Industry Tournament Incentives*

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Abstract

We introduce and empirically assess *industry* tournament incentives for CEOs. The measures we develop for the size of the tournament prize all derive from the difference in pay between the CEO at her firm and the highest-paid CEO among similar competing firms. Based on GMM with instrumental variables, we find that this external pay gap is reliably positively associated with firm performance and risk and riskier internal investment decisions and financial policy. The industry tournament incentive is weaker for new CEOs and retiring CEOs, but stronger in homogenous industries and when the CEO's past stock performance is above industry median.

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Key words: Industry tournament incentives; CEO incentives; Firm performance; Firm risk; Financial policy; Investment policy.

1. Introduction

Prior empirical work finds that tournament incentives affect the performance of professional golfers (Ehrenberg and Bognanno (1990)) and race-car drivers (Becker and Huselid (1992)) and the risk-taking behavior of mutual fund managers (Brown, Harlow, and Starks (1996); Chen, Hughson, and Stoughton (2011)). Kale, Reis, and Venkateswaran (2009) find that tournament incentives *internal* to the firm, among top executives, as measured by the pay differential between the CEO and other named executive officers, are positively associated with firm performance. Focusing on the option-like character of tournament incentives, Kini and Williams (2011) find a positive relation between this internal pay differential and firm risk, as well as R&D intensity, firm focus, and leverage. Internal tournament incentives appear to provide senior executives with the incentive to work harder and better and to increase firm risk through investment and financial policy.[1]

We extend the primary elements of the logic on tournament incentives for executives inside companies to examine tournament incentives for CEOs arising *external* to the firm. We measure external tournament incentives by the pay differential between the CEO and higher-paid CEOs within a group of sufficiently similar firms, specifically those that operate in the same product market(s). The argument is that high pay and/or other desirable characteristics of the CEO position at *other* perhaps larger and more prominent companies in the same or related

[1] See Lazear and Rosen (1981) and Green and Stokey (1983) on the incentive properties of tournaments. When monitoring is unreliable or costly, a principal can achieve stronger incentives using relative performance evaluation (RPE) than absolute performance measures (Murphy, 1999). In a tournament setting, multiple agents compete for a fixed number of slots. In golf and auto racing, this means winning the match or race and the associated monetary and other prizes. In a company, the mechanism can be a "horse race" for promotion, and the winning agent receives a prize, such as higher pay, perquisites, and status in the new position. (See Vancil (1987), Lorsch and Khurana (1999), and Naveen (2006) on the costs and benefits of the "horse race" model of executive succession.) Generally, agent performance is increasing in the spread between the winner and loser prizes (Lazear and Rosen (1981)). Moreover, given the option-like character of tournaments, competitors in the tournament will have the incentive to select actions that increase risk, thereby increasing the probability of winning the tournament and obtaining the prize payoff (e.g., see Chen, Hughson, and Stoughton (2011)).

industries will provide incentives to CEOs at their *own* companies. If a CEO leads a company that delivers outstanding performance, through high quantity or quality of managerial input or from risk-taking, then that CEO is more likely to be a strong candidate for the industry prize, specifically a more desirable position leading another company. Such a position can be attractive because of high compensation, enhanced span of control, high visibility, and status as CEO of a leading company in the industry. Based on this logic, we empirically examine the effects of CEO industry tournament incentives on firm performance, risk, investment policy, and financial policy.[2]

There are numerous examples of CEOs improving their compensation and stature after performing well at a prior firm. In late March of 2005, Mark Hurd was announced as CEO of Hewlett-Packard, the large computer and printer hardware company, to replace outgoing CEO Carly Fiorina (Konrad (2005)). Mr. Hurd arrived from NCR, a small computer services company known for ATM machines, data warehouses, and relationship management software. Mr. Hurd, after becoming CEO in 2003, led an ambitious turnaround at NCR that resulted in 332% stock return over his two years as CEO. Hurd moved from a company of 28,000 employees (NCR) to the much bigger HP (151,000 employees). Hurd's compensation at NCR in 2004 was $2.02 million. In 2008, Hurd was paid approximately $34 million (Jones (2009)) by HP.[3]

More generally, there is a functioning external labor market for top executives. There are formal mechanisms, such as the formation of peer groups for benchmarking executive pay, that provide information to top executives on compensation at other firms (e.g., Bizjak, Lemmon and

[2] Consistent with the argument on risk-taking, using U.S. plant-level data for firms across a broad spectrum of industries, Li, Low and Makhija (2011) show that career concerns shape real investment decisions by CEOs. For example, they find younger CEOs, who have more mobility and a longer professional horizon, undertake more active, aggressive investments.

[3] While NCR and HP are in related industries, mobility does occur across less similar firms. For example, Steve Odland, CEO of Tops Markets, was promoted to CEO of Royal Ahold, the parent of Tops, in 2000. He then moved to become CEO of Auto Zone in 2001. After leading Auto Zone to become the number-1 auto parts retailer in the US, Mr. Odland moved in 2005 to become CEO of Office Depot.

Nguyen (2010)). Of course, peer group comparisons are intended to set pay at the firm, rather than induce executives to move to greener pastures. But executives do move, particularly when they perform well. Fee and Hadlock (2003) find that executives who jump to CEO positions at new employers come from firms that exhibit above average stock price performance. They find that this relationship is more pronounced for more senior executives and that no such relationship exists for jumps to non-CEO positions. Through a survey of 401 CEOs, Graham, Harvey and Rajgopal (2005) find that over 75% of CEOs believe upward mobility in the labor market is more important than the compensation scheme at the firm in influencing their decisions as CEO. Focusing on CEOs with prior CEO experience, Gudell (2010) shows that not only do they earn a higher level of total compensation than those with no prior CEO experience, but their future compensation is positively associated with prior performance. Accordingly, we apply the notion of the promotion tournament to external labor market opportunities for CEOs to understand "industry tournament incentives" (ITI).[4]

Notwithstanding the above, there are grounds for skepticism. Agrawal, Knoeber, and Tsouhoulas (2006) argue that internal candidates for a vacant CEO position tend to be favored over external candidates. They find this effect in the data after controlling for candidate qualifications (e.g., skill, talent, and experience). Indeed, a large proportion of CEO hires come from inside the firm. Cremers and Grinstein (2011) find that 68% of CEOs emerge from the labor market internal to the hiring firm. If the external labor market is not very active, then

[4] Among other contributions to the literature on external labor market discipline and opportunities, Fama and Jensen (1983) delineate the incentives for executives associated with ex post settling-up in the managerial labor market. One primary focus of prior work on the labor market for directors and managers has been on retention and turnover of top executives. Numerous empirical studies provide evidence on turnover of the top management team when firm performance is poor (e.g., Coughlan and Schmidt (1985); Warner, Watts, and Wruck (1988)) or when the firm faces financial distress (e.g., Gilson (1989); Cannella, Fraser, and Lee (1995)). Other studies broaden the question to consider board seats: see Gilson (1989, 1990) on bankruptcy; Kaplan and Reishus (1990) on dividend cuts; Coles and Hoi (2003) on takeover protection; and Brickley, Coles, and Linck (1999) on stock and accounting performance.

external tournament incentives would be small or absent and would have little power to explain firm performance and risk.

On the other hand, it is possible that executives can and do obtain the external tournament prize, in the form of a large increase in compensation, without switching firms. The potential external opportunity would likely put pressure on the current firm to increase the compensation of the sitting CEO, so that the CEO need not move but can still extract at least some of the benefit of the external opportunity. Mechanisms for this include peer benchmarking (Bizjak et al. (2010)) and countering an actual or anticipated external offer to the CEO. External tournament incentives can be effective even if the CEO does not depart.

These arguments frame the empirical question. To what extent do industry tournament incentives matter? Focusing on *internal* tournament incentives, Kale, Reis, and Venkateswaran (2009) examine performance and Kini and Williams (2011) study risk taking. In similar manner, we test the hypotheses that firm performance and risk-taking depend positively on the extent to which CEOs face significant *external* incentives that arise from the possibility of promotion to a position with higher pay, status, span, and visibility at a firm further up the industry hierarchy.

We construct several measures of industry tournament incentives, all of which relate to the gap between CEO compensation at the firm of interest and maximal or near-maximal CEO compensation potentially available among firms that are similar based on product market and, in some cases, size. Based on GMM with instrumental variables, we find that firm performance, as measured by Tobin's *Q* and annual return on equity (*ROE*), is significantly positively related to all measures of industry tournament incentives. For a one-standard-deviation increase in our primary measure of the CEO external pay gap, *Q* increases by 0.38 and *ROE* increases by 0.013. These increases are quite large in relation to median *Q* (1.67) and median annual *ROE* (0.115).

Likewise, firm risk, as measured by the standard deviation of quarterly cash flows and standard deviation of daily stock returns, is significantly positively related to industry tournament incentives. For a one-standard-deviation increase in the external pay gap, the standard deviation of stock return (cash flow) increases by 0.003 (0.001), as compared to the median of 0.025 (0.007). For evidence on the mechanisms by which CEOs increase risk, we examine investment decisions and financial policy. R&D intensity, firm focus, and leverage all increase in the industry pay gap, while capital expenditure decreases in industry pay gap.

Several additional matters are noteworthy. First, in addition to including a wide variety of control variables, industry fixed effects, and lags, we address endogeneity concerns by identifying and using instrumental variables and applying GMM in estimation. Among other determinants, the CEO external (industry) pay gap depends on the average compensation of geographically-close CEOs, the standard deviation of compensation in the industry, and aggregate CEO pay in the industry, as instruments, and other controls, including firm size and stock return volatility. Second, in assessing the effects of industry tournament incentives on performance, risk, and policy, we control for both the internal tournament incentives (the internal pay gap) of Kale, Reis, and Venkateswaran (2009) and Kini and Williams (2011) and the standard performance and risk-taking incentives (delta and vega) arising from the structure of managerial compensation, all of which by and large continue to have explanatory power for performance and risk. Third, the industry pay gap tends to have a stronger effect on firm performance and risk when the probability of the CEO winning the tournament prize is higher.

Our analysis contributes to the literature in several respects. First, we extend the logic of promotion-based tournaments to propose the notion of industry tournament incentives for CEOs. Elements of this logic appear in Agrawal, Knoeber, and Tsoulouhas (2006), Kale, Reis, and

Venkateswaran (2009), and Kini and Williams (2011), though none pursue the notion. In terms of risk-taking, the idea is more fully formed in the literature on mutual funds (Brown, Harlow, and Starks (1996); Chen, Hughson, and Stoughton (2011)), but the focus therein has been on that particular form of financial intermediation. We build on these contributions to fashion the idea of industry tournament incentives for corporate CEOs and then empirically test the implications for firm performance and risk. Second, our analysis builds on the large prior literature on managerial incentives. In addition to compensation-related incentives of the CEO (delta and vega) and the recently examined internal promotion-based tournament incentives, our empirical design includes external tournament incentives. Third, our results evoke the importance of the external labor market for managerial incentives that affect firm performance and risk. This is particularly relevant for those interested in the ability of shareholders to assemble in concert the full spectrum of incentive and monitoring devices to maximize firm value. Shareholders are unlikely to have much control over the external pay gap, which in part is the likely reason it is possible in the first place for our experiments to detect in the data the positive effect of industry tournament incentives (ITI) on performance, risk, and policy. Finally, our results relate to the public controversy over CEO pay. The industry tournament for CEOs, with the significant pay prize at stake, is a likely explanation for some of the upward pressure on CEO pay (Jensen, Murphy, and Wruck (2004); Bebchuk and Fried (2003); Bebchuk and Grinstein (2005)).

The remainder of the paper is arranged as follows. Section 2 describes the data and develops our measures of industry tournament incentives. Section 3 describes the instrumental variables approach we employ and presents results relating industry tournament incentives to manager, firm, and industry characteristics. Section 4 explores the relation between firm performance and industry tournament incentives. Section 5 supplies our empirical results on the

implications of the external pay gap for firm risk, while Section 6 explores the effects of external tournament incentives on investment and financial policy. Section 7 reports results that control for the probability of the CEO winning the tournament. Section 8 reports results for financial firms and utilities. Section 9 characterizes in our data how the determinants of CEO turnover and the characteristics of incoming CEOs are consistent with the presence of an active industry tournament. Section 10 concludes.

2. Data, Variable Definitions, and Summary Statistics

2.1. Data Sources

We obtain CEO compensation data from the Standard and Poor's (S&P) ExecuComp database, which covers about 1,500 firms each year that are in the S&P 500, S&P mid-cap 400, and S&P small-cap 600 indices. In general, our sample period covers 1992 to 2005. We choose this sample period so as to avoid data complications associated with the 2006 change in executive compensation reporting requirements (see Coles, Daniel, and Naveen (2010)) and to allow direct comparison to the results in Kale, Reis, and Venkateswaran (2009), Kini and Ryan (2011), and Cremers and Grinstein (2011). We include all firm-years that have an identifiable CEO (using CEOANN). We obtain stock return data from the Center for Research in Security Prices (CRSP) and firm characteristics from the Compustat Industrial and Segment files. Our main sample (1992-2005), excluding financial and utility firms, aggregates to 17,702 firm-year observations arising from 2,265 unique firms and 4,136 unique CEOs.

Execucomp provides data on salary, bonus, stock awards, option grants, and total compensation for up to five executives. For total compensation, we use TDC1, which for 2005 and prior eschews using option grant values reported by the companies in favor of using Black-

Scholes. Thus, using TDC1 for 1992-2005 means we can use the same valuation approach for options across all firms.[5]

2.2. Measures of CEO Industry Tournament Incentives

The tournament-based pay structure performs well when all agents receive a common shock that is highly correlated with the random component of the agents' own outputs (Lazear and Rosen (1981)). Accordingly, it is natural to group firms as similar competitors based on product market. We apply the Fama-French 30-industry classification to define the "industry" in which firms and CEOs compete.[6]

The tournament model in Lazear and Rosen (1981) suggests that every CEO but one in the industry has the incentive to compete for the CEO position in the same industry with the highest pay (and perhaps other desirable attributes). One obvious approach is to define the industry tournament incentive as the compensation gap between the CEO in question and the highest-paid CEO in the same industry. One difficulty is that extreme compensation within an industry in a particular year may be due to an unusual, transitory event, in which case maximal industry CEO compensation is not likely to approximate what the executive would receive if they "won" the tournament. To control for potential outliers, we winsorize the measure by using second-highest CEO pay rather than maximal pay.[7] Therefore, our first and primary measure of industry tournament incentives, denoted *Indgap1*, is defined as the maximum of \$0 and the compensation gap between the CEO under consideration and the *second*-highest-paid CEO in the same industry. Thus, *Indgap1* is \$0 for both the highest-paid and second-highest paid CEOs in

[5] TDC1 in Execucomp has some missing values, in which case we use the individual components reported in Execucomp to calculate TDC1. This adds 171 additional firm-year observations.
[6] The details are available from http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/ftp/Siccodes30.zip.
[7] Hall and Liebman (1998) find that regression results with CEO compensation as the dependent variable are sensitive to outliers.

the industry. To check robustness, we also perform our analysis using the pay gap based on maximal industry pay, which we denote *Indgap1_raw*.

