Executive Pay Dispersion, Corporate Governance and Firm Performance

Kin Wai Lee
Nanyang Technological University

Baruch Lev*
New York University

Gillian Hian Heng Yeo
Nanyang Technological University

May 2005

* Stern School of Business, Henry Kaufman Management Center, 44 West Fourth Street, Suite 10-92, New York, NY 10012. Telephone: 212.998.0028, Fax: 212.995-4001, Email: blev@stern.nyu.edu.

Abstract

Much of the research on management compensation focuses on the level and structure of executives' pay. In this study, we examine a compensation element that has not received so far considerable research attention—the *dispersion* of compensation across managers—and its impact on firm performance. We examine the implications of two theoretical models dealing with pay dispersion—tournament vs. equity fairness. Tournament theory stipulates that a large pay dispersion provides strong incentives to highly qualified managers, leading to higher efforts and improved enterprise performance, while arguments for equity fairness suggest that greater pay dispersion increases envy and dysfunctional behaviour among team members, adversely affecting performance. Consistent with tournament theory, we find that firm performance, measured by either Tobin's *Q* or stock performance, is positively associated with the dispersion of management compensation. We also document that the positive association between firm performance and pay dispersion is stronger in firms with high agency costs related to managerial discretion. Furthermore, effective corporate governance, especially high board independence, strengthens the positive association between firm performance and pay dispersion. Our findings thus add to the compensation literature a potentially important dimension: managerial pay dispersion.

JEL classification : G30; G34; J33; L22

Keywords : Compensation, Corporate Governance, Performance, Pay dispersion.

Deleted: ;

1. Introduction

Executive compensation has been a central research topic in economics and business during the past two decades, recently gaining impetus in the wake of corporate scandals that have exposed significant vulnerabilities in corporate governance and the subsequent far reaching regulatory changes (Sarbanes-Oxley). Prior research into executive compensation has primarily focused on issues related to the level and structural mix (salary, bonus, stocks) of compensation packages, and their sensitivity to firm performance (Lambert and Larcker (1987), Jensen and Murphy (1990), Yermack (1995), Hall and Liebman (1998), Core et al. (1999), Murphy (1999), and Bryan et al. (2000)). Early compensation studies focused on the CEO, subsequently expanding the scope to the compensation of the entire managerial team. Thus, for example, Aggarwal and Samwick (2003) report that managers with divisional responsibilities have lower pay–performance sensitivities than do managers with broad oversight authority, who in turn have lower pay–performance sensitivities than does the CEO, concluding that pay–performance sensitivity increases with the span of authority. Similarly, Barron and Waddell (2003) examine the characteristics of compensation packages of the five highest paid executives, reporting that higher rank managers have a greater proportion of incentive-based compensation in pay packages than do lower ranked executives.

The issue of pay *dispersion* across managerial team members has received conceptual attention by labor economists and organization theorists, yet scant empirical research has been performed to date. In this study, we investigate empirically the effect of managerial compensation dispersion on firm performance. We draw on two competing models—the tournament theory and equity fairness arguments—to formulate our hypotheses: Tournament theory (Lazear and Rosen (1981)) views the advancement of executives in the corporate

hierarchy as a tournament in which individuals compete for promotion and rewards. High-performing executives with considerable managerial potential win promotion and commensurate compensation. A large spread of compensation across corporate hierarchical levels attracts talented and venturesome participants to compete in the managerial tournament, providing extra incentives to exert effort. The winners' talent and the extra effort exerted will, according to the tournament model, translate to high firm performance.

The empirical evidence on the tournament theory is rather limited and results are mixed. Supporting evidence comes from studies of sport activities (Ehrenberg and Bognanno (1990), Becker and Huselid (1992)) and by controlled experiments (Bull et al. (1987)). In business settings, Main et al. (1993), using survey data for top executives in 200 US firms, during 1980-1984, report that a greater spread of top-executive compensation is positively related to firm performance. Similarly, based on proprietary data of 210 Danish firms during 1992–1995, Eriksson (1999) provides somewhat weak evidence that higher pay dispersion is positively related to firm performance. In contrast, O'Reilly et al. (1988) do not find support for the tournament argument in a sample of 105 Fortune 500 firms, and Conyon et al. (2001) report that variation in executive compensation is not associated with enhanced firm performance in a sample of 100 UK firms in 1997.

In contrast with the tournament model, notions of equity fairness postulate that the quality of social relations in the workplace affect firm performance (Akerlof and Yellen (1988, 1990), Milgrom (1988), Milgrom and Roberts (1990)) and that large pay dispersion adversely affects employee relations and morale, leading to counterproductive organizational activities, which eventually reduce firm performance. Supporting evidence for the adverse effects of wage dispersion on performance is also limited. Using a sample of university faculty, Pfeffer and

Langton (1993) report that greater wage dispersion within academic departments reduces faculty satisfaction as well as research productivity and collaboration among colleagues. There is also some preliminary evidence in business settings (e.g., Drago and Garvey, 1998) that supports the argument for equity fairness.

In this study we examine a sample of 12,197 firm-year observations for 1,855 U.S. companies spanning the period 1992-2003, and find that firm performance, measured by Tobin's *Q* and alternatively by stock returns, is positively associated with the compensation dispersion of the firms' top-management team. Additionally, we document that firms with large compensation dispersion have higher future return on assets than comparable lower pay dispersion companies. Collectively, our results suggest that the compensation dispersion of the top management team is positively related to firm performance.

Our analysis also indicates that the association between firm performance and pay dispersion is conditional on agency costs and corporate governance structure. Specifically, high pay dispersion is associated with better performance in firms with high agency costs related to managerial discretion (e.g., firms with large R&D expenditures). This finding supports the notion that in firms with assets or activities that are difficult for shareholders to monitor, a greater pay dispersion relieves some of the managers-shareholders agency costs by motivating managers to improve long-term firm performance. Our findings are also consistent with prior studies reporting that firms with high growth opportunities are more likely to substitute direct monitoring with equity-based compensation incentives to reduce agency costs of managerial discretion (Smith and Watts (1992), Gaver and Gaver (1993), Bryan, Hwang and Lilien (2000)). We further find that the positive association between firm performance and pay dispersion is stronger for firms with more effective corporate governance. Specifically, firms with a high

proportion of outside directors on the board and with CEOs who are not board chair have a stronger positive association between firm performance and pay dispersion. Thus, our results corroborate the complementary roles of compensation contracts and corporate governance in reducing agency costs (Mehran (1995), Hartzell and Strark (2003)).

This study contributes to the managerial compensation research on several dimensions. Primarily, it provides comprehensive and updated evidence that managerial compensation dispersion is positively associated with firm performance. Pay dispersion per se was so far a somewhat neglected area in managerial compensation research. Our study thus contributes to recent research that focusses on the executive-team compensation (Aggrawal and Samwick 2003; Barron and Waddell 2003), compared to prior compensation research that was often restricted to the CEO. This study also extends the literature on the interaction between corporate governance and the structure of managerial compensation. For the corporate governance strand of research we show that improved governance structures (such as a higher proportion of independent board members and separation of the CEO and Chairman positions) enhances the positive association between pay dispersion and firm performance. Thus, corporate governance and managerial pay dispersion are complementary, and perhaps mutually enhancing mechanisms for strengthening firm performance. In the context of shareholders-mangers agency costs, we provide evidence suggesting that managerial pay dispersion can potentially mitigate agency costs in firms that are difficult to monitor. More generally, our study supports the notion that the structure of executive compensation affects agency costs and firm performance.

The rest of this paper is organized as follows. Section 2 discusses prior related research and presents our hypotheses. Section 3 describes the sample and research methods, while Section

4 presents the primary results. Section 5 reports on various robustness tests and Section 6 concludes the study.

2. Prior Research and Our Hypotheses

2.1. Tournament Theory

This theory (Lazear and Rosen (1981)) views the advancement of executives in a corporate hierarchy as a contest in which individuals compete for promotion and rewards. High-performing executives win promotions and receive prizes in the form of generous pay and perks in their new positions. The compensation spread across hierarchical levels (large "prizes" at the top) provides extra incentives to participate in the managerial "tournament" and exert considerable efforts to win the top prize.[1] The main elements of the tournament theory are as follows: (i) Tournaments reward players with prizes based upon *relative* performance. The best performer receives the largest prize while the worst performer receives the smallest. (ii) Rewards are intrinsically nonlinear. (iii) The spread in prizes increases with the number of competitors. (iv) Participants with low ability will choose higher risk strategies to increase the probability of winning. Thus, a participant's ability is negatively related to the variability of his/her performance. (v) The disincentive effects of mixed tournaments (where players do not exert sufficient effort) can be reduced by handicapping the more able players or by sorting players into tournaments of homogeneous ability[2].

[1] Tournament theory suggests that, in the presence of costly monitoring of an employee effort and output, compensation may differ from employees' marginal product and yet be economically efficient. Efficiency is secured by the widening of pay dispersion across the corporate hierarchy (especially toward top positions) acting as an incentive to those lower in the hierarchy to accept wages at less than their expected marginal products, in order to enter a self-financing quasi-lottery (rank-order tournament), where the main prize is the top executive job.

[2] A mixed tournament is one where players know ex ante the ability of other players, possibly leading low-ability players to quit.

Empirical evidence supporting the tournament theory was obtained in sport settings. For example, Ehrenberg and Bognanno (1990) examine the performance of golfers and conclude that as prize differentials increase, players' performance improves. Becker and Huselid (1992) examine the performance of drivers in professional auto racing, and report that pay dispersion has positive incentive effects on both individual performance and driver safety. In a business setting, Main et al. (1993) use survey data for 200 firms during 1980-1984 and report that pay differential increases substantially as one ascends the corporate hierarchy, consistent with tournament theory's prediction that extra weight on top-ranking prizes motivates participants to aspire to higher goals, and that the dispersion in top compensation increases with the number of contestants. The main finding of Main et al. (1993) is that firm performance is positively associated with executive pay dispersion. In a similar vein, Bognanno (2001) reports that the CEO pay rises with the number of vice presidents competing for the top position. However, he finds that inconsistent with the tournament prediction, firms do not maintain short-term promotion incentives, as longer time in position prior to promotion reduces the effect of pay increase from the promotion[3]. Finally, Conyon et al. (2001) examine a sample of 100 large UK firms during 1997–1998 and find no evidence that larger pay dispersion is positively associated with improved firm performance. O'Reilly et al. (1988) report similar findings for the US. Thus, the business-setting evidence on the tournament theory is mixed and somewhat dated.

---

[3] The tournament theory predicts that apart from the promotional incentives and pay differentials between jobs, short-term incentives are also necessary to motivate employees to compete for top positions in the

2.2 Equity Fairness

Economic theory asserts that in equilibrium wages are equal to employees' marginal productivities. Such mainstream thinking has been challenged: Drawing on social exchange models, equity notions, and related work in sociology and psychology, Akerlof and Yellen (1988, 1990), Milgrom and Roberts (1988), and Levine (1991) argue that *low* pay dispersion may have a positive effect on employee efforts and productivity by creating harmonious and efficient labor relations thereby leading to higher output and productivity[4]. In a similar vein, Levine (1991) develops a model showing that lowering pay dispersion can increase employee cohesiveness, which in turn will enhance productivity.

