1. Introduction

The theory of tournaments as incentive schemes has generated substantial interest.\(^1\) Tournament theory is unique in generating incentive-based predictions about wage structures across the firm. As such, it may be more easily testable than other incentive theories. It has also been proposed as an explanation for very high CEO compensation. In this paper, I appraise the state of empirical and theoretical research on tournaments in furthering our understanding of compensation and incentives in organizations. I argue that many existing tests are not very helpful in assessing the relevance of tournaments in this setting. I propose more precise tests, but conclude that several of these tests may be difficult to implement with compensation data. I identify shortfalls in tournament theory suggested by current evidence on compensation practices and the limitations this imposes on empirical work. The arguments are illustrated with evidence on tournaments from personnel data of a single firm.

Briefly, tournament theory shows that a firm may motivate employees by running competitions for rewards (promotions are the typical example). This can sometimes be preferable to individualistic schemes (e.g., bonuses). For instance, if accurately measuring individual performance is costly, the firm may economize by measuring only rank ordering of performances. Relative evaluation also insures employees against risks common to, or closely correlated among, workers. Moreover, it may be that rewards are relatively indivisible, and employees implicitly compete for them, in which case some tournament-like aspect to compensation may be inevitable. The firm might offer large rewards on promotion because promotions bid-up the outside value of those who win, and employees may compete for a limited number of slots. Along these lines, the key assumptions in these models are usually that the structure and number of jobs in a hierarchy are relatively fixed, and that wages are more closely attached to jobs than to individuals.

Tournament theory generates many predictions. First, larger prizes motivate more effort and performance. Second, a greater effect of extra effort on the chance of winning brings greater motivation. The effect of extra effort is smaller, the more likely is the outcome of the tournament (probability of winning closer to zero or one); and larger, the more the outcome is a toss-up (probability of winning closer to ½). For this reason, the theory predicts a U-shaped relationship between promotion rates and rewards, with larger prizes when the chance of winning is very low or very high, and smaller prizes for chances of winning closer to ½.

The theory has been extended to sequential contests for multiple promotions up the hierarchy. In such settings, rewards must grow larger at each stage to maintain incentives, because there are fewer future rewards to strive for, and time horizons shorten with tenure. Thus, a third prediction is that pay grows in a “convex” manner with hierarchical level. A fourth prediction is that the last prize, the gain earned on becoming CEO, will be still larger, to give incentives equivalent to an infinite horizon of future competitions.

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2. Tournaments or Standards?

A tournament in which employees compete for fixed slots is one model of how a firm chooses whom to promote. Another plausible model is one in which the firm sets a fixed performance standard, and promotes all who meet the target, so that the number promoted is random. This model of a standard generates identical predictions to those outlined above. Intuitively, a tournament is just like a standard, except that the standard (performance sufficient to beat enough competitors to win) is a moving target. This similarity presents a problem for testing tournaments. Evidence on the predictions above cannot distinguish between tournaments and standards. Therefore, many claimed tests of tournaments are really tests of the more general hypothesis that firms use promotion-based incentive schemes, either tournaments or standards.

Because the theories have the same predictions about rough characteristics of compensation structures, distinguishing tournaments and standards may be less important than testing whether firms set wages to generate incentives from promotions. However, the distinction between tournaments and standards is interesting for another reason. If firms keep job slots largely fixed, this suggests that there are large costs to changing the structure of the hierarchy. This would imply that organizational change is difficult and costly.

One way to distinguish between tournaments and standards would be to examine the extent to which job slots are fixed. Also, tournament incentives change with the number of contestants, though the effects vary with promotion rates; the same is not true for standards. Neither of these two tests has been conducted to date. Tournament theory has also been extended to analyze the effects of performance measurement relative to peers. Because standards do not involve relative evaluation, these extensions might also be used to distinguish tournaments from standards. One prediction is that employees may attempt to collude with or sabotage their competitors. Furthermore, when contestants differ in abilities, they will have different incentives for risk-taking behavior (even when they are risk neutral) in a tournament. Front-runners will take too few risks, while underdogs will take too many risks. These adverse effects of tournaments may lead to lower rewards (pay compression) than would otherwise be optimal. If such effects could be detected, they would be strong evidence in favor of tournaments.