Selecting peer groups to form performance percentile benchmarks for CEO pay is a common practice and, moreover, peer groups tend to be comprised of firms of similar size from the same industry (Bizjak, Lemmon, and Naveen (2008), Faulkender and Yang (2010), and Bizjak, Lemmon and Nguyen (2011)). Accordingly, we use net sales to control for firm size. In each year and for each industry, we divide firms into two groups based on whether annual net sales is above or below the industry median.[8] Based on this sample partition, our second measure of industry tournament incentive, denoted *Indgap2*, is the compensation gap between the CEO and the highest paid CEO in the same half-industry..

Our third measure of industry tournament incentives supposes that the maximum distance a CEO can hope to move up in terms of compensation is half of the firms in the industry. The idea is that it is likely to take more than one move for a CEO in a firm near the bottom of the pay hierarchy to be promoted to be CEO in a top firm. For example, the best the lowest-paid CEO in the industry might be able to achieve is a move to the median (in CEO pay) firm in the industry. The second to the bottom might be able to move to the next firm above the median, and so forth up to the median firm, where that CEO and all CEOs paid above the median potentially would be able to move to the highest-paying slot. We denote this measure as *Indgap3*.

For all of these measures, the notion is that the tournament incentive is more effective when the "promotion" prize is bigger and the gap is wider (Lazear and Rosen (1981)). Panel A in Table 1 contains descriptive statistics. While in some instances, CEOs are purported to

[8] As in all calculations herein that partition a sample into subsamples based on the median of a variable, if the sample contains an odd number of observations we assign the median firm to the subsample comprised of observations above the median. If multiple observations tie at the median, we randomly order the tied firms and assign them in alternating fashion to the above- and below-median groups, starting with the former.

receive very low cash salary, in general CEOs receive significant cash payments, option awards, and stock grants. The industry pay gap measures accord with the substantial level and dispersion of compensation awards to CEOs over the sample period. The median (mean) of our first and primary measure of industry pay gap using second-highest CEO pay within an industry as the benchmark (*Indgap1*) is $13.85 million ($23.86 million). *Indgap1_raw* is larger, with a median (mean) of $22.60 million ($57.16 million). Large outliers contribute to the difference of the means between these two measures. For example, Charles Wang, the CEO of Computer Associates, received a large stock grant in 1998 that brought his total compensation to $655.45 million.[9] Of course, the minimum industry CEO pay gap is $0.[10]

Table 1 verifies that both *Indgap2* and *Indgap3* appear similar to *Indgap1* but, as expected, are substantially smaller than *Indgap1_raw*. For example, the medians ($10,873,290 and $7,164,660, respectively) are less than half the median of *Indgap1_raw*. Even so, the median of the industry tournament incentives measures exceed substantially the median of CEO pay in our sample ($1,966,910). The size of the CEO tournament prize looks to be large relative to typical CEO pay. Note also that the standard deviation of ITI is quite large.

Table 2 confirms that the industry CEO pay gap measures are distinct. The measures are correlated, but imperfectly so. For example, the Pearson correlation between *Indgap1* and *Indgap2* (*Indgap3*) is 0.522 (0.432), and the correlation between *Indgap2* and *Indgap3* is 0.628. Likewise, the three relevant Spearman correlation coefficients are significantly positive but also are substantially less than 1.

[9] The second highest CEO pay within the same industry in 1998 was $43.23 million (Siebel Systems). The lowest CEO compensation in that industry in 1998 was at J. D. Edwards, a computer software company, with total CEO compensation equal to $140,227.

[10] Other small industry pay gaps appear in our data. For example, in Paper and Paper Products in 1993, the CEO of International Paper received a total of $2,673,574, which was only slightly smaller than the maximum in the industry of $2,684,109, the total for the CEO of 3M. The difference, *Indgap1_raw*, in this instance is $10,535, while *Indgap1* is $0.

2.3. Dependent Variables: Performance, Risk, and Policy

To measure firm performance we employ Tobin's *Q*, the ratio of the sum of market value of equity and the book value of debt to total assets, and *ROE*, return on equity, calculated as net income divided by shareholder equity. The mean and median for *Q* are 2.23 and 1.65 and for *ROE* are 7.23% and 11.46% (Panel D of Table 1). As for firm risk, we utilize *Stock return vol*, measured as the standard deviation of one-year daily stock returns, and *Cash flow vol*, the seasonally-adjusted standard deviation of cash flows over assets for a five year window (year t to t+4). We require at least a three-year window to compute *Cash flow vol*. We obtain quarterly cash flows over total assets from Compustat (EBITDA/TA). We then calculate the quarterly mean values across the five-year window and then subtract these means from their respective quarterly values. We compute cash flow volatility as the standard deviation of these seasonally-adjusted cash flows over assets over the period year t to t+4. Mean (median) *Stock return vol* is 0.030 (0.025) and mean (median) *Cash flow vol* is 0.012 (0.007).

Indicators of the riskiness of firm investment policy include: *R&D*, defined as R&D expenditures divided by total assets; *CAPEX*, capital expenditures divided by total assets; *# Segments*, the number of operating segments (Compustat segment database); *H-index*, the sum of the square of segment sales divided by the square of firm sales (the Herfindahl index in firm sales); and *Book leverage*, which is book value of interest-bearing debt divided by total assets.

2.4. Internal Tournament Incentives

Kale, Reis, and Venkateswaran (2009) and Kini and Williams (2011) demonstrate the empirical importance of within-firm tournament incentives. We follow them to calculate *Firm gap* as the difference between CEO total compensation and median VP total compensation.[11]

[11] Like Kale, Reis, and Venkateswaran (2009) and Kini and Williams (2011), we eliminate cases with negative *Firm gap*. The regression results are the same if, instead, we assign a value of zero.

Vice presidents (VPs) are the group of (up to) next-four named executive officers (NEOs). This variable captures the increase in a median VP's compensation if she wins the internal promotion tournament. As Panel A of Table 1 indicates, the median (mean) firm pay gap for our sample is $1.138 million ($3.14 million), which are similar to those reported in Kale et al. (2011) and Kini and Williams (2011). Note that the internal pay gap is dwarfed by the prize in the external tournament.

Also note that there is a mechanical relation between the external and internal tournament incentive measures. Holding all else constant, for each dollar that CEO pay rises, the external (internal) pay gap falls (rises) by a dollar. Nonetheless, per Table 2, the Pearson correlations among the internal and external tournament incentive measures are close in magnitude to zero, which suggests that the economic forces that determine each are distinct.

2.5. Incentives from the Structure of Managerial Compensation: Delta, and Vega

It is crucial to control for incentive effects already established to be empirically important. To control for managerial incentives arising from the structure of CEO compensation, we calculate CEO delta and vega (e.g., Coles, Daniel, and Naveen (2006)). In computing these measures, we include direct stock ownership, restricted stock, and existing and newly granted stock options, all based on accumulated grants net of dispositions. CEO delta represents the sensitivity of CEO wealth to firm performance.[12] Following Aggarwal and Samwick (2003), we define *CEO delta* to be the change in executive wealth per $1 change in shareholder wealth.

[12] For direct stock ownership and restricted stock, we compute the number of shares of stock held by the executive divided by the number of shares outstanding. For stock options, we follow Yermack (1995) and compute the option delta from the Black-Scholes option-pricing model (the change in the value of the stock option for a one dollar change in the stock price) multiplied by the ratio of the number of options held to total shares outstanding. Following Core and Guay (1999), we compute option deltas separately for new option grants and existing options. For newly granted options, we assume a maturity of seven years because executive stock options are generally exercised early (Carpenter (1998); Huddart and Lang (1996); Bizjak, Bettis, and Lemmon (2003)). For existing options, we assume that unexercisable options (those that are not vested) have a maturity of six years and that exercisable options (vested) have a maturity of four years. The dividend yields and volatility estimates for each firm year are given in Execucomp. The risk free rate is from the US Federal Reserve Bank website.

CEO vega is the change in the dollar value of the CEO's wealth for a 0.01 change in the annualized standard deviation of stock returns.

2.6. Control Variables

CEO specific characteristics include: *CEO tenure*, the number of years as the firm's CEO; *CEO age*, the CEO's age as of the sample year; and *CEO insider*, an indicator variable that takes the value 1 if the CEO is an insider, and the value of 0 otherwise. Following Parrino (1997), we define an insider to be an executive who has been with the company for at least one year prior to becoming the CEO. *Duality* takes the value of 1 if the CEO is also the chair of the board, and equals 0 otherwise. *New CEO* equals 1 in the CEO's first year of service as CEO, and 0 otherwise. *Retire CEO* is equal to 1 if the CEO's age is more than 62 years, and 0 otherwise. *Duality*, *CEO tenure*,and *CEO age* help control for CEO power, experience, and perhaps talent. Similarly, though Kale et al. (2011) and Kini and Williams (2011) use the internal pay gap to measure tournament incentives internal to the firm, an alternative interpretation is that it proxies for power and entrenchment of the CEO, with the internal pay gap increasing in those dimensions.

Other firm level control variables include: *Succession plan*, a dummy variable equal to 1 if the firm lists a President and/or COO as a top five highest paid executive in the current year, and 0 otherwise (Kini and Williams, 2011); *Stock return (1YR)* is the one-year stock return including dividends; *Sales growth* is defined as average yearly sales growth over years *t*-4 through *t*-1; *ROA* is return on assets, calculated as net income before extraordinary items and discontinued operations divided by total assets; *CAPEX* is investment in property, plant, and equipment divided by total assets; *FCF* is free cash flow, calculated as operating income before depreciation minus interest expense minus income taxes minus cash dividends minus capital

expenditure divided by total assets. *Industry stock return vol* is the volatility of industry stock return for the prior year based on daily return of an equal-weighted portfolio using all firms in the industry.

3. Determinants of Industry Tournament Incentives

We argue that the industry pay gap provides tournament-based incentives for managers to improve firm performance and to increase risk. In performance-on-structure and structure-on-structure regression specifications, however, omitted variables, measurement error, and simultaneity or reverse causation can be concerns (Coles, Lemmon, and Wang, 2011). Such concerns are likely to be relevant for our empirical questions.

One potential line of attack is to supplement a comprehensive set of control variables with instruments. This approach benefits from careful attention to identifying likely sources of endogeneity, suitable control variables, and proper instruments..

3.1. Endogeneity Concerns

The industry pay gap is likely to be influenced by firm performance and risk. Several mechanisms for such simultaneity come to mind. First, consider a firm that has a very good year. High performance is likely to cause a large increase in CEO compensation, which would lead to a reduction of the gap between maximum pay in the industry and the pay of the CEO. Second, to the extent that CEO wealth and pay are convex in firm performance, through option holdings, for example, more risk taking will increase expected CEO compensation. This implies a reduction in the expected value of the industry pay gap. Finally, firms with extraordinary growth opportunities are likely to demand extraordinary talent and skill on the executive team and to pay accordingly. If *Q*, aside from being a performance measure in our analysis, is a measure of

growth opportunities, then higher *Q* would lead to higher CEO pay and a lower industry pay gap. These specific mechanisms for reverse causation would reduce the likelihood of finding a positive relation between industry tournament incentives and the dependent variables, specifically firm performance and risk.

To illustrate the potential for problems from omitted variables, it is likely that growth opportunities affect both of the dependent variables, firm performance and risk, and our primary explanatory variable, the industry pay gap, through CEO compensation. Including a common proxy for growth opportunities, Tobin's *Q*, does no good because we use it as a key outcome variable. Lagged *Q* is unsuitable because investment opportunities (and *Q*) are persistent. Fortunately, other proxies for growth opportunities are available. We use R&D intensity, investment in hard assets, and sales growth, as well as industry fixed effects, to capture the growth opportunities. This case is illustrative. Likewise, below we identify other potential omissions and attempt to include suitable proxies.

3.2 Three Instruments for the Industry Pay Gap

To address endogeneity concerns, we utilize GMM with instrumental variables. A proper instrument will satisfy the relevance and exclusion conditions (Roberts and Whited (2011) and Kennedy (2003)). Applied in our case, relevance requires a strong economic argument for why the instrument affects the industry pay gap, along with supporting evidence that the partial correlation, after controlling for other determinants of the pay gap, of the instrument with the pay gap is significant. The exclusion condition supposes that the instrument does not suffer from the same problem as the original predicting variable. In particular, the instrument cannot be correlated with the error term in the explanatory equation for performance or risk, which implies

that the instrument affects firm performance and risk only through its effect on the industry pay gap and there is no reverse effect of the dependent variable on the instrument.

Recall that we define all the industry pay gap measures as the difference between highest (or second-highest) CEO pay in the benchmark group and the CEO's own compensation. The maximum and second-largest are industry-level variables, while CEO pay varies across firms in the industry. We propose three instruments.

First, for each CEO-firm-year we calculate the average compensation of geographically-close CEOs. We expect the average compensation of geographically-close CEOs to be positively associated with the total compensation of the CEO in the firm and, hence, negatively associated with the industry pay gap. Bouwman (2011) finds that CEOs care about their wages relative to those of geographically-proximate CEOs in their reference group.[13] We follow Bouwman (2011) to construct *Geo_CEO_Mean* as average total compensation received in the *previous* year by all other CEOs of firms headquartered within a 250-kilometer radius of the firm, i.e., that are "geographically close."[14] The Pearson correlation of *Geo_CEO_Mean* with *CEO total compensation* is 0.143, which is significantly different from 0 at the 1% level. The correlations between *Geo_CEO_Mean* and maximal industry pay vary from 0.212 up to 0.343 ($p < 0.01$ for all cases) across the three pay measures of tournament incentives.

[13] Likewise, Kedia and Rajgopal (2009) argue competition for employees cause firms to grant more stock options to rank-and-file workers when a higher percentage of geographically-close firms grant more options.

[14] We obtain the location (city) of the headquarters of every firm in the sample from Compustat and latitude and longitude data from the Census 2000 U.S. Gazetteer. There are 33 firms with headquarters outside the U.S. For our 2SLS regressions, we exclude these firms. Since Compustat assigns the latest headquarters location to all years, we verify the headquarters location for every firm over the entire sample period using 10Ks (and other financial documents if needed), and correct the location if necessary. We also confirm that city names correspond with the names found in the Gazetteer "places" files and correct the name when needed. When we do not find a city name in the Gazetteer file (90 instances), we check the location of the city on maps.google.com and assign the observation to the nearest place that is on the Gazetteer file within a 15-kilometer radius of the original location. We estimate the actual distance between cities with the Haversine formula, which gives great-circle distances between two points on a sphere.