Further insight into the economic efficiency associated with a low pay dispersion is provided by Lazear (1989), and Milgrom and Roberts (1990): If promotion and salaries are based on relative rather than individual performance, as postulated by tournament theory, then employees will advance not only by performing well, but also by seeing to it that their rivals perform poorly. Consequently, employees have weaker incentives to cooperate, and in extreme cases may engage in outright sabotage of others' activities. To mitigate this, a firm may encourage cooperation by, among other things, reducing pay dispersion. Low dispersion may reduce effort, but at the same time increase cooperation. Thus, in general, it is optimal on productivity grounds to compress wage structure, to some extent, to promote cooperation (Lazear

---

corporate hierarchy. The absence of short-term incentives may induce competitors to prematurely exit the tournament.

[4] The notion that a large pay dispersion may have negative impact on employees through feelings of inequity, leading to a weakened loyalty and increased dysfunctional conflict can be traced to Hicks (1963, p. 334), who stated that "the purely economic correspondence between wage paid to a particular worker and his value to the employer is not a sufficient condition for efficiency. It is also necessary that there should not be strong feelings of injustice about the relative treatment of different employees, since these would diminish the efficiency of the team."

(1989))[5]. In a similar vein, Milgrom and Roberts (1990) use the principal-agent framework to suggest that employees may engage in rent-seeking activities to secure influence over organizational decision processes. Such influence-oriented activities arise when organizational decisions affect the distribution of wealth or other benefits among members or constituent groups. In their selfish interest, the affected individuals attempt to influence the decision process to their benefit. For example, if firms cannot perfectly monitor output, workers may have incentives to exaggerate their output and lobby for higher wages. Thus, for example, the proponents of a project (e.g., R&D) may devote excessive effort to build the best possible case for investing in that project, hiding potential difficulties and focusing on the upside, while at the same time trying to denigrate competing proposals. Such arguments have led Milgrom and Roberts (1990) to promote wage compression under certain circumstances to alleviate these counterproductive activities.

Empirical tests of the above equity fairness arguments include the work of Pfeffer and Langton (1993), who report that the higher the wage dispersion of university faculty, the lower their satisfaction and research productivity and the less likely it is that faculty members will collaborate on research. Interestingly, wage dispersion has a weaker adverse effect on satisfaction in private universities where salaries are not likely to be publicly known than in public institutions. Similarly, Cowherd and Levine (1992), examining 102 business units of 41 North American and European firms report a positive relationship between product quality and various measures of interclass pay equity (low wage dispersion). Drago and Garvey (1998) report that strong promotion incentives are associated with reduced employee cooperation and

[5] An implication of this proposition is that concern over equity fairness is more important when close collaboration among employees is desirable, as well as when employees are personally more aggressive in self-promotion at the cost of others (Lazear's "hawks"). Pay equity has less of an impact on economic

individual efforts. Contradicting the equity fairness predictions, Hibbs and Locking (2000) report that compression of wage dispersion in Swedish companies depressed output and labor productivity.

In summary, the tournament theory predicts a positive association between firm performance and pay dispersion whereas the equity fairness notions predict a negative association. While the tournament and the equity fairness arguments concerning the impact of pay dispersion on performance provide distinguishable predictions, the empirical evidence—particularly in business settings—is limited and often mixed. To fill the void, we formulate and test the following primary hypothesis.

Hypothesis H1:

Firm performance is positively associated with the dispersion of managerial compensation.

2.3 Interaction between pay dispersion and agency costs

Both the tournament and equity fairness assertions apply to all employees. When the top management team is considered, agency issues and governance structure may play an intervening role in the relation between pay dispersion and firm performance. We draw on the theoretical foundations of tournament theory to examine the effect of agency costs on the relation between firm performance and pay dispersion. An implication of the tournament theory is that when it is difficult to directly monitor management's effort, large pay dispersion can mitigate agency costs associated with moral hazard problems and information asymmetry between managers and external shareholders.[6] Thus, when managers are endowed with specific, hard to

---

efficiency when output is more individually based and when employees are personally more restrained (Lazear's "doves").

[6] Lazear (1981) argues that when employee productivity is affected by extraneous factors or noise, employees will reduce their efforts, because such efforts are less likely to affect productivity or outcome.

communicate knowledge—such as in R&D-intensive firms—or have considerable discretion over funds, undesireable managerial behaviour (e.g., inflating the prospects of R&D projects in order to secure large internal budgets, or to inflate stock prices) may be alleviated by a large pay dispersion: The prospects of the "big prize" (CEO compensation) lie in the future, when the outcome of the R&D projects or other investments will materialize, thereby providing *ex ante* disincentives to inflate investment prospects.[7]

Accordingly, we condition the examined relation between pay dispersion and firm performance on agency proxies. Agency costs related to monitoring difficulties vary across firms (Jensen & Meckling, 1976). Smith and Watts (1992) argue that agency costs and moral hazard problems are likely to be more pronounced in firms with high growth opportunities, since the scope for managerial discretion over spending is greater in such firms than in low-growth companies. Himmelberg, Hubbard and Palia (1999) argue that agency/monitoring costs are positively associated with the scope of managerial discretion as measured by research and development (R&D) intensity and advertising intensity. Specifically, when activities are difficult to monitor (as are R&D and advertising expenditures), increases in managerial ownership reduce agency costs of managerial discretion. We conjecture that firms with high agency costs related to managerial discretion will use a larger pay dispersion (a related dimension to managerial equity ownership) in order to mitigate agency problems and improve firm performance. Our second hypothesis is thus:

A larger pay dispersion according to Lazear will counteract, to some extent, the adverse impact of uncertainty and noise on employee efforts and productivity.

[7] The emphasis of tournament theory on measuring the *relative* performance of employees, rather than the absolute performance, also accommodates situations where managerial activities are hard-to-monitor. In such cases, an ordinal (relative) ranking of employees' performance is more practical than a cardinal ranking.

Hypothesis H2:

The positive association between firm performance and managerial pay dispersion is stronger in firms with large agency costs of managerial discretion.

2.4 Interaction between pay dispersion and corporate governance structure

Corporate governance structures are likely to affect the association between firm performance and pay dispersion. For example, the dysfunctional effects of large pay dispersion among top managers (according to equity fairness arguments) may be mitigated by independent board members overseeing managerial activities and by effective monitoring of managerial performance by institutional investors ("active investors"). Prior studies suggest that compensation contracts complement other corporate governance mechanisms, such as board independence and institutional investors ownership. Mehran (1995) reports, for example, that firms with a large number of outside directors make more extensive use of equity-based compensation. Similarly, Harley and Wiggins (2004) find that firms with entrenched CEOs and those who also chair the board provide managers with a lower equity-based pay. These results suggest that powerful CEOs use their positions to reduce board monitoring and at the same time make their own compensation less sensitive to stock price performance. Hartzell and Starks (2003) report that institutional investor ownership is positively related to the performance sensitivity of managerial compensation. They interpret their results to imply that institutional investors monitoring tends to be complementary to incentive compensation systems, both mitigating agency problems between shareholders and managers. Given the evidence that the structure of compensation contracts complements corporate governance in mitigating agency

costs, we conjecture that pay dispersion—a dimension of incentive compensation systems—is more strongly associated with performance in firms with strong corporate governance structures.

Hypothesis H3:

The positive association between firm performance and managerial pay dispersion is stronger in firms with effective corporate governance.

3. Data and Research Methods

3.1. Sample

Our sample is drawn from all firms listed in the Execucomp database during 1992-2003. We exclude utility and financial services companies due to concerns that government regulations of these industries might affect the structure of executive compensation and its impact on performance. We obtain financial statement data from Compustat and stock returns from CRSP. Compact Disclosure provides the information on managerial equity ownership and board structure. Compensation data are derived from the Execucomp database. The final sample consists of 12,197 firm-year observations, representing 1,855 listed US companies for the period 1992–2003.

3.2 Model Specification

The central hypothesis examined in this study is that firm performance is positively associated with managerial pay dispersion. Following prior studies (Morck et al. (1988), Hermalin and Weisbach (1991), and Himmelberg et al. (1999)), we measure firm performance by Tobin's *Q*, and regress it on pay dispersion and a set of control variables[8]. The dependent

[8] We alternatively measure firm performance by its stock return and report these results in Section 4.4.

variable, TOBINQ, is measured as the market value of common equity plus book value of liabilities, divided by the book value of total assets of the firm at the end of the fiscal year. Following prior studies (Aggrawal and Samwick (2003), Barron and Waddell (2003)), we define the top management team as the five highest paid executives whose compensation is disclosed in the Execucomp database. Compensation dispersion is measured by the coefficient of variation of total pay (comprising of salary, bonus, stock options granted, long-term incentive pay, restricted stock grants, and other compensation), across the top managerial team, namely the standard deviation of compensation divided by the mean. Pay dispersion is denoted by DISPAY. Under hypothesis H1, we expect the coefficient of DISPAY to have a positive sign in the TOBINQ regression.

Hypothesis H2 predicts that the positive association between firm performance and pay dispersion is higher in firms with high agency costs associated with managerial discretion. Following Himmelberg, Hubbard and Palia (1999), we use two proxies for the scope of managerial discretion: R&D intensity (RDSALE) and advertising intensity (ADVSALE). R&D intensity is measured as the sum of R&D expenditures divided by sales for the prior five years. Advertising intensity is the sum of advertising expenditures divided by sales for the prior five years. To test hypothesis H2, we include in the regression the *interaction* between pay dispersion and R&D intensity (DISPAY * RDSALE), and the interaction between pay dispersion and advertising intensity (DISPAY * ADVSALE). We expect both interaction terms to be positive.

Hypothesis H3 maintains that pay dispersion and corporate governance are complementary mechanisms in affecting firm performance. To test H3, we interact DISPAY with various corporate governance effectiveness proxies: Prior studies (Mehran (1995); Shleifer

and Vishny (1997); Core, Holthausen and Larcker (1999)) suggest that effective corporate governance is driven by a high proportion of outside directors, high institutional equity ownership, high insider equity ownership, and a separation of the CEO and chairman positions. Accordingly, we expect the interaction terms between pay dispersion and the proportion of outside directors (DISPAY * OUTDIR), between pay dispersion and the size of institutional ownership (DISPAY * INSTIEQ), and between pay dispersion and insider equity ownership (DISPAY * INSIDEQ) to be positive, whereas the interaction term between pay dispersion and the CEO duality (DISPAY * CEODUAL) to be negative.

In addition to our focus variables DISPAY and the various interaction terms discussed above, we include in the regression the following control variables, reflecting firm attributes and governance indicators, which were shown in previous research to be associated with Tobin's Q:

1. Firm Attributes

(a) ROA—return on assets: profitability has a significant impact on the firm's market value and consequently on its *Q* ratio. Accordingly, we include in the regression the firm's return on assets (ROA) as a control variable. ROA is measured as operating profit after depreciation divided by average total assets.

(b) SIZE—firm size, computed as the natural logarithm of annual sales, is another control variable, given the evidence of a negative relation between size and stock performance.

