equity during 2000 to 2008. Obviously, this excessive pay is not related with performance. In September 2008, when Lehman filed for bankruptcy, shareholders lost most of their investment if they held the shares from 2000 to 2008. As reported by Bebchuk et al. (2010), the cumulative raw return with reinvested dividends is 0 at the year 2008. At stark contrast, the bonus was not clawed back even with this extreme poor performance. The collapse of the companies and subsequent financial crisis ignited public complaints of excess compensation. Examining the determinants of CEO pay could improve our understanding of labor market efficiency and corporate governance.

I use logarithm of total compensation as the dependent variable, logarithm of market value and five-year stock return as the control variables, and compensation risk as the independent variable. I estimate the compensation risk based on compensation mix: the percent of stock-based compensation to total compensation. The results show that the logarithm of total compensation is significantly associated with compensation mix. Therefore, I conclude that compensation risk explains the differences in pay between technology firms and non-technology firms. The higher the compensation risks CEOs take, the higher the compensations they demand. Specifically, if the compensation mix increases 10%, the CEO could earn 4.4% higher compensation.

Though economic determinants and compensation risk explain the differences in CEO compensation, it is still possible that CEOs extract rents from weak governance companies. To extend the findings of Core et al. (1999), I test whether a CEO serving as the board chair increases his/her compensation and whether the stocks held by institutional investors reduce CEO compensation. The results show that CEO compensation is associated with board chair duality. Specifically, if a CEO serves as the board chair, he/she earns 6.6% higher compensation. I do not find any evidence that CEO compensation is associated with institution holding.

This study reports that compensation risk explains the difference in CEO pay between technology firms and non-technology firms. My work is related to Conyon et al. (2011). Conyon et al. (2011) focus on compensation risk to explain the difference in CEO pay between the U.S. and U.K. My work applies compensation risk to explain the difference in CEO compensation by focusing on U.S. listed firms. This research design eliminates other alternative explanations of the difference in CEO pay between countries. For example, Conyon and Murphy (2000) argue that, compared to CEOs in U.K., CEOs in U.S. receive greater stock options because of institutional and cultural acceptance. The difference in stock options contributes to the difference in CEO pay between U.S. and U.K. Therefore, the compensation risk embedded in stock options provides a reasonable explanation of the difference in CEO pay.

My results support the labor market efficiency hypothesis. Specifically, CEO pay is associated or explained by firm factors such as market value, performance, CEO talent, and compensation risk. Frydman and Saks (2007) analyze CEO compensation from 1936 to 2005. They find that the level of CEO compensation remains stable from 1945 to mid-1970 and rises at faster rate in the following two decades at growth rate of more than 10 percent annually from 1995 to 1999. Jensen et al. (2004) attribute the explosion in the level of CEO compensation to an inability of boards to evaluate the true costs of options. Kaplan and Rauh (2010) examine the question of rapid growth of pay in recent two decades. They conclude that “the evidence is more consistent with theories of skill-biased technological change, superstars, greater scale, and their interaction than with the other theories.” (p. 1007).

My study extends Conyon et al. (2011) by using compensation mix to proxy for compensation risk. My work is related to Fernandes et al. (2009) who find that stock-based compensation is much more prevalent in the U.S. than other 27 countries. If the pay setting process is determined by market equilibrium, CEOs demand higher pay to compensate risks.

I organize the paper as follows. The next section reviews the compensation literatures. Section 3 develops testable hypotheses. Section 4 describes the samples, variable measurement. Section 5 presents results, section 6 presents robustness, and section 7 concludes the paper.

2. Literature review

A considerable body of literature has examined the high level of CEO pay in the United States. Scholars provide three explanations. First, Conyon et al. (2011) find that CEOs in the United States have higher pay and higher stock and option incentives. Therefore, compensation risk embedded in stocks and options could explain the apparent higher pay for U.S. CEOs. Second, Gabaix and Landier (2008) argue that the escalation of CEO pay is market driven. In other words, the labor market efficiently determines the pay level of a CEO. Third, Bebchuk and Jesse (2004) argue that board members cater to rent-seeking entrenched managers. They predict that executives could earn higher pay or pay that is not associated with performance if they have more power than their boards.

2.1 Compensation risk

Pratt (1964) develops a utility function of consumption to explain risk-aversion and risk premium. He predicts that a decision maker with relative risk-aversion will demand greater pay to compensate the risks he/she takes. If a decision maker is risk-averse, he/she discounts the consumable assets at risk. At every level of risk, his/her cash equivalent (the amount which he/she would like to exchange the risky assets) is less than the expected value of the risky assets.

He defines the risk premium as the expected monetary value minus the cash equivalent. He concludes that a risk-averse decision maker always has a risk premium greater than zero.

Hall and Murphy (2002), Cai and Vijh (2005) suggest that the risk premium is associated with the proportion of the executive's wealth that is invested in firm equity and the CEO's risk-aversion. They cannot observe both outside wealth (wealth not restricted in company stock) and risk-aversion. Yet, they assume that the proportion of CEO company stocks to outside diversified assets is one to two. For instance, if the executive has $1,000 in company stocks, they assume that outside diversified assets could be $500 to $1,000. In addition, they assume that the top executive's relative risk-aversion parameter is two or three.

Lambert et al. (1991) suggest that shareholders evaluate the compensation plan from a cost-effectiveness perspective, which is different from the top executives' point of view. Shareholders can diversify their investments to reduce risk, but top executives cannot sell nor short their stock options. The market value of options is built on the assumption that shareholders and market investors could diverse their risks. Since top executives cannot diversify their risks if they hold options, they evaluate the compensation plan at a price less than the market price of traded options. Lambert et al. (1991) develop a model to calculate the option value from the top executives' point of view. They conclude that the higher portion of top executives' wealth is tied to the company's stock price, the higher the relative risk-aversion they have, and consequently the less perceived value of the stock options.

Fernandes et al. (2009) compare pay of chief executive officers (CEOs) in 2,543 firms in 27 countries. They find that U.S. CEOs' compensations are significantly higher than those of their foreign counterparts and that a greater portion of their pay is in the form of stocks and options.

They do not develop a theory to explain the correlation between total compensation and compensation mix: percent of stock-based pay to total compensation. They regress compensation mix on logarithm of total compensation after controlling for firm characteristics, which include logarithm of sales, return on assets, stock return, CEO/chair dummy, and institutional ownership. They find that total compensation is associated with compensation mix at significantly less than 0.01 levels.

To explore the differences in pay between the U.S. and U.K., Conyon and Murphy (2000) compare the total compensation of U.S. CEOs with those of U.K. CEOs. They find that U.S. CEOs have higher pay and higher stock and option incentives. By extending Pratt (1964), Conyon et al. (2011), I argue that the compensation risk could explain the apparent higher pay for U.S. CEOs. To explore this hypothesis, they first partition the total compensation into risk premium for bearing stock-based compensation and "risk-adjusted pay". To estimate the risk premium, they first assume that a CEO is relatively risk-averse and has a power utility. The utility of $1 cash is greater than the utility of $1 options. Though the expectation value of $1 cash and $1 options is same, the utility to a risk-averse CEO is different. To compensate for the risk that a CEO takes, he/she demands higher pay. The risk premium is the dollar amount to compensate this utility difference.

Risk premium is part of the pay package used to compensate the CEO for holding the firm's stocks and options. Since the CEO can't sell these equities and diversify his/her wealth to reduce risk, he/she demands a portion of additional pay. "Another way to think of this risk premium is: How much less pay would the CEO accept if he were released from the restriction that he hold a substantial fraction of his wealth in firm stock?" (Conyon et al., 2011, p.417). Conyon et al.

(2011) assume CEOs either get the risk premium and keep the firm equity or sell the firm equity and diversify investment without risk premium. Conyon et al. (2011) assume that CEOs are indifferent to these two conditions and estimate the risk premium accordingly.

To sum up, agency theory predicts that the higher compensation risks that CEOs take, the higher compensations they demand.

2.2 Arm's length contracting model

To reduce agency problems, CEOs and board directors could make optimal agreements on compensation according to arm's length contracting (e.g. Holmstrom, 1979). More recently, Gabaix and Landier (2008) develop a market equilibrium model of CEO compensation. They suggest that the increase in CEO compensation is associated with the changes of the market capitalization of companies. Agency issues cannot completely explain the rise in CEO compensation. They predict that CEO pay is associated with both firm size and the average size of firms in the industry. The six fold increase of market value of large US firms leads the six fold increase of CEO pay in the 1980-2003 period. As the managerial power approach can't explain the six fold increase of CEO pay because it would imply that on average 80% of CEO compensation in U.S. comes from rents. They do not think this fraction might be possible. As a result, they conclude that the rise of CEO pay is determined by market forces, rather than resulting from agency issues.