3. Evidence on Predictions of Tournament Models

The empirical literature on tournaments is growing. However, many studies use data from contexts other than employees in firms, such as golf, auto racing, lab experiments, and chicken farming. Such studies can (and do) verify that tournaments work as suggested by the theory, but they do not shed light on the relevance of the theory for compensation in hierarchies. Some studies do use compensation data, and these are the focus here.

Effects of Reward Size on Effort and Output: Unfortunately, it is unlikely that this prediction will be easy to test using organizational data. Getting accurate data on performance in many jobs is quite difficult (performance

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ratings typically distinguish little between employees). Indeed, it is on this basis (expense of accurately measuring effort or performance) that tournament theory is often justified.

**Effects of Promotion Rates on Optimal Prizes:** A subset of the second prediction, that for low promotion rates the size of the prize increases as the chance of winning promotion decreases, has received some support in organizational data. However, such a test of tournaments is fundamentally very weak: a simpler and probably more plausible marginal productivity theory yields the same prediction. Since the promotion probability roughly equals the inverse of the span of control, this prediction essentially says that the difference in pay between levels should be larger when the span of control is larger. Any reasonable theory of hierarchical production, combined with the usual assumption of pay equal to marginal product, predicts exactly this. Since marginal productivity theory is more primitive and parsimonious, the fact that wage differences tend to increase as promotion rates fall is not powerful or convincing evidence for tournaments.

It is possible to distinguish tournament from marginal productivity effects, but only in cases where the probability of promotion is very high, for then tournament theory predicts that prizes will rise with promotion rates, the opposite of marginal productivity theory. Unfortunately, in most firms promotion rates are in the range from 0 to ½ (this is guaranteed when contestants vie for a single job), so it may be nearly impossible to distinguish between the two theories using firm data to test this prediction.

**Convex Salary Structures with Level, and High CEO Pay:** The third and fourth predictions, that rewards increase at an increasing rate with hierarchical level, with an especially large increment at the top, are also consistent with hierarchical production and related models. Since it is almost unassailable that wages increase with level, the leap to a convex increase is not a large one for marginal productivity theory. Any model with increasing returns to talent in hierarchical production, e.g., through positive externalities on productivity of subordinates, generates this prediction. Further, convexity of salaries with level automatically predicts that the largest pay increment will come at the top, so it is difficult to know exactly how much of the return to becoming CEO is one effect or another. The especially large increase at CEO is also consistent with a “superstar” effect in the labor market for top executives. Once more, the predictions of tournament models do not distinguish them adequately from other important and quite plausible models.

Distinguishing tournaments and marginal productivity effects on convexity of wages requires different econometric approaches than usually used. First, in tournaments the reward at each stage is the discounted (by time and probabilities of winning again) present value of options on future contests the employee may compete in. Thus, a complete specification of the prize, including future probabilities and rewards (and options and stock for CEOs) at all higher levels, is desirable. Evidence that such a measure is more closely related to promotion rates than are average pay differences between levels would support tournaments. Furthermore, under tournaments prizes should be larger the longer one waits to earn them. A human capital accumulation model would have the same prediction, but a marginal productivity model might predict the opposite: if the firm sorts employees by talent, those who are passed over longer are likely to be less talented. Thus, evidence that prizes fall with time to promotion would be evidence against tournaments.

**Some New Evidence:** Table 1 presents regressions comparing how marginal product and tournament theories explain rewards on promotion, using personnel data on all management employees of one firm with eight management levels and seventeen major titles (Level 8 is the CEO). The table is intended to illustrate some of the methodological points made above. Each observation is for an individual promoted that period. Independent

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variables include span of control between previous and current levels, time to promotion, and a quadratic measure of each employee’s promotion probability. Promotion probability is the fitted value for each promotee in a logit predicting promotions. I also include a quadratic of the number of employees in the promotee’s previous title, to look for size of contestant group effects predicted for tournaments but not for standards. The dependent variable is the raise earned on promotion, a proxy for (and probably much smaller than) the total discounted prize. Similar regressions are run for bonuses.

