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Rank-Order Tournaments and Incentive Alignment: The Effect on Firm Performance

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ABSTRACT

We investigate simultaneously the impact of promotion-based tournament incentives for VPs and equity-based (alignment) incentives for VPs and the chief executive officer (CEO) on firm performance. We find that tournament incentives, as measured by the pay differential between the CEO and VPs, relate positively to firm performance. The relation is more positive when the CEO nears retirement and less positive when the firm has a new CEO, and weakens further when the new CEO is an outsider. Our analysis is robust to corrections for endogeneity of all our incentive measures and to several alternative measures of tournament incentives and firm performance.

In the Olympics prizes are awarded, not on the basis of absolute performance, but on the basis of relative performance. Similarly, in most organizations, one of the most important rewards is promotion.

Green and Stokey (1983, p. 349)

ISSUES RELATING TO THE LEVEL of chief executive officer (CEO) compensation and the gap between CEO and worker remuneration receive considerable attention from the financial media. More often than not, the media contend that CEOs in the United States receive excessive pay and that the gap between CEO and worker pay is now at its highest ever. A recent article in the *New York Times* by Eduardo Porter (May 25, 2007) further asserts that this excessive pay disparity now extends to the top echelons of the corporate hierarchy, that is, between the

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CEO and executives at the next level of the corporate hierarchy. Many articles, including the one in the *New York Times*, attribute these large compensation gaps to increased CEO power on boards, the increased ability of CEOs to set their own pay, heightened competition for top management talent, and indexing compensation to industry benchmarks. In this article, we investigate a potentially positive aspect of the compensation disparity between the CEO and the next level of executives, whom we call VPs for ease of exposition. We consider the gap between CEO and VP compensation as a feature of tournament incentives first proposed by Lazear and Rosen (1981) and investigate its impact on firm performance.[1]

Our analysis of managerial incentives encompasses two important features that are common to the economic organization of typical corporations. The first feature is management by a team consisting of a CEO and a cadre of lower-rung executives. The second feature is the prevalence of two distinct incentive mechanisms in most corporations, output- or performance-based incentives and promotion incentives. As Baker, Jensen, and Murphy (1988) note, since the CEO is at the top of the corporate hierarchy, this rules out promotion-based tournament incentives for the CEO and leaves performance-based compensation as the only incentive.[2] A VP, on the other hand, faces both performance-based equity incentives and promotion-based tournament incentives. In a typical rank-order tournament, the best relative performer is promoted to the next level in the hierarchy, while the others are passed over. Promotion to the next level carries with it higher pay and therefore provides managers with an incentive to expend higher effort, which, in turn, increases their chances of promotion as well as the firm's output. Given the availability of alternative incentive mechanisms, we believe that an examination of the effect of executive compensation on firm performance ought to include both of these incentive mechanisms. While there is considerable theoretical and empirical research in finance on performance-based incentives for managers, promotion-based tournament incentives have received scant attention. To our knowledge, our study is the first to examine simultaneously the impact of performance-based incentives for the CEO and both performance- and promotion-based tournament incentives for VPs on firm performance.

We follow the extant literature (e.g., Aggarwal and Samwick (2003)) and measure performance-based or "alignment" incentives by the sensitivity of a manager's equity ownership to stock price changes. Constructing an empirical proxy for a VP's tournament incentives potentially involves two factors. The first is the size of the tournament incentive, which is an increase in the VP's compensation (or prize size) on promotion to CEO, and the second is the likelihood or probability of promotion. Lazear and Rosen (1981) and Prendergast

[1] An article by Tim Harford on Forbes.com (May 23, 2006) offers tournaments as a tongue-in-cheek explanation of why CEOs are paid much more than lower-level executives.

[2] Corporate CEOs may be affected by external tournaments in which they compete with other CEOs (e.g., Malmendier and Tate (2005) and Agrawal, Knoeber, and Tsoulouhas (2006)). In our analysis, we control for the effect of such tournaments and distinguish between CEO appointments from outside and from within (e.g., Weisbach (1988), Parrino (1997), and Huson, Malatesta, and Parrino (2004)).

(1999) illustrate that an agent's effort increases with the size of the promotion prize. If each agent perceives himself/herself as being equally likely for promotion then firms can set tournament incentives simply by adjusting the size of the prize. Consequently, empirical researchers in labor economics (e.g., Bognanno (2001)) use the compensation gap between the CEO and VPs as the measure of tournament incentives. However, firms can also affect the probability of promotion, for instance, by choosing to hire a CEO from outside or by designating a CEO successor. As a result, the compensation gap and the probability of promotion can affect tournament incentives.

In view of the two dimensions of tournament incentives, namely, prize size and the probability of promotion, we investigate the effect of tournament incentives on firm performance as follows. First, using a sample of nearly 18,000 firm-year observations over the period 1993 to 2004, we examine the determinants of the pay gap between the CEO and VPs, which is our measure of the size of the tournament prize. These determinants include executive, firm, and industry characteristics, which affect the prize size directly and/or through their effect on the probability of promotion. Next, in the spirit of Lazear and Rosen (1981), we examine the relation between the prize size and firm performance and include performance-based incentives for the CEO and VPs in the analysis. Finally, we supplement the analyses by taking into account the joint effect of the tournament prize and variations in the probability of promotion on firm performance. We examine how events that are likely to affect the probability of promotion change the relation between the prize size and firm performance. Our hypothesis is that the prize–performance relation should become weaker (stronger) when an event decreases (increases) the perceived probability of promotion.

Our findings on the determinants of the prize size suggest that VPs' perceived probability of promotion has a significant impact on the pay gap; the lower the probability, the greater is the gap. For instance, the gap in total and long-term compensation is larger when the firm has just hired a new CEO. The gap is even larger when the new CEO is from outside the firm as opposed to an insider who has been promoted. We also find a strong positive relation between the pay gap in a firm and the median pay gap in the industry in which the firm operates, which suggests that industry norms are an important determinant of the tournament prize size.

In our next set of tests, we find a significantly positive relation between the CEO–VP pay gap and firm performance. We find that the positive relation between pay gap and firm performance holds for gaps in short-term, long-term, as well as total executive pay. We also find a positive relation between the CEO and VPs' equity-based alignment incentives and firm performance. The positive relations between tournament and alignment incentives and firm performance continue to hold after we adjust for the potentially endogenous determination of tournament incentives, performance-based incentives, and firm performance.

We then investigate how changes in the probability of promotion affect the positive relation between the tournament prize size and firm performance. A firm hiring a new CEO offers an interesting context to determine the importance of tournament incentives. When the CEO is new, tournament incentives

should be weak because the previous tournament for the CEO's job is over and the new tournament is at an early stage. We find that this is indeed the case; the relation between tournaments and firm performance is weaker when the firm has a new CEO. The impact of a new CEO further depends on whether the new CEO is an outsider or an existing VP promoted from within the firm. By making an insider the CEO, the firm shows a preference for promoting from within, which should marginally increase the perceived probability of promotion. If the new CEO is an outsider, the perceived probability of promotion for firm VPs should decrease further, that is, over and above the decrease due to hiring a new CEO. Consistent with this hypothesis, we find that tournament incentives are significantly weaker when the new CEO is an outsider as compared to when he/she is an insider.

The perceived probability of internal promotion should be lower in firms that operate in homogeneous industries because outsiders also compete for the CEO's job.[3] Tournament effects may be weaker in these industries because firm VPs are more likely to have better outside employment opportunities. We find some evidence that the effect of tournaments on performance is weaker when the firm operates in a homogeneous industry. An equivalent but contrasting situation is when the incumbent CEO is close to retirement. In this case, the effect of tournament incentives on firm performance should be stronger. We document evidence showing that tournament effects are indeed stronger when the incumbent CEO is more than 62 years of age.

Our study investigates the relation between managerial compensation and firm performance and relates specifically to two strands of literature on incentive mechanisms—rank-order tournaments and performance-based contracts. Performance incentive contracts tie employees' future earnings to current performance (e.g., Becker and Stigler (1974) and Lazear and Rosen (1981)), which raises the possibility that employers can misrepresent the output level achieved when performance is not verifiable. Lazear and Rosen (1981) show that pure rank-order tournaments solve this problem because tournament prizes are committed in advance, which precludes employers from reneging on promised payouts. Further, as Milgrom and Roberts (1992) contend, promotion is the only available incentive mechanism in situations where there is little or no information about the absolute performance of the employee, or when systematic shocks may affect an individual's performance. Our finding of a positive relation between tournament incentives and firm performance offers support to the predictions of tournament theories.

Further, as Baker et al. (1988) note, most optimal compensation models assume that the owner/principal owns 100% of the firm's equity. This assumption usually does not hold in the case of the CEO who sets the salary structure for VPs (Murphy (1999)). Relaxing the assumption of 100% ownership by the principal opens the door to questions of "fairness" in the setting of executive pay,

[3] Our conjecture is consistent with Parrino (1997), who argues that it is easier for managers to transfer their skills in homogeneous industries and finds that intraindustry mobility of CEOs is higher in homogeneous industries.

which may break the optimality of performance-based contracts.[4] Garvey and Swan (1992) formalize this notion in a model of a CEO who: (1) wants "good relations" with subordinates (Murphy (1999)), (2) has low pay–performance sensitivity (Jensen and Murphy (1990)), and (3) faces high personal costs in firm bankruptcy (Gilson (1989)). The authors show that the optimal compensation scheme in such a setting is a hybrid of rank-order tournament incentives and output-based rates. Our analyses and findings on the joint effectiveness of alignment and tournament incentives contribute to the literature on hybrid incentive schemes.

We also add to the labor economics literature on the determinants of tournaments (e.g., Ehrenberg and Bognanno (1990) and Bognanno (2001)) by identifying several new determinants including industry characteristics, promotion from within versus outsiders, CEO succession planning, and CEO retirement. We find that many of these new factors significantly affect the size of the tournament prizes. Finally, our findings on performance-based incentives contribute to the large body of empirical work based on the principal–agent framework pioneered by Jensen and Meckling (1976) and Holmstrom (1979). A significant portion of the existing empirical research on compensation-based incentives and firm performance focuses on the equity-based incentives of CEOs. However, Holmstrom and Kaplan (2003) argue that *all* key executives should hold "meaningful" amounts of firm equity to align manager and shareholder interests further. In light of their argument, our analysis encompasses the relation between performance-based incentives of both CEOs and VPs and explicitly accounts for the endogeneity between CEO- and VP-equity ownership and firm performance.

Our paper is organized as follows. In the next section, Section I, we describe our sample and variables. In Section II, we discuss our findings on the determinants of tournaments. Section III contains our findings on the effect of tournaments and managerial alignment on firm performance and includes a discussion of our empirical treatment of endogeneity issues. In Section IV, we discuss our findings on several scenarios under which the interaction between the prize size and probability of promotion either strengthens or weakens the relation with firm performance. In Section V, we present the findings of a number of tests that relate to the robustness of our results. We provide concluding remarks in Section VI.