Kaplan and Rauh (2010) explore the rapid growth of pay during two recent decades. They compare the compensations among Main Street CEOs, Wall Street employees, lawyers, and sport stars. They find that the increase of CEO pay can't match with that of lawyers and sport stars. They conclude that "the evidence is more consistent with theories of skill-biased technological change, superstars, greater scale, and their interaction than with the other theories." (p. 1007)

Lustig et al. (2011) attribute the increase of CEO pay to inequality and to the increase of pay to performance sensitivity (PPS) due to technological changes. Following the technology innovation, the structure of productivity growth shifted to general growth. Since managers could transfer part of organizational wealth to potential employers, the increased organizational wealth broadens the choices of CEOs in prosperous large firms, and the increase of CEO pay responds to the positive performance.

To sum up, according to the arm's length contracting approach, only economic factors determine the CEO pay.

2.3 Managerial power approach

The managerial power approach, however, does not think that executive compensation contracts are a solution to the agency problem. Yet, managerial entrenchment problems come from the compensation contracting process. The board is not assumed to focus solely on shareholders' interest when it negotiates CEO pay (Bebchuk & Jesse, 2004).

Core et al. (1999) found that excess compensation is associated with both board structure and ownership structure. Specifically, the following facts matter: Whether a CEO serves as the chair of the board; the size of the board; the percent of insider directors; the number of outsider directors appointed by the CEO, the number of directors who are considered as "gray" directors; the percentage of outsider directors who are old than 69, and the percentage of outside directors who serve three or more other boards. With respect to ownership structure, CEO compensation is negatively associated with the CEO's ownership and the existence of an external blockholder with more than 5% of equity. The low CEO compensation is associated with the existence of non-CEO internal ownership of 5% more equity. Furthermore, the predicted excessive compensation is negatively associated with firm accounting performance and stock return performance.

Bebchuk et al. (2010) analyze U.S. compensation data from 1996 to 2005. They find that opportunistic timing affects the options granted to independent directors, who are responsible for negotiating executive compensation. The firm grants options to independent directors and the CEO when the stock is at its lowest price during the month. The correlation of option timing between the CEO and directors indicates that the compensation process is not as efficient as arm's length contracting predicts. Therefore, it leads to excessive compensation of CEOs. The excessive compensation is significantly associated with the existence of a majority of independent directors on the board, with the existence of an independent compensation committee, and with CEOs who have long tenure.

Though a group of studies concludes that board structure could explain cross-sectional variation in CEO pay, Hermalin and Weishbach (2003) criticize such evidence as being unconvincing because board structure might be an endogenous variable. Board structure and CEO compensation could depend on some unknown firm factors and CEO features. To mitigate the endogeneity problem, Chhaochharia and Grinstein (2009) analyze the regulation event of the Sarbanes-Oxley Act on board structure. As new rules, rather than unknown firm factors and CEO features, contribute to the changes of board structure, the association between CEO pay and board structure becomes more convincing. They found that CEO pay dropped significantly if firms were more influenced by these new rules on board structure after controlling for firm size, performance, firm effects, and industry effects. Besides, the governance mechanisms such as having an outside blockholder on the board or a high concentration of institutional investors or a new board requirement can be effective even when another governance mechanism does not work.

Jensen et al. (2004) analyze the increase of CEO compensation. They argue that U.S. compensation committees historically underestimate the full cost of options, and therefore overpay CEOs with stock options.

Bizjak et al. (2010) found that compensation peer groups contribute to the increase in CEO compensation. Likewise, Balsam et al. (2011) concluded that differences in CEO compensation between Canada and U.S. continue to exist despite a common language, similar customs, largely similar corporate governance and regulatory regimes, similar management education institutions and significant free trade in goods and services. To mitigate these differences and increase their compensation, Canadian firms are increasingly adopting U.S. pay practices and U.S. compensation levels by using U.S. firms in compensation peer groups, by being cross-listed on U.S. stock exchanges, and by taking over U.S. firms.

To sum up, powerful CEO could extract rents from the company because of corporate governance weaknesses.

3. Hypothesis development

3.1 Compensation risk

CEOs receive compensations from their firms. Their compensation includes salaries and incentive plans, which are composed of stocks and options. Agency theory predicts that the incentive plan should become a part of the executive compensation plan, because it could align the interests of CEOs with the interests of shareholders. Agency theory assumes that CEOs are risk-averse and that shareholders are risk-neutral. Shareholders would be more likely to take on risky projects if the expected net present value of those risky projects is greater than zero; however, the risk-averse CEOs would not take these projects, as shareholders expected, without incentive plans. To align the interests of CEOs with those of shareholders, shareholders force CEOs to accept compensation contracts with both salaries and incentive plans. While shareholders achieve the benefits of alignment, they have to pay the costs for these incentives. If the optimal contracts force CEOs to hold more stocks and options, CEOs will require higher pay. Prior research by Conyon and Murphy (2000) provides some descriptive support for this conjecture.

Why do CEOs demand higher pay if their compensations include a higher portion of stocks and options? CEOs could invest their cash payments in a diversified portfolio, but their stocks and options in companies are undiversified. Stock market theory predicts that diversified portfolios could reduce risk. As a result, when CEOs hold more stocks and options in companies, the higher the risks they would take on because of their undiversified positions. Risk-averse CEOs would prefer 1$ in cash to 1$ in stocks and options. Utility theory predicts that if CEOs are risk-adverse, the utility of 1$ in cash is greater than that of 1$ in stocks and options. The empirical research states that risk-averse and undiversified CEOs discount the utility of their stocks and options in their companies. (Hall & Murphy, 2002). Consistent with both agency theory and empirical research, Conyon et al. (2011) argue that risk-averse CEOs would rather keep more highly diversified stocks so that they do not treat for example, $1,000 in firm stocks to be equal to $1,000 in more diversified stocks. The less their wealth is diversified, the more risks the CEOs bear, and the greater pay they require to compensate for the risks embedded in stocks and options.

To explore this hypothesis, Conyon et al. (2011) partition the total pay into risk premium and risk-adjusted pay. Conyon et al. (2011) think that a part of CEO pay works as a reward to the executives to hold the firm stocks and options rather than sell these stocks to diversify their portfolio. In other words, risk premium is a portion of annual pay that rewards executives to keep equity in an undiversified firm in the coming year. Risk premium is the difference in pay that the CEO would accept if he/she receives cash instead of stocks and options. From a utility point of view, Conyon et al. (2011) assume that CEOs would either receive the risk premium and keep the firm stocks, or would sell the firm stocks and diversify portfolios without risk premium. Since CEOs treat these two options as the same, Conyon et al. (2011) estimate the risk premium by following the mathematical equation: “E[U(wealth unconstrained)]=E[U(wealth constrained to firm equity, outside wealth, risk premium)]”(p.417).

To estimate the risk premium, Conyon et al. (2011) calculate the equity incentives, assume the percent of CEO outside wealth, and assume relative risk-aversion of CEO.

The first step is to calculate equity incentives. If a CEO invests more money into a firm's stocks and options, the incentives are greater. A small part of the equity incentives comes from the sensitivity of the CEO's annual pay to the return of the stock. A much greater portion of the incentives depends on the sensitivity of the CEO's holding of the firm's equity to the changes of the stock price. Jensen and Murphy (1990) state that equity incentives align the interests of a CEO and shareholders together so that a part of the CEO's total equity incentives comes from stocks and options. Conyon et al. (2011) assume that $1000 worth of stock has $1000 worth of incentives. Yet, options could leverage the stock investment so that the incentive of options is greater than that of stocks. By applying the method used by Core and Guay (2002), Conyon et al. (2011) calculate the delta of options. Delta is defined as the sensitivity of the option price to the stock price.

The second step is to calculate the percent of CEO outside wealth and the relative risk-aversion of a CEO. Hall and Murphy (2002), Cai and Vijh (2005) suggest that risk premium is associated with the proportion of the manager's wealth in the firm's equity and the CEO's risk-aversion. They can't observe both relative risk-aversion and outside wealth. Yet, Conyon et al. (2011) assume that the proportion of inside wealth to outside wealth is between one and two. For instance, if a CEO keeps $1,000 worth of stock of the company, they assume that his/her outside wealth is worth between $500 and $1,000. Besides, Conyon et al. (2011) assume that the relative risk-aversion parameter of a CEO is either two or three.

If a CEO keeps 67% of his/her assets in the company's stock and has a relative risk-aversion of two, Conyon et al. (2011) estimate that the risk premium is 7.6%. They explain the risk premium of 7.6% as follows: if the CEO has $1,000 in the company's stocks, he/she will require a risk premium of $76 per year as a reward for his/her undiversified position. Risk premium could also be explained as an extra pay to the expected return. For example, if a risk-neutral shareholder expects a return of 5% on the company's share, an undiversified executive will demand a return of 12.6%, and 7.6 % as extra return.