(c) CAPSALE—capital expenditures: Corporate market value obviously depends on future growth opportunities, which are affected by capital expenditures. We measure this variable as the ratio of annual capital expenditures to sales.

(d) SEGNUM—business segments: prior studies (Lang and Stulz (1994), Berger and Ofek (1995)) report that corporate diversification reduces firm value. We proxy for this diversification discount by the number of business segments (divisions) of the firm (SEGNUM).

2. Corporate Governance Indicators

(a) INSIDEQ, INSIDEQSQ—Past studies (Jensen and Meckling (1976), Mehran (1995)) suggest that a large managerial equity ownership reduces agency costs and increase firm value by aligning managers' interests with those of shareholders. Accordingly, we include in the regression a variable reflecting managerial ownership (INSIDEQ), measured as the percentage of common equity owned by officers and directors. However, Morck et al. (1988) report that at high levels of managerial ownership the managerial entrenchment effect, which is detrimental to value, dominates the alignment-of-interest effect. To control for such managerial entrenchment at high ownership levels we include in the regression INSIDEQSQ, which is the square of the share of common equity owned by officers and directors.

(b) INSTEQ—Finally, Shleifer and Vishny (1997) argue that dispersed shareholders may lack incentives to monitor managers due to the free-rider problem associated with costly monitoring, while large shareholders (institutional investors) are more effective monitors of managers. To control for this aspect of shareholder monitoring, we include a variable, INSTEQ, which reflects the proportion of common shares outstanding owned by institutional investors.

(c) OUTDIR—Board structure plays an important role in monitoring managers and thereby in firms' valuation (Weisbach (1988), Hermalin and Weisbach (1991), and Jensen (1993)).

Independent (nonexecutive) directors are more likely to exert effective monitoring over managers than directors who are also executives (Fama and Jensen 1983). We accordingly include in the regression the variable OUTDIR, which is the proportion of independent directors (defined as directors who are neither current nor former officers of the firm) on the board.

(d) CEODUAL—Core et al. (1999) report that firms in which the CEO is also the chairman of the board have weaker corporate governance and, hence, presumably lower performance and value. To control for the CEO–Chairman duality, we create a dummy variable (CEODUAL) which takes the value of one if the CEO is also the chairman of the board and zero otherwise.

(e) BOARDSIZE—According to Jensen (1993), there are inefficiencies associated with large boards which are often ineffective due to coordination problems. Indeed, Yermack (1996) reports that firm value is negatively associated with board size. We therefore include in the regression BOARDSIZE, measured as the number of directors on the company's board as of the annual shareholders meeting date.

Our cross-sectional regression model is the following:

$$\begin{aligned}\text{TOBINQ}_{it} = {} & \beta_0 + \beta_1 \text{DISPAY}_{it} + \beta_2 \text{DISPAY}_{it} * \text{RDSALE}_{it} + \beta_3 \text{DISPAY}_{it} * \text{ADVSALE}_{it} \\ & + \beta_4 \text{DISPAY}_{it} * \text{OUTDIR}_{it} + \beta_5 \text{DISPAY}_{it} * \text{CEODUAL}_{it} \\ & + \beta_6 \text{DISPAY}_{it} * \text{INSIDEQ}_{it} + \beta_7 \text{DISPAY}_{it} * \text{INSTEQ}_{it} \\ & + \beta_8 \text{RDSALE}_{it} + \beta_9 \text{ADVSALE}_{it} + \beta_{10} \text{ROA}_{it} + \beta_{11} \text{SIZE}_{it} + \beta_{12} \text{CAPSALE}_{it} \\ & + \beta_{13} \text{SEGNUM}_{it} + \beta_{14} \text{INSIDEQ}_{it} + \beta_{15} \text{INSIDEQSQ}_{it} \\ & + \beta_{16} \text{INSTEQ}_{it} + \beta_{17} \text{OUTDIR}_{it} + \beta_{18} \text{CEODUAL}_{it} + \beta_{19} \text{BOARDSIZE}_{it} + \varepsilon_{it}, \end{aligned} \quad (1)$$

where subscripts denote firm i in year t (t = 1992–2003).

4. Empirical Results

4.1 Descriptive Statistics

Table 1 reports on the sample descriptive statistics. The mean and median TOBINQ are 2.12 and 1.64 respectively. The mean dispersion (coefficient of variation) of management compensation (DISPAY) is 0.62 with an interquartile range of 0.33, suggesting considerable sample cross-sectional variability of pay dispersion. We also compute the mean and standard deviation of the compensation of the top five executives. This mean ($1,980 million), along with the standard deviation ($4,104 million), and interquartile range ($1,481 million) further indicate substantial sample variation of compensation. The data in Table 1 also show that, on average, the sample firms are profitable (mean ROA is 10.35%), relatively large (mean and median annual sales of $3,642 million and $960 million, respectively), and operate on average in 3.7 business segments or divisions (mean SEGNUM is 3.7). The mean and median of BOARDSIZE indicate 9 directors per firm. The mean proportion of independent directors on the board (OUTDIR) is 62%, and 60% of the sample firms had CEOs who also chaired the board of directors. At the mean, insiders own 12% of equity (median = 4%), and institutional investors own 57% of equity.

Table 2 provides the industry distribution of pay dispersion, our focus variable. For each year, we partition the sample based on the median coefficient of variation of compensation (DISPAY). Column (1), labeled "low pay dispersion," indicates the firms in the industry with DISPAY below the sample median, and column (2), labelled "high pay dispersion," indicates the firms in the industry with DISPAY above the sample median. For each industry group in columns (1) and (2), the top number is the average value of DISPAY, and the bottom figure in parenthesis is the number of observations (firm-years) in the industry with DISPAY below or above the sample median. Thus, for example, for the first industry—agriculture and mining—

306 firm-years had pay dispersion below the sample median, while 302 firm-years had pay dispersion above the sample median. The former group had an average pay dispersion of 0.44 vs. 0.78 of the latter (above median) group. Column (3) of Table 2 reports the industry mean compensation dispersion (0.61 for agriculture and mining). Inspection of column (3) across the industries in Table 2 indicates that pay dispersion is pervasive and fairly uniform at mean levels of 0.55-0.65 across industries. Column (4) indicates that for each industry, the mean coefficient of variation of compensation for the low-dispersion companies (column (1)) is significantly lower (at the 1% level) than that of the high-dispersion companies (column (2)). This accords with the descriptive statistics in Table 1, indicating that our sample exhibits considerable intra-industry variability in the dispersion of top-management compensation.

Table 3 reports the Spearman correlation coefficients between our variables. Firm performance (TOBINQ) is indeed positively correlated with the dispersion of management compensation (DISPAY). Furthermore, firms with high market valuation (TOBINQ) have higher profits (ROA), higher growth opportunities (CAPSALE), higher managerial equity ownership (INSIDEQ), and smaller boards (BOARDSIZE) than do firms with lower values of TOBINQ. Firms with high pay dispersion (DISPAY) have higher R&D intensity (RDSALE), higher advertising intensity (ADVSALE), are of larger size, have a higher number of business segments, more outside directors on the board, more CEOs serving also as board chairpersons, and higher institutional ownership than do their counterparts with low pay dispersion.

4.2 The Association between Pay Dispersion And Firm Performance

Table 4, Panel A presents a pooled ordinary-least-squares regression estimates of the model in Equation (1): TOBIN's *Q* regressed on the dispersion of management compensation

(DISPAY) along with control variables. The t-statistics are based on Huber-White robust standard error, a generalization of White (1980) standard error, which is robust to both serial correlation and heteroscedasticity. Column (1) presents the pooled regression results with year and industry dummies, but without the interaction terms. The coefficient of pay dispersion, DISPAY, is positive and significant at the 1% level (*t*-statistic 5.63), supporting hypothesis H1 which predicts that firm performance is positively associated with the dispersion of management compensation[9]. To assess the economic significance of the association between pay dispersion and firm performance, we focus on the pay dispersion coefficient, 0.3647. Thus, if a firm's pay dispersion increases from the 25th sample percentile (0.4248 in Table 1) to the sample median (0.5687), the increase in TOBINQ is 0.05248 (0.3647 × (0.5687 – 0.4248)). Based on the sample mean book value of assets of $4,175 million, the consequent increase in firm market value is $219 million (0.05248 × 4,175). Similarly, if a firm's DISPAY increases from the median to the 75th percentile of the sample, the associated increase in market value is $271 million. Thus, variation in pay dispersion of top management is associated with economically substantial changes in the market value of companies.[10]

Hypothesis H2 predicts that the positive association between firm performance and pay dispersion is stronger in firms with high agency problems associated with managerial discretion. We use two proxies for the scope of managerial discretion: R&D intensity (RDSALE) and advertising intensity (ADVSALE). In column (2) of Table 4 we include the interaction terms between pay dispersion and R&D intensity, and between pay dispersion and advertising

[9] We obtain qualitatively similar results when the pooled equation (1) is re-estimated using Generalized Method of Moments (Hansen 1982), which produces standard errors that are not affected by serial correlation of successive observations and cross-sectional heteroscedasticity. In addition, sensitivity analysis (see section 4.7) that attempts to mitigate serial correlation problems by taking the time-series mean for each firm also yield similar results.

intensity. The estimated coefficients of both interaction terms are positive and significant at the 1% and 5% level, respectively, indicating that the positive association between firm performance and pay dispersion is stronger in firms with high R&D and advertising intensities. This finding, focusing on pay dispersion, extends prior studies (Smith and Watts (1992), Gaver and Gaver (1993), Himmelberg, Hubbard and Palia (1999)) reporting that equity-based compensation (not dispersion) is higher in firms with a greater scope of managerial discretion, presumably aimed at reducing agency costs between managers and shareholders. Thus, our findings suggest that pay dispersion is a relevant contracting dimension in designing executive compensation to enhance firm performance.

Hypothesis H3 maintains that pay dispersion and corporate governance mechanisms are complementary devices in affecting firm performance. In column (3) of Table 4 we interact various corporate governance indicators with pay dispersion. The interaction between pay dispersion and the proportion of outside directors on the board (DISPAY * OUTDIR) is positive and significant at the 5% level, suggesting that board independence strengthens the positive association between pay dispersion and firm performance. Similarly, the interaction between pay dispersion and CEO duality (DISPAY * CEODUAL) is negative and significant at the 1% level, indicating that a CEO who is also the chairman of the board weakens the association between pay dispersion and firm performance. This extends the Core, Holthausen and Larcker (1999) finding that CEOs earn excessive compensation when they also occupy the board chairmanship, consistent with the notion that CEO duality increases the rent-seeking influence over the

[10] We obtain even higher estimates of the market value change associated with pay dispersion from our simultaneous equations estimates (Table 7).

compensation process[11]. Collectively, these findings support the view that compensation structure (here—the pay dispersion aspect) and corporate governance are complementary mechanisms to mitigate agency costs.

