Corporate Tournaments

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This study examines aspects of pay and promotion in corporate hierarchies in the context of tournament theory. Evidence supports the tournament perspective in that most positions are filled through promotion and pay rises strongly with hierarchical level. Furthermore, the winner's prize in the CEO tournament increases with the number of competitors for the CEO position. Not all evidence is supportive: the square of the number of competitors is negatively associated with the CEO prize. Additionally, firms do not appear to maintain short-term promotion incentives, as lengthier time in position prior to a promotion reduces the pay increase from the promotion.

I. Introduction

As the public controversy over the remarkable level of CEO pay continues to flare up in the popular press, the theory of tournaments has received attention in the academic literature in part because of the basis it provides for the skewed pay structures observed in many settings and the justification it may provide for skewed corporate pay structures and, hence, high levels of CEO pay.[1] From this perspective, the advancement of executives in a corporate hierarchy is viewed as a tournament in which individuals compete with one another for promotion. The better execu-

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[1] See Jensen and Murphy (1990), Crystal (1992), and Abowd and Bognanno (1995) for studies concerning the level of CEO pay. See Lazear and Rosen (1981), Rosen (1986), O'Reilly, Main, and Crystal (1988), Gomez-Mejia and Balkin (1992), McConnell and Brue (1992), Rees (1992), Main, O'Reilly, and Wade (1993), Gibbs (1995), and Chan (1996) for applications of tournament theory to CEO pay.

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tives win promotions and receive a prize in the form of higher pay in their new positions. The gaps in pay between the hierarchical levels in the organization, combined with uncertainty over who will be promoted, provide executives with the incentive to work hard in order to increase the probability of advancement. High levels of CEO pay are supported by the extra effort they elicit from lower-level executives competing for advancement, and they serve to maintain the incentives of executives nearing the top of a hierarchy.[2]

This article explores the determinants of pay in corporate hierarchies as well as the relationship between pay and promotion and presents a narrowly focused effort to determine whether the skewed pay structures at the top of large U.S. corporations result from an attempt to manage tournament incentives according to a specific tournament model. While executive pay and promotion are of general interest, exploring the pay gap at the top of corporations will have a bearing on whether tournament theory should be used to justify CEO pay levels.

Empirical findings regarding the operation of corporate tournaments relate largely to one theoretical result, namely, that larger rewards are necessary to provide proper incentives for competitors as the probability of promotion deviates from one-half (Gibbs 1993). Leonard (1990) found support for this result when he found that pay differentials were greater the lower the promotion rate and between levels higher up the corporate ladder. Using changes in the number of vice presidents (VPs) to reflect changes in the probability of promotion to CEO, O'Reilly, Main, and Crystal (1988) found no support for the hypothesis that the gap between CEO pay and mean VP pay should increase with a greater number of vice presidents. However, Main, O'Reilly, and Wade (1993) subsequently found that the size of the prize received on promotion to CEO is positively influenced by an increase in the number of the firm's executives on the board of directors of the company or of a subsidiary. In their paper, the "prize" was the present value, over the expected tenure of the CEO, of the gap between the pay of the CEO and the mean pay of the firm's executives who served on a board.

Another line of research has explored the detailed internal workings of the firm as they relate to pay, promotion, and hierarchy through the use of company personnel records. Lazear (1992) used 13 years of personal records from the 1970s and 1980s to study the influence of job assignment on wages and turnover for full-time workers at a large durable-goods manufacturer. Several of Lazear's findings are relevant to a discussion of corporate tournaments. Job change was critical to wage growth within the firm studied. Wage declines were experienced by workers remaining

[2] See Rosen (1986) for the mathematical tournament model that is the basis of this description.

more than 7 years in the same job. The effect of a job change was felt both in current wages and in subsequent wage growth. In addition, most of the variation in the firm's pay was found to be between jobs and not within jobs. Clearly, a strong link exists between pay and promotion in this firm. Lazear also found that hiring took place into nearly all of the firm's jobs, though some were more likely than others to serve as a port of entry.

In a series of papers, Baker, Gibbs, and Holmstrom (1993, 1994*a*, 1994*b*) also used personnel records in exploring the 20-year history of pay and promotion in a single large firm. Several of the results from their papers have a bearing on the validity of the tournament explanation of executive compensation. Consistent with the operation of tournaments, evidence of an internal labor market was found in that hiring was concentrated in the lower levels of the firm while exit was almost evenly distributed across levels. The hierarchy was also found to be stable despite growth in the firm over the 20-year period studied. Similar to Lazear's finding, pay increases came through promotion. Real pay fell with increasing tenure in position (Baker et al. 1993). Promotion and wage growth depended on performance, as highly rated executives were more likely to be promoted, and the rewards to promotion increased at an increasing rate with level (Baker et al. 1994*b*; Gibbs 1995).

In conflict with tournament theory, longer waits before promotion reduced the pay raise accompanying promotion (Gibbs 1995). The reduced probability of promotion, stemming from having been passed over previously, ought to have been accompanied by a larger pay increase in order to preserve promotion incentives. Those passed over for promotion were not found to be given additional rewards or punishments within their position to compensate for reduced promotion incentives. Gibbs found no evidence that the firm altered short-term incentives in response to changes in promotion incentives. In addition, wage growth and the speed of past promotions revealed information about the prospect of further promotion. Gibbs found that executives who were promoted quickly had above-average wage growth prior to promotion, which suggests that wage growth provides some information on the likelihood of promotion. Predictability was also suggested in that faster promotion to one level brought faster promotion to the next (Baker et al. 1994*a*).

This study exploits a rich database that tracks individual executives at more than 600 firms for up to 8 years between the years 1981 and 1988.[3] The database has information on the annual base pay and bonus, reporting level, and various personal and job characteristics for about 25,000 managers and executives per year. Executives range from the CEO, reporting

[3] These data are maintained by the Center for Advanced Human Resource Studies at Cornell University.

Table 1
Executive Characteristics by Level (One Observation per Executive)

Level	Age	Education	Tenure	Years in Current Job	% Hired into Current Job
1	57.1 (6.6)	17.0 (1.6)	22.3 (12.3)	6.7 (7.1)	17 (38)
2	51.4 (7.6)	17.0 (1.7)	16.1 (11.0)	4.5 (4.3)	23 (42)
3	48.4 (8.3)	16.8 (1.8)	14.3 (10.3)	4.2 (4.0)	23 (42)
4	46.8 (8.5)	16.5 (1.8)	14.1 (10.1)	4.1 (3.9)	22 (41)

NOTE.—Standard deviations are in parentheses.

level one, down to 11 reporting levels beneath the CEO. However, the rate at which executives are sampled falls after the fourth level, and for this reason no data pertaining to executives beneath the fourth level are used. As well as data on individual executives within firms, the database contains firm stock market information drawn from the Center for Research in Security Prices Stock File and firm accounting information from Standard and Poor's Compustat Services. All compensation and financial data are in 1980 dollars.