By applying compensation risk theory to explore the question of why U.S. CEOs earn more than their U.K. counterparts, Conyon et al. (2011) conclude that the compensations of U.S. CEOs are composed of more stocks and stock options and U.S. CEOs bear more risks in their wealth than U.K. CEOs. Controlling for firm and industry characteristics, Conyon et al. (2011) suggest that U.S. CEOs receive higher compensation and bear much higher risks embedded in stocks and options than U.K. CEOs do. After estimating risk premiums, they find that risk-adjusted pay (total pay minus risk premiums) may explain the pay difference between U.S. CEOs and U.K. CEOs.

To extend the risk premium and risk adjusted pay hypothesis of Conyon et al. (2011), I apply the compensation risk hypothesis to explain the pay differences in U.S. listed firms. I expect that CEOs will earn a higher pay if a greater proportion of their compensation is stock-based compensation. As a result, I hypothesize the following:

H1: Ceteris paribus, CEO compensation is positively associated with the risk or variability of the compensation package.

3.2 Managerial power approach

In most public corporations, shareholders delegate the board of directors to negotiate the CEO compensation contract. If such directors can and are willing to judge the quality of the CEO performance fairly, they can hire and fire the CEO objectively, thus in turn leading to an efficient compensation contract. But in reality, sometimes they can't observe the managers' behavior objectively because of the insufficiency of information or because of the high cost of information. In addition, they may not be willing to negotiate CEO pay solely on the shareholders' interest. The managerial power approach assumes that not only are CEOs self-interested, but board directors are also self-interested. The managerial power approach, however, does not think that executive compensation contracting could efficiently mitigate the agency problem. On the contrary, the managerial entrenchment problem comes from the pay-setting process. The board is not assumed to focus solely on the shareholders' interest when it negotiates CEO pay (Bebchuk & Jesse, 2004).

Directors face a series of problems to monitor the quality of CEOs. First, CEOs could affect the nomination of new directors. As a result, directors who are nominated by a CEO or who get help from a CEO will favor the CEO as a reciprocal principle. Second, directors could become too busy to oversee the CEO compensation contract. Third, the CEO could control the agenda of the board meeting so that they don't have time to question the CEO. Weak corporate governance can lead to over compensation or excess compensation. From the managerial power view, CEOs could get rents.

Economists define "rents" as extra returns that companies or individuals attain because of their positional advantages. Likewise, the "rents" in the paper refer to the extra pay that top executives use their power to obtain more than those bargaining in arm's length contracting with a board that intend to maximize shareholder value with sufficient time and information to perform the task properly. Because rents are associated with managerial power, the managerial power approach expects that CEOs with more power receive higher pay. All CEOs could extract rents by abusing their power, but board structure and ownership structure may mitigate the problem of managerial power. To sum up, CEOs could commonly influence their boards. Their powers vary in different corporate governance structures. The managerial power approach expects that executives could earn higher pay or pay that is not associated with performance if they are relatively more powerful than their counterparts.

The null hypothesis is based on the optimal arm’s length contracting model. A firm’s governance structure motivates optimal executive contracting and maximizes firm performance. The market and economic determinants, such as firm size, firm performance, and compensation risk, should completely describe the equilibrium level of compensation. Both board structure and ownership structure variables should be insignificant in the null hypothesis. Alternatively, if I find that the total compensation is significantly associated with board structure and ownership structure, I reject the null hypothesis.

H2: Ceteris paribus, CEO compensation is associated with board structure.

H3: Ceteris paribus, CEO compensation is associated with ownership structure.

4. Sample, variable measurement, and descriptive statistics

4.1 Data and sample

U.S. compensation data was retrieved from the Compustat Execucomp database, which includes the S&P 500, S&P MidCap 400, and S&P Small Cap 600. The Execucomp database includes five directors' compensation information. I use the key word "CEOANN-CEO annual flag" to retrieve all the CEOs' compensations. In addition, I retrieve financial information such as net sales, net income, market value, return on assets, one-year return to shareholders and five-year return to shareholders for each firm year from Compustat. I match the dataset with the key variable "GVKEY" Company ID number. I use five-year stock return as the control variable, which is better than the noisy one-year stock return. My sample consists of 8,471 firm-years for the 2001-2005 period.

The corporate governance data was retrieved from Risk Metrics. I matched the corporate governance data with the compensation data by company ticker number, year indicator, and CEO indicator. This data requirement reduced the sample to 1,009 firm-years. (Table 1)

4.2 Measurement

4.2.1 Executive compensation

The dependent variable is the logarithm of total CEO compensation. The total compensation includes salary, bonus, other annual compensation, restricted stock grants, long term incentive plan, all other compensation, and value of options (Black-Scholes value) (referred to as TDC1 in the Execucomp database). I also partition the total compensation into stock-based compensation and cash compensation. I define the stock-based compensation as the total value of options and restricted stock awarded to the CEO. The cash compensation is the total compensation minus the stock-based compensation. The compensation mix used in statistical analysis is the proportion of stock-based compensation to total compensation.

4.2.2 Economic determinants

Consistent with prior research, the control variables include size and performance. Net sales, net income, and market value can all be considered as proxies for size. I also test one-year stock return, five-year stock return, and return on assets (ROA) separately. Stock return is the percentage of stock market return to shareholders in one-year period or five-year period. I apply the dividend reinvestment method to calculate the stock return. Return on assets is calculated as the ratio of earnings before interest and taxes to total assets.

4.2.3 Technology dummy and year dummies

Consistent with Murphy (2003), technology firms are defined as the companies with primary SIC codes 3570, 3571, 3572, 3576, 3577, 3661, 3674, 4812, 4813, 5045, 5961, 7370, 7371, 7372, and 7373. If a firm is a technology firm, the technology dummy is coded as one and zero otherwise. I use the "technology dummy" to analyze the differences in compensation between technology firms and non-technology firms. I also classify both technology firms and non-technology firms into Fama-French 12 industries, which were defined in table 2.

Consistent with Balsam (2011), I introduce year dummies to eliminate the time series effect. If a CEO's compensation is in year 2001, the year 2001 dummy is "1" and "0" otherwise. I define the year 2002 dummy, year 2003 dummy, and year 2004 dummy accordingly.

4.2.4 Corporate governance

I use the following proxies to determine the effectiveness of corporate governance. Empirical research predicts that the managerial entrenchment problem is higher if a CEO also serves as the board chair (Core et al. 1999). I define CEO/Chair as an indicator variable, which is equal to one if a CEO also serves as chair, and zero otherwise. Consistent with Bebchuk et al. (2010), I include indicator variables, such as compensation committee chairman and compensation committee member. The compensation committee takes responsibility for negotiating a compensation contract with a CEO. If a CEO also plays a critical role in the committee, it is more likely that the CEO abuses his/her power to increase pay for himself/herself. Compensation committee chairman is an indicator variable equal to one if a CEO also serves as the chairman of the compensation committee, and zero otherwise. Compensation committee member is an indicator variable equal to one if a CEO also serves as the member of the compensation committee, and zero otherwise. Audit chair is an indicator variable equal to one if a CEO also serves as the chair of the audit committee, and zero otherwise. Audit member is an indicator variable equal to one if a CEO serves as the member of the audit committee, and zero otherwise. Corporate governance variable is an indicator variable equal to one if a CEO serves as the corporate governance committee member, and zero otherwise. Institutional holding is the percent of the shares held by the institutional investors.

4.3 Descriptive statistics of economic determinants

Consistent with the earlier work of Murphy (2003) and Ittner, Lambert, and Larcker (2003), I compare the total compensation, market value, and five-year stock return between technology firms and non-technology firms. I summarize the sample means of the CEO compensation level and composition by sample firms by technology firms and by non-technology firms. Table 3 shows the descriptive statistics between technology firms and non-technology firms.

Table 3 panel A presents descriptive statistics of sales, net income, market value, return on assets, and five-year stock return to shareholders and one-year stock return to shareholders. The sales and net incomes in technology firms are significantly lower than those in non-technology firms. The market values of equity in technology firms are higher than those in non-technology firms. The difference is statistically significant at the 10% level. The one-year stock returns to shareholders of technology firms are not statistically significantly different between technology firms and non-technology firms. Finally, the five-year stock returns to shareholders in technology firms are significantly lower than those in non-technology firms.

Table 3 panel B shows that salary, bonus, restricted stock grants, option grants, and total compensation in technology firms differ significantly from those in non-technology firms. The mean of salaries in technology firms is $543,000, which is significantly lower than that in non-technology firms at $712,000. The mean bonus in technology firms is $597,000, which is significantly lower than the mean bonus in non-technology firms at $945,000. The mean value of the stocks in technology firms is $568,000, which is significantly lower than that in non-technology firms at $752,000. Most importantly, the mean of options in technology firms is $4,941,000, which is significantly higher than that in non-technology firms at $2,027,000. The higher stock options in technology firms cause the higher total compensations in technology firms at $6,956,000, which is significantly higher than that in non-technology firms at $4,964,000. The results are consistent with the findings of ILL. The CEOs in technology firms earn higher pay than those in non-technology firms.

