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Testing implications of a tournament model of school district salary schedules

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ABSTRACT

Using panel data on the salary schedules of public school teachers and administrators, I look for evidence of a tournament wage structure. A tournament model is presented, where teachers compete for promotion to administrators. Districts can create incentives for teachers by offering either a higher pay premium for promotion or a larger probability of promotion. The model predicts an inverse relationship between these two values. Evidence supporting this prediction is found in the data. In contrast, an alternative model of incentive pay, where returns to seniority substitute for imperfect monitoring, is not supported empirically. This result is consistent with intuition that tenure protections make it hard for districts to fire shirking teachers, making returns to seniority a poor method of providing incentives.

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1. Introduction

A great deal of debate is centered on numerous recently implemented or proposed incentive pay, or "pay-for-performance" initiatives for public school teachers, in which teacher pay is linked to student outcomes like test scores or attendance.[1] As the impacts of these explicit incentive pay programs are being studied, it remains possible that salary schedules of teachers and administrators without explicit incentive pay schemes may contain implicit incentives in them to elicit teacher effort. One possible avenue for these incentives is through a tournament model, where teachers compete for positions as school administrators. If the salary increase for being promoted to an administrative position is sufficiently large, and if promotion depends on a teacher's performance, then the opportunity for advancement provides an incentive for teachers to increase their effort levels.

The classic tournament model (Lazear & Rosen, 1981) shows that firms can provide incentives to all workers through compensation schemes that pay according to a worker's ordinal rank rather than her productivity, and this contract can provide an efficient allocation of resources. Malcomson (1984) shows that the payoffs to tournament promotion depend on the probability of winning the tournament. Empirical evidence in support of this theory comes from tournaments with a single winner, where it has been shown that the larger the number of contestants (i.e. the smaller the fraction of contestants winning), the higher the prize differential for winning. Main, O'Reilly, and Wade (1993), Eriksson (1999) and Conyon, Peck, and Sadler (2001) verify this with respect to competition for promotion to CEO.[2]

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[1] Eberts, Hollenbeck, and Stone (2002) provide a case study of a merit pay scheme and find that it increased student retention but had no effect on average GPA. Lavy (2002, 2004) finds that a merit pay program in Israel caused significant student gains and was more cost-effective than non-incentive based funding increases. Cullen and Reback (2006) study a school-level accountability system and find that administrators manipulated the composition of student test-takers to maximize scores.

[2] For more recent examples of tournament models see Levy and Vukina (2004), Szymanski (2003), and Lin and Yang (2003).

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The purpose of this paper is to test whether the pay schedules of teachers and administrators exhibit evidence of a tournament. I develop a two-period principal-agent tournament model and use it to show that, in the optimal contract, a district trades off between higher promotion probability and higher salary differential between administrators and teachers. The promotion probability is measured by the ratio of administrators to teachers in a district. Using panel data on the wage schedules and teacher/administrator ratios of school districts, I test this relationship at the district level.

An alternative method of providing incentive pay to teachers may come from the returns to seniority found explicitly in most public school teachers' contracts, discouraging workers from shirking by offering greater rewards if they stay on the job. Lazear's (1979, 1981) model of deferred compensation, where workers are paid less than their marginal productivity when young and more when old, has been verified empirically in previous studies (e.g., Kotlikoff & Gokhale, 1992), though never with teacher salaries. If this is the case with contracts for teachers, then returns to seniority may be an efficient way to pay teachers. To determine if returns to seniority are being used as incentive pay, one can look at how workers are monitored to see if those who are monitored more closely are offered a flatter wage-seniority profile. I also test this model, using as a proxy for monitoring intensity the ratio of teachers to school administrators, coordinators, or supervisors.

This paper can be understood in relation to Ballou and Podgursky (2002, hereafter "BP"), who also investigate the determinants of returns to seniority among public school teachers. The factor which they find to be the most important determinant is rent-seeking by teachers' unions. They also offer three alternate explanations for returns to seniority, which they dismiss without testing: human capital, where the wage profile represents growth in teacher productivity; the Lazear (1979, 1981) model of imperfect monitoring; and turnover costs (Salop & Salop, 1976). Their rent-seeking hypothesis is supported by the data, which show that unionized districts offer higher returns to seniority than non-unionized districts.