Section II considers the evidence of tournament operation in hiring, tenure, and pay structures in large U.S. corporations. The summary information on hiring, tenure, and pay by hierarchical level appears consistent with the notion of tournaments. Pay regressions presented in Section II document large rewards associated with promotion to a higher reporting level in the corporation. However, the immediate pay increase accompanying promotion is much smaller than the mean pay gap between levels because those executives who are promoted tend to earn above average in their level before promotion. Accordingly, an executive's pay relative to the average pay in his level is an indicator of promotion likelihood. I provide evidence of this for those promoted to CEO.

Section III presents a tournament model and conducts a detailed analysis of the gap between CEO pay and the mean pay of competitors for the CEO position to determine if this gap behaves according to hypotheses drawn from the model. The empirical work in Section III reexamines the test of tournament theory conducted by Main et al. (1993). While the tournament theory implication tested by Main et al. is supported, CEO pay did rise with additional competitors; the square of the number of competitors was not positive as was suggested by the model under specific assumptions.

II. Executive Characteristics by Reporting Level and Pay Regressions on Level

Table 1 shows executive characteristics by level on age, education, tenure, years in current job, and the percentage of employees hired from the outside directly into their current jobs. Column 1 indicates the job level

defined by reporting relationships, with CEOs as level 1, level-2 executives reporting to the CEO, level-3 executives reporting to level-2 executives, and level-4 executives reporting to level-3 executives. Tenure is high for all four listed levels but especially so for CEOs. Not reported in table 1, but suggested by columns 4 and 5, is a relatively long time period that current CEOs spend at the company in lower positions. Lower-level executives are younger on average and have less tenure than the CEO.

At levels 1, 2, 3, and 4, roughly 80% of the executives were promoted into their current positions rather than having been hired directly from the outside. Accordingly, entry into firms occurs pretty evenly across levels. This argues against firms operating specific points of entry at low levels in the firm and relying solely on their internal labor markets to staff higher-level positions. Despite substantial entry into high levels of the firm, the means in table 1 provide evidence of most executives advancing to top positions from within the firm after having spent most of their working life in it. This is consistent with a tournament model in which winners advance through the ranks.

Internal promotion versus external hiring is also studied by Baker et al. (1994*a*, 1994*b*), who report that external hiring occurs at all levels but much less so at upper levels and not at all within three levels of the CEO in the firm they study. Lazear (1992) finds that while substantial variation existed in the rate of outside hiring, the rate was high in general across jobs in his firm's data. Externally hired workers made up at least 35% of job incumbents in 90% of the jobs. It should be noted that Lazear's sample excluded employees earning more than $100,000. The percentage of external hires may have been less in higher-ranking jobs.

I begin my investigation of CEO wage determination by distinguishing in table 2 the rewards associated with promotion, which are central in tournament theory, from the classical determinants of wages such as age, experience, and education. Column 1 is an ordinary least squares (OLS) estimation controlling for level, age, age squared, and education. This estimation shows that a change in level from the fourth to the first raises pay 151%, from fourth to second raises pay 65%, and from fourth to third raises pay 21%. An extra year of age brings an 11% increase in pay; however, age squared is negative, giving age and income a concave profile. One extra year of education adds 6% to pay. Figure 1 shows the strength of the relationship between pay and reporting level without controls and illustrates that the pay gaps between levels increase as the top of the firm's hierarchy is reached. The pay gaps between levels combined with promotion from within the firm create a tournament structure that would create promotion incentives for executives.

Columns 1, 2, and 3 of table 2 have similar estimates for the variables they have in common. Column 2 is again an OLS estimation, but it controls for additional variables: whether the executive was hired directly

Table 2
Coefficients of Regressions of ln(Salary + Bonus) on Level and Individual Characteristics, with and without Firm and Individual Fixed Effects

	Dependent Variable: ln(Salary + Bonus)				
	OLS (1)	OLS (2)	Firm Fixed Effect (3)	Firm and Individual Fixed Effects (4)	Firm and Individual Fixed Effects (5)
Intercept	6.8258	6.7705			
Level 1: CEO	1.5128	1.5024	1.5984	.1728	.2425
	(121.3)	(122.1)	(169.9)	(11.6)	(14.9)
Level 2: Reports directly to CEO	.6454	.6437	.7520	.0397	.0559
	(111.6)	(113.1)	(168.7)	(7.3)	(11.9)
Level 3: Reports to level-2 executive	.2073	.2099	.2727	.0106	.0145
	(53.9)	(55.5)	(92.0)	(3.5)	(5.9)
Age	.1139	.1136	.0781	.1343	.1346
	(55.8)	(52.7)	(46.6)	(45.7)	(45.9)
Age^2	−.0009	−.0009	−.0007	−.0008	−.0008
	(43.9)	(41.9)	(37.5)	(28.6)	(28.7)
Education	.0595	.0662	.0242	.0010	.0013
	(60.5)	(67.1)	(30.1)	(.3)	(.4)
1 = hired into job; 0 = promoted into job		−.0453	−.0034	−.0424	−.0427
		(7.9)	(.8)	(7.9)	(7.9)
Tenure		.0048	.0029		
		(6.3)	(5.0)		
Tenure^2		.0001	.00004		
		(2.8)	(2.5)		
Years in current job		−.0221	−.0144	−.0019	−.0027
		(22.9)	(19.1)	(2.5)	(3.9)
(Years in current job)^2		.0004	.0003	−.0004	−.0003
		(7.5)	(8.4)	(7.9)	(5.6)
Years in current job for level 1; 0 for others				.0128	
				(7.7)	
Years in current job for level 2; 0 for others				.0006	
				(.6)	
Years in current job for level 3; 0 for others				−.0001	
				(.1)	
Years in the same job before promotion to level 1; 0 for others.					−.0182
					(4.5)
Years in the same job before promotion to level 2; 0 for others.					−.0064
					(6.0)
Years in the same job before promotion to level 3; 0 for others.					−.0026
					(4.1)
N	73,062	73,062	73,062	73,062	73,062
R^2	.43	.45	.69	.98	.98

NOTE.— Absolute value t-statistics are in parentheses. Means and standard deviations of these variables appear in the appendix.

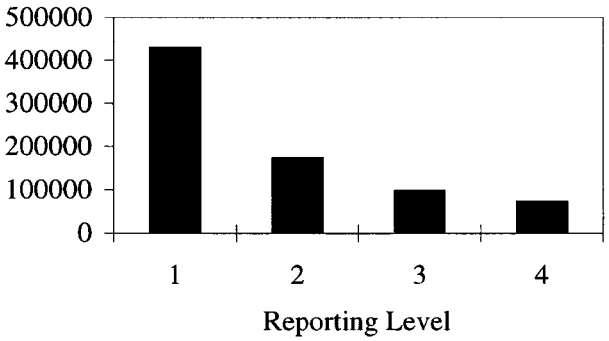

FIG. 1.— Mean salary and bonus for executives of various reporting levels in 1980 dollars

into the current job, years in the current job, years in the current job squared, tenure, and tenure squared. Executives newly hired into their positions earn 5% less than other executives of their level and age. This is somewhat surprising because of the commonly held belief that new hires receive preferential treatment.