I. Data Sources, Variable Construction, and Sample Description

A. Data Sources

We obtain CEO and VP compensation data from the December 2005 release of Standard and Poor's (S&P) ExecuComp database, which covers about

[4] In a recent working paper, Rajgopal and Srinivasan (2006) address the "fairness" issue by examining determinants of pay dispersion among the top executives in a firm. Bebchuk, Cremers, and Peyer (2007) examine the fraction of total senior executive compensation that accrues to the CEO and its relation to Tobin's q.

1,500 firms per year that are in the S&P 500, S&P mid-cap 400, and S&P small-cap 600 indices. We define a CEO as the person who is identified as the chief executive officer of the firm in ExecuComp (CEOANN = CEO), and classify all other executives as VPs. Our sample period is from 1993 to 2004 and includes all firm-years that have an identifiable CEO and at least three VPs.[5] We obtain stock return and firm characteristics data from the Center for Research in Security Prices (CRSP) and Compustat Industrial and Segment files. We require several CEO- and VP-related variables, including the age and experience of the CEO, whether the CEO is an insider or outsider, and the number and designation of VPs. ExecuComp provides data on CEO age and whether the CEO is from inside or outside the firm for about 50% of the CEOs, and on CEO experience for about 90% of our sample. We obtain information on missing CEO age, CEO experience, and whether the CEO is an insider from other sources, which include firm proxy statements, the *International Directory of Company Histories*, *Marquis Who's Who* publication, Forbes's surveys, and the Standard and Poor's *Register of Corporations, Directors, and Executives*. We manually determine the designation of every VP for each firm-year in our sample from ExecuComp as president, chief financial officer (CFO), or chief operating officer (COO). Our final sample contains complete data on all variables for 2,367 unique firms, 4,202 CEOs, 25,461 VPs, and 17,987 firm-years.[6]

B. Measures of Tournament Incentives

An executive's total compensation is the sum of (1) short-term compensation in the form of salary, bonus, and other fixed annual payments, and (2) long-term compensation in the form of stock and option grants and other long-term incentive payouts. The compensation gap between the CEO and the VPs is our primary measure of tournaments (e.g., Bognanno (2001) and Bloom (1999)). We compute three versions of this gap: *Total Gap*, which is based on total compensation, *ST Gap*, which is based only on short-term compensation, and *LT Gap*, which is based only on long-term compensation. Specifically,

$$\text{Log}(\textit{Total Gap}) = \text{Log}(\text{Total compensation of CEO} - \text{Median value of total compensation of all VPs in the firm-year}).$$

We compute log *(ST Gap)* and log *(LT Gap)* in an analogous manner. There are instances in which the gap is negative because the CEO's compensation is less than the median VP's compensation. We follow previous studies (e.g., Hartman (1984), Slemrod (1990), and Cassou (1997)) and monotonically transform all

[5] Eliminating the restriction of having at least three VPs increases our final sample by 348 and does not significantly alter any of our results.

[6] We are unable to identify whether 178 (out of 4,202) CEOs in our sample are insiders or outsiders, which reduces our sample by 499 firm-years to 17,488 observations in tests that use this variable.

observations by adding a constant equal to the absolute value of the minimum gap to each observation.[7]

C. Alignment Incentive Measures

As in Aggarwal and Samwick (2003), we define *Alignment* as the sum of stock and option sensitivities to a \$100 change in shareholder wealth. Specifically,

$$\begin{aligned} \textit{CEO Alignment} = &(\text{Number of shares held by the CEO} + \text{delta of} \\ &\text{options} * \text{number of options held by CEO})/ \\ &\text{total number of shares outstanding} * 100. \end{aligned}$$

We use the percentage of stock ownership at the beginning of the year for each executive to obtain the stock-based sensitivity of an executive's equity portfolio. For option holdings, we use the number of options held by the manager at the beginning of the year, which represents option grants made in prior years. The proxy statement does not provide the exercise prices for these options but instead their intrinsic value. Following Murphy (1999), we determine an average exercise price for all previously granted options based on their year-end intrinsic value. Further, we treat all options held at the beginning of the year as a single grant with a 5-year time to maturity.[8] We obtain the risk-free rate using data from the 5-year Treasury bill constant-maturity series available from the Federal Reserve Bank's official Web site, and the dividend yield on the stock from ExecuComp. We estimate stock return volatility as the annualized standard deviation of 60 monthly total stock returns to shareholders prior to the sample year. We drop observations with less than 12 usable monthly returns. Using the above information, we compute the average delta of prior option grants using the modified Black–Scholes formula. For VPs, we compute the alignment variable described above for each VP and define *VP Alignment* as the median value of the alignment variable for all VPs in a particular firm-year.

D. Summary Statistics for Managerial Incentives

We present summary statistics for managerial compensation, tournament, and alignment measures in Table I. Panels A and B present details of CEO

[7] Short-term, long-term, and total gaps are negative in 551, 2,022, and 770 firm-years, respectively. Prior to the log transform, we add \$271,000, \$1,040,000, and \$810,000 to all observations for *ST Gap*, *LT Gap*, and *Total Gap,* respectively. We address the issue of negative gaps in alternative ways, including: (1) the inverse hyperbolic sine (IHS) transformation of the compensation gap, which is defined for all real values (Burbidge, Magee, and Robb (1988)), (2) the nontransformed dollar amount of the compensation, (3) the coefficient of variation of CEO and VP compensation, (4) the ratio of the CEO's compensation to the median VP's compensation, and (5) dropping all observations that have a negative gap (Diamond and Hausman (1984)). For all these alternatives, our results are qualitatively similar to the reported results.

[8] We use an average term of 5 years for maturity of options. Kaplan and Minton (2006) argue that the average tenure of the CEO has reduced over the years. Using 4, 6, or, 7 years as the maturity period in the analysis does not significantly alter any of our findings.

Table I

Summary Statistics for Managerial Compensation, Tournament Incentives, and Alignment Incentives

Panels A and B present summary statistics for the compensation of the chief executive officer (CEO) and the median value for other executives in the firm-year (Median VP), respectively, as listed by ExecuComp. Panels C and D present summary statistics for tournament incentives and alignment incentives, respectively. Panel E contains Spearman's rank correlations among the incentive measures. The sample period is from 1993 to 2004 and has 17,987 firm-year observations. All our compensation, tournament, and alignment incentive measures are defined in Appendix A. All variables are winsorized at the 1st and 99th percentile levels. The symbol (*) denotes statistical significance at the 5% level or better.

Compensation, Tournament, and Alignment	Mean	Median	Lower Quartile	Upper Quartile
Panel A: CEO Compensation				
Short-term compensation ($ 000) (*ST Comp*)	1,334.69	919.60	560.55	1,559.48
Long-term compensation ($ 000) (*LT Comp*)	3,043.69	886.07	198.09	2,678.24
Total compensation ($ 000) (*Total Comp*)	4,378.38	1,978.45	985.58	4,331.32
Panel B: Median VP Compensation				
Short-term compensation ($ 000) (*ST Comp*)	518.83	383.13	264.50	593.28
Long-term compensation ($ 000) (*LT Comp*)	686.87	248.67	75.40	681.07
Total compensation ($ 000) (*Total Comp*)	1,224.60	689.58	405.00	1,313.95
Panel C: Tournament Incentives				
ST Gap ($ 000)	778.72	513.36	261.07	956.85
LT Gap ($ 000)	1,975.55	579.27	79.81	1,938.84
Total Gap ($ 000)	2,765.54	1,205.00	494.40	2,948.71
σ*VP Comp* ($ 000)	791.12	341.15	157.59	792.02
Panel D: Alignment Incentives				
CEO Alignment ($ per $100 of shareholder wealth)	3.52	1.24	0.44	3.24
VP Alignment ($ per $100 of shareholder wealth)	0.25	0.15	0.06	0.32

	ST Gap	*LT Gap*	*Total Gap*	σ*VP Comp*	*CEO Alignment*	*VP Alignment*
Panel E: Correlations among Incentive Measures						
LT Gap	0.399*	1				
Total Gap	0.565*	0.976*	1			
σ*VP Comp*	0.363*	0.584*	0.599*	1		
CEO Alignment	−0.088*	−0.086*	−0.093*	−0.033*	1	
VP Alignment	−0.106*	−0.069*	−0.083*	−0.036*	0.196*	1

and median VP compensation. Panels C and D provide summary statistics for tournament and alignment measures and Panel E reports Spearman rank correlations among them. We note that CEO compensation is significantly greater than median VP compensation, which is consistent with the existence of tournaments. The distribution of *LT Gap* is skewed; a likely reason is that long-term

compensation tends to vary significantly over the years, while short-term compensation is reasonably steady each year. The variable σ*VP Comp* is the log of the standard deviation of VPs' total compensation and captures the possibility of a tournament among VPs (e.g., Milgrom and Roberts (1992) and Gibbs (1994)). The average value for *CEO Alignment* is considerably larger than average *VP Alignment*. Finally, the correlation between *CEO Alignment* and *VP Alignment* is positive and the correlations among all tournament variables are positive.

E. Measures of Firm Performance and Other Variables

Our primary measures of firm performance are *return on assets* (*ROA*) and *Firm q*, defined, respectively, as the ratio of the firm's net income to total assets and the ratio of the sum of market value of equity and the book value of debt to total assets.[9] We also repeat our analysis with two additional measures of operating performance based on Loughran and Ritter (1997). These are: (1) *OIBD to Capital*, which is the ratio of a firm's operating income before depreciation to net fixed assets, and (2) *ROE*, which is the ratio of net income to book value of equity. Panel A of Table II presents summary statistics for all firm performance measures. We note that all our performance measures correlate positively with each other.

Panel B of Table II presents summary statistics for variables relating to CEO and VP characteristics. The variable *CEO Age* is the CEO's age as of the sample year and *CEO Experience* is the number of years as the firm's CEO. The median CEO in our sample is 55 years old and has been the CEO of the firm for 5 years. We define *New CEO* as a dummy variable that equals one in the CEO's first year of service as CEO and zero otherwise. Following Parrino (1997), we define an insider to be an executive who has been with the firm for at least 1 year prior to becoming the CEO.[10] The dummy variable *CEO Is Insider* is equal to one if the CEO is such an insider and zero otherwise.[11] The variable *Retiring CEO* is a dummy variable that equals one when *CEO Age* is more than 62 years. We define *Chair* as equal to one when the CEO is also the Chair of the board. The variable *No. of VPs* is equal to the number of executives in any firm-year other than the CEO. We define *Succession Plan* as a dummy variable that equals one if either of the following two conditions is satisfied: (1) the firm has a VP whose title is either *President* or *Chief Operating Officer* and who is not the Chair, and (2) the difference in short-term compensation between the CEO and the highest paid VP is less than 10% *and* the compensation of the

[9] Anderson and Reeb (2003), Bebchuk and Cohen (2005), and Palia (2001) are some of the studies that use *Firm q* and *ROA* as measures of firm performance.

[10] In order to obtain this information we first obtain the company joining date for the CEO and then compare this with the date that this executive becomes the CEO. Both these dates are available for 2,134 CEOs from ExecuComp. We use other sources outlined in Section II to fill in the missing data for 1,890 of the remaining 2,068 CEOs.