In terms of the exclusion condition, we do not expect the average level of pay for nearby CEOs to affect firm performance or risk except through industry tournament incentives. Submitting this expectation to further inspection, one concern is that production technology or investment opportunities might be correlated with geographic location for some types of firms, such as mining firms that co-locate near mineral deposits or high-tech firms spawned from top universities nearby. On the other hand, with modern communication and transportation (distribution) technologies, many firms have broad geographic span and compete on a national or even global basis. Thus, there should be at most a weak link between the location of a firm's headquarters and investment opportunities. Nevertheless, we address this concern through the following channels. First, when calculating average compensation of geographically-close CEOs, we exclude all CEOs within the same industry based on Fama-French 30 industry classification. Second, in the second stage, we control for investment opportunities by including R&D and capital investment (for performance) and *Q* (for firm risk and policy). Third, we employ industry fixed effects in both regression stages.[15] These and other controls should increase the likelihood that this instrument and the two other instruments described below satisfy the exclusion condition

Our second proposed instrument extends to the industry level the notion that "fair" wages for employees depend on a firm's ability-to-pay (Kahneman, Knetsch, and Thaler (1986)). We measure the industry's ability to pay top executives by total compensation received by all CEOs within industry. *Ind CEO comp* should be related to both maximal CEO pay in an industry and individual CEO pay. The Pearson correlation between *Ind CEO comp* and *CEO total*

[15] We also consider product market demand or competitiveness as potential candidates for instruments. In unreported regressions, we use the Herfindahl Index of industry sales as a proxy for product market competitiveness and find that it does not affect the industry pay gap. Moreover, Giroud and Mueller (2011) show that firms in noncompetitive industries have lower equity returns, worse operating performance, and lower firm value. Product market demand and competitiveness seem unlikely to satisfy the exclusion condition.

compensation is 0.140 ($p < 0.01$). The correlations between *Ind CEO comp* and maximal CEO pay vary from 0.520 up to 0.824 across the three industry pay gap measures ($p < 0.01$ in all three cases).[16] In terms of the exclusion condition, we do not expect aggregate pay to CEOs in the industry to directly affect firm performance and risk. Moreover, we include control variables, as described below, to remove any effects of the instrument on the dependent variables that would arise through omitted variables. For example, to control for the indirect linkage between individual firm performance, through industry performance, and industry CEO pay, in the second stage we include total sales of all firms within the industry (*Ind sales*) as a measure of industry performance and ability to pay. To control for the possibility that average or aggregate CEO talent in the industry drives both total pay to CEOs in the industry and firm performance, we control for individual CEO experience and firm/CEO performance.

Third, Cremers and Grinstein (2011) find that variation in talent pool explains cross-sectional variation in CEO compensation across industries. We extend this idea to variation within each industry, with dispersion of CEO talent in the industry affecting the industry pay gap. CEO talent and the competitiveness of the CEO labor market are not directly observable, so we use the distribution of CEO compensation within the industry as a proxy for our measures of industry pay gap. For each industry in each year, we calculate the standard deviation of CEO total pay (*SD CEO comp*). A priori it is likely that industry pay dispersion will be associated with variation in maximal pay across industries and with variation in individual CEO pay relative to the industry maximum. The Pearson correlations between *SD CEO comp* and maximal CEO pay vary from 0.481 up to 0.735 across the three industry pay gap measures ($p < 0.01$ in all three cases). The correlation between *SD CEO comp* and *CEO total compensation* is 0.174 ($p < 0.01$).

[16] Total industry compensation also reflects the observation that when maximal CEO pay is relatively high in one industry, all other CEOs in that same industry tend to be highly paid as well (Dicksen and Katz (1986)).

For the exclusion condition, we see no clear avenue to argue that *SD CEO comp* affects firm performance or risk directly except through ITI. In terms of factors that could affect both dispersion of compensation and the dependent variables, one possibility is that industry performance risk affects firm performance risk (and also firm performance through compensation to investors for bearing for firm risk), which affects variation in CEO compensation, which affects *SD CEO comp*. To break this long chain, we control for volatility of prior industry stock market returns in both stages.

3.3. Other Factors that Affect the Size of the Industry Prize

First, consider individual CEO compensation. We follow prior research in selecting the observable firm and manager characteristics that determine the level of CEO compensation. Variables include firm size, performance, and sales growth, industry volatility, and CEO tenure and age.[17] Because the dependent variables in the second stage, specifically *Q*, ROE, stock return volatility, cash flow volatility, and policy variables, can be persistent, it is important to avoid the use of their lagged values in the second stage. Under our IV approach, all first-stage variables except instruments are required in the second stage. Thus, we use other proxies so that we have flexibility in selecting a measure of growth opportunities for the second stage. For example, rather than *Q* or R&D, in some instances we use sales growth for growth opportunities. Likewise, we use stock return rather than accounting performance and industry-level rather than firm-level stock return volatility for risk CEOs face. Second, for maximal pay in the industry, per Section 3.2 above, we control for the volatility of industry performance and the number of CEOs (firms) in the industry comparison group. Finally, again, we include year and industry fixed effects.

3.4. Factors that Affect the Probability of Winning the Industry Tournament

[17] See Graham et al. (2011) and Coles, Daniel, and Naveen (2006) on various factors that determine CEO pay.

The results in Kale, Reis, and Venkateswaran (2009) and Kini and Williams (2011) suggest that firms set a higher internal promotion-based tournament prize when the probability of winning the tournament is lower. This connection is likely to be more tenuous for the external industry pay gap, the reason being that the firm does not have the discretion to set the industry maximum CEO pay, firm CEO pay, and promotion probability in a coordinated way. Nonetheless, we test this empirical possibility. In addition, the marginal incentive effects of the pay gap for performance and risk taking are likely to be higher when the probability of winning the prize is higher. We test this possibility in Section 8.

We employ several proxies for probability of winning the industry tournament prize. The more recently the CEO has assumed that position, the more uncertainty there is about skill level and match both inside the firm and elsewhere and, thus the less likely it is that the CEO will obtain the prize. The probability of turnover for a new CEO (*New* CEO = 1) should be lower. Similarly, when a CEO is close to retirement (*Retire CEO* =1), the likelihood of an immediate promotion to another (bigger) firm in the same industry is also lower. An increase in the number of CEOs in the same industry (*Ind # CEOs*) is likely to be associated with a decline in each CEO's probability of winning the tournament (Main, O'Reilly and Wade (1993)). When a CEO also holds the position of board chair (*Duality* = 1), the CEO/chair may receive private benefits from authority and control that reduce the probability of departing.[18] Prendergast (1999) suggests that the existence of a designated successor significantly increases the probability of promotion for one agent and lowers it for the others. We proxy for whether a successor is likely to have been identified by *Succession plan*, a dummy variable that equals to 1 if the firm lists a President and/or COO as a top five highest paid executive in the current year, and 0 otherwise.

[18] An opposing aspect of duality, however, is that CEO/chair pay is higher (Brickley, Coles, and Jarrell (1997)) so the gap relative to maximal industry pay is lower, all else equal.

3.5. Findings on the Determinants of the Size of the Tournament Prize

Table 3 presents our findings on the determinants of the industry pay gap. All regressions in the table are pooled time-series, cross-sectional regressions with instruments, industry fixed effects, year dummies, and observable firm, CEO, and industry characteristics. The dependent variable in each specification is one of the industry pay gap measures. All variables on the right hand side of the regression are lagged one year relative to the dependent variable. Columns 1-4 report results for the primary specifications. Column 5 includes additional variables that include the probability of moving to claim the tournament prize.

CEO pay increases in firm size (Murphy (1999)), so it is natural to find that Ln (*Indgap1*) and Ln (*Indgap1_raw*) decrease in firm size. In contrast, *Indgap2* (column 3) and *Indgap3* (column 4) are constructed conditional on firm size and compensation level, respectively, and both are positively related to firm size. Better firm stock performance leads to higher CEO pay which leads to a lower external pay gap. While there is some evidence that CEO age is positively related to the industry pay gap, CEO tenure is not. The industry pay gap is negatively but only weakly related to industry stock return volatility. We find support for the notion that a greater number of CEOs in the same industry (and a corresponding lower promotion probability for each CEO) is associated with a higher industry pay gap. Column 5 includes four additional proxies for the probability of winning the industry tournament prize. The coefficients on these proxies vary in size and significance.

Turning to our chosen instruments, as expected, the coefficient estimate on Ln(*Geo CEO mean*) is always negative and is significant at least at the 5% level in four of five specifications and at 10% in the other. The coefficients on the dispersion of CEO compensation within the industry (*SD CEO comp*) are positive and significant at 5% in all regressions. Likewise, the

effect on the industry pay gap of industry "ability-to-pay" (industry total compensation, *Ind CEO comp*) is positive significant at 5% in three models and 10% in two specifications. These instruments individually appear to satisfy the relevance condition.

We turn now to Sections 4–9, wherein we present our main results.

4. Industry Tournament Incentives and Firm Performance

Following Kale, Reis, and Venkateswaran (2009), Ehrenberg and Bognanno (1990), and Becker and Hauselid (1992), we expect to find a positive relation between firm performance and external tournament incentives. Because of the endogeneity concerns delineated above, on the right-hand side we use the industry pay gap predicted using the IV specifications reported in Table 3. We employ the independent variables from that first stage, though not the instruments, along with additional control variables. The standard IV and 2SLS estimators are special cases of the GMM estimator. We use GMM, by way of ivreg2 in Stata, which can produce consistent and efficient estimates in the presence of errors that are not i.i.d. As the dependent variables are likely to be time-persistent, here and throughout we report industry-clustered and Newey-West-corrected (up to four lags) standard errors. In order to isolate the effects of external tournament incentives, we control for CEO delta arising from the managerial compensation contracts, NEO tournament incentives internal to the firm, growth opportunities, and other variables. In all regressions, we include year and industry fixed effects.

4.1. Industry Tournament Incentives and Performance: Empirical Results

Tables 4 and 5 report estimates of the relation between industry tournament incentives and firm performance. In Table 4, the first two columns present results using contemporaneous Tobin's *Q* as the dependent variable. For OLS (column 1), the coefficient on Ln(*Indgap1*) is -

0.007, which is not statistically significant from zero. Column 2 contains GMM IV results for the second stage based on the first stage reported as column 1 of in Table 3. The coefficient on Ln(*indgap1*) is 0.261 ($p < 0.01$). The Hausman exogeneity test rejects the null hypothesis that the OLS and GMM IV estimates on Ln(*Indgap1*) are the same at the 1% level. The difference in results is consistent with the notion that better firm performance and higher firm value shrink the external pay gap, so that the estimate on Ln(*Indgap1*) is attenuated in the OLS specification through reverse causation. In contrast, the sign and the magnitude of the coefficient using GMM IV are consistent with a positive effect flowing from industry tournament incentives to firm performance. In terms of economic significance, a one-standard-deviation increase in *Indgap1*, acting through Ln(*Indgap1*) and the estimated GMM IV coefficient, increases Tobin's *Q* by 0.38, which is economically significant in comparison to the average (median) Tobin's *Q* of 2.23 (1.65) in our sample.[19] To frame the economic magnitude of this and similar calculations, note that the standard deviation of *Indgap1* is quite large and the same is true as well for our other measures of the external pay gap.

Columns 3 and 4 in Table 4 repeat the analysis for return on equity (*ROE*) as the performance measure. Again, we use industry fixed effects and report OLS and GMM IV results. Based on OLS, the coefficient on Ln(*Indgap1*) is negative and statistically significant. Using GMM IV, the coefficient is positive and significant. Again, the Hausman exogeneity test rejects, at the 1% level, the null hypothesis that the OLS and IV estimates are the same. This suggests that the feedback effect of *ROE*, as better performance increases CEO pay and reduces the industry pay gap, contaminates OLS. The GMM IV coefficient on Ln(*Indgap1*) in column 4 is 0.009 ($p < 0.05$). In terms of economic significance, a one-standard-deviation increase in

[19] We use the natural logarithm of the industry pay gap in most regressions. To calculate the economic significance, we first compute the level of industry gap 0.5 standard deviation above and below the industry mean. We then compute the difference between the natural logarithm of the high and low industry pay gap.

Indgap1 increases the *ROE* in the next year by 0.013, which represents a sizeable increase in comparison to the average (median) *ROE* in our sample of 0.073 (0.115).

Table 5 reports the results for similar specifications based on alternative measures of the industry pay gap, Ln(*Indgap1_raw*), Ln(*Indgap2*), and Ln(*Indgap3*). We continue to employ GMM IV because of endogeneity concerns. When Tobin's *Q* is the dependent variable (columns 1-3), the coefficients on all three alternative industry tournament incentive measures are positive and significant at the 1% level. In terms of economic significance, a one-standard-deviation increase in *Indgap2* and *Indgap3* implies increases of 0.44 and 0.60 in contemporaneous Tobin's *Q*, respectively, both of which are large in relation to the mean and median of Tobin's *Q* in our sample. When *ROE* is the firm performance measure (columns 4-6), the coefficients on all three alternative industry tournament measures remain positive and statistically significant at least at the 5% level. A one-standard-deviation increase in *Indgap2* and *Indgap3* implies increases of 0.035 and 0.048 in *ROE*, as compared to median *ROE* of 0.115 in our sample. The Hausman exogeneity test rejects the null hypothesis that the OLS and IV estimates are the same at the 1% level in five of six models and at the 5% level in the sixth.

There is both empirical evidence and theoretical support for the assertion that GMM IV estimation with weak instruments can perform poorly in absolute terms and in comparison to OLS (see Stock, Wright and Yogo (2002)). Tables 4 and 5 report the F-test for relevance for the collection of instruments used in each of the first-stage regressions that support the second stage specifications. As a rule of thumb, the F-statistic of a joint test whether all excluded instruments are significant should be bigger than 10 in case of a single endogenous regressor. The eight first-

stage F-statistics in Tables 4 and 5 vary from 103.21 up to 641.62.[20] We conclude that our instruments collectively satisfy the relevance condition.

In Tables 4 and 5, the coefficients on CEO delta are positive and significant when *Q* is the dependent variable but insignificant when the dependent variable is accounting performance. In five of the eight GMM IV specifications, the coefficient on internal (VP) tournament incentives is positive and statistically significant. These latter results provide some support for the findings in Kale, Reis, and Venkateswaran (2009).

We include a number of control variables so as to reduce the likelihood that our instruments have any effect on performance through omitted variables. These specific controls include industry stock return volatility, industry sales, growth opportunities (e.g., R&D intensity and capital expenditures), CEO experience, CEO/firm stock performance, the square ofthe logarithm of firm size, and industry and year fixed effects. Of these, the measures for growth opportunities have relatively strong explanatory power. The signs of the coefficients on the remaining control variables generally are similar to those documented in prior literature (e.g., Coles, Daniel, and Naveen (2006)).

Whether the instruments satisfy the exclusion condition cannot be tested because the exogeneity condition involves an unobservable residual. When there are more instruments than endogenous regressors, however, we can perform a so-called Hansen J-test for overidentifying restrictions, which is the GMM equivalent of the Sargan test. This tests whether all instruments are exogenous, assuming that at least one of the instruments is exogenous. As reported in Tables 3 and 4, none of the eight J-statistics is significant at conventional levels. Given that our three instruments, *Geo_CEO_Mean*, *SD CEO comp*, and *Ind CEO comp* are variants on the same

[20] The F-statistic is formed based on Kleibergen-Paap Wald statistics using critical values from Stock and Yogo (2005).

theme, the competitiveness and depth of CEO labor market, the results of the J-tests are consistent with the notion that it is unlikely that some can satisfy the exclusion condition whilst others do not.[21]

Overall, the GMM IV results in Tables 4 and 5 suggest that there is a strong relation between performance and each of our three measures of CEO industry tournament incentives. Moreover, *CEO delta* and VP internal tournament incentives often continue to have explanatory power for performance.

4.2. Additional Explanations

CEO entrenchment represents a seemingly credible alternative explanation for the results on performance and the external pay gap. Higher entrenchment is likely to be associated with lower firm performance, higher CEO pay, a lower external pay gap, and also a higher internal pay gap. Thus, we should observe a positive relation between performance and the external pay gap. By the same logic, we should also observe a negative relation between performance and the internal pay gap. Tables 4 and 5 show positive coefficients on the internal pay gap, which is inconsistent with the entrenchment hypothesis.[22] Moreover, we include proxies for CEO power and entrenchment (e.g., duality, CEO tenure, and CEO ownership (or delta)) as controls, which suggests that tournament incentives rather than CEO entrenchment drive the positive relation between firm performance and the external and internal pay gaps.