Chan (1996) considers tournaments in which candidates outside the firm participate, which reduces the probability of winning for internal competitors. To compensate for the reduced probability of winning for internal candidates, different options exist. One possibility is to raise the promotion prize. Chan precludes this possibility on the basis of potential interference with workplace cooperation (see Lazear 1989). The alternative, suggested by Chan, is to raise the probability of winning for internal candidates for a given set of characteristics; in other words, internal candidates receive the benefit of a handicap. Chan concludes that external hires have overcome these handicaps and are therefore substantially better than internal competitors. In light of Chan's argument, we recognize that the handicap results in external hires receiving the same prize as an internal winner would but receiving relatively less given their superior productive characteristics than internal executives. With the prize set in advance, external hires get a relatively smaller return to their productive characteristics than do weaker internally promoted executives. The empirical finding in this article that new hires receive 5% less after controlling for their individual characteristics may reflect the lower return for externally hired executives. Subsequent work would need to seriously test Chan's implication that externally hired executives are superior, for instance, it would need to show that external hires display greater subsequent wage growth than executives promoted from within.

The number of years an executive remains in his current job, controlling for age and tenure, reduces pay 2% per year. This 2% annual loss would have a strong cumulative effect for executives who remain in their po-

sitions for lengthy periods, and it highlights the importance of periodic promotions. Both Lazear (1992) and Baker et al. (1994*b*) find that promotion is crucial to increasing real wages. Tenure in the firm exerts a positive but very small influence on pay. The influence of age on pay is strong, even in comparison with promotion, after considering that age advances annually and promotions are infrequent. It is age and not tenure that picks up the annual increases in pay, which suggests that general training is more important than specific training in wage determination for top management.

The firm fixed effects included in column 3 of table 2 do not cause the coefficients to differ by much from those in column 2. The first three columns all show that, after controlling for age, education, and various tenure variables, the executive's level is still highly significant and large rewards result from movement up the hierarchy. The results in column 4 of table 2 are quite different from those of the earlier columns.[4] After including both firm and individual fixed effects, the coefficients on the level variables are much smaller than were estimated in the first three columns. The individual fixed effects in column 4 cause the level estimates to be driven entirely by those executives who change levels in the data.[5] Interpreting the coefficients, the pay gain resulting from rising from the fourth level to the first is 17%, from the fourth to the second is 4%, and from the fourth to the third is 1%. The small estimates on level changes occur, in part, because the promoted executives were earning on average $16,650 more than the mean pay of others in their firm and at their level prior to promotion. Apparently, no compensating wage differentials for the lack of promotion opportunities exist. Furthermore, promoted ex-

[4] Tenure has been removed from the individual fixed effect models because two linear time trends (age and tenure) cannot be identified.

[5] There are 8,830 observations of level changes. Of these, 60% are promotions to higher levels, and 40% are demotions to lower levels. The sum of all second, third, fourth, fifth, sixth, seventh, and eighth observations on individual executives is 63,445, so changes in level occur in 14% of the repeated observations on individuals. Concern over the possibility of coding error in the level variable was raised when in 74% of the 8,830 cases where the level changed, the job code of the executive did not. However, treating the cases in the 74% as coding errors and recoding them so as to maintain the previous level had almost no effect on the level estimates in col. 4 of table 4. Looking at the pay differences before promotion for the executives making up the 26% of cases (2,320 observations) where level and job code both changed showed the same pattern as that for the entire 8,830 cases. Promoted executives were earning on average $28,390 more than others of their level before promotion. Demoted executives were earning $10,800 less than those in their level before demotion. In this group of 2,320, 68% of the level changes were promotions and 32% were demotions. I have continued to use the full 8,830 cases in table 4 because using only the 2,320 cases of level changes results in level changes in only 3.7% of the eligible cases. The 14% found with all level changes included seems more reasonable.

Table 3
Pay Changes for Stationary and Promoted Executives, Pay Differences between Promoted Executives and Those in Their New Higher Level, and Pay Differences between Promoted Executives and Their Peers prior to Promotion

Level	Mean Pay Change for Stationary Executives	Mean Pay Change for Executives Promoted into Given Level	After Promotion: Pay of Promoted Executives Less Mean Pay in New Higher Level	Before Promotion: Pay of Executives to Be Promoted Less Mean Pay in Level
1	28,883	58,071		
	(122,667)	(75,070)		
2	12,363	14,137	−14,018	92,880
	(41,773)	(30,486)	(58,028)	(88,854)
3	5,661	6,536	−6,303	30,120
	(18,976)	(16,994)	(36,664)	(57,789)
4	3,832			9,080
	(12,550)			(32,998)

NOTE.—"Mean of difference in pay" is the promoted executive's pay less the mean pay at his old lower level in his firm; an average of this difference is taken across all executives promoted to the given level. All other columns are computed correspondingly. Standard deviations are in parentheses.

ecutives earned on average $8,340 less than other executives in their new level after promotion.

Table 3 shows the pay changes for stationary executives, the pay changes for promoted executives, the pay of promoted executives less the mean pay of those in their new higher level, and the pay of promoted executives before promotion less the mean pay of those in their level before promotion. It is clear that the pay increase is greater for executives who are promoted and that before promotion executives were earning more than others at their level. After promotion, executives earn less than the average pay in their new levels. Therefore, the pay change that occurs in the year when an executive changes level is less than the mean difference in pay between levels. The picture of the pay changes that accompany advancement in the firm portrays executives as starting a new pay grade at the bottom and advancing through the pay grade gradually before promotion to the bottom of the next; this is the sort of compensation structure discussed in compensation administration textbooks (see Milkovich and Newman 1987).

The finding that the immediate pay change upon promotion is not dramatic is consistent with the results of Murphy (1985), Lazear (1992), and Baker et al. (1994*b*). Lazear (1992) estimates that pay increases are 21% larger on average for promoted workers in the year of promotion. Baker et al. find that promoted executives have above-average earnings in their level prior to promotion and below-average earnings subsequently. For comparison purposes, they find that the immediate pay change from promotion from level 4 to level 3 is 4.5%, from level 3 to level 2 is 22.3%,

and from level 2 to level 1 is 14.8%. These figures are calculated from raw data on transitions and not from regressions controlling for individual and firm characteristics. Murphy (1985) finds somewhat larger pay increase results in his data. He estimates the average pay increase accompanying promotion from VP to president to be 20.9% and from VP to CEO to be 42.9%.