Table 3 panel C shows that the percentages of stock-based pay in technology firms are significantly different from those in non-technology firms. From 2001 to 2005, for each year, the percent of stock-based pay in technology firms is significantly higher than that in non-technology firms. The results support the notion that CEOs in technology firms earn higher pay and that they also take much higher compensation risks embedded in stock-based compensation.

4.4 Econometric models

4.4.1 Compensation mix

H1 indicates that CEO compensation is associated with the riskiness or the variability of the CEO's total compensation.

Core et al. (1999) use "mix of pay" as a proxy for compensation risk. They define mix of pay as the proportion of the difference between total compensation and salary to total compensation. To extend their work and consistent with Fernandes et al. (2009), I use compensation mix (stock-based compensation/ total compensation) as a proxy to estimate the relative risk of CEO compensation. Specifically, I first partition the total compensation into cash compensation, including salary and bonus, stock-based compensation, including options and stock grants.

To explore whether total compensation is associated with compensation mix, I use logarithm of total compensation as the dependent variable and compensation mix as the independent variable. The control variables include logarithm of market value, five-year stock return, technology dummy, and year dummies. I also explore the interaction of technology dummy and compensation mix. The regression model is listed below.

$$\text{Log (total compensation}_i) = \alpha + \beta 1\,(\text{compensation mix}_i) + \beta 2(\text{ technology dummy}_i) + \beta 3\,(\text{compensation mix}_i * \text{technology dummy}_i) + \beta 4(\text{ controlled variables}_i) + \varepsilon_i \qquad (1)$$

Peterson (2009) argues that in panel datasets, the residual of ordinary least square (OLS) may not be independent across firms or across years. The classical assumption of OLS is violated. To solve the issue, I add year dummies to eliminate time series effects and cluster the standard errors by firm level. Since the panel dataset has more than 1500 firms every year, the number is greater than the year observation five, the larger number of clustered standard errors in firm level minimize the bias of standard error. I control for technology firms by inserting a technology dummy.

Consistent with the prior empirical study (Smith & Watts, 1992), I conjecture that larger firms demand talented managers with higher equilibrium wages. According to Gabaix and Landier (2008), if executive's ability contributes to the firm performance in the long-run, then total compensation could be most significantly associated with total market value; if an executive only has a temporary impact, net income becomes more relevant. Here, I take a similar approach as Gabaix and Landier (2008) did to let the data speak. I retrieve all CEOs' compensations in the Execucomp for 2001-2005 period and examine which proxy for firm size predicts CEO compensation convincingly.

I take the following proxies into account: total market value, net income and net sales. I regress the logarithms of CEO compensation on these size proxies, controlling for year and technology dummy.

Table 5 suggests that total compensation is most significantly associated with market value when market value, net income, and sales are included in the model together as the independent variables in the regression (column I). The coefficient on market value is the highest one when I regress the three proxies individually (columns II-IV).

In addition, table 4 shows that the logarithm of market value of equity has the highest statistical association with the logarithm total compensation. As a result, in the following text, I use the firm's market value as the proxy for size. Since the logarithm of market value is highly correlated with the logarithm of sales and net income. I only use logarithm of market value as a proxy for size.

Agency theory suggests that stock options offer management incentives to maximize the long-run performances of firms. The standard agency models predict that the level of pay is positively associated with firm performance. I use three possible candidates for firm performance: five-year stock return, one-year stock return, and return on total assets.

I examine the association between total compensation and firm performance by using both accounting and stock price measures. To overcome the advantages and disadvantages of these performance measures, I include both accounting and stock performance measures. This approach is consistent with Balsam et al. (2011). Accounting measures normally report that the actual operational achievements in one year and are not affected by the volatility of stock prices, but they cannot directly link them to the long-term performance. Besides, a CEO could manipulate accounting earnings by discretional accrual. At contrast, CEO cannot manipulate returns of shares in the long-term, because the market price could correct unreasonable prospects of the long-run performance in a timely manner. To overcome the limitations of both measures, I add accounting and stock return measures. The results could be more convincing if they are unchanged by these two measures. I use the net income and return on assets as accounting measures. I investigate the five-year stock return instead of one-year stock return because the latter is a noisy measure and is more affected by the speculative bubble.

I regress the logarithm of CEOs' equity incentive for the samples of all CEOs on these proxies, controlling for year dummies and technology dummy.

Table 6 shows that the total compensation is most significantly associated with the five-year stock return, if I add the three proxies together as the independent variables in the regression module (column I). Furthermore, the correlation between the total compensation and the five-year stock return is the highest among the models II, III, and IV. As a result, in the following text, I use five-year stock return as a proxy for firm performance.

4.4.2 Board structures and ownership structures

H2 and H3 predict that CEO compensation is associated with board structure and ownership structure. I replicate the approach of Core et al. (1999) to identify whether CEO compensation is associated with board structure and ownership structure. The dependent variable is logarithm of total compensation. The independent variables are board structure and ownership structure. The control variables include logarithm of market value, five-year stock return, compensation mix, technology dummy, and year dummies. The regression model is listed below.

$$\text{Log (total compensation}_i) = \alpha + \beta 1 (\text{compensation mix}_i) + \gamma 1 (\text{board Structure}_i) + \gamma 2 (\text{ownership structure}_i) + \beta 2 (\text{logmarket value}_i) + \beta 3 (\text{stock return}_i) + \beta 4 (\text{technology dummy}_i) + \beta 5 (\text{year dummies}_i) + \varepsilon_i \quad (2)$$

5. Results

5.1 Compensation risk

Table 7 presents the results for the model described by the equation (1). Table 7 shows that logarithm of total compensation is statistically significantly associated with compensation mix. Since I use compensation mix as a proxy for compensation risk, I conclude that total compensation is significantly associated with compensation risk. The CEOs in technology firms get higher pay than those in non-technology firms; however, they take much higher compensation risks. I conclude that compensation risk explains the differences in pay between technology firms and non-technology firms. The magnitude of the coefficient suggests that a 10% increase in the percentage of the compensation mix: stock-based compensation to total compensation translates into a 4.4% increase of total compensation. This result is consistent with Fernandes et al. (2009). They find that total compensation is significantly associated with compensation mix. Fernandes et al. (2009) select 2543 firms from 27 countries. They suggest that a 10% increase in the percentage of compensation mix translates into a 20% increase of total compensation.

I take a difference in difference approach in the regression model. In column I, logarithm of total compensation is the dependent variable. I include variables to control for size and performance. I use logarithm of market value as a proxy for size and five-year stock return to shareholders as a proxy for firm performance. Consistent with Gabaix and Landier (2008), CEOs of larger firms earn higher levels of compensation. The coefficient between the logarithm of market value and the logarithm of total compensation is 0.66; the significance level is less than

0.01. The total compensation is not significantly associated with the five-year stock return to shareholders.

The coefficient between logarithm of total compensation and the technology dummy is 0.034; the significance level is less than 0.01. In the module, I include year dummies to control for the time series effect, but I do not report the coefficients since they are not the focus of this study.

In column II, the dependent variable is the logarithm of total compensation. I add compensation mix as the independent variable. I control for logarithm of market value and five-year stock return. The coefficient between the logarithm of market value and the logarithm of total compensation is 0.44; the significant level is less than 0.01. The coefficient between logarithm of total compensation and five-year stock return to shareholders is negative 0.02; the significant level is 0.01. The coefficient between logarithm of total compensation and compensation mix is 0.44; the significant level is less than 0.01. The result supports hypothesis I. Total compensation is positively associated with compensation risk after controlling for firm size and performance. The regression model explains a reasonable amount of cross-sectional variation, as evidenced by the adjusted R-square of 60%. Most importantly, the adjusted R-square increases from 0.432 to 0.602 after I include compensation mix as the independent variable. Compensation risk could strengthen the explanatory power of the model.

In column III, I add the interaction effect between technology dummy and compensation mix. The coefficient between the technology firms and the total compensations is negative 0.18, which means that CEOs in technology firms are not paid with higher compensation. The interaction effect is significant and the coefficient is 0.18, which means that compensation mix plays more important role in explaining the CEO compensation in technology firms.

5.2 Board structure and ownership structure

I use the equation (2) to test the hypothesis II and III. That is, I examine whether total compensation is associated with board structure and ownership structure. The board structure includes CEO/chair indicator, CEO compensation committee chair indicator, CEO compensation committee member indicator, CEO audit committee chair indicator, CEO audit committee member indicator, and CEO governance committee member indicator. The ownership structure include institutional holding.