[11] Note that this is a CEO–firm-specific variable and assumes the same value for all years that a CEO–firm combination appears in our sample.

Table II
Summary Statistics for Firm Performance Measures and Other Variables

The table presents summary statistics for the dependent variable, firm performance, and other variables used in the study. Panel A reports summary statistics for firm performance measures. Panel B reports summary statistics for CEO and VP characteristics. Panel C reports summary statistics for firm and industry characteristics. The sample period is from 1993 to 2004. All variables in the table are defined in Appendix A. All variables are winsorized at the 1st and 99th percentile levels.

Variable	*N*	Mean	Median	Lower Quartile	Upper Quartile
Panel A: Firm Performance Measures					
ROA (%)	17,987	3.17	4.04	1.18	7.85
Firm q	17,987	1.98	1.48	1.15	2.19
Panel B: CEO and VP Characteristics					
CEO Age	17,987	54.74	55.00	50.00	60.00
CEO Experience	17,987	7.59	5.00	2.00	10.00
New CEO	17,987	0.11	0.00	0.00	0.00
CEO Is Insider	17,488	0.75	1.00	0.00	1.00
*New CEO * CEO Is Insider*	17,488	0.08	0.00	0.00	0.00
Retiring CEO	17,987	0.17	0.00	0.00	1.00
Chair	17,987	0.67	1.00	0.00	1.00
No. of VPs	17,987	5.31	5.00	4.00	6.00
Succession Plan	17,987	0.52	1.00	0.00	1.00
CFO Is VP	17,987	0.67	1.00	0.00	1.00
Panel C: Firm and Industry Characteristics					
Firm Size	17,987	7.10	7.03	6.08	8.11
Stk. Return Volatility (%/month)	17,987	1.71	1.11	0.61	2.18
No. of Segments	16,931	2.78	2.00	1.00	4.00
Industry Homogeneity	17,987	0.22	0.20	0.13	0.30
Leverage	17,987	0.23	0.22	0.08	0.35
Capital to Sales	17,987	0.46	0.22	0.12	0.48
R&D to Capital	17,987	0.23	0.00	0.00	0.12
Advertising to Capital	17,987	0.06	0.00	0.00	0.00
Dividend Yield (%/ year)	17,987	1.30	0.59	0.00	2.14

highest paid VP is at least 20% greater than the second-highest-paid VP.[12] The indicator variable *CFO Is VP* equals one if any of the VPs in the firm-year is the CFO.

Panel C of Table II presents summary statistics for firm and industry characteristics. We define *Firm Size* as the natural log of the firm's net sales for the year and *Stk. Return Volatility* as the variance of the firm's monthly stock

[12] This is a modified version of the variable in Naveen (2006), who does not impose any restriction on the difference in compensation between the highest and the next highest paid VP. Our results remain unchanged when we use either or both conditions to define succession plans.

returns over the 60-month period prior to the sample year. The variable *No. of Segments* is from the Compustat Segment files and represents the number of business segments in each firm-year. We follow Parrino (1997) and construct the variable *Industry Homogeneity* to measure the similarity between firms within an industry after isolating market effects.[13] The variable *Capital to Sales* is the ratio of net fixed assets to net sales and *Leverage* is the ratio of the firm's long-term debt to total assets. Finally, the definitions of variables *R&D to Capital*, *Advertising to Capital*, and *Dividend Yield* are as the names suggest.

II. Determinants of the Size of the Tournament Prize

The expected payoff for a VP in the tournament for promotion to CEO is the product of the prize size and the probability of promotion. If the expected payoff is constant, an increase (decrease) in the probability of promotion should lead to a decrease (increase) in the prize size. Below we present the hypotheses and empirical evidence on the relation between industry, firm, CEO, and VP characteristics and the size of the tournament prize (the pay gap) either directly or through their effect on the perceived probability of promotion.

A. Factors That Affect the Prize Size through the Effect on the Probability of Promotion

First, when the firm has a new CEO, the tournament for the previous CEO's job has just ended and the tournament for the new CEO's position is in its infancy. As a result, the probability of promotion for VPs in the near future is lower. Therefore, we hypothesize that the pay gap should be greater when the firm has just hired a new CEO. Further, when a firm hires the new CEO from outside instead of promoting an insider, the perceived probability of promotion for incumbent VPs decreases further because they recognize the possibility that future CEOs may also be outsiders. We hypothesize that the compensation gap when the new CEO is an outsider should be greater than when the new CEO is an insider. The likelihood of hiring an outsider as CEO is also higher when firms operate in homogeneous industries (Parrino (1997)). Consistent with our previous hypothesis we expect that the size of the tournament prize to increase with *Industry Homogeneity*.

Conversely, when a CEO is close to retirement, the likelihood of an immediate promotion for VPs should increase and, consequently, the compensation gap should be lower when the firm has a *Retiring CEO*. Next, an increase in

[13] First, we assign firms in the CRSP monthly returns file to their respective two-digit historical SIC industry code (obtained from Compustat data item 324 or DNUM if data 324 are missing) 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 *Industry Homogeneity* 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.

the number of VPs will lead to a decline in individual VPs' probability of winning the tournament (Main, O'Reilly, and Wade (1993)), implying a positive relation between the pay gap and *No. of VPs*. When the CEO *does not* also hold the position of chair, this oftentimes indicates that the CEO is under some sort of probation. As a result, the likelihood of a promotion is higher, implying that the compensation gap should be higher when the CEO is also the *Chair*. 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, resulting in a "biased" tournament. Therefore, we hypothesize that the compensation gap should be higher when the firm has a *Succession Plan* in place. Finally, Mian (2001) documents that only about 5% of the CFOs attain the position of CEO or president, indicating that the position of the CFO is usually a terminal one. Consequently, when the CFO is one of the VPs, the probability of promotion is greater for the other VPs, which implies a negative relation between *CFO Is VP* and the pay gap.

B. Factors That Affect the Prize Size Directly

Lambert, Larcker, and Weigelt (1993) provide evidence that the largest pay gap exists between the CEO and VPs and Murphy (1999) documents that executive pay increases with firm size. These two findings together suggest a positive relation between *Firm Size* and CEO–VP compensation gaps. Murphy (1999) documents that firms benchmark executive compensation to pay levels of similar firms in the industry. Therefore, we hypothesize that the size of the wage gap in a firm will relate positively to the *Median Industry Gap*. Nalebuff and Stiglitz (1983) and Zabojnik and Bernhardt (2001) posit that firms are more likely to use tournament incentives when extracting managerial effort from an output signal is more difficult. The variables *Stk. Return Volatility* and *No. of Segments* capture aspects of this signal extraction problem and should relate positively to the size of the tournament prize.

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

Our findings on the determinants of the CEO–VP pay gap are in Table III.[14] Our first hypothesis is that the gap will be greater when there is a new CEO and the second is that the gap when the new CEO is an outsider is greater than when the new CEO is an insider. To determine these two effects, we combine the coefficients on the variables *New CEO*, *CEO Is Insider*, and their product and report the findings in Panel B of Table III.[15] The first row in the panel indicates that the coefficients are significantly positive when we measure tournament prize size using total and long-term gaps. The second row presents results from

[14] In all our analyses, we use heteroskedasticity-robust standard errors clustered by firm (Petersen (2009)) to compute statistical significance.

[15] Appendix B contains details of our computations for these comparisons, which we also use later in Table VIII.

Table III

Determinants of Tournaments: Fixed Effects Regressions

Panel A reports fixed effects OLS regressions of *Total, ST,* and *LT Gap* on CEO, VP, firm, and industry characteristics. Panel B reports results of *F*-tests for comparisons between two groups. The sample period is from 1993 to 2004. Here, *Total Gap* is the difference between the CEO's *Total compensation* and the median VP's *Total compensation* for any given firm-year and *ST (LT) Gap* is the difference between the CEO's *ST* (*LT*) *compensation* and the Median VP's *ST* (*LT*) *compensation* for any given firm-year. All other variables are defined in Appendix A. All variables are winsorized at the 1st and 99th percentile levels. All specifications contain year dummies and firm fixed effects. Values of the *t*-statistics are in parentheses and are computed using heteroskedasticity robust standard errors, clustered by firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Fixed Effects OLS Regressions for the Determinants of Pay Gaps

Dependent Variable:	Log (*Total Gap*)	Log (*ST Gap*)	Log (*LT Gap*)
Constant	3.211***	2.101***	3.095***
	(4.59)	(2.66)	(4.73)
New CEO (β_5)	0.305***	−0.005	0.338***
	(5.05)	(−0.10)	(5.52)
CEO Is Insider (β_6)	−0.105**	−0.108***	−0.038
	(−2.45)	(−2.96)	(−0.87)
*New CEO * CEO Is Insider* (β_7)	−0.320***	−0.072	−0.344***
	(−5.02)	(−1.39)	(−5.47)
Industry Homogeneity	0.078	0.187	0.142
	(0.36)	(0.79)	(0.64)
Retiring CEO	0.003	0.059**	−0.029
	(0.11)	(2.32)	(−0.91)
Chair	0.030	0.006	0.029
	(0.93)	(0.19)	(0.92)
No. of VPs	0.031***	−0.011	0.043***
	(4.21)	(−1.58)	(5.59)
Succession Plan	−0.086***	−0.155***	−0.031
	(−4.26)	(−7.82)	(−1.50)
Log (*Median Industry Gap*)	0.714***	0.666***	0.753***
	(15.42)	(15.17)	(14.69)
CFO Is VP	0.041*	0.049***	0.024
	(1.84)	(2.78)	(1.04)
Log (*CEO Age*)	−0.410**	−0.066	−0.436***
	(−2.54)	(−0.33)	(−3.09)
Log (*CEO Experience*)	0.006	0.045*	−0.016
	(0.25)	(1.83)	(−0.69)
Firm Size	0.070**	0.067**	0.043
	(2.45)	(2.27)	(1.55)
Stk. Return Volatility	−1.497	−4.538***	−0.357
	(−0.85)	(−2.61)	(−0.21)
No. of Segments	−0.017**	−0.010	−0.016**
	(−2.09)	(−1.50)	(−1.96)

(*continued*)

Table III—*Continued*

Panel B: Tests of Comparisons between Groups			
Comparisons (*F*-statistic)	Log (*Total Gap*)	Log (*ST Gap*)	Log (*LT Gap*)
(a) New CEO [$\beta_5 + \beta_7$* Mean(Insider)]	0.067*	−0.056**	0.083**
with continuing CEO	(2.69)	(3.96)	(4.14)
(b) New CEO from outside [$-(\beta_6 + \beta_7)$]	0.425***	0.179***	0.382***
with new CEO from inside	(40.85)	(7.64)	(40.03)
Within R^2	0.13	0.12	0.12
No. of observations (year dummies)	16,460 (yes)	16,460 (yes)	16,460 (yes)
No. of firms (firm fixed effects)	2,166 (yes)	2,166 (yes)	2,166 (yes)

comparing the pay gap between insider and outsider CEOs. We find that all three measures of the pay gap are significantly greater when the new CEO is an outsider. Thus, the results in Panel B are generally consistent with the negative relation between the probability of promotion and the size of the tournament prize.