[21] To further assess the exclusion condition, we group the instruments based on similarity of the arguments for including them in the first place (Section 3.2 above). *SD CEO comp* and *Ind CEO comp* both measure how industry-wide conditions in the labor market pertain to maximum compensation. *Geo_CEO_Mean* and *Ind CEO comp* both indicate market conditions (nearby versus in the industry) for individual CEO compensation. The Hansen test (four J statistics, not reported herein) fail to reject the null hypothesis for each pair of instruments for each of Q and ROE.

[22] Similarly, if entrenchment is associated with lower firm risk, arising from actions taken by the CEO to protect her position in the firm, then the industry pay gap would be negatively related to firm risk. As we report in Section 5, we find the opposite.

In similar style, though we also control for it with *CEO tenure* and prior firm performance, we reconsider CEO ability as an explanation for the positive relation between firm performance and the internal pay gap reported here and in Kale, Reis, and Venkateswaran (2009). Higher ability would cause better firm performance, higher CEO pay, and a higher internal pay gap, but also a lower external pay gap. Thus, we would observe a negative relation between performance and the external pay gap. Tables 4 and 5, controlling for the internal gap, provide evidence on the external pay gap that is inconsistent with CEO ability giving rise to our results on internal tournament incentives.

Finally, supposing that unobserved heterogeneity, specifically CEO ability and entrenchment, is constant through time, we repeat all of the analysis using firm-level fixed effects. The results are qualitatively similar.

4.3. Do Industry and Internal Tournament Incentives Reinforce One Another?

In an internal rank-order tournament among executives for the CEO position, the best relative performer is promoted. Promotion to the CEO position carries with it higher pay, status, and span of control. The potential for promotion provides managers with an incentive to expend higher effort. That additional managerial input increases the likelihood of promotion as well as firm output. One difficulty, however, with the internal horse-race model is that it need not be time-consistent. Once a well-qualified, effective executive has assumed the CEO position, absent outside options the likelihood that one of the other NEOs will become CEO in the near or medium term is substantially reduced. There is no reason for the company to dislodge the winner of the horse race, in which case any internal tournament incentives would be significantly diminished.

In this context, the CEO labor market and external tournament incentives take on a significant role. Our conjecture is that it is precisely because of the presence of the external tournament that internal tournament incentives have power. While the firm would want to retain an effective, top-rank CEO, such a CEO is likely to depart when offered a significantly better outside opportunity, in which case the internal horse race is still on, thereby providing significant internal tournament incentives. The presence of external opportunities for CEOs gives incentive power to the internal tournament and completes the logic of the hypotheses that underlie the findings in Kale, Reis, and Venkateswaran (2009) and Kini and Williams (2011).

Likewise, the internal tournament serves to deliver winners to the CEO position. The victors in the internal horse race become primary competitors for the top CEO positions in the industry. Accordingly, we surmise that the internal and external tournaments are "supermodular" insofar as they reinforce the effectiveness of one another.[23]

5. Industry Tournament Incentives and Firm Risk

We have established that firm performance is positively related to CEO industry tournament incentives. It appears that the CEO industry pay gap provides CEOs, and perhaps other NEOs on the executive team, the incentive to perform better. We also hypothesize that the possibility of being promoted to a better firm with higher compensation gives executives the incentive to increase firm risk. Increasing firm risk, through investment or financial policy, for example, can generate uncertain but extreme performance that increases the likelihood a CEO or other executive is promoted over peer CEOs.[24] Goel and Thakor (2008) provide a model that

[23] We are grateful to Nagpurnanand Prabhala for discussions that gave rise to this idea.

[24] Increasing risk in this way also increases the probability of the CEO being far out of the money in the competition for the tournament prize, but in a winner-take-all tournament losing is the same, regardless of whether it is a close or distant loss. That said, a CEO can potentially lose her job when performance is extremely bad. Thus, there is a

addresses this connection between tournament incentives and corporate risk taking. The idea also is familiar insofar as Kini and Williams (2011) find a relation between internal tournament incentives and firm risk and Brown Harlow, and Starks (1996) and Chen, Hughson, and Stoughton (2011) apply the notion to competition among mutual fund managers.[25]

We examine two measures of risk: stock return volatility, *Stock return vol*, which is the variance of daily stock return for the calendar year t; and Cash flow volatility, *CF vol*, which is the seasonally-adjusted standard deviation of quarterly EBITDA divided by total assets from year t through year t+4. Our primary explanatory variable is the CEO industry pay gap. Of course, in determining firm risk CEOs face potential costs of reduced expected utility arising from exposure to risk through performance-contingent compensation. On the other hand, convexity in executive compensation can offset the risk exposure arising from CEO delta to possibly increase the incentive to take risk (Guay (1999); Coles, Daniel, and Naveen (2006)). Thus, it is necessary to control for CEO delta and vega arising from the compensation scheme, as well as VP tournament incentives (per Kini and Williams (2011)), to assess whether industry tournament incentives affect firm risk.

Based on prior literature (Servaes (1994); Bhagat and Welch (1995); Opler, Pinkowitz, and Stulz (1999); Nam, Ottoo, and Thornton (2003); and Coles, Daniel, and Naveen (2006)), we also control for firm size, Tobin's *Q*, book leverage, the growth rate of sales, stock return, and CEO age and tenure. Unobserved variables, such as CEO risk aversion, are likely to affect both the dependent variable (firm risk) and independent variable (industry tournament incentive). For

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tradeoff between the cost from the increased likelihood of being fired and the benefit from increasing promotion probability and expected payoff. If the benefits exceed the costs, this tradeoff suggests that the chosen risk level will increase with the magnitude of the prize (pay gap) in the industry tournament.

[25] There is a potential countervailing effect. In an industry with big pay gaps, high-paying firms will understand that low-paid CEOs have strong incentives to take risks. Therefore, when a low-paid CEO delivers strong performance, the high-paying firms realize that this performance was more likely due to luck than skill and, thus, the firm will be less willing to hire the low-paid CEO.

instance, a less risk-averse CEO will take more risks and earn more through increased option value, which leads to a lower industry pay gap. Although the omitted variable problem works against finding a positive link between firm risk and industry pay gap, we try to mitigate the bias through year and industry fixed effects and instrumental variable estimation with GMM. Tables 6 and 7 report the results. The first two columns in Table 6 show the results using daily stock return volatility (*Stock return vol*$_{+1}$) for the year ahead. Columns 3 and 4 use forward cash flow volatility (using 20 quarterly numbers over years t+1 to t+5, *CF vol*$_{+1}$) as the dependent variable. For convenience in reporting, we multiply the left-hand-side variables by 100.

For stock return volatility, OLS (column 1) yields a negative and significant coefficient of -0.012 on Ln(*Indgap1*). GMM IV (column 2) gives a positive coefficient on Ln(*Indgap1*), 0.190, which is significant at the 1% level. This differential is consistent with the omitted variable problem leading to a biased OLS parameter estimate on industry tournament incentive. The Hausman exogeneity test rejects the null hypothesis that the OLS and GMM IV estimates on Ln(*Indgap1*) are the same at the 1% level. A one-standard-deviation increase in *Indgap1* implies a 0.003 increase stock return volatility, as compared to a mean (median) of 0.03 (0.025).

Columns 3 and 4 replace the dependent variable with cash flow volatility. The OLS coefficient on Ln(*Indgap1*) is not different from zero, while the GMM IV coefficient is positive and significant at the 5% level. Again, the Hausman exogeneity test rejects the null at the 1% level. Based on GMM IV, a one-standard-deviation increase in *Indgap1* implies an increase of cash flow volatility of 0.002, versus mean (median) cash flow volatility of 0.012 (0.007).

Table 7 reports specifications like those in Table 6 but based on the alternative measures of tournament incentives, Ln(*Indgap1_raw*), Ln(*Indgap2*) and Ln(*Indgap3*). In all six specifications, three for stock return volatility and three for cash flow volatility, the coefficients

on the CEO industry tournament incentive measures are positive and significant. The estimated effect of a change in the industry pay gap measure is economically significant in all six instances. The Hausman test rejects the null hypothesis that the OLS and GMM IV estimates are the same at the 1% level in five of six models and at the 5% level in the sixth.

To address further the possibility that the instruments are weak, Tables 6 and 7 report the F-test for relevance for the collection of instruments used in each of the first-stage regressions that support the second stage specifications. The eight first-stage F-statistics in Tables 6 and 7 vary from 21.82 up to 123.46. We conclude that our instruments satisfy the relevance condition.

In terms of the Hansen test for overidentification, as reported in Tables 6 and 7 none of the eight J-statistics is significant at conventional levels. Moreover, we again group the instruments based on pairwise similarity, *SD CEO comp* with *Ind CEO comp* and *Geo_CEO_Mean* with *Ind CEO comp*. The J-tests (not reported) fail to reject the null hypothesis when, for each pair of instruments for each of *Stock return vol* and *CF vol*, one of the pair of instruments is excluded. Overall, the Hansen J-test results are inconsistent with the notion that some of the instruments satisfy the exclusion restriction while others do not.

The effects of delta and vega on firm risk are positive but vary in statistical significance. The coefficients on the internal pay gap are positive in all eight GMM IV models and are significant at the 5% level in six out of the eight. Growth opportunities, as measured by Tobin's *Q*, are positive and significant at 1% in all eight models. The signs of the coefficients on the remaining control variables are generally similar to those documented in prior literature (e.g., Coles, Daniel, and Naveen (2006)).In summary, using GMM with instruments, industry and year fixed effects, two measures of firm risk, and three different measures of the CEO industry pay gap, industry tournament incentives have a positive effect on firm risk that is economically and

statistically significant. These results support the contention that a greater industry tournament incentive leads to higher risk taking by CEOs.

6. Industry Tournament Incentives and Investment and Financial Policy

We now assess the potential avenues through which the CEO industry pay gap is associated with firm risk by exploring the relation between industry tournament incentives and the riskiness of investment and financial policy. We hypothesize that usage of policies that increase firm risk, such as R&D intensity, firm focus, and leverage, will increase in the industry pay gap, while the relation will be negative for investment in hard assets. We use two measures for firm focus, the Herfindahl index for industry sales and the number of operating segments. For investment policy we use R&D intensity and scaled capital. For financial policy we use book leverage.[26]

Table 8 reports the results. In all five specifications the estimated coefficient on Ln(*Indgap1*) has the predicted sign and is significant at the 5% level in four cases and the 10% level in the other case.[27] R&D intensity increases in industry tournament incentives, while capital expenditures decrease. Firm focus and *Book leverage* increase in industry tournament incentives.[28]

In terms of economic significance, a one-standard-deviation increase in *Indgap1* implies an increase of R&D intensity of 0.003, as compared to average *R&D* of 0.037, and a decrease of *CAPEX* by 0.007, as compared to the average of 0.064. The same size increase in *Indgap1*

[26] Compustat does not report segment sales data for many firms prior to 2002, so we have fewer observations when using *H-index* as the dependent variable, as compared to using the number of segments. If a firm does not report R&D expenditures or capital expenditures, we assume the value to be zero.
[27] The results are similar using the three alternative measures of industry tournament incentives.
[28] If an industry has larger pay gaps between firms (in both directions), then the CEO's future pay is riskier. A risk-averse CEO may offset this higher risk by taking on lower leverage, etc., which lowers return volatility. This confounding force would mute the effects of ITI.

implies a decrease of the number of segments by 1.04 (average *number of segments* per firm is 4.56) and an increase of the industry Herfindahl index of firm sales by 0.129 (mean *H-index* is 0.543). Finally, a one-standard-deviation increase in *Indgap1* implies an increase in *Book leverage* of 0.016, as compared to mean *Book leverage* of 0.194.

7. Promotion Probability and Industry Tournament Incentives

A higher probability of winning the prize will increase the incentive effect of a given prize in the industry CEO tournament. Thus, we re-estimate the performance and risk specifications using OLS but include the interaction of prize size, Ln(*Indgap1*), and a proxy for the probability of winning. Per Section 3.4 above, our proxies include whether the CEO is new (*New CEO*), whether the CEO is near retirement (*Retire age*), and the attractiveness of the CEO as a candidate based on prior stock returns (*St ret dum*). We also use industry homogeneity, because the likelihood of hiring an outsider as CEO is higher when firms operate in homogeneous industries (Parrino (1997)). We follow Parrino (1997) to construct *Ind Homo*, which measures the similarity among firms within an industry after isolating market effects.[29] A lower probability of winning the tournament reduces the incentive effect of the external pay gap. Thus, for firm performance or risk as the dependent variable, the estimated coefficient on the interaction of Ln(*Indgap1*) with *New CEO* and *Retire age* should be negative, while the estimates on the interaction of each of *St ret dum* and *Ind Homo* with Ln(*Indgap1*) should be positive.

[29] First, we assign firms in the CRSP monthly returns file to their respective Fama-French 30 industry code and then regress each firm's prior 60 monthly returns on an equally weighted monthly industry index and the market return. For each firm, we then compute the partial correlation coefficient between the firm's returns and the industry index while holding market returns constant. The variable *Ind Homo* is the average partial correlation coefficient for all firms within an industry. We use a 5-year rolling estimation period for each year in the sample.

Table 9 shows that the proxies for probability of winning the industry tournament perform mostly as predicted. Panel A considers Tobin's *Q* (columns 1-4) and *ROE* (columns 5-8) as dependent variables. Panel B considers stock return volatility (columns 1-4) and cash flow volatility (columns 5-8) as dependent variables. Each interaction term appears in four specifications, one each for the two firm performance measures and the two firm risk measures. For Ln(*Indgap1*) x *New CEO*, all four coefficients are negative and three are significant at the 5% level and one at the 10% level. The four estimated coefficients on Ln(*Indgap1*) x *Retire age* are all negative but only one is statistically significant. For Ln(*Indgap1*) x *St ret dum*, all four coefficients are positive and significant at the 1% level or better. The four coefficients on the interaction term for *Ind Homo* are positive and are significant at the 10% level when the dependent variable measures firm risk. Overall, Table 9 provides evidence that industry tournament incentives are more effective when the probability the CEO can win the tournament is higher. The results are similar for the three alternative measures of industry tournament incentives. Taken together, our conclusions on the external pay gap are robust to controlling for the probability of obtaining the prize. Increasing (decreasing) the probability of winning the tournament increases (decreases) the incentive effect of a given size of the prize. [30]

8. Industry Tournament Incentives among Financial Firms and Utilities

We examine the implications of industry tournament incentives separately for financial firms and utilities. We examine utilities because the incentive effects of the CEO industry tournament are less likely to be present among regulated utilities. Banks and other financial firms are particularly important in light of their systemic role in the recent economic and

[30] Though we do not employ GMM IV methods here, insofar as variation in the probability of winning represents an exogenous source of variation, the structure of the experiment and the nature of the results in Table 9 add credibility to our hypotheses and our interpretation of the GMM IV results.

financial crisis and the corresponding attention directed by regulators to the structure of executive compensation and incentives in such financial services companies.

Without reporting the results in detail, we find that industry tournament incentives have no effect on performance or risk for utilities firms and do not affect the performance of financials firms. On the other hand, industry tournament incentives have a statistically significant positive effect on the volatility of cash flows and stock returns in financial firms. The effect also is economically significant. A one-standard-deviation increase in *Indgap1* implies an increase of return (cash flow) volatility of 0.005 (0.001), which represents 22 (25) percent of the mean return (cash flow) volatility for financial firms of 0.023 (0.004).