Using individuals as the unit of analysis has the advantage that fitted promotion probabilities vary widely, and can be measured separately from overall spans of control for each job title. This may enable separate estimation of tournament and marginal productivity effects. However, in such regressions it is then impossible to use expected discounted present value measures of rewards, which would not vary across individuals in the same job title. Such measures are better suited to regressions with data across a large number of job titles, perhaps with jobs as the unit of analysis.

The number of employees in the group eligible for promotion has no impact on the size of the prize. While a very crude test, this does not support tournaments over standards in this firm. The relationship between promotion rate and prize is as predicted by tournament and standard models: negative, with a positive quadratic term. According to these terms, the prize is smallest at a promotion rate of roughly ¼. The coefficients on years to promotion and the span of control variable both support marginal product theory over tournaments. A 25% change in the typical span of control (3.4) would change the prize by $200, roughly 5% of the average prize. Thus, there are mixed results supporting both theories. In this firm wages seem to reflect both marginal products and promotion-based incentives.

4. Evidence on Assumptions of Tournament Models

Wages Attached to Jobs: The assumptions of tournament models have been subjected to almost no empirical study to date. One exception is an analysis of wage variation within jobs in the sample firm, which I discuss here. A key assumption of tournaments is that wages are attached more to jobs than to individuals. If so, then job mobility is the chief source of wage growth and incentives. This is a widespread presumption in labor and institutional economics. In the data used here, the typical pattern emerges: in both panel and cross-sectional wage regressions, about 70% of the variance in pay can be explained by only five job level dummies. This is twice what is explained by traditional human capital variables. Such a finding is highly consistent with a variety of other studies.

On the surface, this is strong evidence for a key assumption of tournaments. However, in this firm there is also substantial variation in pay among those within the same job, and complicated individual wage dynamics underlying the gross wage patterns. For example, wage increments on promotion are much smaller than average differences in wages between job levels: there are not extraordinarily large wage jumps in promotion years. Wage jumps on promotion that are much smaller than average wage differentials between levels have also been found in a study of data across many firms. This suggests that previous studies may have overstated the uniformity of wages within versus between jobs. Wage regressions with job classification dummies may yield high R²s, because of large differences between mean wages across jobs, even though there may still be important variation beneath the surface.

Fixed Job Slots: A second key assumption of tournament theory (and the one that distinguishes it from the theory of promotion standards) is that job slots are relatively fixed. If this is so, then employees compete for positions. This has never been tested, though such a study would be interesting. To do so, one would ideally like micro data on reporting relationships within a firm, in order to precisely know which jobs feed into which. It is

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8 See Gibbs 1995, op. cit., for details of the method.
10 Bognanno, 1994, op. cit.
also necessary to control for changes in firm size due to growth or decline, and for external hiring and exits. However, in practice, the variation in number of employees in each position might be very small even under a standard, because random events tend to cancel each other out.

Table 2 presents informal evidence on how fixed the number of slots is in the sample firm, showing correlations among promotion and hiring rates into, and promotion and exit rates out of, titles each year (the number of lateral transfers or demotions is trivial). The table also includes promotion rates adjusted to correct for fluctuations in total employment, by subtracting the firm’s overall growth rate each year. If the number of slots available for internal promotion is fixed, then the promotion rate should vary closely with the rate at which employees leave the title through promotions or exits. As seen in the table, promotion rates do vary positively with both, but not with very high correlations. Furthermore, fixed slots should mean that promotion into a job is negatively correlated with hiring from the outside. This is observed, but the correlation is very small. Using adjusted promotion rates strengthens the predicted correlations, but not by much. Such low correlations provide little evidence that job slots are strictly fixed in this firm.