We find no relation between *Industry Homogeneity* and pay gaps. Additionally, we find no evidence that the prize size decreases as the incumbent CEO nears retirement. The coefficient on *No. of VPs* is significantly positive in the total and long-term gap regressions, which is consistent with our hypothesis that a greater number of VPs results in a lower promotion probability for individual VPs and a consequent increase in the pay gap. We find no support for the hypothesis that pay gaps should be greater when the CEO is also the *Chair*. The negative coefficient on *Succession Plan* is contrary to the expectation that when the firm has a designated successor, pay gaps will be larger to offset the effect of a lower probability of promotion. We find some evidence that the relation between *CFO Is VP* and pay gaps is positive, which is not consistent with our hypothesis.

We find evidence supporting some of our hypotheses regarding factors that affect the prize size directly. First, the coefficient on *Firm Size* is significantly positive in two of the three measures of tournament prize. Next, consistent with our hypothesis, we find a positive and statistically significant relation between the respective median industry gaps and all of our three measures of pay gap.[16] Our findings on the conventional determinants of tournaments are generally in keeping with those in the literature (e.g., Bognanno (2001)). The CEO's age is negatively related to log *(Total Gap)* and log *(LT Gap)* but unrelated to log *(ST Gap)*. The CEO's experience relates (weakly) positively to log (*ST Gap*) but is unrelated to the other two tournament measures. We find little evidence supporting the prediction that pay gaps must be larger when managerial effort is difficult to verify. The coefficients on the variables *Stk. Return Volatility* and

[16] Note that the median industry gap is log *(Median Industry ST Gap)* when log *(ST Gap)* is the dependent variable. Similarly, the median industry gaps represent median industry values for *LT* and *Total* gaps in the respective specifications.

No. of Segments are either generally not significant or inconsistent with our hypotheses.

III. Tournament Incentives, Alignment, and Firm Performance

We measure tournament incentives by the size of the prize, which implicitly assumes that the firm does not set the probability of promotion. We relax this assumption in the next section and consider both the prize size and the probability of promotion simultaneously. It is possible that an unobserved variable such as CEO ability affects our independent variables (tournament and alignment incentives) as well as the dependent variable (firm performance). For instance, more "able" CEOs will earn more as well as perform better. Further, unobservable CEO ability may vary over time because of on-the-job learning (e.g., Baker, Gibbs, and Holmstrom (1994)). Even if true CEO ability were constant over time, shareholders' perception of this ability, which determines compensation, may vary over time as shareholders update their priors on CEO ability.[17] In our empirical analysis, we consider both these issues and treat them as follows. First, assuming that unobserved heterogeneity is constant over time, we estimate a firm-level fixed effects model. Next, if omitted variables vary over time, Wooldridge (2002) shows that fixed effects alone are insufficient since they make the estimates inconsistent. Thus, to capture the possibility of time-varying omitted variables such as managerial ability, we also employ an instrumental variables two-stage least squares (2SLS) approach with firm fixed effects.

A. Results from OLS Fixed Effects Regressions

We report our findings on the incentive effects of tournaments and alignment on firm performance from estimating a firm fixed effects model in Table IV. The first two columns in the table present results using total gap as the tournament measure and in the next two columns we report results when we replace log (*Total Gap*) with log (*ST Gap*) and log (*LT Gap*) as tournament measures. Across almost all model specifications, the proxy for all three measures of the prize size is positive and significant. The estimate of log *(LT Gap)* although positive is not significant at conventional levels with *ROA* as the dependent variable. The coefficients on both *CEO Alignment* and *VP Alignment* are also positive and statistically significant in all specifications. These findings from estimating the firm fixed effects model offer considerable support to the conjecture that alignment effects in the case of CEO and both tournament and alignment effects in the case of VPs positively affect firm performance. Among the control variables, the coefficient estimate on log *(σ VP Comp)* is positive and significant in the *Firm q* specifications, the coefficient on log *(CEO Age)* is

[17] Studies that recognize and address the endogeneity between managerial ownership and firm performance include Aggarwal and Samwick (2006), Coles, Lemmon, and Meschke (2005), and Palia (2001).

Table IV

Effects of Tournament and Alignment Incentives on Firm Performance: Fixed Effects Regressions

The table reports fixed effects OLS regressions of *ROA* and *Firm q* on tournament and alignment incentives. The sample period is from 1993 to 2004. The dependent variables are firm performance measured as *ROA,* which is the ratio of net income to total assets and *Firm q* equal to market value of equity + book value of debt / total assets. Here, *Total Gap* is the difference between the CEO's *Total compensation* and the median VP's *Total compensation* for any given firm-year; *ST (LT) Gap* is the difference between the CEO's *ST (LT) compensation* and the median VP's *ST (LT) compensation* for any given firm-year; and *CEO (VP) Alignment* represents the stock price sensitivity of the CEO's (VP's) stock and option portfolio at the beginning of the year. All the control variables are defined in Appendix A. All variables are winsorized at the 1st and 99th percentile levels. All specifications contain year dummies and firm fixed effects. Values of the *t*-statistics are in parentheses and are computed using heteroskedasticity robust standard errors, clustered by firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Log (*Total Gap*)		Log (*ST Gap*) and Log (*LT Gap*)	
Dependent Variable	*ROA*	*Firm q*	*ROA*	*Firm q*
Constant	−20.428***	5.631***	−23.313***	5.409***
	(−3.13)	(6.77)	(−3.52)	(6.51)
Log (*Total Gap*)	0.429***	0.059***		
	(4.74)	(4.68)		
Log (*ST Gap*)			1.050***	0.068***
			(6.82)	(3.88)
Log (*LT Gap*)			0.119	0.040***
			(1.41)	(3.66)
CEO Alignment	0.128***	0.015***	0.134***	0.016***
	(4.67)	(3.76)	(4.79)	(3.79)
VP Alignment	2.429***	0.151***	2.417***	0.150***
	(5.63)	(2.93)	(5.56)	(2.91)
Control Variables				
Log (σ*VP Comp*)	0.021	0.110***	0.036	0.110***
	(0.21)	(9.33)	(0.36)	(9.33)
Log (*CEO Age*)	−2.657***	−0.281**	−3.007***	−0.296**
	(−2.74)	(−2.43)	(−3.08)	(−2.56)
Industry Homogeneity	5.419***	0.463*	5.250***	0.455*
	(2.97)	(1.91)	(2.90)	(1.88)
Firm Size	9.139***	−0.650***	9.097***	−0.650***
	(6.32)	(−3.25)	(6.30)	(−3.24)
Firm Size Squared	−0.491***	0.029**	−0.498***	0.028**
	(−5.32)	(2.07)	(−5.41)	(2.04)
Stk. Return Volatility	−70.667***	−9.906***	−65.560***	−9.619***
	(−3.28)	(−4.35)	(−3.07)	(−4.21)
Capital to Sales	−3.255***	−0.328***	−3.162***	−0.324***
	(−6.58)	(−4.49)	(−6.32)	(−4.42)
Leverage	−19.314***	−1.027***	−19.006***	−1.011***
	(−14.72)	(−6.66)	(−14.66)	(−6.54)
R&D to Capital	−3.372***	0.053	−3.444***	0.049
	(−4.05)	(0.57)	(−4.15)	(0.53)
Advertising to Capital	0.063	0.109	0.044	0.110
	(0.05)	(0.70)	(0.03)	(0.71)
Dividend Yield	−0.500***	−0.110***	−0.458***	−0.107***
	(−7.13)	(−11.34)	(−6.50)	(−11.14)
Within R^2	0.15	0.13	0.15	0.13
No. of observations (year dummies)	17,987 (yes)	17,987 (yes)	17,987 (yes)	17,987 (yes)
No. of firms (firm fixed effects)	2,367 (yes)	2,367 (yes)	2,367 (yes)	2,367 (yes)

negative and statistically significant in all the regressions, and the coefficient on *Industry Homogeneity* is positive and significant in all the four regressions. The signs of the coefficients on the remaining control variables are generally similar to those documented in prior literature.

B. Instrumental Variables Estimation

We next consider the scenario in which the relation between managerial compensation and firm performance may be endogenous. Since both tournament and alignment incentive measures are related to managerial compensation, we treat all tournament and alignment variables as endogenous.

The instruments for the endogenous variables in our analysis include log (*Median Industry Total Gap*), log (*Median Industry ST Gap*), log (*Median Industry LT Gap), Industry CEO Alignment*, and *Industry VP Alignment*. These instrumental variables are median values of the incentive measures for firms in the same two-digit Standard Industrial Classification (SIC) code and in the same size quartile as the firm. The underlying economic rationale for these instruments is from Murphy (1999), who documents that the level and structure of managerial compensation varies by firm size and industry. Since tournament and alignment incentives are based on managerial compensation, median values for firms that are in the same industry and of similar size are natural choices for instrumental variables. Further, from our earlier analysis, we know that the median industry values for all three measures of pay gaps are significant determinants of the size of the tournament prize. Thus, median industry gaps provide good exogenous variation, making them ideal candidates as instruments for tournament incentives. In order to obtain additional heterogeneity, we also include other determinants of the gap such as *No. of VPs* and *CFO Is VP* as instruments.[18] We then conduct statistical tests to determine the relevance (correlation with the endogenous variables) and validity (orthogonality to the residuals or exogeneity with the dependent variable) of these instrumental variables. We find that all three measures of median industry gap, median industry CEO, and VP alignments, *No. of VPs*, and *CFO Is VP* satisfy the relevance and validity criteria necessary for appropriate instruments.[19]

Table V presents results from estimating the 2SLS specification with log *(Total Gap)* as the tournament measure. In the first three columns of the table, we

[18] We choose a subset of tournament determinants as instruments instead of using all the determinants to obtain a parsimonious set of instruments that satisfy the relevance and validity criterion. Thus, the first-stage equations for tournament variables in the 2SLS estimates in Tables V and VI are different from the determinants of tournaments regressions in Table III. We thank Jeffrey Wooldridge for clarifying this issue.

[19] To verify the sensitivity of our results to the choice of instruments, we construct two additional instruments. First, we compute *Bachelors,* which is the percentage of full-time employees in an industry with a bachelors degree or higher. In the spirit of Milbourn (2003), and Rajgopal, Shevlin, and Zamora (2006), we construct our second measure, *CEO reputation*, as the number of articles returned by the *Dow Jones News* retrieval service in nine selected publications. We replace *CFO Is VP* and *No. of VPs* with *Bachelors* and *CEO Reputation* as instruments and find that all our reported results remain robust to these alternate instruments.