9. The CEO Labor Market: Incoming and Outgoing CEOs

Potential interfirm mobility of top executives is an important ingredient in the industry tournament. To frame and provide additional support for our analysis of external tournament incentives, we characterize: the rate and determinants of CEO turnover for all firms in the S&P 1500, over the period 1992 to 2009, and the attributes of incoming CEOs newly hired over 1992-2005. We use the longer period for CEO departures because that analysis does not require compensation data.

9.1. CEO Turnover in the Presence of Industry Tournament Incentives

We define turnover in a given fiscal year t as when the CEO in year *t* is no longer the CEO by the following year *t+1*. Following Kaplan and Minton (2012), "non-standard turnover" is departure due to an acquisition or bankruptcy/delisting, while all other turnover, arising from normal hiring and firing, is "standard." Panel A of Table 10 presents the level of CEO turnover

by year and by type. Standard turnover, our focus and the focus in much of the literature, is 11.42%, and non-standard turnover due to acquisition and delisting is 3.71%.[31]

We estimate rudimentary probit models to examine the determinants of the likelihood of standard CEO turnover. The dependent variable is equal to one if a CEO departs in that year and zero otherwise. We report the marginal changes in the probability of CEO turnover, labeled as ΔProb, implied by the probit coefficient estimates, that result from a unit change in the explanatory variables,[32] In some specifications, we use the 1998-2009 subsample, because 1997-1998 roughly coincides with the large increase in CEO pay described in Bebchuk and Grinstein (2005) and a modest increase in CEO turnover rate (Panel A).

We follow Kaplan and Minton (2012) and Jenter and Kanaan (2010) to include: market performance, measured as the annual return on the S&P 500 index; relative industry performance, measured as the difference between the return on the median firm in the industry and the return on the S&P 500 index; and relative firm performance, measured as firm stock return minus the return for the median firm in the same industry (Fama-French 30). Following Huson et al. (2001), we include the change in accounting performance, measured as the change of ROA from year t-1 to year t, and the natural logarithm of firm sales. Finally, we include a CEO retirement age dummy, equal to 1 if lagged CEO age is greater than or equal to 62, and 0 otherwise.

Panel B of Table 10 reports the results. The first two columns show the results for standard turnover for a simple, often-used specification. Our results are similar to those in prior papers (e.g., Table 4, Kaplan and Minton (2012)). The likelihood of CEO turnover decreases in all three performance measures.

[31] The total turnover rate in our sample is 15.13% over the entire sample period, implying average CEO tenure of 6 years. Kaplan and Minton (2012) report a 15.6% turnover rate using S&P 500 firms for a slightly different sample period.

[32] For indicator variables, the coefficient represents the change in the probability associated with moving the indicator from zero to one.

In columns 3 and 4, which contain our main results on turnover, we augment the specification to include the square of industry-adjusted stock return. This term pertains directly to CEO mobility and external tournament incentives. The idea is that better firm performance means the CEO is less likely to be dismissed but also that at some point the CEO performs so well that the CEO is more likely to depart voluntarily, as she is hired away at better terms by another firm. Thus, under the industry tournament incentive model, we predict that the estimated coefficient on the quadratic term will be positive. The results are consistent with our hypothesis. The estimated coefficient on the quadratic term is positive and highly significant for the full sample and more recent subsample. Based on the estimates for the 1998-2009 subsample (column 4), the derivative of CEO turnover likelihood in industry-adjusted firm performance is negative until the independent variable reaches 0.817. Once industry-adjusted performance reaches this level, which falls between the 90th and 95th percentile in the data, the derivative becomes positive, so *better* performance is associated with a higher departure probability.

To further assess this result, we compare the performance of CEOs who depart to become CEO of another S&P 1500 company versus departing CEOs who do not. Median industry-adjusted stock return (unadjusted 1-year stock return) for the former group is 1.4% (11.6%), while performance of the latter group is significantly lower in both economic and statistical terms at -10.5% (1.0%). Thus, the probit results appear to be consistent with top performers moving up the industry CEO hierarchy.[33]

Two additional remarks are in order. First, comparing column 1 with 3 and 2 with 4, including the quadratic term leads to a more negative coefficient on the linear term. This combined with the negative portion of the quadratic term implies higher (more negative)

[33] We obtain similar results when we add lags of the independent variables and when we use annualized two-year versions of those independent variables. These models address the likely possibility that prior performance is used to assess the CEO (e.g., see Table 5 of Kaplan and Minton (2012)).

turnover-performance sensitivity for poor performers than reported in prior literature. Second, our probit results (columns 3 and 4), which to our knowledge are new to the literature, raise concerns about misspecification of executive turnover-performance sensitivity models.

9.2. Characteristics of Incoming CEOs

Among new CEOs, we identify the immediately prior employer. In our sample, between 1992 and 2005 there are 575 new CEOs arriving from outside the firm, which represents 15.6% of total new CEOs during that period.[34] We define an outside new CEO as coming from the same industry group based on the Fama-French 30-industry classification. We also determine whether the outside new CEO receives an increase in pay.[35]

Figure 1 characterizes incoming CEOs. Out of 575 outside new CEOs, 249 of them were ex-CEOs in a previous employer. The other 326 (56.7%) of new CEOs served in at least one senior management position at their prior company.[36] When new CEOs are ex-CEOs, they tend to come from the same industry group (145 or 58.2% of the cases).[37]

We argue that part of the prize for industry tournament is the pay increase an executive receives by moving. To assess whether this is the case in our sample, we identify CEOs whose

[34] ExecuComp identifies the executive who is the CEO (variable CEOANN) and the year in which the CEO was appointed (variable BECAMECEO). For firms with missing data on one or more of BECAMECEO and CEOANN, we inspect the proxy statement in that year and the previous year to ascertain whether the CEO is new. The percentage of new CEOs that are come from outside the firm is similar to that documented in Denis and Denis (1995) and Huson, Parrino and Starks (2001).

[35] ExecuComp provides data on whether CEO is hired from inside or outside for about 50% of the CEOs. For the remaining cases, we examine proxy statements and rely on data from Florian Peters, Alexander Wagner, Dirk Jenter, and Fadi Kanaan, to whom we are grateful.

[36] The distribution is similar to that documented in Cremers and Grinstein (2011): 62% of outside new CEOs in their sample are VPs in previous employers.

[37] One may argue that industry tournament incentives do not apply for executives inbound from a different industry group (41.8% of cases in our sample). Such executives, however, often have some relevant industry experience (Parrino (1997); Cremers and Grinstein (2011)). For example, they might have worked in the past in the same industry or the previous employer operates in multiple industries, some of which are related to the industry of the new employer. Moreover, some executives possess significant general human capital or broadly applicable expertise (e.g., supply chain, logistics, information technology, retail, intellectual property), in which case the notion of external tournament incentives can extend more broadly across industries. Along these lines, Custodio, Ferreira, and Matos (2011) show that that pay is higher for CEOs with general managerial skills. Indeed, in their data they find that pay increases the most when firms hire a new CEO from outside the firm and switch from a specialist to a generalist CEO.

total compensation in the current firm when she becomes the CEO is higher or lower than the total compensation she received when she leaves the previous employer ("low comp. → high comp." in the former case and "high comp. → low comp." in the latter case). Out of 575 outside new CEOs, 448 (=107+77+131+133), or 78%, receive an increase in pay after they become the CEO in the new firm. If we focus on the new CEOs who are ex-CEO in the previous employer, 74% (= (107+77)/249) receive an increase in total compensation, with an average dollar increase of $11.8 million. By way of comparison, in our sample CEOs hired from inside the firm receive an increase in pay on average of $0.90 million. These figures, combined with evidence from Gudell (2010), indicate that there exists a substantial financial reward for new CEOs with prior CEO experience, in particular, and for other externally sourced CEOs as well. [38] [39]

10. Conclusion

Empiricists have focused on executive wealth-performance sensitivity since the early 1990s (Jensen and Murphy (1990)), on executive risk-taking incentives starting 10 years later (Rogers (2002); Coles Daniel, and Naveen (2006)), and more recently on internal tournament incentives for executives (Kale, Reis, and Venkateswaran (2009); Kini and Williams (2011)). We conceptually and empirically extend the literature on corporate incentives to include CEO industry tournament incentives external to the firm.

Our measures of CEO industry tournament incentives all have substantial power to explain firm performance, risk, investment policy, and financial policy. The estimated effects of the

[38] Gudell (2010) argues that the incidence of serial CEOs is increasing. Gudell (2010) also presents empirical evidence that significant implicit incentives, through career concerns of the sort associated with external industry tournament incentives, apply with particular force to serial CEOs.

[39] Moreover, this external CEO labor market appears to impose significant pressure on corporate compensation policy. First, there is the widely publicized and analyzed increase through time in CEO pay. Second, in part by way of the process of benchmarking pay to peer firm pay, a CEO need not move to obtain the tournament prize.

CEO industry pay gap are economically significant.

It seems likely that it would be possible to extend the idea of industry tournament incentives beyond CEOs to other named executive officers. Just as CEOs appear to be motivated by the possibility of being promoted to another firm in the same industry with higher compensation, so might other executives who possess discretion and influence over firm assets. Indeed, in our sample, 56% of new CEOs were not CEO at their prior firm. Though on average the external industry pay gap is likely to underestimate the size of the tournament prize for non-CEO NEOs, it is plausible that some of the substantial effects on firm performance and risk we estimate arise from external tournament incentives for those executives.

Performance-on-structure and structure-on-structure empirical designs must surmount at least one significant conceptual hurdle (e.g., see Coles, Lemmon, and Wang (2011)). In this study, structure encompasses various aspects of the organization, including internal and external tournament incentives, NEO delta and vega, financial policy, and investment policy. Performance measures include firm value (e.g., *Q*), accounting return, and firm risk. We find, among other results, that Tobin's *Q* increases in both internal and external tournament incentives. The logical question arises as to why all firms don't increase these incentives and, thereby, increase firm value and *Q*. Of course, if firms had done so then we would not have observed the data that give rise to the estimated positive relation in the first place. At least two explanations for a relation between performance and structure are possible. One is that the observed positive relation represents equilibrium co-variation driven by one or more omitted variables. A second is that transaction costs prevent adjustment by firms of the organization form. Simply, the transaction costs of adjusting executive incentives exceed the benefits. The argument is not particularly plausible for the internal pay gap which, absent benchmarking to the external market,

is under the control of the firm. In contrast, this transaction costs argument is more plausible in the case of external tournament incentives, because a firm has little control over the compensation and perquisites offered at other companies, particularly at the firm that provides maximal pay.

Appendix: Data Sources and Definitions

Variable	Source	Definition
Incentives		
Indgap1 ($000)	Execucomp	Second-highest CEO's total compensation within industry – CEO's total compensation
Indgap1_raw ($000)	Execucomp	Highest CEO's total compensation within industry – CEO's total compensation
Indgap2 ($000)	Execucomp	Highest CEO's total compensation within industry and size – CEO's total compensation
Indgap3 ($000)	Execucomp	Above median CEO's Total compensation within industry – CEO's total compensation
Firm gap ($000)	Execucomp	CEO's total compensation – Median VP total compensation
CEO delta (per $1)	Execucomp	(Share owned at the beginning of the year + Average delta of prior option grants*No. of options)/Number of shares outstanding
CEO vega ($000)	Execucomp	The dollar change in the CEO's wealth for a 0.01 change in standard deviation of returns
CEO total comp ($000)	Execucomp	Short-term compensation + long-term compensation
CEO short-term comp ($000)	Execucomp	Salary + bonus + other annual payments
CEO long-term comp ($000)	Execucomp	Restricted stock grants + options granted + long-term incentive payouts + total other annual payments
CEO Characteristics		
CEO tenure	Execucomp	The number of years as the firm's CEO
CEO age	Execucomp	The CEO's age in sample year
Duality	RiskMetrics	A dummy variable = 1 if the CEO is also the chair of the board, and 0 otherwise
Succession plan	Execucomp	A dummy variable = 1 if the firm lists a President and/or COO as a top five highest paid executive in the current year, and 0 otherwise
Insider CEO	Execucomp	A dummy variable = 1 if the current CEO ascended to his position from within the firm, and 0 otherwise
New CEO	Execucomp	A dummy variable = 1 in the CEO's first year of service as CEO, and 0 otherwise
Retire CEO	Execucomp	A dummy variable = 1 if the CEO's age is more than 62 years, and 0 otherwise
Industry Characteristics		
Ind # CEOs	Execucomp	The number of CEOs within each industry
Ind sales ($000,000)	Execucomp	The sum of net sales for all firms within each industry
H-index	Execucomp	The sum of the square of segment sales divided by the square of firm sales, the industry Herfindahl index of firm sales
Ind Homo	CRSP	Mean partial correlation between firm's returns and an equally weighted industry index for all firms in the same Fama-French 30 industry code holding market return constant with prior 60 monthly returns..
Industry stock return vol	CRSP	The volatility of industry stock return for the prior year based on daily return of an equal-weighted portfolio using all firms in the industry

Firm Characteristics		
Q	Compustat	The ratio of the sum of market value of equity and the book value of debt to total assets
ROE	Compustat	Return on equity per share, calculated as net income divided by shareholder equity
Stock return vol	CRSP	Stock return volatility based on one-year of daily returns
CF vol	Compustat	Cash flow volatility which is the seasonally-adjusted standard deviation of quarterly EBITDA divided by total assets from year t to year t+4
R&D	Compustat	R&D expenditures divided by total assets
CAPEX	Compustat	Capital expenditures divided by total assets
# segments	Compustat	The number of operating segments as reported in Compustat segment database
Total assets	Compustat	Total assets
Book leverage	Compustat	Book leverage which is interest-bearing debt divided by total assets
Stock return 1YR	Compustat	One year stock return
St ret dum	Compustat	A dummy variable =1 if Stock return 1YR is above the industry median, 0 otherwise
Sales growth	Compustat	The average sales growth over years *t*-4 through *t*-1
ROA	Compustat	Return on assets, calculated as net income before extraordinary items and discontinued operations divided by total assets
Capital investment	Compustat	Investment in property, plant, and equipment divided by total assets
FCF	Compustat	Free cash flow = (operating income before depreciation - interest expense - income taxes minus cash dividends - capital expenditure) / total assets
Instrumental Variable		
Geo CEO mean	Execucomp Compustat	The average total compensation received in the *previous* year by CEOs who work at firms in the different industry and headquartered within a 250-kilometer radius of the firm
SD CEO comp	Execucomp	The standard deviation of CEO's total compensation within each industry
Ind CEO comp ($000)	Execucomp	The sum of total compensation across all CEOs within each industry