The small immediate pay change attributable to promotion might give the impression that tournament incentives would be weak. In terms of the incentives provided by promotion to CEO, Main et al. (1993) find that while the immediate change in pay is small and perhaps not large enough to fit with tournament theory, the present value of the change in pay with promotion from VP to CEO over one's career is quite large. They estimate this present value to be $6.2 million in total compensation, a prize that they state is large enough to be consistent with tournament theory. The estimate in this current article of the prize received from promotion to CEO, from the viewpoint of those in the running for the promotion rather than from the current CEO's viewpoint, is about 1980US$1.8 million in terms of base salary and bonus. Regardless of an executive's level in the firm, the cumulative value of a promotion over time is larger than the immediate change in pay.

Level in the firm explains a lot of the variation in pay between executives. In a regression including only an intercept and the three level dummy variables, 30% of the variation in log pay is explained. The same regression including company fixed effects explained 63% of the variation in log pay. In comparison, individual characteristics explain somewhat less variation. Age, education, tenure, and an intercept explain 24% of the variation in pay, and adding firm fixed effects raises this to 45%. At a point in time, an executive's level is statistically more important than individual characteristics in determining pay. However, the individual characteristics that are available here are imperfect measures of executive performance, biasing this simple comparison in favor of the importance of the level. A comparison between level and personal characteristics at a point in time also ignores the influence of ability in determining the level to which the executive has risen. Gibbs (1995) finds that good performance ratings increase the chances of promotion, linking performance with the executive's level in the firm. Baker et al. (1994*b*) make the inference that executive ability drives both wage growth and promotion; this may account for the generally smooth wage growth that is observed in these data.

Column 4 of table 2 explores whether the effect of years in position varies by level. To this end, interactions between level dummy variables and the number of years an executive has served in the same job have been included. These interactions show the difference in the coefficients between the given level and level 4 with respect to the effect of years in

the same job on pay. Controlling for other time-related influences on pay, these interactions reveal that increasing tenure in position reduces pay for all executives except CEOs. With both firm and individual effects included, the pay changes with time in position are significantly positive only for CEOs and are negative for those of other levels. This result could come from an attempt to motivate CEOs, or it may indicate that the influence of CEOs over their own pay is increasing with tenure in position.

In column 5 of table 2, the executive's tenure in position in the year prior to a promotion is interacted with level dummy variables.[6] If the executive is not promoted in a given year, the variable is set equal to zero. This is done to determine whether those who have been stationary in their position for a longer period are given larger or smaller rewards when promoted. If tournament incentives are to be maintained, as the survival value of the tournament decreases, rewards should increase. If the time to promotion is increasing for an executive, the survival value of the tournament is falling because the number of future promotion opportunities over the remainder of his career is being reduced. Contrary to theory, Gibbs (1995) found that executives who go longer without a promotion get smaller pay increases upon promotion. Column 5 suggests a similar result; an additional year in the same position prior to a promotion in level reduces the pay increase from promotion. It appears to be the case that firms do not maintain promotion incentives by altering rewards to compensate for changes in the rate or probability of promotion.

The positive relationship between promotion and relative pay in level prior to promotion displayed in table 3 raises the question as to what extent promotion can be predicted. At all of the reporting levels studied in these data, promoted executives tended to earn more than the mean pay in their level prior to promotion. The effect is stronger at higher executive levels. Of those promoted from level 4 to level 3, approximately 60% had higher than mean pay at level 4. For those promoted from level 3 to level 2, 70% had higher than mean pay while at level 3, and 90% of those promoted from level 2 to level 1 had above-mean pay while at level

[6] The number of years an executive has spent in the same level, rather than position, is the measure of stationarity that is consistent with promotion defined as a rise in level. Unfortunately, this measure can only be computed from the data for a small fraction of the sample. The executive's tenure in position prior to promotion is used instead because data on the year an executive was assigned to his or her position was available in the first 5 years of the sample. We note the distinction because an executive may change positions without changing levels or may change levels without changing positions. Incidentally, tenure in position in the year prior to promotion is used because position may change simultaneously with level, causing tenure in position upon promotion to be zero for many executives.

Table 4
Predictability in CEO Promotions Consecutive Years prior to CEO Promotion in Which the New CEO Was the Highest Paid Non-CEO in the Firm (Cases of Promotions to CEO = 125)

	Years in Advance							
	7	6	5	4	3	2	1	0
Number of instances	1	3	5	11	19	24	38	24
Cumulative %	.8	3.2	7	15	31.2	50.4	80.8	100

2. Baker et al. (1994*a*) find a strong relationship between relative pay and promotion even at low levels in the hierarchy of the firm they studied. They find that of executives promoted from level 8 to level 7, 60% had above-mean pay at level 8; for executives promoted from level 7 to level 6, 67% had above-mean pay at level 7; for executives promoted from level 6 to level 5, 75% had above-mean pay at level 6; and for executives promoted from level 5 to level 4, 92% had above-mean pay at level 5.

Table 4 illustrates the forecasting power of current wages on the likelihood of promotion. In more than 80% of the cases of transition to level 1, the promoted executive was the highest-paid non-CEO in the firm in the previous year. In more than 50% of the cases, the new CEO was the highest paid non-CEO executive 2 or more years in advance of the promotion to CEO. Thus, the current relative wage is an excellent predictor of promotion to CEO 1 year in advance and a good predictor 2 years in advance. For longer horizons, it becomes more difficult to draw such decisive inferences from these data, since data for many firms cover less than 8 years. While pay rank is a key indicator for promotions to CEO in these data, Baker et al. (1994*b*) find that fast wage growth is more important than pay rank at lower levels in the hierarchy of the firm they study.

Predictability is problematic for a tournament explanation of CEO pay. People compete in tournaments to increase their probability of advancement. If the winner is known, competition has no purpose. The evidence provided here shows that the incoming CEO is known prior to the departure of the incumbent CEO. This might be viewed as shortening the period of competition.

It may be that if cooperation is important, the benefits from having the heir apparent identified in advance to ensure an orderly transition override the benefits from a longer period of competition. However, we need not assume a one-period, single tournament framework. Incentives are not eliminated if the promotion structure is viewed as a sequence of tournaments taking place at all levels in the firm. The end of one tournament begins the next and starts the competition among a younger group of CEO candidates. It may also be that the executive dubbed the next

CEO begins to assume top executive duties and wages prior to the departure of the incumbent CEO. In this case, the tournament is not being ended prematurely. It is just that the title transfer is the last step in the transition and is not the point marking the end of the tournament. If future research could show that the CEO could be identified early in his career, rather than a few years prior to taking the position, a tournament theory justification for the very high levels of CEO compensation would not be plausible. Such a conclusion would be premature based on the evidence presented here.