Table V

Effect of Tournament and Alignment Incentives on Firm Performance: 2SLS with *Total Gap*

The table reports fixed effect 2SLS regressions of *ROA* and *Firm q* on tournament and alignment based on *Total Gap*. The sample period is from 1993 to 2004. The dependent variables are firm performance measured as *ROA,* which is the ratio of net income to total assets and *Firm q* equal to market value of equity + book value of debt / total assets. Here, *Total Gap* is the difference between the CEO's *Total compensation* and the median VP's *Total compensation* for any given firm-year, and *CEO (VP) Alignment* represents the stock price sensitivity of the CEO's (VP's) stock and option portfolio at the beginning of the year. All control and instrumental variables are defined in Appendix A. Statistics from tests for relevance and validity of instruments are reported in the bottom panel. All variables are winsorized at the 1st and 99th percentile levels. All specifications contain year dummies and firm fixed effects. Values of the *t*-statistics are in parentheses and are computed using heteroskedasticity robust standard errors, clustered by firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	First Stage			Second Stage	
Dependent Variable	*Total Gap*	*CEO Alignment*	*VP Alignment*	*ROA*	*Firm q*
Constant	3.179***	−3.518	1.266***		
	(4.31)	(−0.84)	(6.35)		
Endogenous Variables					
Log (*Total Gap*)				1.115***	0.133***
				(3.66)	(3.39)
CEO Alignment				0.235***	0.019**
				(3.05)	(2.13)
VP Alignment				12.909***	0.755***
				(7.83)	(4.43)
Control Variables					
Log (σ*VP Comp*)	0.089***	0.059	−0.003	0.086	0.110***
	(5.55)	(1.47)	(−0.83)	(0.77)	(8.30)
Log (*CEO Age*)	−0.471***	3.944***	0.013	−2.544**	−0.247**
	(−3.95)	(4.22)	(0.46)	(−2.34)	(−2.00)
Industry Homogeneity	0.077	1.966**	0.118*	4.054**	0.389
	(0.41)	(2.22)	(1.77)	(2.00)	(1.54)
Firm Size	0.072	−1.770***	−0.196***	11.903***	−0.489**
	(0.65)	(−3.62)	(−5.23)	(7.70)	(−2.41)
Firm Size Squared	−0.003	0.061*	0.008***	−0.621***	0.021
	(−0.32)	(1.73)	(3.46)	(−6.39)	(1.48)
Stk. Return Volatility	−0.934	−4.263	−0.550	−65.322***	−9.547***
	(−0.52)	(−0.62)	(−1.15)	(−3.07)	(−4.19)
Capital / Sales	−0.039	−0.279	−0.049***	−2.598***	−0.290***
	(−0.56)	(−1.11)	(−4.38)	(−4.91)	(−3.85)
Leverage	−0.203**	0.474	0.089***	−19.861***	−1.049***
	(−2.08)	(1.16)	(3.06)	(−14.8)	(−6.72)
R&D to Capital	0.041	−0.212	−0.002	−3.366***	0.052
	(1.00)	(−1.21)	(−0.11)	(−4.08)	(0.57)
Adv. to Capital	0.062	−0.752	0.049*	−0.354	0.081
	(0.50)	(−1.58)	(1.93)	(−0.25)	(0.52)
Dividend Yield	−0.035***	−0.129***	−0.012***	−0.299***	−0.097***
	(−3.36)	(−3.30)	(−4.97)	(−3.83)	(−9.55)

(*continued*)

Table V—*Continued*

	First Stage			Second Stage	
Dependent Variable	*Total Gap*	*CEO Alignment*	*VP Alignment*	*ROA*	*Firm q*
Instrumental Variables					
No. of VPs	0.020***	−0.125***	−0.045***		
	(2.75)	(−3.94)	(−22.20)		
CFO Is VP	0.053**	−0.067	−0.005		
	(2.50)	(−0.73)	(−0.92)		
Log (*Median Industry Total Gap*)	0.701***	0.045	0.013***		
	(14.40)	(0.56)	(2.58)		
Industry CEO Alignment	0.009	0.426***	0.003**		
	(1.43)	(7.82)	(2.11)		
Industry VP Alignment	0.005	−0.093**	0.012**		
	(1.04)	(−2.06)	(2.46)		
Within R^2	0.13	0.12	0.10	0.06	0.10
No. of observations	17,987	17,987	17,987	17,987	17,987
No. of firms	2,367	2,367	2,367	2,367	2,367
(Year dummies and firm fixed effects)	Yes	Yes	Yes	Yes	Yes
Tests of Endogeneity, Relevance, and Validity of Instruments					
Difference in Sargan C (χ^2)				62.61***	21.26***
Shea partial R^2	0.07	0.07	0.06		
F-statistic	44.54***	14.95***	102.02***		
Anderson–Rubin F-statistic				22.97***	9.26***
Hansen J-statistic (p-value)				2.00 (0.37)	1.18 (0.55)

report results from the first stage of the 2SLS specification for each of the three endogenous variables and present all the test statistics related to endogeneity and instrumental variable selection in the bottom panel of the table. First, the Difference-in-Sargan C-statistic rejects the null that tournament and alignment variables in the estimated specifications are jointly exogenous to firm performance. The coefficients on individual instruments, *Industry CEO Alignment*, *Industry VP Alignment*, log *(Median Industry Total Gap)*, *No. of VPs,* and *CFO Is VP* are all statistically significant in the appropriate first-stage regressions. These findings indicate that our instruments are individually relevant. The Shea partial R^2 values and the F-statistic provide additional significant support for the joint relevance of all our instruments in the first stage. Further, the Anderson–Rubin F-statistic rejects the null hypothesis and indicates that the endogenous regressors are relevant. Since we have an overidentified specification with more instruments than endogenous variables, we present statistics from the Hansen–Sargan test of overidentifying restrictions to test the validity of the instruments. For both *ROA* and *Firm q* regressions, the Hansen J-statistic is unable to reject the null hypothesis that the instruments are valid and orthogonal to the residuals, and their exclusion from the main estimated equation is appropriate.

The last two columns in Table V present second-stage results on the relation between incentives and firm performance measured using *ROA* and *Firm q,* respectively. The coefficient on log (*Total Gap*) is positively related to *ROA* as well as *Firm q* and the estimates are statistically significant at the 1% level. The coefficients on *CEO Alignment* and *VP Alignment* are also positive and significant in both regressions.

In Table VI, we replace log (*Total Gap*) with log (*ST Gap*) and log (*LT Gap*) as tournament measures. As with total gap, our instruments in these regressions satisfy the relevance and validity criteria, reported in the bottom panel of Table VI. Note that we replace log *(Median Industry Total Gap)* used in Table V with log *(Median Industry ST Gap)* and log *(Median Industry LT Gap)* as instruments for the specifications in Table VI. Tournament incentives measured using short-term and long-term gaps continue to remain positive and statistically significant. In particular, *CEO Alignment* and *VP Alignment* remain positive and significant at the 1% level in the *ROA* and *Firm q* regressions. The 2SLS analysis therefore offers significant support for the positive relation between tournament and alignment incentives and firm performance.

IV. Tournament Incentives, Probability of Promotion, Alignment, and Firm Performance

In this section, we analyze the effect of "total" tournament incentives, that is, both the pay gap and the probability of promotion, on firm performance by considering certain "special scenarios." In Section II, where we analyze the effect of these scenarios on the prize size, an increase (decrease) in the probability of promotion implied a smaller (larger) tournament gap. However, in terms of the relation between tournament incentives and firm performance, for a given gap an increase (decrease) in the probability of promotion will strengthen (weaken) the relation between the pay gap and firm performance that we document in Section III. Thus, we expect the effect of a change in promotion probability on the relation between prize size and firm performance to be exactly the opposite of its effect on the prize size.

First, when the firm has a new CEO, the probability of winning the tournament in the turnover year for incumbent VPs is lower. Therefore, for a given gap, tournament effects on firm performance should be weaker when the firm has just had a CEO turnover. Further, if the new CEO is an outsider, the probability of promotion as perceived by the firm's VPs is likely to be even lower than when the new CEO is an insider. Therefore, tournament effects on firm performance should be weaker when the new CEO is an outsider as compared to the case when the new CEO is an insider. Similarly, in homogeneous industries, there is a greater likelihood of hiring an outside CEO as well as improved outside employment opportunities for VPs. Therefore, the probability of an internal promotion will be lower leading to a less effective tournament. Conversely, when a CEO is close to retirement, tournament effects should be stronger because the probability of an immediate (or a sooner) promotion for VPs is higher. As discussed in Section II, the probability of promotion should be lower when the

Table VI

Effects of Tournament and Alignment Incentives on Firm Performance: 2SLS with *ST* and *LT Gap*

The table reports fixed effects 2SLS regressions of *ROA* and *Firm q* on tournament and alignment incentives based on *ST* and *LT Gaps*. The sample period is from 1993 to 2004. The dependent variables are firm performance measured as *ROA,* which is the ratio of net income to total assets and *Firm q* equal to market value of equity + book value of debt / total assets. Here, *ST (LT) Gap* is the difference between the CEO's *ST (LT) compensation* and the Median VP's *ST (LT) compensation* for any given firm-year, and *CEO (VP) Alignment* represents the stock price sensitivity of the CEO's (VP's) stock and option portfolio at the beginning of the year. All control and instrumental variables are defined in Appendix A. Statistics from tests for relevance and validity of instruments are reported in the bottom panel. All variables are winsorized at the 1st and 99th percentile levels. All specifications contain year dummies and firm fixed effects. Values of the *t*-statistics are in parentheses and are computed using heteroskedasticity robust standard errors, clustered by firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	First Stage				Second Stage	
Dependent Variable	Log (*ST Gap*)	Log (*LT Gap*)	*CEO Alignment*	*VP Alignment*	*ROA*	*Firm q*
Constant	1.710***	3.813***	−4.594	1.248***		
	(2.62)	(5.42)	(−1.09)	(6.15)		
Endogenous Variables						
Log (*ST Gap*)					2.998***	0.178***
					(5.98)	(3.66)
Log (*LT Gap*)					0.490*	0.069**
					(1.74)	(2.42)
CEO Alignment					0.283***	0.022**
					(3.25)	(2.39)
VP Alignment					11.511***	0.672***
					(6.96)	(3.88)
Control Variables						
Log (σ*VP Comp*)	0.022**	0.096***	0.054	−0.002	0.075	0.112***
	(2.34)	(6.07)	(1.36)	(−0.81)	(0.66)	(8.66)
Log (*CEO Age*)	0.205	−0.644***	3.968***	0.013	−3.512***	−0.313**
	(1.52)	(−6.35)	(4.25)	(0.46)	(−3.02)	(−2.45)
Industry Homogeneity	0.103	0.121	2.025**	0.119*	3.704*	0.371
	(0.49)	(0.64)	(2.29)	(1.78)	(1.84)	(1.47)
Firm Size	−0.010	0.133	−1.686***	−0.196***	11.616***	−0.508**
	(−0.11)	(1.12)	(−3.44)	(−5.21)	(7.46)	(−2.49)
Firm Size Squared	0.006	−0.008	0.053	0.008***	−0.637***	0.020
	(0.85)	(−0.89)	(1.51)	(3.44)	(−6.54)	(1.44)
Stk. Return Volatility	−4.763***	0.003	−4.252	−0.551	−50.935**	−8.793***
	(−3.04)	(0.00)	(−0.62)	(−1.15)	(−2.43)	(−3.78)
Capital / Sales	−0.086*	0.004	−0.281	−0.049***	−2.403***	−0.281***
	(−1.67)	(0.09)	(−1.12)	(−4.37)	(−4.32)	(−3.75)
Leverage	−0.311***	−0.082	0.479	0.089***	−18.875***	−1.003***
	(−3.42)	(−0.95)	(1.18)	(3.06)	(−14.20)	(−6.38)
R&D to Capital	0.094***	0.004	−0.210	−0.001	−3.564***	0.042
	(2.63)	(0.10)	(−1.20)	(−0.10)	(−4.32)	(0.46)
Adv. to Capital	0.051	0.017	−0.743	0.050*	−0.338	0.087
	(0.32)	(0.13)	(−1.57)	(1.96)	(−0.24)	(0.57)