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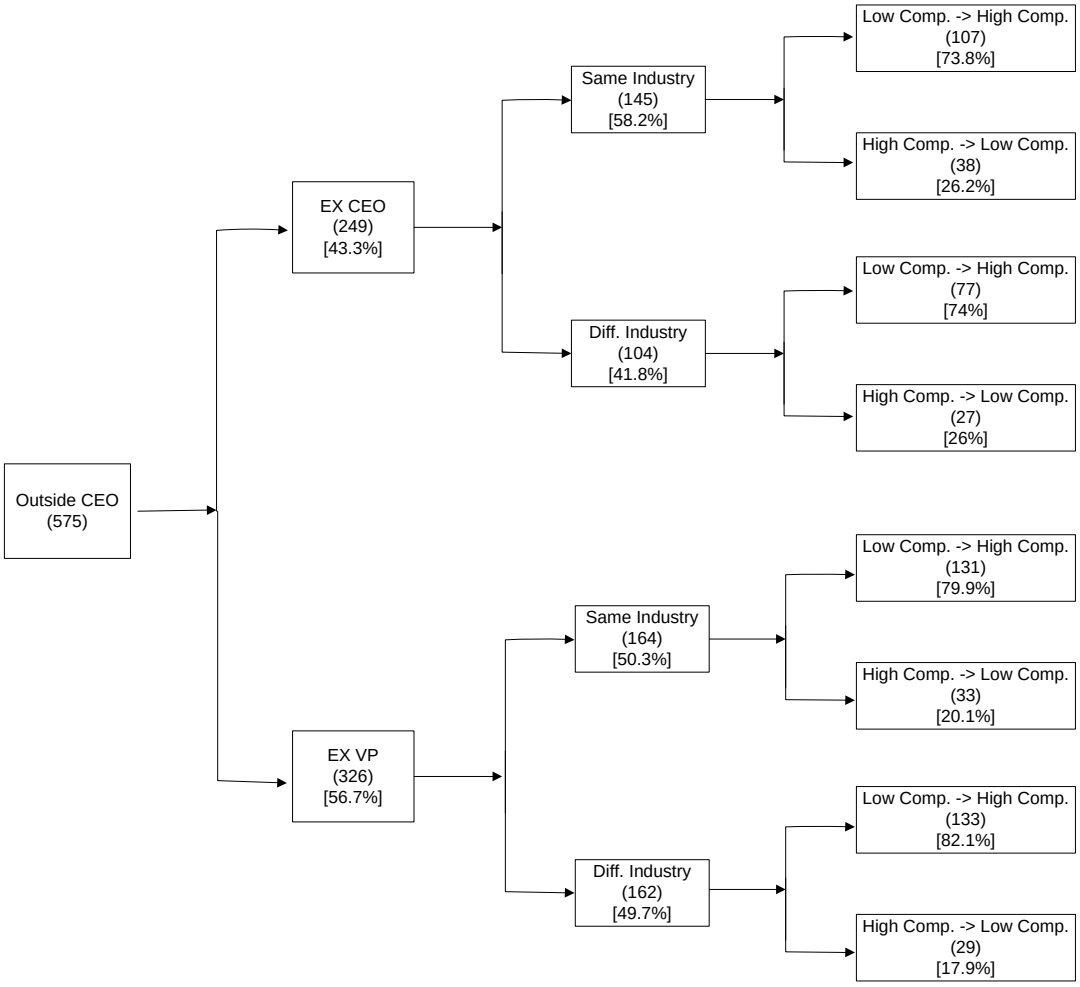

Figure 1: Characteristics of outside new CEOs arriving between 1992 and 2005. Outside new CEOs are CEOs who come from outside the firm. Each cell shows the number of CEOs (in parenthesis) and the percentage of CEOs (in bracket) in the designated category. We separate the outside new CEOs into whether the new CEO's position in the previous employer was CEO or VP. In either case, we further separate the CEOs into whether or not the previous employer and the current firm are in the same industry group defined by Fama-French 30 industry classifications. Regardless of the industry characteristics, we also separate the CEOs depending on whether the total compensation when joining the current firm is higher or lower than that when leaving the previous employer.

Table 1: Summary Statistics

This table presents summary statistics for ExecuComp firms from 1992 – 2005. The sample excludes financial firms and utilities. We provide incentive measures in Panel A, CEO characteristics in Panel B, industry characteristics in Panel C, and firm characteristics in Panel D. See the Appendix for variable definitions. The industry tournament incentive measures and industry instruments are based on the Fama-French 30 industry classification. All variables related to firm characteristics are winsorized at 1% and 99%.

Panel A: Incentives						
Variable	N	Mean	Median	Std Dev	10th Pctl	90th Pctl
Indgap1 ($000)	17702	23856.83	13852.66	29923.99	2834.81	49495.46
Indgap1_raw ($000)	17702	57157.32	22597.58	105232	5852.05	118860.6
Indgap2 ($000)	17702	33614.49	10873.29	78303.19	1804.19	68654.15
Indgap3 ($000)	17702	30013.51	7164.66	78205.93	1565.03	63161.01
Firm gap ($000)	17702	3140.2	1138.1	12251.46	77.665	6709.23
CEO delta (per $1)	17702	0.039	0.014	0.071	0.001	0.105
CEO vega ($000)	17702	65.363	32.504	202.055	0	148.577
CEO total compensation ($000)	17702	4256.6	1966.91	11333.31	524.678	8906.13
CEO short term compensation ($000)	17702	1273.33	892.404	1444.9	350.899	2507.29
CEO long term compensation ($000)	17702	2983.26	906.496	10938.53	7.261	6645.47
Panel B: CEO Characteristics						
Variable	N	Mean	Median	Std Dev	10th Pctl	90th Pctl
CEO tenure	17702	7.391	7	3.985	3	13
CEO age	16490	55.405	55	7.822	45	65
Duality	17635	0.636	1	0.481	0	1
Succession plan	17570	0.500	1	0.500	0	1
Insider CEO	12442	0.659	1	0.474	0	1
New CEO	17702	0.075	0	0.264	0	0
Retire CEO	17702	0.219	0	0.414	0	1
Panel C: Industry Characteristics						
Variable	N	Mean	Median	Std Dev	10th Pctl	90th Pctl
SD CEO comp	17702	7403.37	5002.68	8336.48	1879.98	14363.59
Ind # CEOs	17702	91.813	63	64.921	25	204
Ind stock return vol	17702	0.012	0.011	0.006	0.006	0.018
Ind sales ($000,000)	17702	318717	283651.3	253555.1	59537.8	583509.6
Ind CEO comp ($000)	17702	431494.7	238909.6	454520.3	72448.87	985282.7

Panel D: Firm Characteristics						
Variable	N	Mean	Median	Std Dev	10th Pctl	90th Pctl
Q	17304	2.233	1.647	2.607	1.036	3.778
ROE (%)	17161	7.229	11.458	27.7257	-9.626	25.086
Stock return vol	17218	0.030	0.025	0.021	0.015	0.049
CF vol	15729	0.012	0.007	0.020	0.002	0.026
R&D	17682	0.037	0.002	0.101	0	0.113
CAPEX	17682	0.064	0.048	0.061	0.014	0.131
# segments	9547	4.559	3	4.344	1	12
H-index	9547	0.540	0.422	0.328	0.166	1
Total assets ($000,000)	17682	4787.35	963.978	20173.19	172.597	9819.99
Book leverage	17624	0.191	0.166	0.186	0	0.410
Stock return (1YR)	17317	0.182	0.102	0.536	-0.360	0.739
Sales growth	17626	0.177	0.091	0.817	-0.106	0.440
ROA (%)	17675	2.464	5.006	26.324	-5.761	13.061
Capital investment	17642	0.302	0.247	0.218	0.064	0.637
FCF	17612	0.028	0.047	0.149	-0.057	0.114

Table 2: Correlation Matrix

This table presents the correlation matrix for key incentive measures and measures of firm performance and risk. *Indgap1* is second highest CEO total compensation within the industry - CEO total compensation. *Indgap2* is highest CEO total compensation within the industry and size group - CEO total compensation. *Indgap3* for a CEO with compensation below the industry median is the total compensation of the CEO 50 percentile points higher in the distribution - CEO total compensation, and for a CEO above the median it is maximal CEO compensation in the industry – CEO total compensation. *Firm gap* is CEO total compensation – median VP total compensation. *CEO delta* is (shares owned at the beginning of the year + average delta of prior option grants * no. of options)/ number of shares outstanding. *CEO vega* is the dollar change in CEO expected wealth per 0.01 change in standard deviation of returns. *Q* is the ratio of the sum of market value of equity and the book value of debt to total assets. *ROE* is return on equity per share, calculated as net income divided by shareholder equity. *Stock return vol* is standard deviation of one-year daily stock returns. *CF vol* is cash flow volatility which is the seasonally-adjusted standard deviation of quarterly EBITDA divided by total assets from year t to year t+4. Pearson correlations are above the diagonal and Spearman rank-correlations are above the diagonal. P-values are reported in the parentheses below the coefficients.

	Indgap1	*Indgap2*	*Indgap3*	*Firm gap*	*CEO delta*	*CEO vega*	*Q*	*ROE*	*Stock return vol*	*CF vol*
Indgap1		0.522	0.432	-0.040	0.035	0.014	0.167	-0.008	0.326	0.098
		(0.001)	*(0.001)*	*(0.001)*	*(0.001)*	*(0.064)*	*(0.001)*	*(0.278)*	*(0.001)*	*(0.001)*
Indgap2	0.658		0.628	0.020	-0.012	0.005	0.092	-0.002	0.143	0.018
	(0.001)		*(0.001)*	*(0.179)*	*(0.151)*	*(0.512)*	*(0.001)*	*(0.790)*	*(0.001)*	*(0.024)*
Indgap3	0.381	0.489		0.065	-0.052	0.051	0.122	-0.004	0.163	0.025
	(0.001)	*(0.001)*		*(0.001)*	*(0.001)*	*(0.001)*	*(0.001)*	*(0.639)*	*(0.001)*	*(0.002)*
Firm gap	-0.164	0.031	0.571		-0.031	0.078	0.072	0.001	0.000	-0.004
	(0.001)	*(0.001)*	*(0.001)*		*(0.001)*	*(0.001)*	*(0.001)*	*(0.971)*	*(0.963)*	*(0.591)*
CEO delta	0.157	-0.021	-0.079	-0.189		0.092	0.050	-0.001	0.048	0.041
	(0.001)	*(0.001)*	*(0.001)*	*(0.001)*		*(0.001)*	*(0.001)*	*(0.874)*	*(0.001)*	*(0.001)*
CEO vega	0.028	0.012	0.287	0.348	0.343		0.097	0.0020	-0.017	-0.007
	(0.001)	*(0.114)*	*(0.001)*	*(0.001)*	*(0.001)*		*(0.001)*	*(0.792)*	*(0.028)*	*(0.409)*
Q	0.159	0.120	0.166	0.104	0.047	0.206		-0.001	0.118	0.254
	(0.001)	*(0.001)*	*(0.001)*	*(0.001)*	*(0.001)*	*(0.001)*		*(0.851)*	*(0.001)*	*(0.001)*
ROE	-0.111	-0.001	0.096	0.177	-0.053	0.131	0.413		0.005	0.008
	(0.001)	*(0.887)*	*(0.001)*	*(0.001)*	*(0.001)*	*(0.001)*	*(0.001)*		*(0.477)*	*(0.326)*
Stock Return vol	0.421	0.202	0.061	-0.204	0.253	-0.076	0.004	-0.275		0.211
	(0.001)	*(0.001)*	*(0.001)*	*(0.001)*	*(0.001)*	*(0.001)*	*(0.578)*	*(0.001)*		*(0.001)*
CF vol	0.142	0.031	-0.010	-0.115	0.123	-0.049	0.134	-0.040	0.281	
	(0.001)	*(0.001)*	*(0.227)*	*(0.001)*	*(0.001)*	*(0.001)*	*(0.001)*	*(0.001)*	*(0.001)*	

Table 3: Determinants of Industry Tournament Incentives

This table presents multivariate tests for the determinants of industry tournament incentives using data on ExecuComp firms over 1992 – 2005. The dependent variables are the natural logarithms of *Indgap1*, *Indgap2*, and *Indgap3*. *Indgap1* is second highest CEO total compensation within the industry - CEO total compensation. *Indgap*1*_raw* is highest CEO total compensation within industry - CEO total compensation. *Indgap2* is highest CEO total compensation within the industry and size group - CEO total compensation. *Indgap3* for a CEO with compensation below the industry median is the total compensation of the CEO 50 percentile points higher in the distribution - CEO total compensation, and for a CEO above the median it is maximal CEO compensation in the industry – CEO total compensation. +1 indicates year t+1. All other incentive variables and control variables are defined in the Appendix. IV designates and instrumental variable. We include year and industry fixed effects in all specifications. Industry clustered and Newey-West corrected (up to four lags) standard errors are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

VARIABLES	Ln(*Indgap1*)$_{+1}$	Ln(*Indgap1_raw*)$_{+1}$	Ln(*Indgap2*)$_{+1}$	Ln(*Indgap3*)$_{+1}$	Ln(*Indgap1*)$_{+1}$
Ln(*Total assets*)	-0.271***	-0.244***	0.108***	0.168***	-0.271***
	(0.040)	(0.037)	(0.037)	(0.054)	(0.040)
Stock return (1YR)	-0.057**	-0.059	-0.128*	-0.159***	-0.057**
	(0.026)	(0.050)	(0.063)	(0.046)	(0.027)
Sales growth	0.000	-0.020	-0.071	-0.034	0.002
	(0.010)	(0.018)	(0.045)	(0.033)	(0.010)
Ln(*CEO tenure*)	0.023	-0.022	-0.004	0.042	0.033
	(0.040)	(0.036)	(0.041)	(0.037)	(0.042)
Ln(*CEO age*)	0.164	0.085	0.486***	-0.250	0.492***
	(0.154)	(0.113)	(0.166)	(0.169)	(0.165)
Duality					-0.077*
					(0.040)
Succession plan					-0.016
					(0.034)
New CEO					0.074
					(0.062)
Retire CEO					-0.142*
					(0.071)
Ln(*Ind # CEOs*)	0.590**	0.315	0.424**	0.092	0.589**
	(0.270)	(0.295)	(0.199)	(0.218)	(0.270)
Industry stock return vol	-1.379*	-0.372	-0.392	-0.152	-1.357*
	(0.700)	(0.713)	(0.449)	(0.467)	(0.689)
SD CEO comp (IV)	0.015**	0.021**	0.016**	0.014**	0.015**
	(0.007)	(0.010)	(0.007)	(0.006)	(0.007)
Ln(*Ind CEO comp*) (IV)	0.317*	0.575**	0.446**	0.533***	0.312*
	(0.161)	(0.244)	(0.174)	(0.148)	(0.161)
Ln(*Geo CEO Mean*) (IV)	-0.169**	-0.120**	-0.145*	-0.129**	-0.168**
	(0.063)	(0.046)	(0.078)	(0.051)	(0.064)
Constant	6.353***	4.481**	0.946	2.204	5.144**
	(1.854)	(2.048)	(1.722)	(1.626)	(1.957)
Year Dummy	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	13,611	14,022	14,022	14,022	13,570
R-squared	0.101	0.149	0.056	0.069	0.101

Table 4: Effects of Industry Tournament Incentives on Firm Performance

This table presents multivariate regression of firm performance on industry tournament incentives using ExecuComp firms from 1992 – 2005. The dependent variables are *Q* and *ROE*. +1 indicates year t+1. *Q* is the ratio of the sum of market value of equity and the book value of debt to total assets. *ROE* is return on equity per share, calculated as net income divided by shareholder equity. Ln(*Indgap1*) is the natural logarithm of *Indgap1*, where *Indgap1* is second highest CEO total compensation within industry - CEO total compensation. All other incentive variables and control variables are defined in the Appendix. We include year and industry fixed effects in all specifications. For the GMM IV model, only the second stage regression is reported. Industry clustered and Newey-West corrected (up to four lags) standard errors are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