Table 8 reports the results for the sample firms for the 2001-2005 period, a total 1009 firm-years. The coefficient on CEO/chair is positive. If a CEO also serves as the board chair, the CEO earns higher pay. Consistent with the literatures, a number of empirical studies find that CEO compensation is associated with CEO board chair duality. Core et al. (1999) suggests that agency costs and managerial powers are higher if a CEO is also the chair of the board. However, if the CEO is also the board chair, a higher compensation may be justified because the complex job functions require a talented CEO. I find that CEO total compensation is associated with CEO board chair duality.

The coefficients on compensation committee chairman and on compensation committee member are not statistically significant. The coefficients on audit committee chair and on audit member are also statistically insignificant. The coefficient on corporate governance committee member is also statistically insignificant. The results support that CEO compensation is associated with the CEO duality, rather than the committee level attributes. Consistent with

Chhaochharia and Grinstein (2009), the board could nominate the compensation committee members and approve the compensation decisions. Therefore, the powers of board directors influence the actions of the committees. If a CEO is also the board chair, his/her power cannot be affected by the committee level governance mechanism.

The coefficient on the institutional holdings is not statistically significant. I did not find any evidence that the total compensation is associated with the institutional holdings. This result is different from what is reported by Fernandes et al. (2009). Fernandes et al. (2009) suggest that the total compensation is significantly associated with the institutional holdings. It is possible that this result could change because corporate governance structure may play different roles in the U.S. and in other countries. Besides, they examine the selected samples from LionShares rather than the whole data samples from Standard and Pool 1500 firms. It is possible that the institutional holdings play a more important role in determining the CEO compensation in some countries or in some sectors of the market. Most importantly, the governance mechanisms such as having an outside blockholder on the board and the concentration of institutional holdings and new board requirements may be substitutes, as suggested by Chhaochharia and Grinstein (2009). The new board requirements may improve corporate governance and may reduce excessive compensation to the extent that institutional holding may not play as much of a critical role in CEO compensation as it had played in the past when new board requirements were not yet effective.

6. Robustness

In this section, I test the robustness of the results with a series of alternative choices. First, I apply the Fama-MacBeth procedure to estimate the coefficients. Secondly, I replace total compensation TDC1 with another measure of total compensation TDC2, which is the realized total compensation. Third, I replace the logarithm of market value of equity with the logarithm of sales since a number of compensation literatures use sales as a proxy for firm size. For example, Balsam et al. (2011) use logarithm of sales as a proxy for firm size. I use the accounting information net income as the proxy for firm size. I use the one-year stock return to shareholders as a proxy for firm performance. I use return on assets as a proxy for firm performance. Finally, I regress the change of logarithm of total compensation on change of compensation risk. The results under these robustness tests still support the major conclusions of this study. Compensation risk explains the differences in CEO pay between technology firms and non-technology firms.

6.1 Fama-MacBeth procedure

The datasets in this study are panel datasets, which contain observations on multiple firms in multiple years. If the residuals are correlated either across firms or across years, the OLS standard errors can be biased. To overcome the problem and check the sensitivity of the results, I run the Fama-MacBeth procedure to estimate the coefficients between total compensation and compensation risk. The last column of table 8 presents the results. The logarithm of total compensation is still significantly associated with compensation mix.

6.2 Replace TDC1 with TDC2

Kaplan and Rauh (2010) summarize the differences between TDC1 and TDC2 in Execucomp: “TDC2 estimates the value of total compensation realized by the executive in a given year. This is the sum of salary, bonus, the value of restricted stock granted, the net value of stock options exercised, and the value of long-term incentive payouts. (TDC2 also reflects any benefit that an executive may have received from backdating options.) Because executives typically exercise options that were granted from previous years, TDC2 may represent compensation for more than one year. TDC1 estimates the value of total compensation awarded (but not necessarily realized) to the executive that year. This equals TDC2 but replaces the net value of stock options exercised with the estimated or ex ante value of stock options granted, using a Black-Scholes calculation. TDC1 does not reflect option backdating because it assumes that the stock price on the issue date was the same as the exercise price.” (p. 1008).

I replace total compensation TDC1 with TDC2. The table 9 column I shows that the logarithm of total compensation TDC2 is still significantly associated with compensation mix. The coefficient is positive 0.071. The regression model explains a reasonable amount of cross-sectional variations of CEO pay, as evidenced by the adjusted R-square of 38%.

6.3 Sales and net income, One-year return and ROA

Consistent with Balsam et al. (2011), I use logarithm of sales instead of logarithm of market value as a proxy for firm size. The results of this specification are contained in the table 9, column II. In this alternative specification, the coefficient on compensation mix retains the same sign and significance. The total compensation is still significantly associated with compensation mix. The regression model explains a reasonable amount of cross-sectional variation, as evidenced by the adjusted R-square of 61%.

Consistent with Gabaix and Landier (2008), I use logarithm of net income instead of logarithm of market value of equity as a proxy for firm size. The results of this specification are contained in the table 9, column III. In this alternative specification, the coefficient on compensation mix retains the same sign and statistical significance. The total compensation is still significantly associated with compensation mix. The explanatory power of the model is almost the same with the adjusted R-square of 60%.

I use one-year return to shareholders instead of five-year return to shareholders as a proxy for firm performance, as suggested by Bebchuk (2010). The results of this specification are contained in the table 9, column IV. In this alternative specification, the coefficient on compensation mix retains the same sign and statistical significance. The total compensation is still significantly associated with compensation mix. The regression model explains the reasonable amount of cross-sectional variation, as evidenced by the adjusted R-square of 60.5%.

In addition, I also use return on assets (ROA) as a proxy for firm performance, as suggested by Balsam et al. (2011). The results of this specification are contained in table 9, column V. In this alternative specification, the coefficient on compensation mix retains the same sign and significance. The total compensation is still significantly associated with compensation mix. The regression model explains a reasonable amount of cross-sectional variation, as evidenced by the adjusted R-square of 60.5%.

6.4 Sensitivity of change of compensation mix

Previous results of levels model show that total compensation is positively associated with compensation mix. To exclude the possibility of misspecification in levels model because of omitted variables, I check the robustness with a change model. I regress the change of logarithm of total compensation on the change of compensation risk. The controlled variables include the change of five-year return, the change of logarithm of market value, technology dummy, and year dummies. Table 10 shows the regression results. In this alternative specification, the coefficient on change of compensation mix is 0.68. The magnitude of the coefficient suggests that a 10% increase in the change of compensation mix translates into a 6.8% increase of the change of logarithm of total compensation. The regression model explains a reasonable amount of cross-sectional variation, as evidenced by the adjusted R-square of 50.4%.

7. Conclusion

I present evidence of a direct link between CEO compensation and compensation risk or variability. The CEO total compensation in technology firms is higher than that in non-technology firms because technology firms impose greater risk on their CEOs by giving them a greater proportion of their total pay in the form of variable stocks and stock options. This additional compensation risk explains the pay differences between technology firms and non-technology firms.

I use the logarithm of total compensation as the dependent variable, compensation mix as a proxy for compensation risk, compensation mix and technology dummy as the independent variables, and logarithm of market value of equity and five-year return to shareholder as the control variables. Compensation mix is defined as stock-based compensation to total compensation. An additional robustness test reveals that the total compensation is significantly associated with compensation risk.

The results are largely consistent with the labor market efficiency perspective. Consistent with a market equilibrium model of CEO compensation, the higher CEO compensation in technology firms seems to be commensurate with the higher compensation risk that CEOs in technology firms bear.

The findings of this paper have practical suggestions for corporations and compensation consultants. Compensation designers should consider both the benefits and costs of stocks and stock option grants. An increased portion of stock options definitely aligns the interests of shareholders and CEOs together, and could maximize the retentive effect if CEOs have a significant amount of their wealth in unvested in-the-money options. However, the compensation risk embedded in options could escalate the total compensation. The optimal compensation contract should balance the benefits and the costs of the options.

The findings in this paper also have practical implication on corporate governance. Consistent with the literature, a CEO could earn much higher pay if he/she also serves as the chairman of boards. Though some activists argue for the separation of the roles of chairman and CEO to improve corporate governance, it is also possible that the CEO duality reflects the firm's demand for a high-quality CEO. In addition, many of the guidelines for improving corporate governance state that the members of compensation, audit committee, corporate governance, and nominating committee should be independent. If a CEO takes any of these positions, he/she is more likely to extract rents from the firm. I do not find any evidence that the total compensation is significantly associated with these board structures. It is possible that one kind of governance mechanism could be effective even if other kinds of governance mechanisms are not effective. Chhaochharia and Grinstein (2009) argue that independent committee requirements to enhance board oversight could reduce excessive compensation only if the firm lacks any other governance mechanisms. Practically, firms do not require all governance mechanisms. They just require one set of suitable governance mechanisms.

REFERENCES

Balsam, S., Fan, H., & Mawani, A. (2011). How Canadian CEO compensation is approaching U.S. levels. *Working Paper.*

Bebchuk, L. A., Cohen, A., & Spamann, H. (2010). The wages of failure: Executive compensation at Bear Stearns and Lehman 2000-2008. *Yale Journal on Regulation, 27*(2), 257-282.