(*continued*)

Table VI—*Continued*

	First Stage				Second Stage	
Dependent Variable	Log (*ST Gap*)	Log (*LT Gap*)	*CEO Alignment*	*VP Alignment*	*ROA*	*Firm q*
Dividend Yield	−0.038***	−0.031***	−0.129***	−0.012***	−0.187**	−0.092***
	(−4.65)	(−3.38)	(−3.31)	(−4.95)	(−2.36)	(−9.03)
Instrumental Variables						
No. of VPs	−0.018***	0.033***	−0.126***	−0.045***		
	(−2.74)	(4.35)	(−3.96)	(−22.20)		
CFO Is VP dummy	0.065***	0.030	−0.066	−0.005		
	(3.76)	(1.41)	(−0.72)	(−0.92)		
Log (*Median Industry ST gap*)	0.690***	−0.107***	−0.037	0.007		
	(16.60)	(−2.91)	(−0.31)	(0.96)		
Log (*Median Industry LT gap*)	−0.086**	0.759***	0.188	0.010**		
	(−2.56)	(14.00)	(1.58)	(2.08)		
Industry CEO Alignment	0.001	0.009*	0.428***	0.003**		
	(0.25)	(1.78)	(7.91)	(2.15)		
Industry VP Alignment	0.003	−0.002	−0.092**	0.012**		
	(0.41)	(−0.32)	(−2.04)	(2.46)		
Within R^2	0.11	0.12	0.12	0.10	0.06	0.10
No. of observations	17,987	17,987	17,987	17,987	17,987	17,987
No. of firms	2,367	2,367	2,367	2,367	2,367	2,367
Year dummies and firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Tests of Endogeneity, Relevance, and Validity of Instruments						
Difference in Sargan C (χ^2)					78.59***	21.86***
Shea partial R^2	0.07	0.07	0.07	0.06		
F-statistic	62.02***	40.06***	13.30***	85.67***		
Anderson–Rubin F-statistic					26.03***	9.55***
Hansen J-statistic (p-value)					0.53(0.77)	0.66(0.72)

CEO is also the chair of the board or when the firm has a CEO succession plan in place. Consequently, we hypothesize that the effect of tournament incentives on firm performance will be weaker when the CEO is also the *Chair* or when the firm has a *Succession Plan*.

To investigate the effects of total tournament incentives on firm performance, we interact each special-scenario variable with the pay gap measures. These interaction variables measure the effect of total tournament incentives on firm performance. We then estimate the firm fixed effects model of Table IV, in which these interaction terms and the respective uninteracted variables are included. The general specification we use in these tests is as follows

$$\begin{aligned} Performance = {} & \beta_0 + \beta_1 Gap + \beta_2 CEO\ Alignment + \beta_3 VP\ Alignment \\ & + \beta_4 Log(\sigma\ VP\ Comp) + \beta_5 Gap * New\ CEO \\ & + \beta_6 Gap * Insider + \beta_7 Gap * New\ CEO * Insider \\ & + \beta_8 Gap * Industry\ Homogeneity + \beta_9 Gap * Retiring\ CEO \\ & + \beta_{10} Gap * Succession\ Plan + \beta_{11} Gap\ Chair + \beta_{12} New\ CEO \\ & + \beta_{13} Insider + \beta_{14} Succession\ Plan + \beta_{15} Chair \\ & + \beta_{16} Log(\ CEO\ Age) + \beta_{17} Industry\ Homogeneity \\ & + Controls + \text{Year dummies} + \text{Firm effects} + \varepsilon_{it}. \end{aligned} \tag{1}$$

The coefficients on the interaction variables form the basis of our inferences in this section. We estimate the above model for all three measures of the pay gap as well as for both of our measures of firm performance and present our findings in Table VII. Results for the interaction with the tournament variable log *(Total Gap)* are in the first two columns, with log *(ST Gap)* in the next two columns, and with log *(LT Gap)* in the last two columns. We omit reporting the intercept term and control variables in the table for brevity and expositional convenience.

As in Section II, to test our hypotheses relating to new CEOs, we need to combine the coefficients on the variables *New CEO*, *CEO Is Insider*, and their product. Panel B of Table VII presents results from the tests of our hypothesis on CEO turnover and for comparing the cases of outsider versus insider new CEO.[20] The first row of the panel compares the tournament incentives for the case in which the firm has a new CEO with the case in which the existing CEO continues in the job. We find some support for the hypothesis that tournament incentives are weaker in the year that the firm has a new CEO. Specifically, we find that the effect of log *(Total Gap)* and log *(LT Gap)* on *ROA* declines when the firm experiences a CEO turnover. The next row in Panel B presents results when we compare the effect of tournament incentives for the case in which the new CEO is an outsider with the case in which the new CEO is an insider. Our hypothesis here is that the effect of tournament incentives on firm performance will be weaker when the new CEO is an outsider. We find that this is indeed the case for all three measures of the gap when we measure firm performance by *ROA*.

Detecting the effect of other special-scenario variables on the relation between tournament incentives and firm performance is relatively more straightforward. We consider tournament incentives to be more (less) effective in a special case if the coefficient on the interaction term for that special case is positive (negative). The coefficient on the interaction term for *Industry Homogeneity* is negative and significant in two out of the three specifications for *Firm q*, and negative but just short of statistically significant in the third specification. Thus, there is some evidence to support our hypothesis that tournament incentives are likely to be less effective in industries in which there is a greater possibility of drawing a CEO from outside the firm. These results offer additional support for our earlier findings regarding an outsider CEO.

Consistent with our hypothesis, the coefficient on the interaction variable for *Retiring CEO* is positive and significant in all the three specifications where we measure firm performance by *Firm q*. Therefore, there is some evidence to suggest that tournament incentives are stronger when the CEO is near retirement. Consistent with our predictions the coefficient estimates on the interaction with *Chair* are negative in all six specifications. However, the estimates are statistically significant only when we use *Firm q* as the performance measure and

[20] Note that although the specification in Table III is different from the one in Table VII, the linear combination of the estimates used for each of the two comparisons turns out to be the same. Details are in Appendix B.

Table VII

Effects of Tournament, Promotion Probability, and Alignment Incentives on Firm Performance

Panel A of the table reports fixed effect regressions of *ROA* and *Firm q* on tournament and alignment with interaction terms for subsamples. Panel B contains results from tests of comparisons between two groups. The sample period is from 1993 to 2004. The dependent variables are firm performance measured as *ROA,* which is the ratio of net income to total assets and *Firm q* equal to market value of equity + book value of debt / total assets. The first two columns represent interaction of key variables with log *(Total Gap)*, the next two columns with log *(ST Gap)* and the last two columns with log *(LT Gap)*. Here, *Total Gap* is the difference between the CEO's *Total Compensation* and the median VP's *Total Compensation* for any given firm-year; *ST (LT) Gap* is the difference between the CEO's *ST (LT) Compensation* and the median VP's *ST (LT) compensation* for any given firm-year; and *CEO (VP) Alignment* represents the stock price sensitivity of the CEO's (VP's) stock and option portfolio at the beginning of the year. The interaction variables represent the interaction of the log of *Total, ST*, and *LT Gap* with the *New CEO, CEO Is Insider, Industry Homogeneity, Retiring CEO, Chair,* and *Succession Plan*. All models include the following control variables (reported): log *(CEO Age), Industry Homogeneity*, *New CEO*, *CEO Is Insider*, *Chair*, *Succession Plan*. Unreported control variables include: *Firm Size, Firm Size Square*d*, Stk. Return Volatility, Capital to Sales, Leverage, R&D to Capital, Adv. to Capital,* and *Dividend Yield.* All these variables are defined in Appendix A. All variables are winsorized at the 1st and 99th percentile levels. All specifications contain year dummies and firm fixed effects. Values of the *t*-statistics are in parentheses and are computed using heteroskedasticity robust standard errors, clustered by firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively.

Interacted Tournament Measure Log (*Gap*)	Log (*Total Gap*)		Log (*ST Gap)*		Log (*LT Gap*)	
Dependent Variable	*ROA*	*Firm q*	*ROA*	*Firm q*	*ROA*	*Firm q*
Panel A: Fixed Effect Regressions of Firm Performance on Tournament Incentives for Special Subsamples						
Log (*Total Gap*)	0.263	0.233***				
	(0.82)	(4.68)				
Log (*ST Gap*)			1.489***	0.234***	0.948***	0.062***
			(2.69)	(3.60)	(6.17)	(3.38)
Log (*LT Gap*)			0.121	0.044***	−0.095	0.165***
			(1.45)	(3.94)	(−0.36)	(4.13)
CEO Alignment	0.108***	0.012**	0.114***	0.012**	0.115***	0.012***
	(3.63)	(2.56)	(3.77)	(2.48)	(3.81)	(2.66)
VP Alignment	2.501***	0.166***	2.503***	0.170***	2.476***	0.164***
	(5.25)	(2.93)	(5.24)	(2.97)	(5.16)	(2.88)
Log (σ*VP Comp*)	0.255**	0.121***	0.256**	0.121***	0.252**	0.122***
	(2.28)	(8.94)	(2.30)	(8.94)	(2.26)	(8.98)
Interaction of log (*Gap*) with						
New CEO (β_5)	−0.774***	−0.052*	−0.105	0.008	−0.905***	−0.028
	(−3.11)	(−1.70)	(−0.36)	(0.29)	(−3.24)	(−0.77)
CEO Is Insider (β_6)	0.141	−0.057*	0.161	−0.000	0.138	−0.024
	(0.64)	(−1.74)	(0.51)	(−0.00027)	(0.68)	(−0.87)
*New CEO * CEO Is Insider* (β_7)	0.305***	0.016**	0.409***	0.019**	0.300***	0.016**
	(3.79)	(2.21)	(4.29)	(2.26)	(3.63)	(2.15)
Industry Homogeneity	0.802	−0.304***	−1.538	−0.241	0.955	−0.316***
	(1.09)	(−2.83)	(−1.33)	(−1.64)	(1.43)	(−2.97)
Retiring CEO	0.036	0.014***	0.031	0.018***	0.034	0.014***
	(0.99)	(2.75)	(0.77)	(3.09)	(0.89)	(2.63)
Chair	−0.139	−0.061**	−0.251	−0.117***	−0.053	−0.044
	(−0.76)	(−2.07)	(−0.78)	(−2.68)	(−0.31)	(−1.54)
Succession Plan	0.028	−0.028	−0.215	−0.049*	0.060	−0.013
Reported Controls	(0.21)	(−1.08)	(−1.05)	(−1.70)	(0.50)	(−0.54)
New CEO	2.934*	0.178	−2.517	−0.266	4.058**	−0.003
	(1.67)	(0.80)	(−1.38)	(−1.51)	(2.07)	(−0.013)
CEO Is Insider	−1.396	0.437*	−1.287	0.002	−1.281	0.176
	(−0.86)	(1.83)	(−0.62)	(0.08)	(−0.89)	(0.91)
Industry Homogeneity	−0.227	2.902***	16.738**	2.146**	−1.405	2.927***
	(−0.04)	(3.31)	(2.02)	(2.08)	(−0.26)	(3.48)