The control variables in Table 4 panel A have, in general, the predicted signs across all models. Consistent with prior studies (Mehran (1995), Yermack (1996), Himmelberg et al. (1999)), our results indicate that firms with a high *Q* ratio are more profitable (ROA is significant at 1% level) and have higher growth opportunities (CAPSALE is significant at 1% level) than low-*Q* firms. The coefficient of INSIDEQ is positive and the coefficient for INSIDEQSQ is negative, as in previous studies, consistent with the Morck et al. (1988) alignment-of-interest effect at low managerial equity ownership and the entrenchment effect at high levels of managerial ownership. The coefficient of OUTDIR (outside directors) is positive, suggesting that firm value is positively associated with the extent of board independence. Consistent with Yermack (1996), we also document that firms with a higher market valuation have smaller boards (the coefficient BOARDSIZE is negative at the 1% level).

To control for unobserved firm heterogeneity, we estimate a fixed effects regression model that assigns a unique intercept to each firm, and present the results in Table 4, Panel B. The fixed effects regression estimates are qualitatively similar to those of Panel A: the estimates in column (1) of Panel B indicate that firm value (Q ratio) is positively associated with managerial pay dispersion, and the estimates in columns 2 and column 3 support the hypothesis that the positive association between firm performance and pay dispersion is stronger in firms with greater agency costs associated with managerial discretion. Furthermore, the combined roles of the CEO and board chairman in the same person weakens the positive association

[11] Although the signs on the interaction terms DISPAY*INSIDEQ and DISPAY*INSTEQ are consistent with the notion that strong corporate governance reinforces the positive association between firm

between firm performance and pay dispersion. We also find that firms with more outside directors have a stronger positive association between firm performance and pay dispersion. Taken together, the estimates reported in Table 4 indicate that the association between firm performance and pay dispersion is positive and conditional on certain agency costs and corporate governance structures.

4.3. The Association Between Pay Dispersion and Subsequent Profitability

Tobin's Q is a commonly used measure of firm performance in the finance and economics literature. Alternatively, one can focus on the actual performance of companies. We use operating profitability as an alternative measure of firm performance and examine the association between pay dispersion and the actual (ex post) subsequent profitability of the sample firms. Specifically, we test whether the accounting return on assets (ROA) over the subsequent three years is associated with pay dispersion in the current year . For each year, we classify a sample firm as having *high pay dispersion* if its coefficient of variation of managerial pay is above the sample median pay dispersion. We measure subsequent profitability by the return on assets (ROA) measure, and follow the performance-based *control group matching procedure* employed by Barber and Lyon (1996). Specifically, we match each sample firm with a control firm from the same two-digit Standard Industrial Classification (SIC) code, on the basis of the return on assets in the current year. We require that the control firm's return on asset be within +/- 10% of the sample firm's ROA. If there are no such control firms, we match the firms within the +/-10% ROA filter using all firms in same *one*-digit SIC code. For sample firms without matches on this procedure, we use all firms within the filter bounds regardless of SIC

---

performance and pay dispersion, the coefficients are not statistically significant.

codes[12]. The ROA measure is defined as operating income after depreciation divided by average total assets.

Table 5, Panel A presents the ROA analysis. For parsimony, we present the results based only on cases where the industry-match is at the two-digit SIC level (76% of the sample). The first line in panel A indicates that our matching procedure is successful, as evidenced by the zero mean excess ROA (sample firms' ROA relative to control ones) in the matching year. In the three subsequent years after being classified as having high pay dispersion, the sample firms' ROA is significantly larger than that of their matches. Thus, in the first subsequent year, the high pay dispersion firms outperform the control firms by a mean (median) ROA of 1.63% (0.78%), both statistically significant. In the second year, the high pay dispersion firms outperform the control firms by a mean (median) ROA of 2.15% (1.16%). The abnormal performance in the third year is even larger. These results are consistent with Hypothesis H1 maintaining that high pay dispersion is associated with significant abnormal operating performance.

Hypothesis H2 predicts that the positive association between firm performance and pay dispersion is higher in firms with just high agency costs associated with managerial discretion. Thus, firms with high pay dispersion *and* high agency costs are likely to have better operating performance than firms with just high pay dispersion. As discussed in section 3, our proxies for agency costs of managerial discretion are R&D and advertising intensity. In Table 5 Panels B and C, we present future abnormal ROAs (relative to control firms) for sample firms with above median pay dispersion *and* high R&D intensity (Panel B), and above median pay dispersion *and* high advertising intensity (Panel C). Results indicate that the high pay dispersion and high R&D

[12] In 91% of the cases, the control and sample firms have the same one-digit SIC code, and in 76% of the cases the industry-match is at the two-digit SIC code.

intensity firms have higher ROAs than control firms in years 1 through 3. Similarly, ROAs of high pay dispersion and high advertising intensity firms are significantly higher than those of the control firms in the three subsequent years.

According to hypothesis H3, the positive association between firm performance and managerial pay dispersion is likely stronger in firms with effective corporate governance. To examine this hypothesis, we partition in Table 5, Panel D our sample based on pay dispersion and whether the CEO also chairs the board of directors. Results indicate that firms with high pay dispersion and a CEO who is *not* the chairman of the board statistically outperform the ROA of the control firms by a mean of 1.27% in the first subsequent year. Similarly, the ROAs of these firms are 1.70% and 1.79% higher than those of the control firm in the second and third subsequent years, respectively. In Table 5 Panels E and F, we partition the sample based on median pay dispersion *and* median proportion of outside directors on the board, as well as the median institutional ownership. There is some evidence of excess ROA performance for firms with high pay dispersion and high proportion of outside directors (particularly in Panel E, years 2 and 3). Institutional ownership, however, is not associated with significant excess subsequent ROA over control firms.

In summary, the *ex post* profitability (ROA) analysis reinforces the firm valuation (Tobin's Q) analysis reported in Section 4.2: firms with large pay dispersion have both higher market valuation and higher subsequent profitability than their low pay dispersion counterparts. The improvement in market valuation as well as in subsequent profitability for firms with large pay dispersion is enhanced in firms with high agency costs of managerial discretion, and those with effective governance structure.

4.4. The Association between Pay Dispersion and Stock Returns

Tobin's Q indicates firm's performance relative to net asset value. An alternative, perhaps more direct measure of firm performance is its stock return. Accordingly, we examine the association between the abnormal stock return of the firm and managerial pay dispersion. Specifically, in each sample year we classify the firms on the sample median pay dispersion: High (low) pay dispersion firms are those whose pay dispersion is above (below) the sample median. The focus (dependent) variable is the difference between the calendar-time zero-investment portfolio return from buying high pay dispersion firms and selling the low pay dispersion companies. As in Fama and French (1993), these portfolio returns, Rp_t, are used to estimate abnormal returns using the following three-factor time-series regression equation: [13]

$$Rp_t = \alpha + \beta_1 (RM\text{-}RF)_t + \beta_2 (SMB)_t + \beta_3 (HML)_t + \varepsilon_t, \qquad (2)$$

where RM-RF is the market risk premium, computed as the value-weighted return on all NYSE, AMEX and NASDAQ stocks from the Center for Research in Security Prices (CRSP) database, less the risk-free rate. SMB is the return difference between portfolios of small capitalization and large capitalization stocks. HML is the return difference between portfolios of high and low book-to-market stocks. The subscript t refers to the calendar month of the observations. The regression is run over 144 observations—individual months during January 1992 through December 2003. If Model (2) adequately describes the generation of stock returns, the estimated value of the intercept (α) will indicate the abnormal return of a trading strategy that is long on high pay dispersion firms and short on low pay dispersion ones. Implicitly, this return will indicate the abnormal firm performance, if any, associated with pay dispersion.

[13] We obtain qualitatively similar results with a four-factor model, where the fourth factor is the return momentum (see Carhart (1997)).

Table 6, Panel A presents the abnormal returns (α) estimated by the Fama and French three-factor model (2). Consistent with hypothesis H1, the estimated intercept (Panel A) is significantly positive (0.0031, t = 3.32). Converting this monthly return to an implied annual return indicates that high pay dispersion firms outperform low pay dispersion ones by an annual risk-adjusted average return of 3.76 percent. In Table 6 panel B, we partition the sample firms based on both the median pay dispersion and the median R&D intensity. Consistent with hypothesis H2, the estimated intercept is significantly positive (0.0071, t = 2.05) and substantially large than the unconditional estimate of Panel A (0.0031). Converting this monthly average to an annual return yields an economically large abnormal return of 8.79 percent. Similarly, panel C reports on a trading strategy that is long on high pay dispersion firms having high advertising intensity and short on low pay dispersion with low advertising intensity. This strategy yields an annual return of 3.38% (t=1.84).

In Table 6, panels D, E and F, we examine whether a trading strategy that involves buying firms with high pay dispersion and effective corporate governance and selling firms with low pay dispersion and weak corporate governance yields a positive abnormal return. Thus, in panel D, we sort the sample based on pay dispersion *and* whether the CEO is also the board chairman. Consistent with hypothesis H3, the estimated intercept indicates a positive and significant abnormal annual return of 4.43% for high pay dispersion and separate CEO and board chair positions. In panel E, the estimates indicate that going long on firms with high pay dispersion and high proportion of outside directors and short in firms with low pay dispersion and low proportion of outside directors yields a positive implied annual abnormal return of 0.96% (significant at 10% level). In panel F, the abnormal return from going long on firms with high pay dispersion and high institutional ownership and short in firms with low pay dispersion

and low institutional ownership does not yield a significant abnormal return. This latter finding is consistent throughout our tests.

In summary, our estimates indicate that when firm performance is measured by abnormal stock returns we obtain similar results to those of Tobin's Q: managerial pay dispersion is positively related to firm performance.

5. Robustness Tests

5.1. Endogeneity of Pay Dispersion and Firm Performance

Firm performance and managerial pay dispersion may be endogenously determined. To address this issue, we simultaneously run Equation (1)—the determinants of firm performance—with Equation (3) specifying certain determinants of pay dispersion (see below). We are not aware of a fully developed model for the determinants of pay dispersion and therefore we rely in constructing Equation (3) on extant literature suggesting the following factors as likely affecting pay dispersion.

Growth Opportunities: Firms with high growth opportunities have a large fraction of their value in the form of expected growth (in contrast with assets-in-place). Realization of this growth potential crucially depends on the quality of managers (Smith and Watts 1992). A large pay dispersion is a powerful incentive to attract and retain high-quality and venturesome managers needed to realize the growth potential (Lazear and Rosen 1981). Accordingly, our first presumed determinant of pay dispersion is the expected growth of the company, which we proxy for by the realized sales growth of the firm (SALECHANGE).[14]

Uncertainty: Lazear (1981) argues that uncertainty in measuring employee effort adversely affects their productivity, and a high pay dispersion provides enhanced incentives

mitigating the adverse effect of uncertainty on employee performance. Thus, Lazear predicts that pay dispersion will be greater in firms subject to high degree of uncertainty. Accordingly, we include in Model (3) the volatility of the firm's stock returns over the past sixty months (STDRET)—an uncertainty proxy—as a factor affecting pay dispersion.

Managerial discretion: When managers have considerable discretion over activities and expenditures, it is generally more difficult to monitor their activities, compared with low-discretion managers. A large pay dispersion, promising high prizes in the long-term, may mitigate dysfunctional managerial behaviour, (e.g., cutting R&D in order to increase short-term divisional profits). Following Smith and Watts (1992) and Himmelberg, Hubbard and Palia (1999), we proxy for managerial discretion by R&D and advertising intensities: (RDSALE) and (ADVSALE).