III. Tournament Size and Rewards

The tournament theory implication that increasing the number of competitors in a tournament should increase first prize was upheld by Main et al. (1993) using executive compensation data. This section presents a tournament model that follows the multiplayer format of O'Keeffe, Viscusi, and Zeckhauser (1984) and relies on a result from Gibbs (1993) to draw additional empirically testable prize structure implications. Implications for how the first prize, second prize, and prize gap between first and second place should change with the number of tournament competitors are drawn and empirically tested. The sensitivity of the prize structure to changing the number of competitors is displayed for both prize structures derived from the theoretical model and from empirical estimates.

The model adopts a simple framework with one winner emerging from N competitors in a one-round tournament. In attempting to win first place, risk neutral and equal players exert costly effort. Effort combined with an individual random error produces output. A single first prize is awarded to the player with the greatest output, and all $N-1$ others receive a lesser second prize. Facing identical circumstances, equal players independently decide to exert the same level of effort, leaving random error to determine the winner. The first prize is more than the amount justified by the effort of the winner. More formally, the ith player's output is

$$q_i = e_i + \varepsilon_i, \tag{1}$$

where q_i is output, e_i is effort, and ϵ_i is a mean zero random error term. Player utility is generated according to the function

$$U(Y, e) = Y - c(e), \tag{2}$$

where Y is income and $c(e)$ is the cost of effort.[7] It is assumed that $c(0) = 0$ and that $c(e)$ is strictly increasing. Players exert effort to maximize the following expected utility:

[7] Subscripts have been dropped because players are assumed to be homogeneous.

$$E(U) = P(e)(M - m) + m - c(e), \tag{3}$$

where $P(e)$ is the probability of winning. The winner receives the difference between the first prize (M) and the second prize (m). Maximizing expected utility yields

$$(\partial P/\partial e)(M - m) = c'(e). \tag{4}$$

This states the intuitive result that players will exert effort until the marginal reward to effort is equal to the marginal cost.

The optimal prize structure is derived using equation (4), an efficiency condition, and a zero-profit condition.[8] Efficiency dictates that payments must motivate effort until the marginal cost of effort equals the price of output. The efficient level of effort is exerted when

$$c'(e^*) = v, \tag{5}$$

where v is the price of output. Equations (4) and (5) reveal

$$M - m = v/(\partial P/\partial e). \tag{6}$$

In a competitive equilibrium with efficient effort, firms earn zero profit. The zero-profit condition is written

$$ve^* = P(e)(M - m) + m.$$

Further, as equal players have the same chance of winning ex post, this condition becomes

$$ve^* = (1/N)(M - m) + m. \tag{7}$$

The first and second prizes are found with equations (6) and (7):

$$M = ve^* + [1 - (1/N)][v/(\partial P/\partial e)]; \tag{8}$$

$$m = ve^* - (1/N)[v/(\partial P/\partial e)]. \tag{9}$$

Gibbs (1993) evaluated (∂P/∂e), the marginal effect of effort on the probability of winning, for a tournament with a variable number of winning prizes. His result allows comparisons of tournament prize structures with differing numbers of competitors or winning prizes. For this article, his result has been simplified to the case with one first prize. The error

[8] O'Keeffe et al. (1984) propose three conditions that must be met in fair contests between homogeneous players in competitive markets. Both the efficiency condition and the zero-profit condition used here are from their paper. We assume that their no-shirking condition is met. This condition states that effort will be exerted if the expected gain from the efficient level of effort is greater than that from shirking. Symbolically, the no-shirking condition requires $P(M - m) + m - c(e^*) > m - c(0)$ *or* $P(M - m) > c(e^*)$.

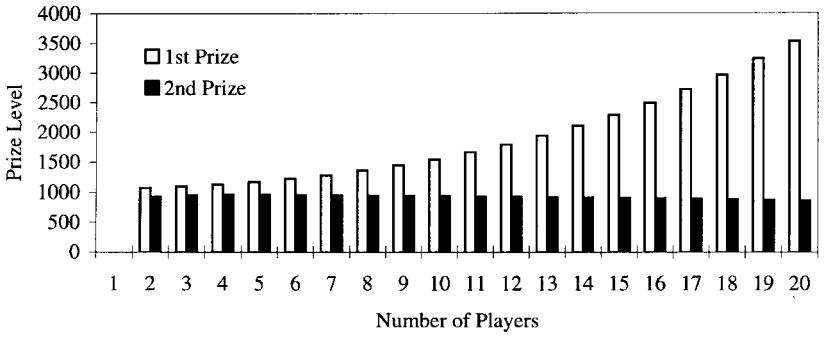

FIG. 2.—Model-generated first- and second-place prizes for tournaments with various numbers of players.

term (ϵ) in equation (1) is assumed to follow a symmetric beta distribution with parameters of the distribution set equal to r. The value assigned to r determines the peakedness of the error distribution. For instance, a value of one specifies the uniform distribution, while greater values assigned to r increase the peakedness of the distribution. Thus we have

$$\frac{\partial P}{\partial e}(N) = \frac{(N-1)!\,(r+N-2)!\,r!}{(N-2)!\,(2r+N-1)!}. \tag{10}$$

Substituting equation (10) into equations (8) and (9) gives the result needed to display the optimal prize structures depicted in figure 2.[9] It is evident from the figure that not only does the first prize increase with the number of competitors, but also with its square. Similarly, the number of competitors and its square have a positive effect on the difference between first and second prize according to the model. These results come about because the probability of winning is less affected by player effort when there are more competitors; therefore, the gap between prizes must increase to motivate effort.

Second prize in figure 2 is nearly constant, though on examination an initial rise and then a fall by the sixth competitor is apparent. Since firms with fewer than five competitors for CEO are excluded from the empirical

[9] The prize structures in figure 2 result from assuming that individual errors follow a beta distribution with both parameters (r) set equal to three. This gives the errors (ϵ) a bell-shaped distribution. Other symmetric beta distributions, except for the uniform distribution, yield the same prize structure implications. The prize gaps in this figure, as well as in figures 3 and 4, do rely on the values of either e or v. Different values of e have no influence on the prize gap, while multiplying v by a constant simply increases the prize gaps by the same multiple without changing how the model's prize gaps compare with each other as N varies.

work in this section, the effect on second prize, if any, from the number of competitors should be negative.

Main et al. (1993) found results supportive of tournaments when they considered as in the running for the CEO position only officers of the company or employees who serve on the board of directors of the parent company or of a subsidiary. For comparability, the same group of executives is considered as competing for the CEO position in this section.[10] In 97% of the more than 100 cases of executives rising to CEO in these data, the executive promoted was an officer or board member of the company. This group is referred to as vice presidents (VPs) or competitors in the text and tables.