This paper makes two contributions to the discussion begun by BP, one minor and one major. The minor contribution is that I test BP's imperfect monitoring explanation for returns to seniority, and I find no empirical support for it. This is consistent with BP's intuition that because of tenure laws, shirking teachers are hard to fire. The major contribution that this paper makes is offering another explanation for teacher salary schedules, one based on a tournament model as described above. This model is tested using data on salaries of both teacher and school administrators, and the results verify the predictions of the model.

The next section of the paper presents the tournament model. Section 3 describes the data, and Section 4 presents empirical results.

2. Model

The model is similar to the two-player tournament model of Lazear and Rosen (1981). That model has one winner and one loser; the model here has a continuum of workers with a fraction of winners. The winners are those teachers promoted to principals, and the losers are those who stay on as teachers. I show that firms provide incentives to workers either through a larger fraction of workers winning or through a higher payout to winners. These methods of incentives are substitutes, so the ratio of administrators to teachers should be negatively correlated with the pay premium for administrators. Also, the model predicts that the payoff to the losers is uncorrelated with the fraction of winners. That is, the returns to seniority for employees who stay on as teachers are uncorrelated with the ratio of administrators to teachers. This prediction conflicts with a prediction of the imperfect monitoring model, thus providing a way to test the two theories against each other.

Suppose that a firm employs workers for two periods with perfect monitoring. The firm offers advancement to workers in the second period based on their (perfectly observed) effort in the first period. Let w_0 be the first period wage, and w_1 and w_2 be the winners' and losers' second period wages, respectively. Workers have a utility function that increases in wages and decreases linearly in effort: $U = v(w_0) - e_i + \beta[Pv(w_1) + (1-P)v(w_2)]$, where P is the probability of being promoted. Since monitoring is perfect and promotion depends only on worker effort in the first period, effort in the second period is irrelevant. Worker i chooses an effort level e_i of either zero or one. The promotion probabilities are based on this effort level; let P_0 be the probability of promotion given $e_i = 0$ and P_1 be the probability given $e_i = 1$.

The firm offers promotions only to those workers with a high effort level in the first period, and the fraction of those workers promoted is q. That is, $P_0 = 0$ and $P_1 = q$. Worker utility for each choice of effort is thus

$$\begin{aligned} U(e=0) &= v(w_0) + \beta v(w_2) \\ U(e=1) &= v(w_0) - 1 + \beta(qv(w_1) + (1-q)v(w_2)) \end{aligned}.$$

Workers have a reservation utility of $v(w_r)$. The firm chooses w_1 and w_2, the wages of the winners and losers, respectively. If the firm wants to induce high effort from all workers, its maximization problem is

$$\max_{w_1, w_2} \pi(1) - w_0 + \beta[\pi(1) - qw_1 - (1-q)w_2]$$

such that

$$\begin{aligned} v(w_0) - 1 + \beta(qv(w_1) + (1-q)v(w_2)) &\geq v(w_r) \\ v(w_0) - 1 + \beta(qv(w_1) + (1-q)v(w_2)) &\geq v(w_0) + \beta v(w_2) \end{aligned}$$

The first inequality is the participation constraint, ensuring that workers prefer the contract to not working at all. The second inequality is the incentive constraint, ensuring that workers prefer a high effort level over a low effort level.

It can be shown that both constraints bind. Solving the model thus yields the following solutions, expressed in terms of the inverse of the utility function $v^{-1}(\cdot)$.

$$w_1 = v^{-1}\left(\frac{1}{\beta q} + \frac{1}{\beta}(v(w_r) - v(w_0))\right)$$

$$w_2 = v^{-1}\left(\frac{1}{\beta}(v(w_r) - v(w_0))\right).$$

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