Organization complexity: Organizational complexity, which generally increases with firm size, calls for highly qualified managers. A large pay spread is likely helpful in attracting and keeping top level managers, and we accordingly expect that the dispersion of management compensation will be positively related to firm size (measured by the natural logarithm of sales (LOGSALE)).

Managers' age and tenure: Finally, Lazear and Rosen (1981) stipulate that a large pay dispersion is often aimed at attracting relatively young employees to participate in the managerial "tournament." We accordingly include the mean age of the top management team (AGE) and the mean tenure of the top management team (TENURE) as additional determinants of managerial pay dispersion.

The preceding discussion leads to Equation (3), specifying the following determinants of pay dispersion:

---

[14] Equation (3) also includes the R&D intensity of the firm which is another proxy for future growth.

$$DISPAY_{it} = \lambda_1 + \lambda_2 SALECHANGE_{it} + \lambda_3 RDSALE_{it} + \lambda_4 ADVSALE_{it} + \lambda_5 SIZE_{it} + \lambda_5 STDRET_{it} + \lambda_6 AGE_{it} + \lambda_7 TENURE_{it} + \lambda_{10it}. \quad (3)$$

Table 7 provides the estimates of three simultaneous estimations of Equations (1) and (3): two-stage least-squares (2SLS), seemingly unrelated regressions (SUR), and three-stage least-squares (3SLS) regressions[15]. In Panel A, the dependent variable is firm performance measured by TOBINQ, whereas in Panel B, pay dispersion (DISPAY) is the dependent variable. Panel A indicates that in all three estimates the coefficient of pay dispersion (DISPAY) is, as hypothesized, positively associated with firm performance. Furthermore, the interaction terms DISPAY*RDSALE and DISPAY*ADVSALE are positive and significant, consistent with the conjecture that the positive association between firm performance and pay dispersion is stronger in firms with greater agency costs of managerial discretion. Similarly, the interaction term DISPAY*OUTDIR is positive and significant, supporting the notion that firms with a higher proportion of outside directors (effective corporate governance) have a stronger association between pay dispersion and performance. The interaction term DISPAY*CEODUAL is negative and significant, consistent with the conjecture that the CEO-chairman duality weakens the positive association between pay dispersion and firm performance. In general, the control variables in Equation (1) have the predicted signs and are statistically significant. Thus, our attempts to control for the endogeneity between firm performance and pay dispersion yield results which are consistent with our earlier findings concerning the positive association between pay dispersion and firm performance.

Table 7, Panel B indicates that pay dispersion is positively associated with SALECHANGE (sales growth), our proxy for growth opportunities. The estimated coefficients

[15] SUR and 3SLS involve generalized least-square estimations and achieve an improvement in efficiency over 2SLS by taking into account cross-equation correlation among the error terms (Greene (2000)).

on RDSALE and ADVSALE are positive and significant at the 1% level. Pay dispersion is also positively associated with the volatility of stock returns (STDRET), our proxy for uncertainty, consistent with the conjecture that firms subject to considerable uncertainty will use pay dispersion to attract high-performing managers possessing a wide array of knowledge and skills (Keck and Tushman (1993)). Finally, we also document that larger firms offer their managers relatively greater pay dispersion, consistent with the notion that operational complexity calls for particularly talented managers which are in turn attracted by a large pay dispersion. There is, however, no evidence that managerial tenure and age are important determinants of pay dispersion.

Given various limitations of our endogeneity tests,[16] we perform additional robustness checks. First, Wang and Zivot (1998) show that the Likelihood Ratio statistic of the Limited Information Maximum Likelihood method provides asymptotically valid inferences on structural parameters in a limited information simultaneous equations model. Accordingly, we perform additional tests using the limited information maximum likelihood method to re-estimate our system of simultaneous equations. These tests yield qualitatively similar results to those of Table 7. Second, Lewbel (1997) suggests the use of higher-order moments of the endogenous variables as instruments. The basic idea is that for certain distributions, higher-order moments can satisfy the requirements of an instrumental variable, even though the associated first moment is correlated with the error term in the structural model. Following Lewbel (1997), we introduced into our estimation a higher moment instrumental variable that is computed as the demeaned

[16] Our simultaneous estimation is subject to various limitations (Ittner, Lambert and Larcker, 2003). First, only firm performance and pay dispersion are treated by us as endogenous. Other firm-specific variables are assumed to be exogenous or pre-determined. Obviously, some of our instrumental variables maybe endogenous too. Second, our variables are likely measured with error, and this will produce inconsistent estimates for the structural equation parameters and their standard errors. Third, the system of equations

TOBINQ times the demeaned DISPAY. Once more, results of this test are qualitatively similar to those of Table 7.

5.2 Additional Robustness Tests

We perform the following additional robustness tests to gain further insight. Considering pay dispersion, one should be concerned with the *turnover* of executives. The compensation of an executive in his/her last year at the firm generally reflects unusual elements, such as severance pay. Similarly, the compensation in the first year often reflects various signing bonuses. These unusual pay elements can affect our measure of pay dispersion. We, therefore, control for these effects by eliminating from the sample firm-year observations in which executives join or leave the firm. Our results, based on this subsample, are qualitatively similar to those reported above.

Murphy (1999) documents a positive association between the level of managerial compensation and firm size, which is often affected by mergers and acquisitions. Mergers and acquisitions may also affect pay dispersion. We, accordingly control for the mergers effects by including in our primary model—Equation (1)—a dummy variable that equals one if the firm engaged in merger and acquisition activities during the examined year, and zero otherwise. Once more, our results are qualitatively similar to those reported earlier.[17]

It is possible that in high technology industries pay dispersion plays a particularly important role in attracting and retaining managers, relative to other sectors. To examine this possibility, we eliminated from the sample observations that are classified as high-technology. Following Francis and Schipper's (1999), we classify as high-technology the following

(1 and 3) may be misspecified because of correlated omitted variables and inappropriate zero restrictions on the coefficients between the exogenous instruments and the endogenous variables.

[17] We also constructed a sub-sample that excludes firms that engaged in mergers and acquisitions. Our results based on this sub-sample are qualitatively similar to those reported above.

industries: SIC codes: 2830-2839, 3570-3579, 3600-3689, 4810-4819,7370-7379, 8370-8379. Once more, our major findings hold for the subsample of no-technology firms ("bricks-and-mortar").

Finally, to allay concerns with serial correlation of the errors in the pooled regressions reported in Table 4, we run the regression in Equation (1) cross-sectionally for each sample year *individually*, and compute the time series means and standard deviations of the estimated yearly coefficients. Our main results concerning the sign and significance of the DISPAY (pay dispersion) variable, and the interactions of DISPAY with other variables remain essentially unchanged.

6. Summary

This study examines the association between the dispersion of top-management compensation and firm performance. According to the tournament theory, higher pay dispersion attracts exceptionally talented executives thereby enhancing firm performance. In contrast, considerations of equity fairness suggest that greater pay dispersion reduces employee motivation and cooperation, leading to lower firm performance.

Consistent with tournament theory, we find that firm performance, measured either by Tobin's *Q* or by the firm's stock return, is positively associated with the pay dispersion of top management. Additional analysis indicates that firms with large pay dispersion generate higher subsequent operating return on assets than those with low pay dispersion. We also find that the association between firm performance and pay dispersion is conditioned on certain agency costs and corporate governance structures. Specifically, our evidence indicates that large pay dispersion is associated with enhanced performance in firms with high agency costs related to

managerial discretion, and in firms with effective corporate governance. We accordingly document that the dispersion dimension of managerial compensation is an important compensation element affecting firm performance.

References

Aggarwal, R., and Samwick, A. 2003. Performance incentives within firms: the effect of managerial responsibility. *Journal of Finance* 58 (August): 1613–1650.

Akerlof, G., and Yellen, J. 1988. Fairness and unemployment. *American Economic Review* 78 (May): 44–49.

Akerlof, G., and Yellen, J. 1990. The fair wage–effort hypothesis and unemployment. *Quarterly Journal of Economics* 105 (May): 255–284.

Baber, W.; Janakiraman, S.; and Kang, S. 1996. Investment opportunities and the structure of executive compensation. *Journal of Accounting and Economics* 21 (June): 297–318.

Barber, B., Lyon, J., 1996. Detecting abnormal operating performance: the empirical power and specification of test statistics. *Journal of Financial Economics* 41: 359–399.

Barron, J., and Waddell, G. 2003. Executive rank, pay and project selection. *Journal of Financial Economics* 67 (February): 305–349.

Bebchuk, L, Fried, J., Walker, D., 2002. managerial power and rent extraction in the design of executive compensation. University of Chicago Law Review 69, 751-846.

Becker, B., and Huselid, M. 1992. The incentive effects of tournament compensation systems. *Administrative Science Quarterly* 37 (June): 336–350.

Berger, P., and Ofek, E. 1995. Diversification's effect on firm value. *Journal of Financial Economics* 37 (January): 39-65.

Bognanno, M. 2001. Corporate tournaments. *Journal of Labor Economics* 19 (April): 290–315.

Bryan, S.; Hwang, L.; and Lilien, S. 2000. CEO stock-based compensation: an empirical analysis of incentive-intensity, relative mix and economic determinants. *Journal of Business* 73 (October): 661–693.

Bull, C.; Schotter, A.; and Weigelt, K. 1987. Tournaments and piece rates: an experimental study. *Journal of Political Economy* 95 (February): 1–33.

Carhart, M., 1997. On persistence in mutual fund performance. *Journal of Finance* 52, 57-92.

Conyon, M.; Peck, S.; and Sadler, G. 2001. Corporate tournaments and executive compensation: evidence from the UK. *Strategic Management Journal* 22 (August): 805–815.

Core, J.; Holthausen, R.; and Larcker, D. 1999. Corporate governance, chief executive officer compensation and firm performance. *Journal of Financial Economics* 51 (March): 371–406.

Cowherd, D., and Levine, D. 1992. Product quality and pay equity between lower-level employees and top management: an investigation of the distributive justice theory. *Administrative Science Quarterly* 37 (June): 302–320.

Demsetz H., and Lehn, K. 1985. The structure of corporate ownership: causes and consequences. *Journal of Political Economy* 93 (December): 1155–1177.

Drago, R., and Garvey, G. 1998. Incentives for helping on the job: theory and evidence. *Journal of Labor Economics* 16 (January): 1–25.

Ehrenberg, R., and Bognanno, M. 1990. Do tournaments have incentive effects? *Journal of Political Economy* 98 (December): 1–26.

Eriksson, T. 1999. Executive compensation and tournaments theory: empirical tests on Danish data. *Journal of Labor Economics* 17 (April): 262–280.

Fama, E., and French K. 1992. The cross-section of expected stock returns. *Journal of Finance* 47 (June): 427-465.

Fama E., and French K. 1995. Size and book-to-market factors in earnings and returns. *Journal of Finance* 50 (March): 131-155.

Fama, E., and Jensen, M. 1983. Agency problems and residual claims. *Journal of Law and Economics* 26 (June): 327–350.