Results in table 5 support the hypothesis that increasing the number of competitors increases the first prize and the difference between the first prize and the second prize, even after controlling for executive and firm variables.[11] In accord with theory, it is worth noting that additional competitors increase the pay gap between CEOs and competitors by increasing CEO pay and not by reducing mean competitor pay. Column 2 shows that the mean pay of high-level firm executives increases .76% with an additional competitor, but this estimate is not statistically significant. Not only is the test of tournament theory conducted by Main et al. successfully replicated but even the magnitudes of the estimates are similar. Main et al. find that an additional competitor adds 3% to the prize associated with promotion to CEO, which is very close both to the 2.9% pay increase for CEOs in annual pay estimated in column 1 and to the 4% increase in the pay gap in column 3.

To see the extent to which the gap in pay between CEOs and competitors differs between the theoretical model and those generated from

[10] Results similar to those presented below were obtained when the group competing for CEO included the number of executives in the top six job titles from which CEOs are most often promoted. Most of the executives in these six positions are also officers or board members. Insignificant results were obtained when competitors were defined as those executives reporting directly to the CEO.

[11] In studies of the sensitivity between CEO pay and firm performance, it is important to measure all components of pay, not just base pay and bonus pay. This is because the various components of pay differ in their responsiveness to changes in firm performance, as some of the components are based directly on the firm's stock price. The use of base pay and bonus pay alone does not compromise this empirical test in the same way because it is unlikely that firms would manipulate stock options, insurance, club memberships, and so on in a way systematically different from base pay and bonus pay in response to a change in the number of VPs. In fact, these other components, since they are harder to value and observe, would be a poor vehicle for manipulating tournament incentives. Underestimating the pay gap between CEOs and VPs by leaving out other forms of compensation only affects the conclusions in this section if other forms of compensation behave differently from base and bonus pay in response to changes in the number of VPs.

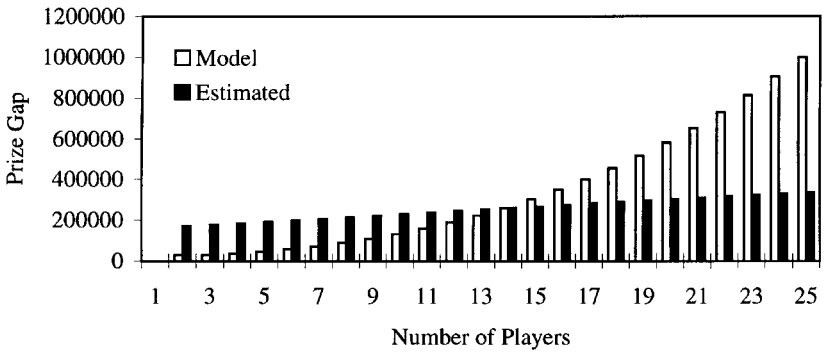

FIG. 3.—Differences between first- and second-place prizes generated from empirical estimates and the model. The empirical responsiveness to various numbers of players comes from the coefficients on the number of executive board members and the number of board members squared from column 3 of table 5. The model assumes the error term in equation (1) follows a beta distribution with both parameters equal to 3.

the parameter estimates in column 3, figures 3 and 4 are presented. The "Estimated" bars in figure 3 take account of the estimated parameters on the number of competitors and the number of competitors squared from column 3 of table 5. The "Model" bars reflect the prize gap from the theoretical model, assuming that the errors follow a beta distribution with the parameter r in equation 10 set to three.[12] In figure 4, the "Model" bars reflect errors that are uniformly distributed. This distribution is chosen because, as the number of competitors increases, it gives the most slowly increasing prize gaps and the one in which the prize gap increases are nearly linear. Both figures are calibrated so that the model's prize gaps and the estimated prize gaps are equal with 14 competitors, the mean number of CEO competitors in the data, and at a prize gap equal to $260,000, the mean gap in pay between CEOs and the group of competitors for CEO. In both figures, the estimated pay gap rises much more slowly than is predicted by the theoretical model. The pay gaps do not rise fast enough with additional competitors to compensate for the reduction in the probability of winning.

Using the pay gap in a single year to judge if promotion incentives are optimally managed does not take into account the prize that would accumulate over time as a result of promotion to CEO and may hide the responsiveness of the true prize to changes in the number of competitors.

[12] The estimated pay gaps for the differing numbers of competitors were generated by evaluating the following expression: $e^{(11.96+N(0.043760)-NN(0.000531))}$, where N is the number of competitors. The pay gaps from the model were generated by subtracting eq. (9) from eq. (8) in the article and evaluating the marginal probability with eq. (10).

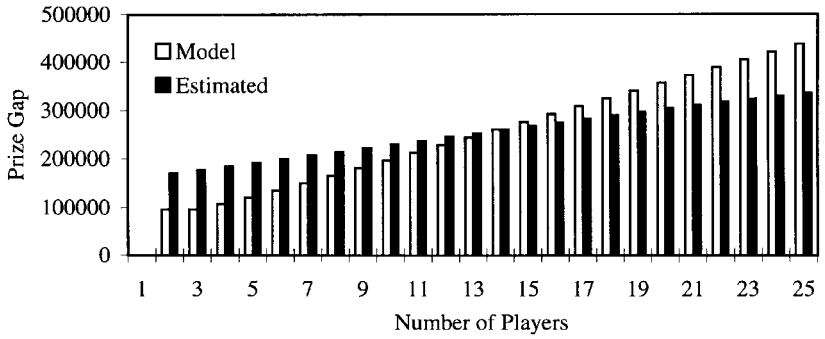

FIG. 4.—Differences between first- and second-place prizes generated from empirical estimates and the model, assuming uniformly distributed errors. The empirical responsiveness to various numbers of players comes from the coefficients on the number of executive board members and the number of board members squared from column 3 of table 5.

Columns 4, 5, and 6 of table 5 use the prize from promotion to CEO as the dependent variable. The prize is constructed as the present value of the current year's pay gap between the average VP and the CEO, assuming that both the incumbent CEO and the successor will retire at age 65. This present value takes into account the number of years the average VP would serve as CEO and the number of years before the promotion opportunity would take place. The discount rate is assumed to be 3%. If the CEO was already 65 or over, retirement was assumed to take place in 2 years. The prize variable is computed as

$$\text{CEO prize} = \frac{\sum_{i=1}^{N} (G_0)/[(1+r)^{i-1}]}{[(1+r)^{P}]}, \tag{11}$$

where N is the difference in age between the CEO and the mean age of the VPs, G is the current difference in base and bonus pay between the CEO and mean for VPs, r is 3%, and P is the number of years until the current CEO retires.