(*continued*)

Table VII—*Continued*

Interacted Tournament Measure Log (*Gap*)	Log (*Total Gap*)		Log (*ST Gap*)		Log (*LT Gap*)	
Dependent Variable	*ROA*	*Firm q*	*ROA*	*Firm q*	*ROA*	*Firm q*
Log (*CEO Age*)	−3.106**	−0.501***	−3.168**	−0.535***	−3.342***	−0.515***
	(−2.49)	(−3.25)	(−2.53)	(−3.46)	(−2.66)	(−3.34)
Chair	1.380	0.493**	1.948	0.801***	0.688	0.358
	(0.97)	(2.13)	(0.89)	(2.69)	(0.52)	(1.63)
Succession Plan	−1.451	0.148	0.330	0.270	−1.560*	0.037
	(−1.35)	(0.74)	(0.23)	(1.37)	(−1.67)	(0.20)
Panel B: Comparisons (*F*-Statistic)						
(a) New CEO $\beta_5 + \beta_7$* Mean(Insider)* with continuing CEO	−0.547**	−0.040	0.200	0.022	−0.68***	−0.016
	(5.86)	(1.96)	(0.55)	(0.75)	(7.08)	(0.22)
(b) New CEO from outside with new CEO from inside − $(\beta_6 + \beta_7)$	−0.446**	0.041	−0.57*	−0.019	−0.438**	0.008
	(4.21)	(1.85)	(3.15)	(0.26)	(4.79)	(0.09)
Within R^2	0.16	0.14	0.16	0.14	0.16	0.14
No. of observations	17,488	17,488	17,488	17,488	17,488	17,488
No. of firms	2,314	2,314	2,314	2,314	2,314	2,314
Year dummies and firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

when tournament incentives are measured using log *(Total Gap)* or log *(ST Gap)*. Finally, we find little evidence to support our hypothesis that having a designated successor in place weakens the incentive effects of tournaments.

V. Robustness and Economic Significance

We repeat all analyses using several alternative tournament measures, which include: (1) the Gini coefficient, (2) the normalized rank or cumulative density function (CDF) of gaps, (3) the compensation gap between the CEO and the *highest*-paid VP, and (4) the compensation gap between the CEO and the *mean* VP.[21] We find that the determinants of these alternative tournament measures are generally similar to those we report in Table III for our primary tournament measures. Next, we reestimate the fixed effects regressions on firm performance (Table IV) using the alternate tournament measures and, in unreported results, find that *CEO Alignment*, *VP Alignment*, and all four alternate measures of tournaments are positive and statistically significant at the 1% level when *Firm q* is the dependent variable. When *ROA* is the firm performance measure, three of the four tournament measures are positive and statistically significant.[22] We also repeat the 2SLS analyses of Table V with alternative tournament measures (for log *(Total Gap)*) and present abbreviated findings

[21] The Gini coefficient is commonly used in the macroeconomics literature to measure income disparity (e.g., Donaldson and Weymark (1980), La Porta et al. (1998), Bloom (1999), and Biais and Perotti (2001)) and equals $1 + \frac{1}{n} - \frac{2}{n^2 \bar{y}}(y_1 + 2y_2 + \cdots ny_n)$, where n is the number of executives including the CEO, $y_1, y_2 \ldots y_n$ is the compensation paid to each of the n executives in decreasing order of size, and $\bar{y}$ is their mean compensation.

[22] These results for the determinants and the fixed effects regressions are available in Tables IA.I and IA.II, respectively, in the Internet Appendix, which can be found at http://www.afajof.org/supplements.asp.

in Table VIII. In these tests, our instruments include industry medians for the four respective tournament measures and median industry values for alignment in addition to the instruments *CFO Is VP* and *No. of VPs*. We report only relevant variables and limited statistics on the validity and relevance of these instruments. We find that all the tournament variables relate significantly positively to both *ROA* and *Firm q*. Further, we find that *CEO* and *VP Alignments* relate positively to *ROA* and *Firm q* in all specifications except one.

We reexamine the fixed effects and 2SLS regressions using alternate performance measures, *OIBD to Capital* and *ROE*.[23] We find that log *(Total Gap)* and log *(ST Gap)* relate positively to both alternate measures of performance in the fixed effects as well as the 2SLS specifications. The coefficient estimate on log *(LT Gap)* is always positive but statistically significant only in the *OIBD to Capital* regressions. The instruments in the 2SLS are always relevant but the Hansen *J*-statistic in the *OIBD to Capital* regression rejects exogeneity at the 10% level. We follow the methodology outlined in Faleye, Mehrotra, and Morck (2006) and construct another measure of firm performance, *Total Factor Productivity* (*TFP*), using the Cobb–Douglas production specification for the firm's output. We reestimate the fixed effects regression specifications (Table IV) using *TFP* instead of *Firm q* and *ROA*. In unreported results, we find that log *(Total Gap)* and log *(ST Gap)* continue to remain positive and statistically significant but the coefficient on log *(LT Gap)* is not significantly different from zero.

Finally, conventional instrumental variable estimators obtained from the 2SLS procedure although consistent may be inefficient in the presence of arbitrary heteroskedasticity (Hansen (1982)). To address this issue, we reestimate all the 2SLS analyses using the generalized method of moments (GMM) estimator to allow for efficient estimation (Baum, Schaffer, and Stillman (2003)). In unreported results, we find that the coefficient estimates and statistical significance from the GMM estimation are almost identical to those reported in Tables V and VI. To account for differences among CEO characteristics rather than firm-level heterogeneity, we repeat all our analyses for determinants of the gap (reported in Table III) and the effect of incentives on firm performance (reported in Tables IV–VI) using CEO fixed effects. All our earlier findings remain robust to this change in specification. Taken together, our results indicate that tournament incentives relate positively to firm performance and that these findings are robust to several alternate measures of tournament incentives as well as firm performance. The earlier tests offer evidence that there is a significant relation between firm performance and both tournament and alignment incentives. To gain some insight into the importance of these incentives for shareholder wealth, we investigate returns to portfolios that differ in levels of alignment and tournament incentives. Using a modified version of the procedure used by Gompers, Ishii, and Metrick (2003), we divide our sample of firms into portfolios that differ in terms of magnitudes of tournament and

[23] These results are available in Table IA.III in the Internet Appendix, which can be found at http://www.afajof.org/supplements.asp.

Table VIII

Effects of Tournament and Alignment Incentives on Firm Performance: 2SLS Regressions Using Alternate Tournament Measures

The table reports 2SLS fixed-effect regressions of *ROA* and *Firm q* on tournament and alignment alignments with alternate tournament measures. The sample period is from 1993 to 2004. The dependent variables are firm performance measured as *ROA,* which is the ratio of net income to total assets and *Firm q* equal to market value of equity + book value of debt / total assets. Gini Coefficient *(Total Comp)* $= 1 + \frac{1}{n} - \frac{2}{n^2 \bar{y}}(y_1 + 2y_2 + \ldots ny_n)$ where n is the number of executives for firm i in year t, including the CEO, and y_1, y_2,..y_n represent the *Total compensation* paid to each of the n executives, in decreasing order of size. Here, *CDF (Total Gap)* is the cumulative density function or normalized rank of the total gap for each year in the sample; *Total Gap (Max VP Comp) (Mean VP Comp)* is the difference between the *CEO's Total compensation* and the highest paid (Mean) VP's *Total compensation* for any given firm-year*; CEO (VP) Alignment* represents the stock price sensitivity of the CEO's (VP's) stock and option portfolio at the beginning of the year; and σ *VP Comp* is the standard deviation of the *Total compensation* among all the VPs for any firm-year. All models include the following control variables: log *(CEO Age), Industry Homogeneity, Firm Size, Firm Size Squared, Stk. Return Volatility, Capital to Sales, Leverage, R&D to Capital, Advertising to Capital,* and *Dividend Yield*. All these variables are defined in Appendix A. Statistics from tests for relevance and validity of instruments are reported in the panel below the estimates. All variables are winsorized at the 1st and 99th percentile levels. All specifications contain year dummies and firm fixed effects. Values of the t-statistics are in parentheses and are computed using heteroskedasticity robust standard errors, clustered by firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Using Tournament Measure	Gini Coefficient (*Total Comp*)	*CDF* (*Total Gap*)	Log (*Total Gap Max VP Comp*)	Log (*Total Gap* (*Mean VP Comp*)
Panel A: Firm Performance Measured by *ROA*				
Tournament measure	4.260*	6.352***	2.834***	1.387***
	(1.73)	(4.48)	(4.86)	(3.62)
CEO Alignment	0.231***	0.252***	0.256***	0.231***
	(2.94)	(3.29)	(3.14)	(2.94)
VP Alignment	14.451***	12.420***	12.049***	13.110***
	(6.34)	(7.54)	(6.98)	(7.88)
Log (σ*VP Comp*)		−0.177	1.024***	0.295***
		(−1.27)	(5.25)	(2.71)
Anderson–Rubin F-statistic	18.86***	22.97***	26.46***	22.55***
Hansen J-statistic (p-value)	3.99(0.14)	1.68(0.43)	1.80(0.41)	2.08(0.35)
Panel B: Firm Performance Measured by *Firm q*				
Tournament measure	1.929***	0.749***	0.243***	0.141***
	(6.50)	(4.17)	(3.48)	(3.07)
CEO Alignment	0.016	0.021**	0.021**	0.019**
	(1.62)	(2.32)	(2.36)	(2.10)
VP Alignment	1.529***	0.697***	0.663***	0.766***
	(5.86)	(4.05)	(3.78)	(4.47)
Log (σ*VP Comp*)		0.079***	0.195***	0.133***
		(4.67)	(8.50)	(10.40)
Anderson–Rubin F-statistic	15.42***	9.26***	9.24***	8.13***
Hansen J-statistic (p-value)	5.03*(0.08)	0.99(0.61)	0.64(0.73)	1.20(0.55)

alignment incentives. To isolate the effects of the two types of incentives, we use the double-sorting procedure suggested by Badrinath, Kale, and Noe (1995). We then use the Fama and French (1993) and Carhart (1997) four-factor model to estimate monthly portfolio excess returns for each of these five portfolios. We find that an equally weighted portfolio that is long in the highest quintile of *ST Gap* and short in the lowest quintile of *ST Gap* (after controlling for *CEO Alignment*) generates an excess return of 0.928% per month over the 12-year sample period, with 8 of the 12 years exhibiting positive and statistically significant excess returns. When we use value-weighted portfolios, the overall excess return is 0.338% per month with half the years exhibiting positive excess returns. We then reverse the double-sorting procedure described above to form five portfolios that differ in *CEO Alignment* but are similar in terms of *ST Gap*. The analysis of the returns to these portfolios allows us to investigate the effects of *CEO Alignment* while controlling for *ST Gap*. The excess returns for the entire period are 0.847% and 0.584% with equally weighted and value-weighted portfolios, respectively.[24]

VI. Conclusion

The primary motivation for our study is to examine how promotion incentives based on the differential compensation between CEOs and their potential successors from within the firm affect firm performance. Thus, while alignment with shareholders induces all managers to maximize the value of a firm's equity, tournaments induce lower-level managers to exert greater effort, resulting in an increase in their probability of promotion to CEO as well as an increase in the firm's output. Our argument rests on the premise that while CEO alignment is an important consideration for firm performance, the incentive structures of other top-level managers are also important. What induces CEOs to exert effort is the incentive alignment owing to their ownership in firm-specific equity. For lower-level managers, however, the motivation is due to two sources: how and how much they are currently paid, and how much they can expect to be paid in the event of a promotion to the position of CEO. The latter is essentially the prize in a rank-order tournament, which we examine using compensation differentials between the CEO and the next level of managers, and their probability of promotion.