Bebchuk, L. A., & Jesse, F. (2004). *Pay without performance: The unfulfilled promise of executive compensation.* Harvard University Press.

Bebchuk, L. A., Grinstein, Y., & Peyer, U. (2010). Lucky CEOs and lucky directors. *The Journal of Finance, 65*(6), 2363-2401.

Bizjak, J. M., Lemmon, M. L., & Naveen, L. (2008). Does the use of peer groups contribute to higher pay and less efficient compensation? *Journal of Financial Economics, 90*(2), 152-168.

Cai, J., & Vijh, A. M. (2005). Executive stock and option valuation in a two-state variable framework. *Journal of Derivatives 12(3),* 9-27.

Chhaochharia, V., & Grinstein, Y. (2009). CEO compensation and board structure. *Journal of Finance, 64*(1), 231-261.

Conyon, M. J., Core, J. E., & Guay, W. R. (2011). Are U.S. CEOs paid more than U.K. CEOs? inferences from risk-adjusted pay. *Review of Financial Studies, 24*(2), 402-438.

Conyon, M. J., & Murphy, K. (2000). The prince and the pauper? CEO pay in the United States and United Kingdom. *Economic Journal, 110*(467), F640-71.

Core, J. E., Holthausen, R. W., & Larcker, D. F. (1999). Corporate governance, chief executive officer compensation, and firm performance. *Journal of Financial Economics, 51*(3), 371-406.

Fernandes, N., Ferreira, M. A., Matos, P., & Murphy, K. J. (2009). The pay divide:(why) are U.S. top executives paid more? *ECGI Working Paper*.

Frydman, C., & Saks, R. E. (2010). Executive compensation: A new view from a long-term perspective, 1936–2005. *Review of Financial Studies, 23*(5), 2099-2138.

Gabaix, X., & Landier, A. (2008). Why has CEO pay increased so much? *Quarterly Journal of Economics*, *123*(1), 49-100.

Hall, B., &. Murphy, K. J. (2002). Stock options for undiversified executives. *Journal of Accounting and Economics, 33(1),* 3-42.

Hermalin, B. H., & Michael, W. S. (2003). Boards of directors as an endogenously determined institution: A survey of the economic literature. *Federal Bank of New York Economic Policy Review, 9,* 7.

Holmstrom, B. (1979). Moral hazard and observability. *Bell Journal of Economics, 10*(1), 74-91.

Ittner, C. D., Lambert, R. A., & Larcker, D. F. (2003). The structure and performance consequences of equity grants to employees of new economy firms. *Journal of Accounting and Economics, 34*(1-3), 89-127.

Jensen, M., Murphy, K., & Wruck, E. (2004). Remuneration: Where we've been, how we got to here, what are the problems, and how to fix them. *Working Paper, Harvard University, University of Southern California, and Ohio State University.*

Kaplan, S. N., & Rauh, J. (2010). Wall Street and Main Street: What contributes to the rise in the highest incomes? *Review of Financial Studies*, *23*(3), 1004-1050.

Lambert, R. A., Larcker, D. F., & Verrecchia, R. E. (1991). Portfolio considerations in valuing executive compensation. *Journal of Accounting Research*, *29*(1), 129-149.

Lustig, H., Syverson, C., & Van Nieuwerburgh, S. (2011). Technological change and the growing inequality in managerial compensation. *Journal of Financial Economics, 99*(3), 601-627.

Murphy, K. J. (2003). Stock-based pay in new economy firms. *Journal of Accounting and Economics*, *34*(1-3), 129-147.

Petersen, M. (2009). Estimating standard errors in finance panel data sets: Comparing approaches. *Review of Financial Studies* 22 (1): 435-480.

Smith, C., & Watts, R., (1992). The investment opportunity set and corporate financing, dividend, and compensation policies. *Journal of Financial Economics, 32*(3), 263-292.

Appendix

Definition of variables

Category	Variable Name	Measurement
Dependent variable	Total compensation (COMP)	Sum of salary, bonus, other annual compensation, restricted stock grants, value of options (Black-Scholes Value),long-term incentive plan, and other compensation
Independent variables	Compensation mix (MIX)	Percent of restricted stock grant and value of options to total compensation
	CEO duality (DUAL)	An indicator variable is equal to one if a CEO also serves as chairman of the board, and zero otherwise
	Compensation chairman(CCHR)	An indicator variable is equal to one if a CEO also serves as chairman of the compensation committee, and zero otherwise
	Compensation member (CMBR)	An indicator variable is equal to one if a CEO also serves as member of the compensation committee, and zero otherwise
	Audit chair (ACHR)	An indicator variable is equal to one if a CEO also serves as chair of the audit committee, and zero otherwise
	Audit member (AMBR)	An indicator variable is equal to one if a CEO also serves as member of the audit committee, and zero otherwise
	Corporate governance (GOV)	An indicator variable is equal to one if a CEO also serve as member of the corporate governance committee, and zero otherwise
	Institutional holding(HOLD)	Percent of shares hold by institutional investors
Control variables	Technology dummy (TECH)	An indicator variable is equal to one if a firm is a technology firm, and zero otherwise. Technology firms defined as companies with primary SIC codes 3570, 3571, 3572, 3576, 3577, 3661, 3674, 4812, 4813, 5045, 5961, 7370, 7371, 7372, and 7373.
	Year dummies (YEAR)	If a CEO's compensation is in year 2001, the year 2001 dummy is "1" and "0" otherwise. The year 2002 dummy, year 2003 dummy, and year 2004 dummy are defined accordingly
	Market value(MKT)	Stock market capitalization of thousand $ at end of year
	Net sales (SALE)	Sales of thousand $ at the end of the year
	Net income (INCM)	Accounting earnings after tax of thousand $ at end of year
	Five-year stock return (FRTN)	The percentage stock market return to shareholders in five years
	One-year stock return (ORTN)	The percentage stock market return to shareholders in one year
	Return on assets (ROA)	The percentage of earnings before interest and taxes to total assets

Tables

Table 1:
Sample selection

Compensation year	2001-2005
Total CEO observations in Execucomp	8513
Net Sales, Net Income in Compustat	8471
Return on assets	8470
Market value	8231
Five-year return	7814
One-year return	8394
Corporate governance in Risk Metrics	1009
Final samples	1009

Table 2
Industry classification

	Technology Firms		Non-technology firms	
Fama-French 12 industries	Number	Percent	Number	Percent
*1 Consumer nondurables			498	6%
*2 Consumer durables			236	3%
*3 Manufacturing			1053	12%
*4 Energy, oil, and coal			327	4%
*5 Chemicals and allied products			258	3%
*6 Business equipment	482	6%	491	6%
*7 Telephone and television	100	1%	80	1%
*8 Utilities			427	5%
*9 Whole sale and retail	54	1%	923	11%
*10 Healthcare, medical equipment			521	6%
*11 Finance			1204	14%
*12 Construction, building, transportation, hotels, service, and entertainment	591	7%	1226	14%
Total	1227	14%	7244	86%

Notes:
Technology firms defined as companies with primary SIC codes 3570, 3571, 3572, 3576, 3577, 3661, 3674, 4812, 4813, 5045, 5961, 7370, 7371, 7372, and 7373. Non-technology firms are firms with SIC codes not otherwise categorized as technology firms.
*1 Consumer nondurables are firms with SIC code between 0100 and 0999; between 2000 and 2399; between 2700 and 2749; between 2770 and 2799; between 3100 and 3199; between 3940 and 3989. *2 Consumer durables are firms with SIC code between 2500 and 2519; between 2590 and 2599; between 3630 and 3659; between 3710 and 3711; with 3714, 3716, 3750, 3751, and 3792; between 3900 and 3939; between 3990 and 3999. *3 Manufacturing are firms with SIC between 2520 and 2589; between 2600 and 2699; between 2750 and 2769; between 3000 and 3099; between 3200 and 3569; between 3580 and 3629; between 3700 and 3709; between 3712 and 3713; with 3715; between 3717 and 3749; between 3752 and 3791; between 3793 and 3799; between 3830 and 3839; between 3860 and 3899. *4 Energy, oil and coal are firms with SIC code between 1200 and 1399; between 2900 and 2999. *5 Chemicals and allied products are firms with SIC between 2800 and 2829; between 2840 and 2899. *6 Business equipment are firms with SIC between 3570 and 3579; between 3660 and 3692; between 3694 and 3699; between 3810 and 3829; and between 7370 and 7379. *7 Telephone and television are firms with SIC between 4800 and 4899. *8 Utilities are firms with SIC between 4900 and 4949. *9 Wholesale and retail are firms with SIC between 5000 and 5999; between 7200 and 7299; between 7600 and 7699. *10 Healthcare are firms with SIC between 2830 and 2839; between 3693 and 3693; between 3840 and 3859; between 8000 and 8099. *11 Finance are firms with SIC between 6000 and 6999. *12 Construction, building, transportation, hotels, service, and entertainment are firms with SIC not otherwise categorized.