VARIABLES	Q OLS	Q GMM IV	ROE_{+1} OLS	ROE_{+1} GMM IV
Ln(*Indgap1*)	-0.007		-0.004**	
	(0.007)		(0.002)	
Predicted Ln(*Indgap1*)		0.261***		0.009**
		(0.033)		(0.004)
CEO delta	0.017**	0.261***	0.004**	-0.009
	(0.007)	(0.033)	(0.002)	(0.009)
Ln(*Firm gap*)	0.868**	1.170***	0.038**	0.044**
	(0.361)	(0.261)	(0.015)	(0.017)
Ln(*CEO tenure*)	0.021	0.054***	0.004	0.003*
	(0.015)	(0.010)	(0.003)	(0.002)
Ln(*CEO age*)	0.063	0.042*	0.032***	0.031***
	(0.046)	(0.024)	(0.010)	(0.007)
Stock return (1YR)	-0.544**	-0.613***	0.055*	0.056**
	(0.263)	(0.117)	(0.032)	(0.026)
Sales growth	-0.103	-0.448	-0.240*	-0.244**
	(0.484)	(0.319)	(0.118)	(0.108)
FCF	0.174	0.172*	-0.025**	-0.025***
	(0.137)	(0.098)	(0.012)	(0.009)
R&D	1.088	1.158*	0.522***	0.523***
	(1.181)	(0.656)	(0.127)	(0.073)
Capital investment	4.089***	4.114***	0.244*	0.250**
	(0.976)	(0.904)	(0.131)	(0.103)
Ln(*Total assets*)	-0.257	-0.311***	0.089**	0.093***
	(0.174)	(0.097)	(0.036)	(0.023)
Ln(*Total assets*)^2	-0.750***	-0.994***	0.032	0.035
	(0.183)	(0.127)	(0.030)	(0.023)
Industry stock return vol	1.158***	1.173***	0.054***	0.055***
	(0.168)	(0.071)	(0.010)	(0.008)
Ln(*Ind # CEOs*)	0.047***	0.069***	-0.001	-0.001
	(0.012)	(0.008)	(0.002)	(0.002)
Ln(*Ind sales*)	0.224	0.090	0.004	0.011
	(0.148)	(0.091)	(0.034)	(0.027)
Year Dummy	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Observations	15,454	15,277	13,709	13,551
R-squared	0.199	0.134	0.061	0.060
Endogeneity, Relevance, and Overidentification				
Hansen *J*-Test		1.692		1.709
Hausman Exogeneity Test		83.088***		32.951***
First Stage *F*-Statistics		152.61***		127.43***

Table 5: Effects of Industry Tournament Incentives on Firm Performance: Alternative Tournament Measures

This table presents GMM IV regression (second stage) of firm performance on alternative measures of industry tournament incentives using ExecuComp firms from 1992 – 2005. The dependent variables are *Q* and *ROE*. +1 indicates year t+1. *Q* is the ratio of the sum of market value of equity and the book value of debt to total assets. *ROE* is return on equity per share, calculated as net income divided by shareholder equity. Ln(*Indgap1_raw*) is the natural logarithm of Ln(*Indgap1_raw*), where *Indgap*1*_raw* is highest CEO total compensation within industry - CEO total compensation. Ln(*Indgap2*) is the natural logarithm of *Indgap2*, where *Indgap2* is highest CEO total compensation within industry and size - CEO total compensation. Ln(*Indgap3*) is the natural logarithm of *Indgap3*, where *Indgap3* for a CEO with compensation below the industry median is the total compensation of the CEO 50 percentile points higher in the distribution - CEO total compensation and for a CEO above the median it is maximal CEO compensation in the industry – CEO total compensation. All other incentive variables and control variables are defined in the Appendix. We include year and industry fixed effects in all specifications. Industry clustered and Newey-West corrected (up to four lags) standard errors are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

VARIABLES	*Q* GMM IV	*Q* GMM IV	*Q* GMM IV	ROE_{+1} GMM IV	ROE_{+1} GMM IV	ROE_{+1} GMM IV
Predicted Ln(*Indgap1_raw*)	0.221***			0.020***		
	(0.028)			(0.007)		
Predicted Ln(*Indgap2*)		0.324***			0.026**	
		(0.043)			(0.010)	
Predicted Ln(*Indgap3*)			0.361***			0.029***
			(0.044)			(0.011)
CEO delta	1.210***	1.501***	1.452***	0.009	-0.014	-0.011
	(0.260)	(0.277)	(0.268)	(0.051)	(0.055)	(0.054)
Ln(*Firm gap*)	0.059***	0.098***	0.032***	0.004*	0.002*	0.008***
	(0.010)	(0.014)	(0.012)	(0.002)	(0.001)	(0.003)
Ln(*CEO tenure*)	0.053**	0.039	0.058**	0.033***	0.034***	0.033***
	(0.023)	(0.025)	(0.024)	(0.007)	(0.007)	(0.007)
Ln(*CEO age*)	-0.593***	-0.720***	-0.537***	0.057**	0.066**	0.053**
	(0.116)	(0.124)	(0.118)	(0.025)	(0.026)	(0.025)
Stock return (1YR)	1.184***	1.188***	1.154***	0.054***	0.054***	0.056***
	(0.070)	(0.070)	(0.069)	(0.008)	(0.008)	(0.008)
Sales growth	0.177*	0.182*	0.177*	-0.026***	-0.026***	-0.026***
	(0.099)	(0.104)	(0.098)	(0.009)	(0.009)	(0.009)
FCF	1.175*	1.253*	1.129*	0.519***	0.513***	0.524***
	(0.654)	(0.646)	(0.641)	(0.072)	(0.073)	(0.073)
R&D	4.212***	4.271***	3.850***	0.243**	0.238**	0.273***
	(0.910)	(0.923)	(0.856)	(0.103)	(0.104)	(0.101)
Capital investment	-0.278***	-0.272***	-0.112	0.089***	0.089***	0.074***
	(0.093)	(0.098)	(0.095)	(0.023)	(0.023)	(0.024)
Ln(*Total assets*)	-0.846***	-1.067***	-1.256***	0.047**	0.066***	0.080***
	(0.116)	(0.123)	(0.129)	(0.021)	(0.024)	(0.026)
Ln(*Total assets*)^2	0.057***	0.065***	0.080***	-0.002*	-0.003**	-0.004**
	(0.007)	(0.008)	(0.008)	(0.001)	(0.001)	(0.002)
Industry stock return vol	-0.458	-0.639*	-0.796**	-0.206*	-0.195*	-0.181
	(0.308)	(0.335)	(0.328)	(0.111)	(0.113)	(0.114)
Ln(*Ind # CEOs*)	0.153*	0.074	0.236***	0.015	0.022	0.009
	(0.085)	(0.095)	(0.091)	(0.026)	(0.027)	(0.027)
Ln(*Ind sales*)	-0.128**	-0.114*	-0.179***	0.029*	0.026	0.029*
	(0.063)	(0.068)	(0.067)	(0.016)	(0.016)	(0.016)
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,718	15,718	15,718	15,718	15,718	15,718
R-squared	0.169	0.080	0.118	0.054	0.042	0.043
Endogeneity, Relevance, and Overidentification						
Hansen *J*-Test	0.964	1.258	0.717	1.178	1.351	1.319
Hausman Exogeneity Test	98.999***	93.394***	72.558***	7.942***	5.02**	5.416***
First-Stage *F*-Statistics	641.62***	117.23***	141.21***	472.02***	103.21***	105.00***

Table 6: Effects of Industry Tournament Incentives on Firm Risk

This table presents multivariate regression of firm risk on industry tournament incentives using ExecuComp firms from 1992 – 2005. Financial firms and utilities are excluded. The dependent variables are *Stock return vol* and *CF vol*. +1 indicates year t+1. *Stock return vol* is standard deviation of one-year daily stock returns. *CF vol* is cash flow volatility which is the seasonally-adjusted standard deviation of EBITDA divided by total assets from year t to year t+4. Both *Stock return vol* and *CF vol* are scaled by 10^2. Ln(*Indgap1*) is the natural logarithm of *Indgap1*, where *Indgap1* is second highest CEO total compensation within industry - CEO total compensation. All other incentive variables and control variables are defined in the Appendix. We include year and firm fixed effects in all specifications. For GMM IV specifications, only second stage regression is reported. Industry clustered and Newey-West corrected (up to four lags) standard errors are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

VARIABLES	*Stock return vol*$_{+1}$ OLS	*Stock return vol*$_{+1}$ GMM IV	*CF vol*$_{+1}$ OLS	*CF vol*$_{+1}$ GMM IV
Ln(*Indgap1*)	-0.012*		-0.006	
	(0.006)		(0.007)	
Predicted Ln(*Indgap1*)		0.190***		0.114**
		(0.030)		(0.028)
CEO delta	0.277**	0.500***	0.258	0.109
	(0.108)	(0.156)	(0.334)	(0.167)
CEO vega	0.018**	0.014*	0.001	0.001
	(0.007)	(0.008)	(0.011)	(0.005)
Ln(*Firm gap*)	0.019***	0.004	0.010	0.025***
	(0.006)	(0.007)	(0.008)	(0.007)
Ln(*CEO tenure*)	-0.287***	-0.306***	-0.084*	-0.096***
	(0.046)	(0.021)	(0.045)	(0.021)
Ln(*CEO age*)	-1.008***	-1.075***	-0.189	-0.208**
	(0.176)	(0.080)	(0.177)	(0.085)
Ln(*Total assets*)	-0.310***	-0.262***	-0.234***	-0.207***
	(0.034)	(0.012)	(0.034)	(0.013)
Q	0.013***	0.013***	0.004**	0.004***
	(0.003)	(0.003)	(0.002)	(0.001)
Book leverage	0.833***	0.752***	-0.158	-0.189*
	(0.250)	(0.088)	(0.199)	(0.099)
Stock return (1YR)	-0.002	0.002	-0.000	-0.000
	(0.026)	(0.013)	(0.000)	(0.000)
Sales growth	0.081*	0.086**	0.048***	0.051**
	(0.044)	(0.041)	(0.016)	(0.024)
Industry stock return vol	1.587***	1.449***	0.246	0.164
	(0.553)	(0.286)	(0.283)	(0.261)
Ln(*Ind # CEOs*)	-0.079	-0.301***	-0.345***	-0.459***
	(0.156)	(0.080)	(0.119)	(0.086)
Year Dummy	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Observations	13,392	13,235	12,550	12,405
R-squared	0.396	0.327	0.090	0.057
Endogeneity, Relevance, and Overidentification				
Hansen *J*-Test		1.739		1.505
Hausman Exogeneity Test		43.920***		20.814***
First Stage *F*-Statistics		123.46***		115.97***

Table 7: Effects of Industry Tournament Incentives on Firm Risk: Alternative Tournament Measures

This table presents GMM IV regression (second stage) of firm risk-taking on alternative measures of industry tournament incentives using ExecuComp firms from 1992 – 2005. The dependent variables are *Stock return vol* and *CF vol*. +1 indicates year t+1. *Stock return vol* is standard deviation of one-year daily stock returns. *CF vol* is cash flow volatility which is the seasonally-adjusted standard deviation of quarterly EBITDA divided by total assets from year t to year t+4. Both *Stock return vol* and *CF vol* are scaled by 10^2. Ln(*Indgap1_raw*) is the natural logarithm of Ln(*Indgap1_raw*), where *Indgap1_raw* is highest CEO total compensation within industry - CEO total compensation. Ln(*Indgap2*) is the natural logarithm of *Indgap2*, where *Indgap2* is highest CEO total compensation within industry and size group - CEO total compensation. Ln(*Indgap3*) is the natural logarithm of *Indgap3*, where *Indgap3* for a CEO with compensation below the industry median is the total compensation of the CEO 50 percentile points higher in the distribution - CEO total compensation and for a CEO above the median it is maximal CEO compensation in the industry – CEO total compensation. All other incentive variables and control variables are defined in the Appendix. We include year and industry fixed effects in all specifications. Industry clustered and Newey-West corrected (up to four lags) standard errors are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

VARIABLES	*Stock return* GMM IV	*Stock return* GMM IV	*Stock return* GMM IV	*CF vol*$_{+1}$ GMM IV	*CF vol*$_{+1}$ GMM IV	*CF vol*$_{+1}$ GMM IV
Predicted Ln(*Indgap1_raw*)	0.191***			0.134**		
	(0.021)			(0.030)		
Predicted Ln(*Indgap2*)		0.272***			0.093*	
		(0.036)			(0.020)	
Predicted Ln(*Indgap3*)			0.306***			0.157**
			(0.037)			(0.032)
CEO delta	0.518***	0.749***	0.763***	-0.124	-0.016	0.015
	(0.148)	(0.168)	(0.161)	(0.162)	(0.168)	(0.167)
CEO vega	0.008	0.003	0.012*	0.003	0.005*	0.001
	(0.005)	(0.004)	(0.007)	(0.004)	(0.003)	(0.005)
Ln(*Firm gap*)	0.008	0.039***	0.070***	0.025***	0.040***	0.015*
	(0.006)	(0.009)	(0.009)	(0.006)	(0.008)	(0.008)
Ln(*CEO tenure*)	-0.301***	-0.313***	-0.304***	-0.086***	-0.094***	-0.085***
	(0.020)	(0.022)	(0.021)	(0.020)	(0.021)	(0.021)
Ln(*CEO age*)	-1.056***	-1.145***	-1.036***	-0.205**	-0.252***	-0.191**
	(0.077)	(0.085)	(0.080)	(0.083)	(0.085)	(0.083)
Ln(*Total assets*)	-0.260***	-0.346***	-0.319***	-0.211***	-0.252***	-0.239***
	(0.010)	(0.011)	(0.010)	(0.011)	(0.012)	(0.011)
Q	0.012***	0.013***	0.011***	0.004***	0.005***	0.004***
	(0.003)	(0.003)	(0.003)	(0.001)	(0.002)	(0.001)
Book leverage	0.795***	0.774***	0.824***	-0.169*	-0.175*	-0.151
	(0.086)	(0.090)	(0.089)	(0.095)	(0.095)	(0.096)
Stock return (1YR)	0.011	0.009	0.008	-0.000*	-0.000	-0.000**
	(0.013)	(0.014)	(0.014)	(0.000)	(0.000)	(0.000)
Sales growth	0.091**	0.092**	0.092**	0.051**	0.051**	0.052**
	(0.043)	(0.046)	(0.043)	(0.023)	(0.024)	(0.023)
Industry stock return vol	1.322***	1.208***	1.107***	0.191	0.126	0.092
	(0.276)	(0.303)	(0.302)	(0.250)	(0.257)	(0.258)
Ln(*Ind # CEOs*)	-0.313***	-0.384***	-0.286***	-0.457***	-0.493***	-0.453***
	(0.076)	(0.088)	(0.083)	(0.078)	(0.082)	(0.079)
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,624	13,624	13,624	12,778	12,778	12,778
R-squared	0.351	0.239	0.257	0.078	0.047	0.051
Endogeneity, Relevance, and Overidentification						
Hansen *J*-test	3.777	4.219	3.448	1.123	1.232	0.968
Hausman Exogeneity Test	107.118***	78.575***	80.966***	28.631***	22.786***	21.815***
First Stage *F*-Statistics	138.02***	108.19***	115.92***	107.84***	107.19***	109.23***

Table 8: Effect of Industry Tournament Incentives on Investment and Financial Policy