Fan, J., and Lang, L. 2000. The measures of relatedness: an application to corporate diversification. *Journal of Business* 73 (October): 629–660.

Francis, J., and Schipper, K. 1999. Have financial statements lost their relevance? *Journal of Accounting Research* 37 (Autumn): 319–352.

Gaver, J., and Gaver, K. 1993. Additional evidence on the association between investment opportunity set and corporate financing, dividend and compensation policies. *Journal of Accounting and Economics* 16 (January/July): 125–160.

Greene, 2000. Econometric Analysis. Fourth edition, Prentice-Hall.

Hall, B., and Liebman, J. 1998. Are CEOs really paid like bureaucrats? *Quarterly Journal of Economics* 113 (August): 653–691.

Hartzell, J., and Starks, L. 2003. Institutional Investors and executive compensation. *Journal of Finance* 58 (6): 2351-2374.

Hermalin, B., and Weisbach, M. 1991. The effects of board composition and direct incentives on firm performance. *Financial Management* 20 (Winter): 101–112.

Hibbs, D., and Locking, H. 2000. Wage dispersion and productive efficiency: evidence from Sweden. *Journal of Labor Economics* 18 (October): 755–782.

Hicks, J. 1963. The Theory of Wages. New York: St Martin's.

Himmelberg, C.; Hubbard, R.; and Palia, D. 1999. Understanding the determinants of managerial ownership and the link between ownership and performance. *Journal of Financial Economics* 53 (September): 353–384.

Jensen, M. 1993. The modern industrial revolution, exit, and the failure of internal control systems. *Journal of Finance* 48 (July): 831–880.

Jensen, M., and Meckling, W. 1976. Theory of the firm: managerial behavior, agency costs and ownership structure. *Journal of Financial Economics* 3 (April): 305–360.

Jensen, M., and Murphy, K. 1990. Performance pay and top management incentives. *Journal of Political Economy* 98 (April): 225–264.

Ittner, C., Lambert, R., Larcker, D., 2003. The structure and performance consequences of equity grants to employees of New Economy firms. *Journal of Accounting and Economics* 34, 89-127.

Keck, S., Tushman, M., 1993. Environmental and organizational context and executive team structure. *Academy of Management Journal* 36, 1314-1344.

Knoeber, C., and Thurman, W. 1994. Testing the theory of tournaments: an empirical analysis of broiler production. *Journal of Labor Economics* 12 (April): 155–179.

Lambert, R., and Larcker, D. 1987. An analysis of use of accounting and market measures of performance in executive compensation contracts. *Journal of Accounting Research* 25 (Spring): 85–125.

Lazear, E., and Rosen, S. 1981. Rank order tournaments as optimum labor contracts. *Journal of Political Economy* 89 (October): 841–864.

Lazear, E. 1989. Pay equality and industrial politics. *Journal of Political Economy* 97 (June): 561–580.

Lev, B. 2001. Intangibles—Management, Measurement and Reporting. Washington, DC: Brookings Institution Press.

Levine, D. 1991. Cohesiveness, productivity and wage dispersion. *Journal of Economic Behavior and Organization* 15 (March): 237–255.

Lewbel, A., 1997. Constructing instruments for regressions with measurement error when no additional data are available with an application to patents and R&D. *Econometrica* 65, 1201-1213.

Main, B.; O'Reilly, C.; and Wade, J. 1993. Top executive pay: tournament or teamwork? *Journal of Labor Economics* 11 (October): 606–628

Mehran, H. 1995. Executive compensation structure, ownership and firm performance. *Journal of Financial Economics* 38 (June): 163–184.

Milgrom, P. 1988. Employment contracts, influence activities and efficient organization design. *Journal of Political Economy* 96 (February): 42–60.

Milgrom, P., and Roberts, J. 1988. An economic approach to influence activities in organizations. *American Journal of Sociology* 94: S154–S159.

Milgrom, P., and Roberts, J. 1990. The efficiency of equity in organizational decision processes. *American Economic Review* 80 (June): 154–159.

Morck, R.; Shleifer, A.; and Vishny, R. 1988. Management ownership and market valuation: an empirical analysis. *Journal of Financial Economics* 20 (January/March): 293–316.

Murphy, K. 1999. Executive compensation, in Handbook of Labor Economics (Orley Ashenfleter and David Cards eds.) Amsterdam: North-Holland.

O'Reilly, C.; Main, B.; and Crystal, G. 1988. CEO compensation as tournament and social comparison: a tale of two theories. *Administrative Science Quarterly* 33 (June): 257–274.

Pfeffer, J., and Langton, N. 1993. The effect of wage dispersion on satisfaction, productivity, and working collaboratively: evidence from college and university faculty. *Administrative Science Quarterly* 38 (June): 382–407.

Ryan, H., Wiggins, R., 2004. Who is in whose pocket ? Director compensation, board independence and barriers to effective monitoring. *Journal of Financial Economics* 73 : 497-524.

Shleifer, A., and Vishny, R. 1997. A survey of corporate governance. *Journal of Finance* 52 (June): 737–784.

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

Wang, J., Zivot, E., 1998. Inference on structural parameters in instrumental variables regression with weak instruments. *Econometrica* 66, 1389-1404.

Weisbach, M. 1988. Outside directors and CEO turnover. *Journal of Financial Economics* 20 (January/March): 431–460.

White, H. 1980. A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica* 48: 817-838.

Yermack, D. 1995. Do corporations award CEO stock options effectively? *Journal of Financial Economics* 39 (October/November): 237–269.

Yermack, D. 1996. Higher valuation of companies with a small board of directors. *Journal of Financial Economics* 40 (February): 185–212.

Zingales, L. 2000. In search of new foundations. *Journal of Finance* 55 (June): 1623–1653.

Table 1
Descriptive Statistics

The sample consists of 12,197 annual observations for 1,855 companies compiled for 1992–2003. TOBINQ is the book value of total assets less book value of equity plus market value of common equity divided by book value of total assets. DISPAY is the coefficient of variation of total compensation (composed of salary, bonus, stock options granted, long-term incentive pay, restricted stock granted, and other compensation) paid to the top five executives in the management team during the fiscal year. RDSALE is the sum of research and development costs divided by sales for the prior five years. ADVSALE is the sum of advertising costs divided by sales for the prior five years. ROA is operating profit over total assets. CAPSALE is capital expenditure over sales. SIZE is natural logarithm of sales. SALES is the dollar value of sales. SEGNUM is number of business segments in the firm. INSIDEQ is percentage of common equity owned by officers and directors. INSIDEQSQ is the squared term of INSIDEQ. INSTEQ is the percentage of common equity owned by institutional shareholders. OUTDIR is the proportion of outside directors (defined as directors who are neither current nor former officers of the firm) on the board. CEODUAL equals one if the CEO is the chairman of the board of directors, and zero otherwise. BOARDSIZE is the natural logarithm of the number of directors sitting on each company's board as of the annual general meeting date in the given year.

Variable	Mean	Q1	Median	Q3	Standard Deviation
TOBINQ	2.1172	1.2445	1.6385	2.3757	1.5442
DISPAY	0.6174	0.4248	0.5687	0.7467	0.2806
ROA	0.1035	0.0588	0.1019	0.1491	0.0899
CAPSALE	0.0800	0.0286	0.0478	0.0834	0.0899
RDSALE	0.2015	0	0.02126	0.2577	0.3381
ADVSALE	0.0648	0	0	0.0626	0.1507
SIZE	6.9876	5.9331	6.8673	7.9522	1.4951
SALES (millions of dollars)	3,642	377	960	2,842	9,618
SEGNUM	3.682	1	3	5	3.3757
INSIDEQ (%)	11.61	1.02	4.03	15.76	16.32
INSTEQ (%)	57.06	43.98	59.81	72.79	20.89
OUTDIR	0.6226	0.482	0.70	0.8461	0.1909
CEODUAL	0.5990	0	1	1	0.48
BOARDSIZE	8.9341	7	9	11	3.09

Table 2
Distribution of Pay Dispersion by Industry

The sample consists of 12,197 annual observations for 1,855 companies compiled for 1992–2003. The sample is partitioned based on the median coefficient of variation of total compensation paid to the top five executives in the management team during the fiscal year (DISPAY). The first column 'low pay dispersion' refers to the subsample of firms with DISPAY below the sample median. The second column 'high pay dispersion' refers to the subsample of firms with DISPAY above the sample median. The third column contains the subsample for the respective industry groups. In columns (1), (2), and (3), the top number reported for each industry group is the mean coefficient of variation, and the number of firms is reported in parentheses. Column (4) reports the *t*-statistics for the difference between the mean of low-pay-dispersion firms and high-pay-dispersion firms, given their two-digit SIC industry groups.
***, **, and * denote significance at the 1%, 5% and 10% levels (two-tailed) respectively.

	(1)	(2)	(3)	(4)
Two-Digit SIC Code and Industry Groups	Low Pay Dispersion Firms	High Pay Dispersion Firms	Industry Mean	*t*-statistics for Difference in Means
01–14 Agriculture, mining	0.44	0.78	0.61	24.45***
	(306)	(302)	(608)	
15,16,17 Building, construction	0.41	0.81	0.62	14.28***
	(56)	(61)	(117)	
20,21 Food	0.43	0.80	0.62	21.73***
	(192)	(200)	(392)	
22,23 Textile	0.38	0.85	0.63	18.06***
	(136)	(137)	(273)	
24, 25 Wood, furniture	0.40	0.85	0.65	14.95***
	(102)	(121)	(215)	
26,27 Paper, publishing	0.43	0.76	0.58	23.95***
	(334)	(296)	(630)	
28,29 Chemical, petroleum	0.43	0.77	0.63	32.63***
	(435)	(562)	(997)	
30,31 Rubber, plastics, leather	0.39	0.82	0.56	13.08***
	(126)	(77)	(203)	
32,33,34 Stone, metal	0.43	0.77	0.59	27.45***
	(395)	(349)	(744)	

TABLE 2 (Continued)
Distribution of Pay Dispersion by Industry

Two-Digit SIC Code and Industry Groups	(1) Low Pay Dispersion Firms	(2) High Pay Dispersion Firms	(3) Industry Mean	(4) t-statistics for Difference in Means
35 Industrial machinery	0.42 (473)	0.84 (532)	0.64 (1,005)	34.70***
36 Electrical	0.40 (525)	0.83 (561)	0.62 (1,086)	37.62***
37 Transportation equipment	0.44 (230)	0.80 (270)	0.63 (500)	21.32***
38, 39 Instrumentation, manufacturing	0.40 (409)	0.81 (398)	0.60 (807)	30.51***
40–47 Transportation	0.40 (211)	0.80 (200)	0.60 (411)	20.74***
48 Communication	0.39 (156)	0.85 (166)	0.63 (322)	20.28***
50,51 Durables, non-wholesale	0.41 (267)	0.81 (227)	0.59 (494)	26.61***
52, 53 Building, materials	0.42 (183)	0.81 (109)	0.57 (292)	15.05***
54–59 Food, apparel, retail	0.41 (576)	0.85 (507)	0.62 (1,083)	35.10***
70–75 Hotel, services	0.40 (691)	0.89 (651)	0.63 (1,342)	40.70***
78 to 79 Amusement, recreation	0.48 (48)	0.86 (105)	0.72 (153)	14.80***
80–87 Health services, education	0.43 (218)	0.88 (231)	0.65 (449)	23.38***
Others	0.39 (27)	0.87 (39)	0.68 (66)	13.01***
Total	0.41 (6,096)	0.82 (6,101)	0.62 (12,197)	21.78***

Table 3
Spearman Correlation Coefficients

The sample consists of 12,197 annual observations for 1,855 companies compiled for 1992–2003. See Table 1 legend for variable definitions. The parentheses report the p-value of null hypothesis that the correlation coefficient is zero.
***, **, and * denote significance at the 1%, 5% and 10% levels (two-tailed) respectively.