Table 3

Descriptive Statistics of technology firms and non-technology firms

Panel A	Technology firms			Non-technology firms		
Economic determinants	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.
Net sales (000$)	3519***	494***	10437	5382	1383	15519
Net income (000$)	122***	15	1925	278	66	1939
Market value (000$)	8447*	1137	29169	6889	1548	21631
Return on assets (%)	-5***	2	51	2	4	28
One-year return to shareholders (%)	291	0	6828	131	12	6410
Five-year return to shareholders (%)	-1***	-1***	24	9	8	20
Panel B						
Compensation						
Salary (000$)	543***	459***	346	712	656	379
Bonus (000$)	597***	228***	1553	945	499	1730
Restricted stock (000$)	568***	0	3082	752	0	2582
Options granted (000$)	4941***	1436	16186	2027	697	4412
Total Compensation (000$)	6956***	2809	17095	4964	2770	6998
Panel C						
Compensation mix						
2001	0.60***	0.76***	0.37	0.45	0.49	0.31
2002	0.57***	0.68***	0.33	0.42	0.46	0.29
2003	0.51***	0.60***	0.34	0.39	0.41	0.28
2004	0.54***	0.62***	0.31	0.40	0.42	0.28
2005	0.51***	0.59***	0.30	0.40	0.43	0.27
Panel D						
Corporate governance						
DUAL	0.57***	1	0.495	0.68***	1	0.467
CCHR	0.05	0	0.225	0.05	0	0.226
CMBR)	0.23	0	0.422	0.22	0	0.415
ACHR	0.03	0	0.162	0.04	0	0.196
AMBR	0.18	0	0.384	0.20	0	0.399
GOV	0.15	0	0.359	0.17	0	0.373
HOLD	0.003	0	0.015	0.028	0	0.55

Notes:

***, **, and * are statistically significant at the 0.01, 0.05, and 0.10 levels under two-tailed test.

The total compensation includes salary, bonus, other annual compensation, restricted stock grants, long-term incentive plan, all other compensation, and value of options (Black-Scholes value). In the Execucomp database, it is referred as TDC1. All of compensation components are measured with thousand dollars. Net sales, Net income, and Market value are measured with thousand dollars. Return on assets, One-year return, and Five-year return are measured with percentage. Compensation mix is the percent of stock-based compensation to total compensation. DUAL: CEO duality dummy is equal to one if a CEO also serves as chairman of the board, and zero otherwise. CCHR**:** compensation chairman dummy is equal to one if a CEO also serves as chairman of the compensation committee, and zero otherwise. ACHR**:** compensation member dummy is equal to one if a CEO also serves as member of the compensation committee, and zero otherwise. AMBR**:** audit chair dummy is equal to one if a CEO also serves as chair of the audit committee, and zero otherwise. GOV**:** corporate governance dummy is equal to one if a CEO serves as a member of the corporate governance committee, and zero otherwise. HOLD**:** institutional holding is the percent of shares hold by institutional investors. Technology firms defined as companies with primary SIC codes 3570, 3571, 3572, 3576, 3577, 3661, 3674, 4812, 4813, 5045, 5961, 7370, 7371, 7372, and 7373. Non-technology firms are firms with SIC codes not otherwise categorized as technology firms.

Table 4

Pearson correlation matrix

	COMP	MIX	TECH	DUAL	CCHR	CMBR	ACHR	AMBR	GOV	HOLD	MKT	SALE	INCM	FRTN	ORTN	ROA
COMP	1															
MIX	0.576***	1														
TECH	-0.001	0.162***	1													
DUAL	0.144***	0.010	-0.076***	1												
CCHR	-0.002	-0.010	-0.001	-0.031***	1											
CMBR	0.030**	0.047***	0.008	-0.076***	0.272***	1										
ACHR	-0.005	-0.004	-0.023	-0.061***	-0.074***	0.008**	1									
AMBR	0.007	0.022	-0.015	-0.115***	-0.014***	0.041***	0.266***	1								
GOV	0.079***	0.025*	-0.013	-0.077***	0.095***	0.158***	0.017***	0.031***	1							
HOLD	-0.009	0.018	-0.013	-0.008	0.002	0.002	0.002	0.001	-0.010	1						
MKT	0.640***	0.252***	-0.060***	0.149***	0.010	0.044***	0.002	0.028**	0.125***	-0.055*	1					
SALE	0.575***	0.109***	-0.189***	0.168***	0.009	0.049***	0.023*	0.045***	0.125***	-0.130***	0.784***	1				
INCM	0.601***	0.173***	-0.086***	0.151***	-0.004	0.038***	0.004	0.028*	0.105***	0.068**	0.887***	0.794***	1			
FRTN	0.152***	0.060***	-0.160***	0.000	-0.005	-0.041***	-0.020	-0.001	-0.046***	-0.078**	0.265***	0.046***	0.040***	1		
ORTN	0.021*	0.018*	0.009	-0.032**	0.029**	-0.011	0.001	0.011	0.035***	-0.051*	-0.006	0.008	0.037**	-0.011	1	
ROA	0.080***	-0.009	-0.079***	0.005	0.031**	0.013	0.011	0.022*	0.034**	-0.111***	0.191***	0.208***	0.100***	0.217***	0.174***	1

Notes:

***, **, and * are statistically significant at the 0.01, 0.05, and 0.10 levels under two-tailed test.

COMP: total compensation is the sum of salary, bonus, other annual compensation, restricted stock grants, value of options (Black-Scholes Value), long-term incentive plan, and other compensation.

MIX: compensation mix is the percent of restricted stock grant and value of options to total compensation.

TECH: technology dummy is equal to one if a firm is a technology firm, and zero otherwise.

DUAL: CEO duality dummy is equal to one if a CEO also serves as chairman of the board, and zero otherwise.

CCHR: compensation chairman dummy is equal to one if a CEO also serves as chairman of the compensation committee, and zero otherwise.

ACHR: compensation member dummy is equal to one if a CEO also serves as member of the compensation committee, and zero otherwise.

AMBR: audit chair dummy is equal to one if a CEO also serves as chair of the audit committee, and zero otherwise.

GOV: corporate governance dummy is equal to one if a CEO serves as a member of the corporate governance committee, and zero otherwise

HOLD: institutional holding is the percent of shares hold by institutional investors.

MKT: market value is stock market capitalization of thousand $ at end of year.

SALE: net sales is sales of thousand $ at the end of the year.

INCM: net income is accounting earnings after tax of thousand $ at end of year.

FRTN: five-year stock return is the percentage stock market return to shareholders in five years

ORTN: one-year stock return is the percentage stock market return to shareholders in one year.

ROA: return on assets is the percentage of earnings before interest and taxes to total assets.

Table 5

Results from regressing compensation on size proxies

$$\text{Log (total compensation}_i) = \alpha + \beta 1\ (\text{log market value}_i) + \beta 2(\text{log net income}_i) + \beta 3(\text{log net sales}_i) + \beta 4(\text{technology dummy}_i) + \beta 5(\text{years Dummies}_i) + \varepsilon_i$$

Panel A Total compensation	I	II	III	IV
Log Market	0.37***	0.65***		
	(16.21)	(75.81)		
Log Income	0.11***		0.61***	
	(5.12)		(62.17)	
Log Sales	0.22***			0.60***
	(12.72)			(66.19)
Year dummy	Yes	Yes	Yes	Yes
Technology dummy	Yes	Yes	Yes	Yes
Observations	8231	8231	8471	8471
Adj-R^2	0.444	0.413	0.344	0.367

Notes:

***, **, and * are statistically significant at the 0.01, 0.05, and 0.10 levels under two-tailed test.

The dependent variable is logarithm of total compensation; the independent variable is firm size proxy. In model I, the independent variables are logarithm of market value, logarithm of net income, and logarithm of net sales. In model II, the independent variable is logarithm of market value; in model III, the independent variable is logarithm of net income; in the model IV, the independent variable is logarithm of net sales. The total compensation includes salary, bonus, other annual compensation, restricted stock grants, long-term incentive plan, all other compensation, and value of options (Black-Scholes value). In the Execucomp database, it is referred as TDC1. Coefficient is reported in the first line and t-statistics in the parentheses.