Results for this dependent variable are reported in columns 4, 5, and 6 of table 5. All of these columns omit age as an explanatory variable because of its use in constructing the dependent variable. The influence of the number of VPs on the CEO prize is markedly greater than it was on the annual pay gap, but only in column 4 without controls is the estimate statistically significant. For reference with figures 3 and 4, figures 5 and 6 are similarly produced based on the estimates in column 6. Both figures are calibrated so that the simulated prize from the estimated coefficients and the simulated prize from the theoretical model are equal at 14 competitors and at a prize level of $1,350,000, the mean prize in the

Table 5
Coefficients of Regressions of Log (CEO Base + Bonus), Log (Mean VP Base + Bonus), Log[(CEO Base + Bonus)−(VP Base + Bonus)] and Log(Present Value of Prize from CEO Promotion) on CEO Characteristics and Mean Vice President Characteristics by Firm (One Observation per Firm)

	Dependent Variables					
	ln(CEO Pay) (1)	ln(VP Pay) (2)	ln(CEO Pay−VP Pay) (3)	ln(CEO Prize) (4)	ln(CEO Prize) (5)	ln(CEO Prize) (6)
Intercept	11.6923	5.8160	7.9233	9.6862	−4.2478	−5.5564
Number of executive board members (VPs)	.0289	.0076	.0438	.2051	.1959	.0911
	(3.5)	(1.2)	(4.4)	(2.5)	(1.6)	(.8)
(Number of executive board members)^2	−.0004	−.0002	−.0005	−.0044	−.0025	−.0008
	(2.2)	(1.5)	(2.5)	(2.5)	(.9)	(.3)
CEO age	−.0023		−.0267			
	(.1)		(.5)			
(CEO age)^2	.0002		.0004			
	(.4)		(.8)			
CEO years of education	.0164		−.0007		−.5121	−.1423
	(1.2)		(.0)		(2.5)	(.7)
1 = hired as CEO; 0 = promoted to CEO	.0020		−.0034		1.2730	2.5930
	(.0)		(.0)		(1.2)	(2.2)
Years as CEO	.0157		.0176			.1894
	(2.1)		(1.9)			(1.8)
(Years as CEO)^2	−.0007		−.0008			−.0064
	(2.8)		(2.9)			(2.0)

CEO tenure	−.0068		−.0067			−.0716
	(.9)		(.7)			(.6)
(CEO tenure)^2	.0002		.0002			.0052
	(.9)		(.9)			(2.2)
Mean VP age		.1128	.0535			
		(1.0)	(.3)			
(Mean VP age)^2		−.0008	−.0002			
		(.7)	(.1)			
Mean years of education for VPs		.1410	.1303		1.2931	.8797
		(5.2)	(3.0)		(2.4)	(1.7)
Fraction of VPs hired into their current job		−.0460	.2845		.0349	.1199
		(.3)	(1.1)		(.0)	(.0)
Mean years in current job for VPs		−.0223	−.0490			−.0369
		(.7)	(1.0)			(0.1)
(Mean years in current job for VPs)^2		.0016	.0030			−.0488
		(.5)	(.6)			(.9)
Mean tenure of VPs		−.0233	.0007			−.0119
		(1.3)	(.0)			(1.6)
(Mean tenure of VPs)^2		.0005	−.0003			−.0369
		(1.1)	(.4)			(.1)
Net sales	.0084	.0062	.0091		.0200	.0272
	(2.5)	(2.4)	(2.2)		(.4)	(.6)
Total employment	.0040	.0037	.0037		−.0086	−.0038
	(5.9)	(7.2)	(4.5)		(.9)	(.4)
N	330	332	329	487	311	311
R^2	.37	.43	.41	.01	.05	.18

NOTE.—Absolute value t-statistics are in parentheses.

data. The estimates in column 6 were chosen for the simulation because they present the least responsive estimate of the effect of changing the number of VPs on the prize.

In figure 5, the "Model" bars are produced from the theoretical model assuming that errors follow a beta distribution with the parameter r in equation (10) set to three. Under this assumption, firms are less responsive to changes in the number of CEO competitors than the model predicts. In figure 6, with a uniform error distribution, firms exceed the responsiveness suggested by the model. It is not possible to reject the hypothesis that firms appropriately vary the CEO prize given the range of estimates in table 5 and the arbitrariness entailed in picking an error distribution for the theoretical model.

The square of the number of competitors is consistently negative in table 5. The coefficients on the square of the number of competitors are small, making the overall response in the pay gap and in the CEO prize nearly linear with changes in the number of competitors. Nevertheless, this is inconsistent with the predictions of the model (see table 6).[13] A positive relationship between the CEO pay, the pay gap, and the CEO prize with respect to the square of the number of competitors would have bolstered the idea that firms intentionally manage pay with some sophistication in order to maintain promotion incentives. Table 7 presents the summary statistics for tables 2, 5, and 6.

IV. Conclusion

This article used corporate data across hundreds of firms to explore factors affecting executive pay, especially as they relate to the theory of tournaments. Several aspects of corporate pay and promotion create tournament-like conditions. These properties include (1) a relatively high rate of promotion from within; (2) pay gaps that increase with hierarchical level; (3) hierarchical levels that serve as an important determinant of pay; and (4) large rewards (in present value terms) from promotion. With executives advancing through the firm's hierarchy to reach top positions with increasing rewards from promotion, a tournament environment with promotion incentives seems to characterize the structure of corporations.

Tournament theory predicts that the CEO promotion prize rises with the number of contestants for the position. This does occur for the companies in this study. The hypothesis that the CEO prize responded in

[13] Table 6 is estimated to confirm that on an individual basis the prize from promotion responds as it did in table 5, where each observation reflected the mean of competitor characteristics and there was one observation per firm. The prize variable in table 6 is constructed in the same method; however, it is computed for each individual executive in each year using the age and pay of the particular executive in the computation. The results are consistent in sign but generally smaller in magnitude than in table 5.

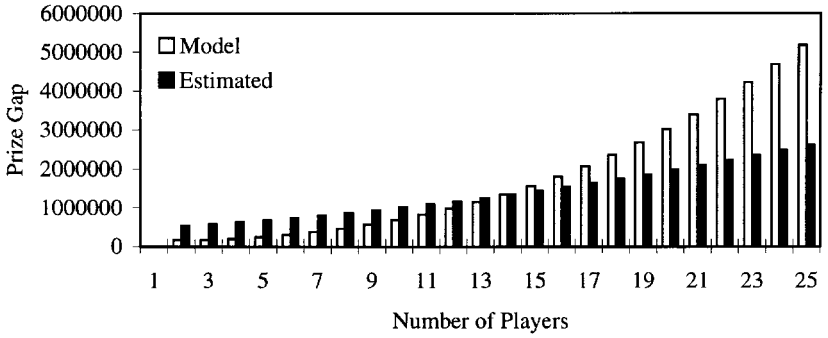

FIG. 5.—Differences between first- and second-place prizes generated from empirical estimates and the model. The empirical responsiveness to various numbers of players comes from the coefficients on the number of executive board members and the number of board members squared from column 6 of table 5. The model assumes the error term follows a beta distribution with both parameters equal to 3.