	TOBINQ	DISPAY	RDSALE	ADVSALE	ROA	CAPSALE	SIZE
TOBINQ	1						
DISPAY	0.033 (<0.01)**	1					
RDSALE	0.275 (<0.01)***	0.052 (<0.01)***	1				
ADVSALE	0.125 (<0.01)***	0.011 (0.23)	0.003 (0.73)	1			
ROA	0.617 (<0.01)***	0.001 (0.92)	0.002 (0.81)	0.138 (<0.01)***	1		
CAPSALE	0.119 (<0.01)***	-0.002 (0.76)	0.067 (<0.01)***	-0.035 (<0.01)***	-0.012 (0.15)	1	
SIZE	-0.117 (<0.01)***	0.122 (<0.01)***	-0.151 (<0.01)***	0.064 (<0.01)***	0.031 (<0.01)***	-0.074 (<0.01)***	1
SEGNUM	-0.148 (<0.01)***	0.112 (<0.01)***	0.048 (<0.01)***	-0.158 (0.04)**	-0.132 (<0.01)***	-0.069 (<0.01)***	0.261 (<0.01)***
INSIDEQ	0.088 (<0.01)***	-0.127 (<0.01)***	-0.106 (<0.01)***	0.025 (<0.01)***	0.091 (<0.01)***	-0.071 (<0.01)***	-0.346 (<0.01)***
OUTDIR	-0.004 (0.66)	0.123 (<0.01)***	0.046 (<0.01)***	0.005 (0.56)	-0.039 (<0.01)***	0.025 (<0.01)***	0.219 (<0.01)***
BOARDSIZE	-0.114 (<0.01)***	-0.017 (0.06)*	-0.167 (<0.01)***	0.041 (<0.01)***	0.002 (0.78)	0.043 (<0.01)***	0.501 (<0.01)***
CEODUAL	-0.021 (0.03)**	0.083 (<0.01)***	-0.015 (0.09)*	0.013 (0.13)	-0.002 (0.81)	0.006 (0.48)	0.173 (<0.01)***
INSTEQ	-0.008 (0.37)	0.118 (<0.01)***	0.057 (<0.01)***	-0.069 (<0.01)***	0.041 (<0.01)***	0.011 (0.23)	0.207 (<0.01)***

Table 3 (continued)
Spearman Correlation Coefficients

	SEGNUM	INSIDEQ	OUTDIR	BOARDSIZE	CEODUAL	INSTEQ
INSIDEQ	-0.241 (<0.01)***	1				
OUTDIR	0.111 (<0.01)***	-0.250 (<0.01)***	1			
BOARDSIZE	0.168 (<0.01)***	-0.216 (<0.01)***	0.297 (<0.01)***	1		
CEODUAL	0.065 (<0.01)***	-0.089 (<0.01)***	0.056 (<0.01)***	0.097 (<0.01)***	1	
INSTEQ	0.143 (<0.01)***	-0.304 (<0.01)***	0.145 (<0.01)***	0.031 (0.01)***	0.091 (<0.01)***	1

Table 4
Regressions of Tobin's *Q* on Pay Dispersion and Control Variables

The sample consists of 12,197 annual observations for 1,855 companies compiled for 1992–2003. In all cases, the dependent variable is TOBINQ, computed as the book value of total assets less book value of equity plus market value of common equity divided by book value of total assets. The sample consists of 12,197 annual observations for 1,855 companies compiled for 1992–2003. DISPAY is the coefficient of variation of total compensation (composed of salary, bonus, stock options granted, long-term incentive pay, restricted stock granted, and other compensation) paid to the top five executives in the management team during the fiscal year. RDSALE is the sum of research and development costs divided by sales for the prior five years. ADVSALE is the sum of advertising costs divided by sales for the prior five years. ROA is operating profit over total assets. CAPSALE is capital expenditure over sales. SIZE is natural logarithm of sales. SALES is the dollar value of sales. SEGNUM is number of business segments in the firm. INSIDEQ is percentage of common equity owned by officers and directors. INSIDEQSQ is the squared term of INSIDEQ. INSTEQ is the percentage of common equity owned by institutional shareholders. OUTDIR is the proportion of outside directors (defined as directors who are neither current nor former officers of the firm) on the board. CEODUAL equals one if the CEO is the chairman of the board of directors, and zero otherwise. BOARDSIZE is the natural logarithm of the number of directors sitting on each company's board as of the annual general meeting date in the given year. t-statistics (reported in parentheses) are based on Huber-White robust standard error, which is a generalization of White (1980) standard error that is robust to both serial correlation and heteroscedasticity. Coefficients on the year indicators and industry indicators are included in all models but are not shown. Panel A presents ordinary least squares regression estimates. Panel B presents regression estimates from a fixed effects model that assigns a unique intercept to each firm and includes dummy variables for years.
***, **, and * denote significance at the 1%, 5% and 10% levels (two-tailed) respectively.

Panel A : Ordinary Least Squares Regression Estimates

Variable	Predicted Sign	(1)	(2)	(3)
Intercept		2.2832 (15.39)***	1.7165 (12.41)***	1.5885 (7.99)***
DISPAY	+	0.3647 (5.63)***	0.0901 (1.81)*	0.3049 (2.03)**
DISPAY * RDSALE	+		0.5585 (2.80)***	0.5305 (2.64)***
DISPAY * ADVSALE	+		0.6712 (2.32)**	0.6881 (2.33)**
DISPAY *OUTDIR	+			0.0027 (1.89)**
DISPAY *CEODUAL	-			-0.4113 (-3.52)***
DISPAY *INSIDEQ	+			0.3487 (0.96)
DISPAY *INSTEQ	+			-0.0056 (-0.02)

Table 4 (Continued)
Regressions of Tobin's *Q* on Pay Dispersion and Control Variables

Panel A : Ordinary Least Squares Regression Estimates

Variable	Predicted Sign	(1)	(2)	(3)
RDSALE	+		1.3451 (9.84)***	1.3614 (9.88)***
ADVSALE	+		0.0104 (0.06)	0.0225 (0.11)
ROA	+	7.9701 (33.28)***	8.6381 (38.37)***	8.6524 (38.49)***
CAPSALE	+	0.6495 (4.07)***	0.5905 (4.23)***	0.6004 (4.30)***
SIZE	+/–	-0.0771 (-6.53)***	-0.0342 (-3.17)***	-0.0342 (-3.19)***
SEGNUM	–	-0.0496 (8.58)***	-0.0249 (-4.88)***	-0.0248 (-4.85)***
INSIDEQ	+	0.0039 (1.78)*	0.0083 (4.03)***	0.0062 (2.02)**
INSIDEQSQ	–	-0.0001 (-0.88)	-0.0001 (-2.49)***	-0.0001 (-2.41)***
INSTEQ	+	-0.0038 (-1.52)	-0.0045 (-1.08)	-0.0044 (-1.35)
OUTDIR	+	0.1197 (1.66)*	0.0007 (0.11)	0.0074 (1.02)
CEODUAL	–	0.0034 (0.13)	0.0152 (0.64)	-0.2654 (-1.09)
BOARDSIZE	–	-0.098 (-3.31)***	0.0176 (0.66)	-0.0166 (-0.62)
Sample Size		12,197	12,197	12,197
F-statistic (*p*-value)		181 (<0.001)	253 (<0.001)	228 (<0.001)
Adjusted R^2		29.25%	39.87%	40.01%

Table 4 (continued)
Regressions of Tobin's *Q* on Pay Dispersion and Control Variables

Panel B : Fixed Effects Regression Estimates

Variable	Predicted Sign	(1)	(2)	(3)
Intercept		2.7946 (6.27)***	2.8327 (6.37)***	2.7891 (6.12)***
DISPAY	+	0.2479 (6.50)***	0.1056 (2.17)**	0.1578 (1.73)*
DISPAY * RDSALE	+		0.3988 (4.00)***	0.3791 (3.79)***
DISPAY * ADVSALE	+		0.5801 (2.49)**	0.6120 (2.62)***
DISPAY *OUTDIR	+			0.0178 (1.73)*
DISPAY *CEODUAL	-			-0.1814 (-2.54)***
DISPAY *INSIDEQ	+			0.0972 (0.41)
DISPAY *INSTEQ	+			0.1501 (0.85)
RDSALE	+		0.0246 (0.18)	0.0092 (0.32)
ADVSALE	+		-1.5344 (-0.24)	-1.5569 (-1.26)
ROA	+	6.8487 (45.97)***	6.9115 (45.34)***	6.9078 (45.27)***

Table 4 (continued)
Regressions of Tobin's *Q* on Pay Dispersion and Control Variables

Panel B : Fixed Effects Regression Estimates

Variable	Predicted Sign	(1)	(2)	(3)
CAPSALE	+	0.4566 (2.70)***	0.4389 (2.60)***	0.4412 (2.62)***
SIZE	+/–	-0.2894 (-10.57)***	-0.2885 (-10.55)***	-0.2892 (-10.57)***
SEGNUM	–	-0.0006 (-0.14)	0.0001 (0.01)	0.0001 (0.04)
INSIDEQ	+	0.0064 (2.74)***	0.0063 (2.71)***	0.0069 (2.48)***
INSIDEQSQ	–	-0.0001 (-1.20)	-0.0001 (-1.27)	-0.0001 (-1.28)
INSTEQ	+	0.0013 (1.12)	0.0013 (1.03)	0.0016 (0.73)
OUTDIR	+	0.0327 (0.42)	0.0105 (0.14)	0.0041 (0.03)
CEODUAL	–	0.0182 (-0.72)	-0.0114 (-0.45)	-0.0994 (-1.16)
BOARDSIZE	–	-0.0152 (-0.44)	0.0049 (0.15)	0.0053 (0.16)
Sample Size		12,197	12,197	12,197
F-statistic (*p*-value)		8.74 (<0.001)	6.27 (<0.001)	6.25 (<0.001)
Adjusted R^2		69.88%	70.08%	70.10%

Table 5
Three-year subsequent operating performance for high pay dispersion firms
The sample consists of 12,197 annual observations for 1,855 companies compiled for 1992–2003. We define a high pay dispersion firm if its coefficient of variation of total compensation paid to the top five executives in the management team is above the median coefficient of variation of total compensation during the fiscal year (DISPAY). We calculate excess ROA by using the matched-firm approach of Barber and Lyon (1996), where the matching firm is the firm in the same industry with the closest prior operating performance, and by using operating income after depreciation.