We show that total, short-term, and long-term gaps between CEO and median VP compensation affect *Firm q* and *ROA* positively, which provides evidence on the effectiveness of tournament incentives. The positive relation between tournament incentives and firm performance remains robust to many alternate specifications, and to several measures of tournaments and firm performance. We then investigate the effectiveness of tournaments in special situations. We show that tournaments are less effective when the firm has a new CEO, and especially when the new CEO is an outsider. Conversely, when the incumbent CEO is close to retirement, we find that tournament incentives are stronger.

[24] These results for the excess returns from the equally- and value-weighted portfolios are available in Tables IA.IV and IA.V in the Internet Appendix, which can be found at http://www.afajof.org/supplements.asp.

Our analyses of tournaments include alignment incentives and we find that alignment incentives also affect performance positively. Overall, our analysis indicates that a rank-order tournament that provides promotion incentives to managers is an important incentive mechanism for motivating corporate managers.

Appendix A
Data Sources and Definitions

This appendix defines the variables used in the study. The data items taken from Compustat are denoted as data numbers. All returns data are from the Center for Research in Security Prices (CRSP). The compensation-related variables are from ExecuComp. Other data sources include proxy statements, the *International Directory of Company Histories*, *Marquis Who's Who* publication, Forbes's surveys, and the Standard and Poor's *Register of Corporations, Directors, and Executives*.

Variable	Source	Definition
Compensation and Alignment		
Short-term compensation (*ST Comp*)	ExecuComp	Salary + bonus + other annual payments
Long-term compensation (*LT Comp*)	ExecuComp	Restricted stock grants + options granted + long-term incentive payouts + total other annual payments
Total compensation (*Total Comp*)	ExecuComp	Short-term compensation + long-term compensation
CEO Alignment (per \$100)	ExecuComp	(Shares owned at the beginning of the year + average delta of prior option grants × no. of options) / number of shares outstanding ×100
VP Alignment (per \$100 of SH equity)	ExecuComp	(Shares owned at the beginning of the year + average delta of prior option grants × no. of options) / number of shares outstanding ×100 (median value for all VPs in a firm-year)
Tournament Variables		
Total Gap (\$ 000)	ExecuComp	CEO's *Total Comp* – Median VP's *Total Comp*
Short-term gap (*ST Gap*) (\$ 000)	ExecuComp	CEO's *ST Comp* – Median VP's *ST Comp*
Long-term gap (*LT Gap*) (\$ 000)	ExecuComp	CEO's *LT Comp* – Median VP's *LT Comp*
Log (*Total Gap*)	ExecuComp	Log (*Total Gap* + 810)
Log (*ST Gap*)	ExecuComp	Log (*ST Gap* + 271)
Log (*LT Gap*)	ExecuComp	Log (*LT Gap* + 1,040)
Gini Coefficient (*Total Comp*)	ExecuComp	$1 + \frac{1}{n} - \frac{2}{n^2 \bar{y}}(y_1 + 2y_2 + \ldots n y_n)$, where y_i is the *Total Comp* of all executives in decreasing order of amount and n is the number of executives
CDF Total Gap (*ST, LT*)	ExecuComp	(Rank of firm's *Total Gap* (in the year) minus 1) / (Number of firms minus 1)
Log (*Total Gap Max VP Comp*)	ExecuComp	Log (CEO's *Total Comp* – Highest paid VP's *Total Comp*)
Log (*Total Gap Mean VP Comp*)	ExecuComp	Log (CEO's *Total Comp* – Mean VP's *Total Comp*)
σ*VP Comp*	ExecuComp	Standard deviation among VPs' *Total Comp*
Firm Performance Measures		
Firm q	Compustat	(Market value of equity + book value of debt) / book value of total assets (Data 6 – data 60 + data 25 × data 199) / data 6
Return on Assets (ROA)	ExecuComp	*ROA*
OIBD to Capital	Compustat	Operating income before depreciation / net fixed assets (OIBD / data 8)
Return on Equity (ROE)	ExecuComp	ROE

(*continued*)

Appendix A—*Continued*

Other Variables	Source	Definition
Total Factor Productivity (TFP)	CRSP and Compustat	Residuals from a regression of log (Sales) on log (Employees) and log (Property, plant, and equipment); the regressions are run by industry-year
New CEO	ExecuComp	Dummy = 1 for first year as CEO, 0 otherwise
CEO Is Insider	ExecuComp, proxies, other	Dummy = 1 if CEO has been with the firm for at least 1 year prior to becoming CEO, 0 otherwise
Industry Homogeneity	CRSP	Mean partial correlation between firm's returns and an equally weighted industry index, for all firms in the same two-digit SIC industry code, holding market return constant (see Parrino (1997)). Estimated based on 60 monthly returns prior to sample year
Retiring CEO	ExecuComp, proxies, other	Dummy = 1 if CEO's age is more than 62, 0 otherwise
Chair	ExecuComp	Dummy = 1 if CEO is also chair, 0 otherwise
Succession Plan	ExecuComp	Dummy = 1 if any VP is either president or COO but not chair, *or* (CEO's *ST Comp* is at most 10% more than highest paid VP *and* highest paid VP's *ST Comp* is at least 20% more than next highest paid VP), 0 otherwise
No. of VPs	ExecuComp	Number of VPs in a firm-year as reported in ExecuComp
CFO Is VP	ExecuComp	Dummy = 1 if one of the VPs is the CFO, 0 otherwise
CEO Age	ExecuComp, proxies, other	Age of CEO in sample year
CEO Experience	ExecuComp, proxies, other	Number of years as CEO up to sample year
No. of Segments	Compustat Segment data	Number of business segments in which firm operates
Firm Size	Compustat	Log (Sales)
Stk. Return Volatility	CRSP	Variance of 60 monthly returns preceding sample year
Capital to Sales	Compustat	Net fixed assets / sales; data 8 / sales
Leverage	Compustat	Book value of debt / total assets; (data 9 + data 34) / data 6
R&D to Capital	Compustat	Research & development expenditure / net fixed assets data 46 / data 8
Advertising to Capital	Compustat	Advertising expenditure / net fixed assets; data 45 / data 8
Dividend Yield	ExecuComp	The dividends per share by ex-date divided by close price for the fiscal year
Log (*Median Industry Total Gap*) (*ST, LT*)	ExecuComp	Log (Median Total gap for firms in the same two-digit SIC and same size quartile) (ST, LT)
Industry CEO Alignment	ExecuComp	Median CEO Alignment for firms in the same two-digit SIC and same size quartile
Industry VP Alignment	ExecuComp	Median VP Alignment for firms in the same two-digit SIC and same size quartile
Bachelors	www.bls.gov	Ratio of full-time employees with a bachelors' degree or higher degree to the total number of full-time employees in the industry-year
CEO Reputation	Factiva	The number of times in the sample year a combination of the CEO's name and company appears in the following list of publications; (i) *The Wall Street Journal*, (ii) *Asian Wall Street Journal*, (iii) *Wall Street Journal Europe*, (iv) *Wall Street Journal Sunday* (v) *Financial Times*, (vi) *New York Times*, (vii) *Washington Post*, (viii) *USA Today*, and (ix) *International Herald Tribune*. For example, "(Microsoft Corp. or Microsoft) and (William Gates or William H. Gates or William Gates or Bill Gates or Will Gates or William H. Gates III)"

Appendix B: Comparison of Coefficient Estimates between Groups

From the general specification in Section IV, consider the following equation, which includes all interaction terms containing the *New CEO* and *CEO Is Insider* dummies:

$$Performance = \beta_0 + \beta_1 Gap + \beta_5 Gap * New\ CEO + \beta_6 Gap * Insider + \beta_7 Gap * New\ CEO * Insider. \quad \text{(B1)}$$

In the above specification, *New CEO* is a dummy variable equal to one if the firm-year has a CEO who is in his/her first year of service as CEO and zero otherwise. The variable *Insider* is a dummy that takes on a value of one when the CEO is promoted from within the firm, and zero otherwise. Note that while the *New CEO* dummy is a CEO–year-specific variable, *Insider* is a CEO–firm-specific variable. Thus, for any CEO, the *New CEO* variable will be equal to one only for the CEO's first year, while the *Insider* dummy will assume the same value for all CEO–firm-years in the sample. Each of the 17,488 firm-years (and CEO-years) in our sample can be classified in one of four categories. For expositional ease, we summarize the values of individual dummies and the resulting estimates from the general specification below:

Scenario	*New*	*Insider*	*New CEO * Insider*	Estimate for $\frac{\partial Performance}{\partial Gap}$
New CEO and outsider	1	0	0	$\beta_1 + \beta_5$
New CEO and insider	1	1	1	$\beta_1 + \beta_5 + \beta_6 + \beta_7$
Continuing CEO and insider	0	1	0	$\beta_1 + \beta_6$
Continuing CEO and outsider	0	0	0	β_1
Reported Comparisons				
(a) New CEO with continuing CEO	$((\beta_1 + \beta_5) + (\beta_6 + \beta_7)^*(Mean(Insider)) - (\beta_1 + \beta_6{}^*Mean(Insider)) = \beta_5 + \beta_7{}^* Mean(Insider)$			
(b) New CEO from outside with new CEO from inside	$(\beta_1 + \beta_5) - (\beta_1 + \beta_5 + \beta_6 + \beta_7) = -(\beta_6 + \beta_7)$			

The specification used in Table III is

$$Performance = \beta_0 + \beta_5 New\ CEO + \beta_6 Insider + \beta_7 New\ CEO * Insider. \quad \text{(B2)}$$

The estimated coefficients for the comparisons (a) and (b) result in the same linear combinations of coefficients when the above specification is used.

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