Table 6

Results from regressing total compensation on performance proxies
$$\text{Log (total compensation}_i) = \alpha + \beta 1 (\text{five}-\text{year return}_i) + \beta 2(\text{one}-\text{year return}_i) + \beta 3(\text{return on assets}_i) + \beta 4(\text{technology dummy}_i) + \beta 5(\text{year dummies}_i) + \varepsilon_i$$

Log total compensation				
Five-year return to shareholders	0.143***	0.154***		
	(12.12)	(13.42)		
One-year return to shareholders	0.014		0.022**	
	(1.241)		(2.03)	
Return on assets	0.055***			0.079***
	(4.683)			(7.23)
Year dummy	Yes	Yes	Yes	Yes
Technology dummy	Yes	Yes	Yes	Yes
Observations	7814	7814	8394	8470
Adj-R^2	0.029	0.026	0.004	0.01

Notes:
***, **, and * are statistically significant at the 0.01, 0.05, and 0.10 levels under two-tailed test.
The dependent variable is logarithm of total compensation; the independent variable is firm performance proxy. In model I, the independent variables are five-year return, one-year return, and return on total assets; in model II, the independent variable is five-year return; in model III, the independent variable is one-year return; in the model IV, the independent variable is return on total assets. Coefficient is reported in the first line and t-statistics in the parentheses. The symbols ** and *** indicate statistical significance at 5% and 1% level, respectively.

Table 7:

Results from regressing total compensation on compensation risk.

$$\text{Log (total compensation}_i) = \alpha + \beta 1 \text{ (compensation mix}_i) + \beta 2 \text{(technology dummy}_i) + \beta 3 \text{ (compensation mix}_i * \text{technology dummy}_i) + \beta 4 \text{(controlled variables}_i) + \varepsilon_i \quad (1)$$

Log total compensation	I	II	III
Log Market	0.66***	0.44***	0.54***
	(73.68)	(68.68)	(69.57)
Five-year return	-0.014	-0.02***	-0.02***
	(-1.487)	(-2.66)	(-3.00)
Technology dummy	0.034***	-0.043***	-0.18***
	(3.916)	(-5.727)	(-13.32)
Compensation mix		0.44***	0.40***
		(57.09)	(47.45)
Compensation mix*			0.18***
technology			(12.11)
Years	Yes	Yes	Yes
Observations	7814	7814	7814
Adj-R^2	0.432	0.602	0.610

Notes:

***, **, and * are statistically significant at the 0.01, 0.05, and 0.10 levels under two-tailed test.

The dependent variable is logarithm of total compensation; the independent variables are economic determinants. In model I, the independent variables are logarithm of market value, logarithm five-year return, and technology dummy; in model II, I add compensation mix as independent variable. The compensation mix is the percent of stock-based compensation to total compensation. Stock-based compensation is restricted stock grants and options; in model III, I add interaction of compensation mix and technology dummy. Coefficient is reported in the first line and t-statistics in the parentheses.

Table 8
Results from regressing total compensation on board structures and ownership structures.

$$\text{Log (total compensation}_i) = \alpha + \beta 1\,(\text{compensation mix}_i) + \gamma 1\,(\text{board Structure}_i) + \gamma 2(\text{ownership structure}_i) + \beta 2(\text{logmarket value}_i) + \beta 3(\text{five} - \text{year return}_i) + \beta 4(\text{technology dummy}_i) + \beta 5(\text{year dummies}_i) + \varepsilon_i \quad (2)$$

Log total compensation	Predicted sign	Year dummies	Fama Macbeth
Five-year return to shareholders	+	-0.02	-0.001
		(-0.963)	(-1.06)
Log Market	+	0.441***	0.331***
		(19.99)	(20.01)
Technology	+	-0.009	0.019
		(-0.439)	(0.29)
Compensation mix	+	0.537***	2.07***
		(25.78)	(25.99)
CEO/chair	+	0.066***	0.163***
		(3.378)	(3.37)
Compensation committee chair	+	-0.008	-0.034
		(-0.371)	(-0.29)
Compensation committee	+	-0.023	-0.08
		(-1.13)	(-1.45)
Audit committee chair	+	-0.01	-0.05
		(-0.475)	(-0.45)
Audit committee member	+	0.036	0.08
		(1.713)	(1.37)
Governance committee	+	0.01	0.04
		(0.475)	(0.56)
Institutional Holdings	-	0.002	0.000
		(0.102)	(0.08)
Observations		1009	1009
Adj-R^2		0.648	0.637

Notes:
***, **, and * are statistically significant at the 0.01, 0.05, and 0.10 levels under two-tailed test.
The dependent variable is logarithm of total compensation. The independent variables are board structure and ownership structure. The compensation mix is the percent of stock-based compensation to total compensation. Stock-based compensation is restricted stock grants and options. If a firm is a technology firm, the technology dummy equal to one and zero otherwise. I define CEO/chair as an indicator variable, which is equal to one if a CEO also serves as chairman of the board, and zero otherwise. Compensation committee chairman is an indicator variable equal to one if a CEO also serve as the chairman of the compensation committee, and zero otherwise. Compensation committee is an indicator variable equal to one if a CEO also serves as the member of the compensation committee, and zero otherwise. Audit chair is an indicator variable equal to one if a CEO also serves as the chair of the audit committee, and zero otherwise. Audit member is an indicator variable equal to one if a CEO serves as the member of the audit committee, and zero otherwise. Corporate governance variable is an indicator variable equal to one if a

CEO also serves as the corporate governance committee member, and zero otherwise. Institutional holding is the percent of share hold by the institutional investors. Coefficient is reported in the first line and t-statistics in the parentheses.

Table 9:
Results from regressing total compensation (TDC2) on compensation risk
Results from regressing total compensation (TDC1) on compensation risk by using alternative controlled variables

$$\text{Log (total compensation}_i) = \alpha + \beta 1 \text{ (compensation mix}_i) + \beta 2 (\text{ technology dummy}_i) + \beta 3 \text{ (compensation mix}_i * \text{technology dummy}_i) + \beta 4 (\text{ controlled variables}_i) + \varepsilon_i \quad (1)$$

Log Total compensation	I TDC2	II TDC1	III TDC1	IV TDC1	V TDC1
Technology	-0.067***	-0.09***	-0.134***	-0.193***	-0.190***
	(-3.865)	(-6.68)	(-8.475)	(-14.588)	(-14.364)
Compensation mix	0.071***	0.467***	0.444***	0.405***	0.407***
	(6.73)	(58.94)	(49.67)	(49.94)	(50.28)
Compensation mix * technology	-0.001	0.153***	0.162***	0.189***	0.184***
	(-0.047)	(10.828)	(9.852)	(13.396)	(13.11)
Log Market	0.532***			0.525***	0.528***
	(54.56)			(72.1)	(71.4)
Log Sales		0.525***			
		(73.05)			
Log Net income			0.522***		
			(63.4)		
Five-year return	0.096***	0.098***	0.022***		
	(10.03)	(13.58)	(2.7)		
One-year return				0.018***	
				(2.57)	
ROA					-0.019***
					(-2.628)
Years	Yes	Yes	Yes	Yes	Yes
Observations	7814	7814	7814	8394	8470
Adj-R^2	0.380	0.619	0.601	0.605	0.605

Notes:
***, **, and * are statistically significant at the 0.01, 0.05, and 0.10 levels under two-tailed test.
In column I, the dependent variable is logarithm of total compensation/TDC2; the independent variables are compensation mix and technology dummy. "TDC2 estimates the value of total compensation realized by the executive in a given year. This is the sum of salary, bonus, value of restricted stock granted, the net value of stock options exercised, and the value of long-term incentive payouts. TDC2 also reflects any benefit that an executive may have received from backdating options." (Kaplan & Rauh, 2010, p. 1007). The compensation mix is the percent of stock-based compensation to total compensation. Stock-based compensation is restricted stock grants and options. If a firm is a technology firm, the technology dummy equal to one and zero otherwise. I add interaction of technology and compensation mix. The control variables include logarithm of market value and five-year return to shareholders. In column II to column V, the dependent variable is logarithm of total compensation/TDC1, which is the sum of salary, bonus, other annual compensation, restricted stock grants, long term incentive plan, all other compensation, and value of options (Black-Scholes value). Coefficient is reported in the first line and the t-statistics in the parentheses.

Table 10:

Results from regressing change of total compensation on change of compensation mix

$$\Delta \text{Log (total compensation}_i) = \alpha + \beta 1 (\Delta \text{compensation mix}_i) + \beta 2(\Delta \text{Five} - \text{year return}_i) + \beta 3(\Delta \text{log maket value}_i) + \beta 4(\text{technology dummy}_i) + \beta 5(\text{year dummies}_i) + \varepsilon_i$$

∆ Log total compensation	
∆ Compensation mix	0.683***
	(73.020)
∆ Five-year return	0.008
	(0.632)
∆ Market value	0.167***
	(13.908)
Technology dummy	-0.21***
	(-2.246)
Year dummy	Yes
Observations	7299
Adj-R^2	0.504

Notes:
***, **, and * are statistically significant at the 0.01, 0.05, and 0.10 levels under two-tailed test.
The dependent variable is the change of logarithm of total compensation; the independent variables are the change of compensation risk. The compensation mix is the percent of stock-based compensation to total compensation. Stock-based compensation is restricted stock grants and options; Coefficient is reported in the first line and t-statistics in the parentheses.