	N	Mean	p-value	Median	p-value
Panel A: Excess ROA from buying high pay dispersion firms					
Year 0	5,098	0.00%	0.472	-0.00%	0.435
Year 1	4,147	1.63%	<0.001	0.78%	<0.001
Year 2	3,275	2.15%	<0.001	1.16%	<0.001
Year 3	2,539	2.86%	<0.001	1.34%	<0.001
Panel B : Excess ROA from buying firms with high pay dispersion firms and high research and development intensity					
Year 0	2,742	0.00%	0.5623	0.00%	0.478
Year 1	2,253	1.85%	<0.001	1.07%	0.001
Year 2	1,784	2.59%	<0.001	1.75%	<0.001
Year 3	1,376	3.64%	<0.001	1.96%	<0.001
Panel C : Excess ROA from buying firms with high pay dispersion firms and high advertising intensity.					
Year 0	2,204	0.00%	0.7862	0.00%	0.476
Year 1	1,826	1.83%	<0.001	1.08%	<0.001
Year 2	1,504	2.48%	<0.001	1.41%	<0.001
Year 3	1,210	3.30%	<0.001	1.90%	<0.001

Table 5 (continued)

	N	Mean	p-value	Median	p-value
Panel D : Excess ROA from buying firms with high pay dispersion firms and CEO is not the chairman of the board					
Year 0	1,918	0.00%	0.3621	0.00%	0.484
Year 1	1,542	1.27%	<0.001	0.65%	0.042
Year 2	1,261	1.70%	<0.001	0.78%	<0.001
Year 3	970	1.79%	<0.001	0.33%	0.0268
Panel E : Excess ROA from buying firms with high pay dispersion firms and high board independence					
Year 0	1,613	0.00%	0.6735	0.00%	0.4829
Year 1	1,378	0.14%	0.1437	0.11%	0.2561
Year 2	1,145	0.48%	0.0797	0.10%	0.0578
Year 3	937	0.87%	0.0073	0.23%	0.0412
Panel F: Excess ROA from buying firms with high pay dispersion firms and high institutional equity ownership					
Year 0	1,604	0.00%	0.7938	0.00%	0.4801
Year 1	1,365	0.00%	0.7525	0.01%	0.085
Year 2	1,131	0.03%	0.2545	0.25%	0.7051
Year 3	893	0.34%	0.2946	0.41%	0.2366

Table 6
Abnormal stock returns and pay dispersion

In each year, we partition the sample based on the median coefficient of variation of total compensation paid to the top five executives in the management team. High (low) pay dispersion firms are those with coefficient of variation of total compensation above (below) the median. The dependent variable is the difference between the calendar-time portfolio returns from buying a portfolio of high pay dispersion firms and selling a portfolio of low pay dispersion firms. The portfolio returns, Rp_t , are then used to estimate abnormal returns using the following regression:

$Rp_t = \alpha + \beta_1 (RM\text{-}RF)_t + \beta_2 (SMB)_t + \beta_3 (HML)_t$

RM-RF is the market risk premium that is computed as the value-weighted return on all NYSE, AMEX and NASDAQ stocks in the Center for Research in Security Prices (CRSP) database less the risk-free rate. SMB is the return difference between portfolios of small capitalization and big capitalization stocks. HML is the return difference between portfolios of high and low book-to-market stocks. The subscript t refers to the calendar month of the observations. The intercept measures the monthly abnormal return conditioned on the model.

	Intercept	RM-RF	SMB	HML	Adjusted R2
Panel A : Portfolio return of firms with high pay dispersion minus Portfolio return of firms with low pay dispersion					
Coefficient	0.0031	0.0005	-0.0012	-0.0008	19.49%
t-statistic	(3.32)***	(2.33)**	(-4.80)***	(-3.38)***	
Implied Annual return	3.76%				
Panel B : Portfolio return of firms with high pay dispersion and high research and development intensity minus Portfolio return of firms with low pay dispersion and low research and development intensity					
Coefficient	0.0071	0.0045	0.0011	-0.0043	22.64%
t-statistic	(2.05)**	(5.55)***	(1.06)	(-5.12)***	
Implied Annual return	8.79%				
Panel C : Portfolio return of firms with high pay dispersion and high advertising intensity minus Portfolio return of firms with low pay dispersion and low advertising intensity					
Coefficient	0.0028	0.0006	-0.0008	-0.0011	9.39%
t-statistic	(1.84)*	(1.72)*	(-1.92)*	(-2.97)***	
Implied Annual return	3.38%				

Table 6 (continued)

	Intercept	RM-RF	SMB	HML	Adjusted R2
Panel D : Portfolio return of firms with high pay dispersion and CEO separated from Chairman of Board minus					
Portfolio return of firms with low pay dispersion and CEO same as Chairman of Board					
Coefficient	0.0036	0.0011	-0.0002	-0.0014	18.48%
t-statistic	(2.27)**	(2.85)***	(-0.43)	(-3.61)***	
Implied Annual return	4.43%				
Panel E : Portfolio return of firms with high pay dispersion and high board independence minus Portfolio return of firms with low pay dispersion and low board independence					
Coefficient	0.0008	0.0001	-0.0028	0.0006	23.72%
t-statistic	(1.67)*	(0.04)	(-5.36)***	(1.44)	
Implied Annual return	0.96%				
Panel F: Portfolio return of firms with high pay dispersion and high institutional equity ownership minus					
Portfolio return of firms with low pay dispersion and low institutional equity ownership					
Coefficient	0.0005	0.0012	-0.0016	-0.0001	21.20%
t-statistic	(0.48)	(4.13)***	(-4.76)***	(-0.11)	
Implied Annual return	0.60%				

Table 7
Endogeneity between Firm Performance and Pay Dispersion

The sample consists of 12,197 annual observations for 1,855 companies compiled for 1992–2003. The dependent variable is TOBINQ in Panel A and DISPAY in Panel B.
TOBINQ is the book value of total assets less book value of equity plus market value of common equity divided by book value of total assets. DISPAY is the coefficient of variation of total compensation (composed of salary, bonus, stock options granted, long-term incentive pay, restricted stock granted, and other compensation) paid to the top five executives in the management team during the fiscal year. RDSALE is the sum of research and development costs divided by sales for the prior five years. ADVSALE is the sum of advertising costs divided by sales for the prior five years. ROA is operating profit over total assets. CAPSALE is capital expenditure over sales. SIZE is natural logarithm of sales. SALES is the dollar value of sales. SEGNUM is number of business segments in the firm. INSIDEQ is percentage of common equity owned by officers and directors. INSIDEQSQ is the squared term of INSIDEQ. INSTEQ is the percentage of common equity owned by institutional shareholders. OUTDIR is the proportion of outside directors (defined as directors who are neither current nor former officers of the firm) on the board. CEODUAL equals one if the CEO is the chairman of the board of directors, and zero otherwise. BOARDSIZE is the natural logarithm of the number of directors sitting on each company's board as of the annual general meeting date in the given year. STDRET is the standard deviation of the monthly stock returns for the prior sixty months. AGE is the mean age of the top five executives in the management team. TENURE is the mean tenure of the top five executives in the management team. In all the regressions, we include year dummy variables and industry dummy variables based on two-digit SIC codes to control for any time trends and industry effects, respectively. t-statistics (reported in parentheses) are based on Huber-White robust standard error, which is a generalization of White (1980) standard error that is robust to both serial correlation and heteroscedasticity.
***, **, and * denote significance at the 1%, 5% and 10% levels (two-tailed) respectively.

Panel A. Determinants of Firm Performance

Variable	Predicted Sign	(1) 2SLS	(2) SUR	(3) 3SLS
Intercept		0.5568	1.5741	1.3598
		(2.54)***	(9.80)***	(6.57)***
DISPAY	+	2.3871	0.3334	1.1750
		(6.62)***	(2.08)**	(3.47)***
DISPAY * RDSALE	+	0.5461	0.5292	0.6956
		(4.61)***	(5.02)***	(6.65)***
DISPAY * ADVSALE	+	0.7074	0.6883	1.0006
		(2.56)***	(2.81)***	(4.10)***
DISPAY *OUTDIR	+	0.1604	0.0019	1.8714
		(2.18)**	(2.03)**	(12.98)***

Table 7 (Continued)
Panel A. Determinants of Firm Performance

Variable	Predicted Sign	(1) 2SLS	(2) SUR	(3) 3SLS
DISPAY *CEODUAL	-	-0.3792 (-4.20)***	-0.4104 (-5.07)***	-0.2047 (-2.57)***
DISPAY *INSIDEQ	+	0.4721 (1.75)*	0.3441 (1.32)	1.6799 (7.05)***
DISPAY *INSTEQ	+	0.1741 (0.94)	0.0064 (0.03)	1.4315 (8.79)***
RDSALE	+	1.2481 (13.81)***	1.3616 (17.24)***	1.0793 (13.11)***
ADVSALE	+	-0.1468 (-0.76)	0.0243 (0.14)	0.3726 (1.02)
ROA	+	8.6276 (59.83)***	8.6521 (68.05)***	8.6326 (67.14)***
CAPSALE	+	0.5421 (4.06)***	0.6014 (5.11)***	0.5453 (4.62)***
SIZE	+/–	-0.0848 (-6.65)***	-0.0348 (-3.89)***	-0.1069 (-8.78)***
SEGNUM	–	-0.0222 (-4.35)***	-0.0247 (-5.51)***	-0.0227 (-5.02)***
INSIDEQ	+	0.0064 (2.38)**	0.0062 (2.52)***	0.0028 (1.17)
INSIDEQSQ	–	-0.0001 (-2.49)**	-0.0001 (-2.73)***	-0.0001 (-2.18)**
INSTEQ	+	0.0061 (1.73)*	0.0044 (1.78)*	0.0132 (1.20)
OUTDIR	+	0.497 (3.55)***	0.0073 (0.05)	1.3064 (1.26)
CEODUAL	–	-0.1671 (-1.19)	-0.2643 (-0.83)	-0.0941 (-1.77)*
BOARDSIZE	–	0.1863 (0.36)	0.0168 (0.56)	0.0897 (0.74)
System Weighted R^2		19.26%	26.46%	35.57%

Table 7 (continued)
Panel B. Determinants of pay dispersion

Variable	Predicted Sign	(1) 2SLS	(2) SUR	(3) 3SLS
Intercept	+/-	0.4012 (15.96)***	0.4004 (15.93)***	0.3947 (16.15)***
SALECHANGE	+	0.0003 (3.53)***	0.0002 (3.61)***	0.0005 (6.83)***
RDSALE	+	0.0395 (4.44)***	0.0393 (4.42)***	0.03531 (4.01)***
ADVSALE	+	0.0496 (2.94)***	0.0497 (2.94)***	0.0483 (2.86)***
SIZE	+	0.0301 (14.93)***	0.0301 (14.98)***	0.0291 (14.67)***
STDRET	+	0.1098 (6.44)***	0.1104 (6.48)***	0.1187 (7.59)***
AGE	+/-	0.0001 (1.27)	0.0001 (1.26)	0.0001 (0.99)
TENURE	+/-	-0.0016 (-0.74)	-0.0017 (-0.92)	-0.0008 (-1.12)
System Weighted R^2		19.26%	26.46%	35.57%