5. Heterogeneity Among Contestants

Tournament theory usually assumes two identical contestants. However, as mentioned above, in the firm studied here there is substantial variation in pay among individuals in the same job title, indicating the possibility of differences in abilities. Employees also differ in wage growth, performance ratings, and other observable characteristics. Tournaments with heterogeneous contestants have not been extensively analyzed. However, some implications have been derived (they apply equally to standards). The most important is that incentives fall as differences between contestants increase; closer races have greater incentives. Thus, heterogeneity is a potentially serious problem for promotion-based incentive schemes, as both front-runners and underdogs will have lower motivation. Some theoretical solutions have been proposed, but I argue in this section that they may not apply in many firm settings.

Handicapping: Handicaps can adjust incentives for heterogeneous contestants by making it harder for an advantaged worker or easier for a disadvantaged worker to win. However, heterogeneity implies sorting of workers in addition to incentives. Most hierarchical production models emphasize the importance of sorting workers into the right jobs. Except in cases of affirmative action, handicapping works directly against the sorting objective and is correspondingly costly; firms face a tradeoff between sorting and incentives. Thus it is far from obvious that handicapping is optimal in hierarchies.

Tracking and Self Selection: Another approach is to put employees into different contests, or different promotion tracks. Unfortunately, without a clear theory of assignment of workers to tracks it is difficult to empirically detect such phenomena. Would the tracks be into different job functions or titles? Might there be different (say slower and faster) tracks within the same jobs? How would this be distinguishable empirically from a model where the firm promotes all who meet a standard, but employees take different amounts of time to qualify (slow and fast learners)?

Another solution has been proposed if workers know their type. In this case, the firm might induce self-selection into different contests by comparing all with the performance of the lowest ability group. Unfortunately, in firms this does not seem to be done: employees are not regularly compared with those at the bottom of the hierarchy. In fact, it may make no sense to do so, because the nature of work varies so much across the hierarchy that such comparisons are infeasible.


Predicting Promotions: Heterogeneity raises an additional question. To some extent winners may be predictable in advance. For example, in the sample firm there is a clear negative relationship between the average real raise earned in years up to promotion, and the time to promotion: those earning faster wage growth will be promoted both faster and more often. Since tournaments work by making promotions uncertain, the implications of such a pattern for running a tournament are unclear.

Summary: The data suggest that there may be more heterogeneity than had previously been realized. The complications arising in tournaments with heterogeneous contestants are rich and interesting, but as of yet there is no convincing general theory of how firms manage such schemes. This makes it difficult to think about empirical tests. If we don’t understand how to manage heterogeneous tournaments, how can we test for tournaments when it appears that heterogeneity is important? How do we tell who competes against whom? What is the relevant time frame? Are tests that suppress heterogeneity, by looking at aggregates such as mean wages and promotion rates, appropriate? This suggests that further theoretical research on heterogeneous tournaments may be necessary before tournaments can be adequately studied empirically.

6. Directions for Future Work

Empirical tests of tournaments have roughly supported the theory, but many questions remain. A key prediction, that larger prizes lead to greater incentives and performance, is unlikely to be testable in organizational contexts. Most tests have focused on three other predictions, about relationships between promotion rates and salary differences between levels, convexity of pay with level, and the large jump in pay at CEO. These tests have made no attempt to distinguish between tournaments and standards, and thus only test the hypothesis that firms run one or the other promotion-based incentive scheme. Nor would it be easy to compare the two theories without detailed data on job slots. A test presented here suggested that job slots are not fixed in the sample firm, which is inconsistent with tournaments but not with standards.

Of greater concern is that the tests fail to distinguish promotion-based incentives from more basic and plausible models of marginal productivity in hierarchies. Furthermore, it may be very difficult to disentangle the theories, because they give the same predictions when promotion rates are in the range usually observed. For this reason, existing tests based on wage and promotion data give little reason to be confident that firms actually do use tournaments, or even promotion-based incentives, in setting wages.

The assumptions of tournaments have not been directly tested, but available evidence is not encouraging. The presumption that wages are largely attached to jobs may well be incorrect. At the same time, empirical evidence does suggest that long term rewards from promotion are large, consistent with the theory. The test for fixed job slots showed little support for that assumption, though more work needs to be done as it is the first such test, and used data from only one firm.