accordance with the model to changes in the number of contestants could not be rejected. However, it should be stated that there was an arbitrariness to the responsiveness of the CEO prize to changes in the number of competitors predicted by the theoretical model because it was sensitive to the specification of the error distribution. Attempts to provide further evidence that firms intentionally manage promotion incentives were not successful. Firms do not appear to adjust short-term incentives in response to promotion incentives as lengthier time in position prior to a promotion reduces the pay increase from the promotion. The square of the number of competitors decreased CEO pay, the pay gap, and the CEO prize. This contradicts the implication of the tournament model presented here that

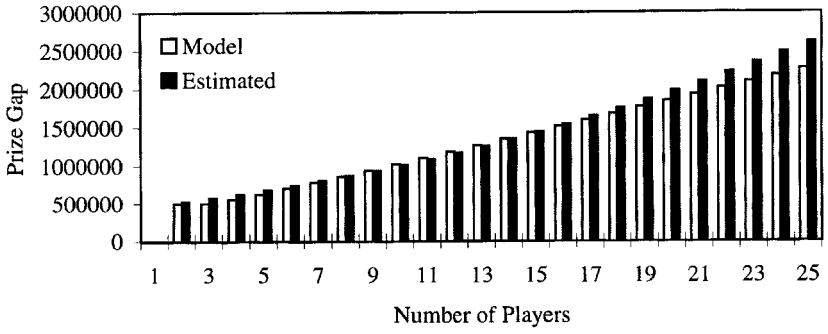

FIG. 6.—Differences between first- and second-place prizes generated from empirical estimates and the model, assuming uniformly distributed errors. The empirical responsiveness to various numbers of players comes from the coefficients on the number of executive board members and the number of board members squared from column 6 of table 5.

Table 6
Coefficients of Regressions of the Log (Present Value of Prize from CEO Promotion) on Individual Vice President Characteristics (All Observations on Executives Serving on Company Boards)

	Ordinary Least Squares (1)	Firm and Individual Fixed Effect (2)	Ordinary Least Squares (3)	Firm and Individual Fixed Effect (4)	Ordinary Least Squares (5)	Firm and Individual Fixed Effect (6)
Intercept	9.9980		−.4166		6.9199	
Number of executive board members (VPs)	.0343	.0879	.0369	.1075	.0414	.0067
	(2.6)	(5.0)	(2.2)	(4.9)	(2.6)	(.3)
(Number of executive board members)^2	−.0007	−.0011	−.00004	−.0008	−.0002	−.0003
	(2.9)	(3.9)	(.1)	(2.4)	(.7)	(.9)
Education			.5936	.−.4658	.2951	−.2849
			(17.3)	(2.4)	(8.7)	(1.5)
1 = hired into job; 0 = promoted into job			.9256	1.2285	−.1181	.7122
			(6.0)	(3.4)	(.6)	(1.9)
Years in current job					−.3565	.0525
					(11.5)	(1.3)
(Years in current job)^2					.0060	−.0088
					(3.5)	(2.8)
Tenure					.1089	-.2813
					(4.8)	(5.0)
Tenure^2					−.0065	−.0059
					(12.5)	(4.9)
Net sales			.0452	.0106	.0820	−.0554
			(5.4)	(.5)	(10.3)	(2.5)
Total employment			−.0103	.0093	−.0105	−.0025
			(7.0)	(2.0)	(7.6)	(.5)
N	20,397	20,397	12,567	12,567	12,567	12,567
R^2	.00	.91	.03	.92	.14	.93

NOTE.—Absolute value t-statistics are in parentheses.

the winner's prize should increase at an increasing rate with the number of competitors. This test may have been unrealistic in expecting firms to follow a secondary implication from a specific model.

This article finds evidence that the position of CEO can be predicted 1 or 2 years in advance with great accuracy by identifying the most highly paid contestant. The interpretation of this finding awaits further work. On the one hand, high predictability of the promotion winner suggests that there is no tournament. On the other hand, it could mean that the tournament is over and that the winner is receiving a high current wage and high expected future wages as the imminent CEO.

Table 7
Summary Statistics for Variables Found in Tables 2, 5, and 6

Variable	Mean	Standard Deviation
Table 2:		
Salary + bonus (dollars)	99,256.96	(89,818.00)
Level 1: CEO = 1; others = 0	.021	(.142)
Level 2: reports to CEO	.113	(.317)
Level 3: reports to level 2	.347	(.476)
Age	48.097	(8.511)
Age^2	2,385.770	(824.393)
Education	16.648	(1.793)
0 = hired into job; 1 = promoted	.222	(.416)
Tenure	14.535	(10.407)
Tenure^2	319.584	(386.595)
Years in current job	4.202	(4.129)
(Years in current job)^2	34.707	(79.811)
Years in current job for level 1; 0 for others	.141	(1.412)
Years in current job for level 2; 0 for others	.514	(2.044)
Years in current job for level 3; 0 for others	1.453	(3.100)
Years in the same job before promotion to level 1; 0 for others	.003	(.135)
Years in the same job before promotion to level 2; 0 for others	.032	(.476)
Years in the same job before promotion to level 3; 0 for others	.091	(.807)
Table 5:		
CEO pay (salary + bonus in dollars)	395,974.31	(189,105.00)
Mean (salary + bonus in dollars) for VPs	135,183.70	(53,317.00)
CEO prize (dollars)	1,342,564.81	(1,355,858.00)
ln(CEO prize)	11.436	(5.518)
Number of VPs	14.630	8.483
(Number of VPs)^2	285.867	(404.857)
CEO age	56.868	(6.274)
(CEO age)^2	3,273.28	(702.751)
CEO years of education	16.827	(1.595)
1 = hired as CEO; 0 = promoted	.159	(.366)
Years as CEO;	6.933	(7.270)
(Years as CEO)^2	100.793	(240.904)
CEO tenure	22.5092	(12.135)
(CEO tenure)^2	653.622	(553.524)
Mean VP age	50.441	(3.828)
(Mean VP age)^2	2,558.96	(384.372)
Mean years of education for VPs	16.916	(.667)
Fraction of VP new hires	.193	(.186)
Mean years in current job for VPs	4.356	(2.030)
(Mean years in current job for VPs)^2	23.089	(23.038)
(Mean tenure of VPs)^2	295.130	(213.083)
Net sales	3.464	(8.019)
Total employment	26.200	(36.131)
Mean salary + bonus for VPs (dollars)	135,184.70	(53,317.00)
Table 6:		
CEO prize (dollars)	1,775,185.48	(2,182,228.00)
ln(CEO prize)	10.339	(6.527)
Number of executive board members (VPs)	19.075	(10.896)
(Number of executive board members)^2	482.572	(679.188)
Education	17.011	(1.672)
1 = hired into job; 0 = promoted into job	.173	(.378)
Years in current job	4.547	(4.190)
(Years in current job)^2	38.206	(76.431)
Tenure	16.958	(10.751)
Tenure^2	403.141	(421.902)
Net sales	3.713	(6.859)
Total employment	35.360	(41.929)

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