This table presents GMM IV regression (second stage) of firm investment and financial policy on industry tournament incentives using ExecuComp firms from 1992 – 2005. The dependent variables are *R&D*, *CAPEX*, Ln*(# segments*), *H-index*, and *Book leverage*. +1 indicates year t+1. *R&D* is R&D expenditures divided by total assets (in percentage). *CAPEX* is capital expenditures divided by total assets (in percentage). Ln*(# segments)* is the natural logarithm of the number of operating segments as reported in the Compustat segment database. *H-index* is the sum of the square of segment sales divided by the square of firm sales. *Book leverage* is interest-bearing debt divided by total assets. Ln(*Indgap1*) is the natural logarithm of *Indgap1*, where *Indgap1* is second highest CEO total compensation within industry - CEO total compensation. All other incentive variables and control variables are defined in the Appendix. We include year and industry fixed effects in all specifications. Industry clustered and Newey-West corrected (up to four lags) standard errors are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

VARIABLES	$R\&D_{+1}$	$CAPEX_{+1}$	$Ln(\#\ segments_{+1})$	$H\text{-}index_{+1}$	$Book\ leverage_{+1}$
	GMM IV	GMM IV	GMM IV	GMM IV	GMM IV
Predicted Ln(*Indgap1*)	0.211**	-0.456***	-0.029*	0.089**	0.010**
	(0.089)	(0.119)	(0.015)	(0.036)	(0.004)
CEO delta	4.982***	-2.380***	0.014	0.188	-0.049*
	(0.512)	(0.731)	(0.082)	(0.166)	(0.029)
CEO vega	0.067*	0.000	-0.002	0.005	-0.001
	(0.038)	(0.019)	(0.002)	(0.003)	(0.000)
Ln(*Firm gap*)	-0.015	-0.146***	0.002	0.020	-0.001
	(0.024)	(0.027)	(0.003)	(0.018)	(0.001)
Ln(*CEO tenure*)	0.034	-0.097	-0.113***	0.037**	-0.015***
	(0.078)	(0.083)	(0.009)	(0.015)	(0.003)
Ln(*CEO age*)	2.105***	0.880**	0.150***	-0.072*	-0.050***
	(0.315)	(0.377)	(0.039)	(0.043)	(0.013)
Q	-0.032***	-0.009**	-0.002***	0.001***	-0.001***
	(0.009)	(0.004)	(0.000)	(0.000)	(0.000)
Ln(*Total assets*)	0.635***	0.116**	0.013**	0.050	0.013***
	(0.045)	(0.045)	(0.006)	(0.035)	(0.002)
Book leverage	1.914***	0.551*	0.074**	-0.111*	
	(0.394)	(0.302)	(0.034)	(0.060)	
Stock return (1YR)	-0.000	0.000	-0.000	-0.000***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sales growth	-0.390***	-0.264*	-0.014**	0.010*	0.004
	(0.081)	(0.148)	(0.007)	(0.005)	(0.004)
Industry stock return vol	1.021	6.250***	0.836***	-0.349**	-0.058
	(0.864)	(1.219)	(0.157)	(0.159)	(0.040)
Ln(*Ind # CEOs*)	1.287***	1.836***	-0.073*	-0.224	-0.031**
	(0.329)	(0.337)	(0.041)	(0.149)	(0.013)
Year Dummy	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	13,565	14,729	15,538	13,569	13,570
R-squared	0.0657	0.023	0.361	0.364	0.063
Endogeneity, Relevance, and Overidentification					
Hansen *J*-test	0.933	2.814	0.804	2.057	2.844
Hausman Exogeneity Test	3.703*	61.679**	3.303*	3.944**	8.219***
First Stage *F*-Statistics	139.66***	144.13***	162.65***	12.96***	138.99***

Table 9: Effects of Industry Tournament Incentives Conditional on Promotion Probability

This table presents fixed effect regression of firm performance and risk-taking on industry tournament incentive interaction terms using ExecuComp firms from 1992 – 2005. The dependent variables are *Q* and *ROE* in Panel A, and *Stock return vol* and *CF vol* in Panel B. +1 indicates year t+1. *Q* is the ratio of the sum of market value of equity and the book value of debt to total assets. *ROE* is return on equity per share, calculated as net income divided by shareholder equity. *Stock return vol* is standard deviation of one-year daily stock returns. *CF vol* is cash flow volatility which is the seasonally-adjusted standard deviation of EBITDA divided by total assets from year t to year t+4. Both *Stock return vol* and *CF vol* are scaled by 10^2. Ln(*Indgap1*) is the natural logarithm of *Indgap1*, where *Indgap1* is second highest CEO total compensation within industry - CEO total compensation. *New CEO* is a dummy variable = 1 in the CEO's first year of service as CEO, and 0 otherwise. *Retire age* is a dummy variable = 1 if the CEO's age is more than 62 years, and 0 otherwise. *St ret dum*: =1 if *Stock return 1YR* is above the industry median, 0 otherwise. All other incentive variables and control variables are defined in the Appendix. We include year and industry fixed effects in all specifications. Industry clustered and Newey-West corrected (up to four lags) standard errors are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Firm Performance

VARIABLES	*Q*	*Q*	*Q*	*Q*	ROE_{+1}	$_{+1}$	$_{+1}$	$_{+1}$
	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Ln(*Indgap1*)	-0.014	0.000	-0.091***	-0.021	-0.391* *ROE*	-0.579*** *ROE*	-0.706*** *ROE*	-0.340
	(0.010)	(0.009)	(0.028)	(0.019)	(0.195)	(0.166)	(0.373)	(0.455)
New CEO	-0.399				4.102			
	(0.410)				(3.692)			
Ln(*Indgap1*) x *New CEO*	-0.038**				-0.699*			
	(0.015)				(0.350)			
Retire age		0.594*				-4.760		
		(0.303)				(5.590)		
Ln(*Indgap1*) x *Retire age*		-0.045				-0.432		
		(0.028)				(0.538)		
St ret dum			-0.644*				2.464	
			(0.342)				(3.972)	
Ln(*Indgap1*) x *St ret dum*			0.158***				0.391***	
			(0.053)				(0.125)	
Ind Homo				2.988				-21.079
				(3.495)				(22.942)
Ln(*Indgap1*) x *Ind Homo*				0.056				0.803
				(0.095)				(2.152)
CEO delta	1.148**	1.086**	1.121***	1.110***	1.279	1.987	1.343	2.057
	(0.432)	(0.404)	(0.379)	(0.381)	(3.718)	(3.689)	(3.679)	(3.744)
Ln(*Firm gap*)	0.046**	0.047**	0.036**	0.045**	0.483*	0.472*	0.399	0.477*
	(0.018)	(0.018)	(0.017)	(0.018)	(0.246)	(0.246)	(0.248)	(0.247)

Ln(*CEO tenure*)	-0.006	0.004	-0.012	0.002	2.885***	3.043***	3.022***	3.053***
	(0.041)	(0.055)	(0.051)	(0.053)	(0.906)	(0.949)	(0.922)	(0.945)
Ln(*CEO age*)	-1.065**	-1.333**	-1.009*	-1.029**	5.601	7.185*	6.283*	5.875
	(0.492)	(0.567)	(0.491)	(0.495)	(3.589)	(4.109)	(3.608)	(3.536)
FCF	0.054	0.066	-0.292	0.059	54.563***	54.614***	52.034***	54.611***
	(1.307)	(1.316)	(1.297)	(1.315)	(11.873)	(11.938)	(11.617)	(11.910)
Book leverage	-0.559	-0.558	-0.518	-0.544	2.840	2.797	3.146	2.699
	(0.547)	(0.548)	(0.531)	(0.546)	(6.897)	(6.900)	(6.839)	(6.854)
R&D	3.142**	3.150**	2.960**	3.141**	23.431	23.586	21.918	23.565
	(1.133)	(1.145)	(1.126)	(1.145)	(15.058)	(15.060)	(14.419)	(14.984)
CAPEX	-0.570*	-0.569*	-0.548	-0.586*	7.418*	7.407*	7.658**	7.539*
	(0.332)	(0.329)	(0.328)	(0.339)	(3.695)	(3.699)	(3.681)	(3.679)
Ln(*Total assets*)	-0.881***	-0.887***	-0.885***	-0.882***	2.887	2.947	2.848	2.937
	(0.221)	(0.224)	(0.230)	(0.224)	(2.942)	(2.945)	(2.866)	(2.932)
Ln(*Total assets*)^2	0.053***	0.054***	0.054***	0.053***	-0.109	-0.115	-0.104	-0.113
	(0.015)	(0.015)	(0.015)	(0.015)	(0.179)	(0.179)	(0.173)	(0.178)
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,563	15,563	15,563	15,563	13,861	13,861	13,861	13,861
R-squared	0.064	0.064	0.094	0.065	0.053	0.053	0.058	0.053

Panel B: Firm Risk

VARIABLES	*Stock return vol*$_{+1}$ OLS	*Stock return vol*$_{+1}$ OLS	*Stock return vol*$_{+1}$ OLS	*Stock return vol*$_{+1}$ OLS	*CF vol*$_{+1}$ OLS	*CF vol*$_{+1}$ OLS	*CF vol*$_{+1}$ OLS	*CF vol*$_{+1}$ OLS
Ln(*Indgap1*)	-0.012*	-0.002	0.008	-0.007	-0.012*	-0.008	0.003	-0.031**
	(0.006)	(0.006)	(0.010)	(0.016)	(0.007)	(0.007)	(0.006)	(0.014)
New CEO	-0.080				-0.256*			
	(0.123)				(0.137)			
Ln(*Indgap1*) x *New CEO*	-0.026**				-0.035**			
	(0.013)				(0.008)			
Retire age		0.409***				-0.099		
		(0.127)				(0.088)		

Ln(*Indgap1*) x *Retire age*		-0.048***				-0.008		
		(0.013)				(0.010)		
St ret dum			0.050				0.111**	
			(0.088)				(0.043)	
Ln(*Indgap1*) x *St ret dum*			0.034***				0.018***	
			(0.009)				(0.006)	
Ind Homo				2.128*				-0.270
				(1.095)				(0.809)
Ln(*Indgap1*) x *Ind Homo*				0.163*				0.132*
				(0.080)				(0.075)
CEO delta	0.274	0.297	0.270	0.260	-0.242	-0.247	-0.256	-0.263
	(0.303)	(0.296)	(0.305)	(0.307)	(0.337)	(0.330)	(0.336)	(0.337)
CEO vega	-0.019	-0.019	-0.015	-0.019	-0.001	-0.001	-0.000	-0.001
	(0.017)	(0.017)	(0.014)	(0.017)	(0.011)	(0.011)	(0.011)	(0.012)
Ln(*Firm gap*)	-0.020***	-0.021***	-0.017***	-0.020***	0.010	0.010	0.011	0.010
	(0.006)	(0.006)	(0.006)	(0.006)	(0.008)	(0.008)	(0.008)	(0.008)
Ln(*CEO tenure*)	-0.288***	-0.283***	-0.277***	-0.283***	-0.077*	-0.085*	-0.082*	-0.082*
	(0.046)	(0.046)	(0.046)	(0.046)	(0.043)	(0.045)	(0.044)	(0.045)
Ln(*CEO age*)	-1.021***	-0.944***	-1.004***	-1.002***	-0.178	-0.162	-0.190	-0.188
	(0.183)	(0.224)	(0.180)	(0.177)	(0.176)	(0.225)	(0.175)	(0.175)
Ln(*Total assets*)	-0.310***	-0.310***	-0.308***	-0.311***	-0.236***	-0.235***	-0.235***	-0.235***
	(0.034)	(0.034)	(0.033)	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)
Q	0.013***	0.013***	0.013***	0.013***	0.004**	0.004**	0.004**	0.004**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Book leverage	0.831***	0.834***	0.808***	0.835***	-0.155	-0.155	-0.159	-0.151
	(0.251)	(0.250)	(0.246)	(0.251)	(0.199)	(0.199)	(0.199)	(0.200)
Stock return (1YR)	-0.004	-0.004	0.053***	-0.004	-0.000	-0.000	-0.000	-0.000
	(0.026)	(0.026)	(0.013)	(0.026)	(0.000)	(0.000)	(0.000)	(0.000)
Sales growth	0.081*	0.081*	0.084*	0.079*	0.049***	0.048***	0.049***	0.046***
	(0.044)	(0.044)	(0.046)	(0.043)	(0.016)	(0.016)	(0.016)	(0.016)
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,290	13,290	13,290	13,290	12,455	12,455	12,455	12,455
R-squared	0.394	0.395	0.402	0.395	0.092	0.091	0.092	0.092

Table 10: CEO Turnover

Panel A summarizes CEO turnover for all firms in ExecuComp between year 1993 and 2009. Standard turnover is turnover that is associated with a company's normal hiring and firing. Non-standard turnover is turnover due to an acquisition or bankruptcy/delisting. Total turnover is the sum of standard and non-standard turnover. All the numbers reported in the panel A are in percentage. Panel B presents probit regression estimates of the likelihood of CEO standard turnover. The dependent variable equals one if the CEO departs in one year and zero otherwise. ΔProb measures the change in the probability of CEO turnover per unit change in the relevant explanatory variables. For indicator variables, the coefficient represents the change in the probability associated with moving the indicator from 0 to 1. Models are estimated with robust standard errors to control for heteroskedasticity. CEO age dummy equals to one if lagged CEO age is greater than or equal to 62 and zero otherwise. Robust standard errors are in parentheses. *, **, and *** indicate significance at the 10%, 5% and 1% levels, respectively.

Panel A: Summary Statistics for CEO Turnover			
Year	Total Turnover	Standard Turnover	Non-standard Turnover
1993	11.84	10.02	1.82
1994	14.48	11.44	3.04
1995	12.45	10.19	2.26
1996	16.14	10.74	5.4
1997	16.4	12.09	4.31
1998	17.91	11.94	5.97
1999	20.04	13.95	6.09
2000	18.77	14.51	4.26
2001	12.39	10	2.39
2002	14.47	12.08	2.39
2003	13.76	10.88	2.88
2004	16.46	12.46	4
2005	15.47	11.93	3.54
2006	16.86	11.83	5.03
2007	15.66	11.68	3.98
2008	13.01	10.3	2.71
2009	11.08	8.16	2.92
1993-2009	15.13	11.42	3.71
1993-1997	14.26	10.9	3.37
1998-2009	15.49	11.64	3.85

Panel B: Probit Regression of CEO Turnover				
Variables	1992-2009 ΔProb	1998-2009 ΔProb	1992-2009 ΔProb	1998-2009 ΔProb
Ret on S&P500	-0.035***	-0.030***	-0.050***	-0.047***
	(0.009)	(0.010)	(0.009)	(0.010)
Ind. Ret - Ret on S&P500	-0.024***	-0.023**	-0.057***	-0.054***
	(0.009)	(0.009)	(0.009)	(0.010)
Ind.-adjusted Stock Ret	-0.047***	-0.041***	-0.071***	-0.067***
	(0.005)	(0.006)	(0.005)	(0.005)
Ind.-adjusted Stock Ret Squared			0.042***	0.041***
			(0.004)	(0.004)
Δ*ROA*	-0.015**	-0.016	-0.015**	-0.017
	(0.006)	(0.013)	(0.006)	(0.012)
Log(Sales)	-0.001	-0.000	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
CEO age dummy	0.206***	0.207***	0.207***	0.207***
	(0.005)	(0.006)	(0.005)	(0.006)
Pseudo R^2	0.112	0.116	0.127	0.121
Observations	24,915	19,178	24,915	19,178