Variation in wages is just a small part of the observable variation among potential competitors. Heterogeneity makes it difficult to examine tournaments empirically, and the incompleteness of theory in this area only complicates matters. Theory indicates that heterogeneity reduces incentives, and suggests several approaches that may be taken to alleviate this problem. However, these suggestions do not seem to be the best approach in organizations. It is not at all clear how a firm might optimally run a tournament in the presence of differences among competitors. It is even plausible that the negative incentive effects of heterogeneity would cause the firm to abandon the tournament and adopt a different incentive scheme, at least for some subset of employees. For this reason, the combination of promotion-based incentive schemes with other forms of incentives also seems worthy of attention.

Finally, existing work has concentrated on the simplest predictions of tournament theory. There are richer predictions that might be examined, such as the potential for sabotage and pay compression. Such predictions might require new approaches, including field research or detailed within-firm data.

It is worth emphasizing that tournaments may be inevitable, to some degree, in organizations. Many rewards are discrete and largely indivisible. It often appears that employees do compete for choice assignments, projects, and promotions. Thus, the theory has the potential to greatly improve our understanding of compensation and incentive systems. Tournaments may be especially relevant at the top of organizations, where small numbers,
lack of outside hiring, fixed slots, and large rewards on promotion are prevalent. Existing empirical work is useful in checking the over-arching features of tournaments, and confirming that they match organizational compensation patterns. However, these tests are a far cry from proving the existence of tournaments in firms. Future theoretical and empirical work must address the issues raised here if we are to ever really understand the relevance of tournaments inside organizations.
**Table 1. Cross-Sectional Analysis of the Prize from Promotion**

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Dependent variables</th>
<th>$ raise on promotion</th>
<th>% raise on promotion</th>
<th>log($ bonus) on promotion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>11,755.71*</td>
<td>16.26*</td>
<td>10.27*</td>
<td></td>
</tr>
<tr>
<td># employees in old title</td>
<td>-6.26*</td>
<td>-0.0018</td>
<td>-0.0022*</td>
<td></td>
</tr>
<tr>
<td>(# empl. in old title)^2</td>
<td>0.0029*</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>Promotion probability</td>
<td>-296.04*</td>
<td>-0.24*</td>
<td>-8.80*</td>
<td></td>
</tr>
<tr>
<td>(Promotion prob.)^2</td>
<td>595.20*</td>
<td>0.56*</td>
<td>12.58*</td>
<td></td>
</tr>
<tr>
<td>Years until promotion</td>
<td>-474.82*</td>
<td>-1.18*</td>
<td>-0.041*</td>
<td></td>
</tr>
<tr>
<td>Span of control</td>
<td>233.29*</td>
<td>0.34*</td>
<td>0.017*</td>
<td></td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>.34</td>
<td>.30</td>
<td>.37</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>5,218</td>
<td>5,218</td>
<td>752</td>
<td></td>
</tr>
<tr>
<td>Dependent mean</td>
<td>3,934.84</td>
<td>8.82</td>
<td>8.31</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Coefficients indicated by * are significant at better than 1%. The last regression is only over employees who received a positive bonus.

**Table 2. Correlations of Promotion, Hiring, and Exit Rates by Title**

<table>
<thead>
<tr>
<th>Correlation</th>
<th>Adjusted promotion rate</th>
<th>Hiring rate</th>
<th>Exit rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Promotion rate</td>
<td>0.93*</td>
<td>-0.054</td>
<td>0.25*</td>
</tr>
<tr>
<td>Adj. promotion rate</td>
<td></td>
<td>-0.054</td>
<td>0.31*</td>
</tr>
<tr>
<td>Hiring rate</td>
<td></td>
<td></td>
<td>0.26*</td>
</tr>
</tbody>
</table>

Notes: Correlations are for each variable of each title in each year. Sample sizes vary from 902 to 1,174. Correlations indicated by * are significant at better than 1%.