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Standard Promotion Practices versus Up-or-Out Contracts (CRI 2009-001)

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Abstract

In most firms a worker in any period is either promoted, left in the same job, or fired (demotions are typically rare), and there is no specific date by which a promotion needs to occur. In other employment situations, however, up-or-out contracts are common, i.e., if a worker is not promoted by a certain date the worker must leave the firm. This paper develops a theory that explains why and when each of these practices is employed. Our theory is based on asymmetric learning in labor markets and incentives associated with the prospect of future promotion. Our main result is that firms employ up-or-out contracts when firm-specific human capital is low while they employ standard promotion practices when it is high. We also find that, if firms can commit to a wage floor for promoted workers and effort provision is important, then up-or-out contracts are employed when low-level and high-level jobs are similar. We believe these results are of interest because they are consistent with many of the settings in which up-or-out is typically observed such as law firms and academic institutions.

Keywords

promotion practices, promotion, up-or-out

Comments

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STANDARD PROMOTION PRACTICES
VERSUS UP-OR-OUT CONTRACTS

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ABSTRACT

In most firms a worker in any period is either promoted, left in the same job, or fired (demotions are typically rare), and there is no specific date by which a promotion needs to occur. In other employment situations, however, up-or-out contracts are common, i.e., if a worker is not promoted by a certain date the worker must leave the firm. This paper develops a theory that explains why and when each of these practices is employed. Our theory is based on asymmetric learning in labor markets and incentives associated with the prospect of future promotion. Our main result is that firms employ up-or-out contracts when firm-specific human capital is low while they employ standard promotion practices when it is high. We also find that, if firms can commit to a wage floor for promoted workers and effort provision is important, then up-or-out contracts are employed when low-level and high-level jobs are similar. We believe these results are of interest because they are consistent with many of the settings in which up-or-out is typically observed such as law firms and academic institutions.

1. INTRODUCTION

Most firms are characterized by what we will refer to as standard promotion practices, i.e., in any period a worker is either promoted, left in the same job, or fired (demotions are typically rare), and there is no specific date by which a promotion needs to occur. In other employment situations, however, up-or-out contracts are common, i.e., if a worker is not promoted by a certain date the worker must leave the firm. There is an extensive theoretical literature on each practice, but only a few papers consider why standard promotion practices are employed in some settings while up-or-out contracts in others. In this paper we ignore the possibility of firms using complex contracts to create incentives and allocate workers across jobs, but rather focus on the choice between these two simple contract forms.¹

Our analysis employs the ideas of asymmetric learning in labor markets and incentives associated with promotion. Asymmetric learning in labor markets, which was introduced to the literature in Waldman (1984) and Greenwald (1986), is the idea that a worker's current employer acquires more accurate information about the worker's ability than do other firms. An important idea in this literature is the promotion-as-signal hypothesis that first appeared in Waldman's paper.² That is, because a worker's current employer has better information about the worker's ability, other firms use job assignments as signals of ability. Thus, when a promotion occurs, other employers infer the worker is high ability and increase what they are willing to pay the worker. There are two resulting implications. First, consistent with empirical evidence, in order to stop the worker from being bid away, a firm significantly increases a worker's wage when a promotion takes place.³ Second, in order to avoid having to pay a higher wage, a firm promotes fewer workers than is first-best efficient.

The incentives associated with the prospect of future promotion were first explored in Lazear and Rosen's (1981) seminal paper on labor-market tournaments.⁴ In that paper workers compete for a

¹ For surveys that discuss promotion practices see Sattinger (1993), Gibbons (1998), Gibbons and Waldman (1999a), Prendergast (1999), Lazear and Oyer (2007), and Waldman (2008). Note that Gibbons discusses up-or-stay contracts which are similar to our standard promotion practices. See Malcomson (1997,1999) for surveys on contracting.

² Other theoretical papers that investigate asymmetric learning in labor markets include Milgrom and Oster (1987), Bernhardt (1995), Chang and Wang (1996), and Owan (2004). Gibbons and Katz (1991) were the first to empirically test for asymmetric learning in labor markets and they find evidence that supports the approach. More recent empirical studies include Kahn (2007), Schoenberg (2007), Pinkston (2009), and DeVaro and Waldman (2008) which specifically looks at the promotion-as-signal hypothesis.

³ Studies that find empirical support for the idea that promotions are associated with large wage increases include Gerhart and Milkovich (1989), Lazear (1992), Baker, Gibbs, and Holmstrom (1994a,b), and McCue (1996).

⁴ Other early papers that investigate labor-market tournaments include Green and Stokey (1983), Nalebuff and Stiglitz (1983), Malcomson (1984), Mookherjee (1984), Rosen (1986), and MacLeod and Malcomson (1988).

promotion through their effort choices and the firm commits to wages before effort levels are chosen. More recently, Zabojsnik and Bernhardt (2001) employ the promotion-as-signal hypothesis to model promotion incentives without assuming commitment (see also Gibbs (1995)). They introduce a human-capital-investment choice for young workers in a model in which promotion serves as a signal. They find that, because of the subsequent high wage due to the signal when a worker is promoted, young workers invest in human capital in order to increase promotion probabilities. They go on to show that this approach explains both the firm-size-wage effect and inter-industry wage differences.

Now we turn to our approach. It is similar to Zabojsnik and Bernhardt's (2001) approach in that the signaling aspect of promotions creates incentives. In our model firms consist of low- and high-level jobs. We assume a single worker in the labor market for two periods, where the worker is more productive in period 2 because of the accumulation of both general and firm-specific human capital. Also, at the beginning of period 2 a promotion signals ability. The final key assumption is that output is a function of ability, effort, and human capital, with the result that in period 1 the worker positively affects the current employer's beliefs about the worker's ability by increasing his or her effort level.

We conduct two analyses of this model. Our first analysis abstracts away from effort choice and considers what the promotion-as-signal argument by itself predicts concerning the choice between standard promotion practices and up-or-out. Our main result here is that a low level of firm-specific human capital results in up-or-out while a high level results in standard promotion practices. The logic follows. On the one hand, given standard promotion practices there is a distortion concerning the promotion decision because of signaling, where the distortion is higher the lower the degree of firm-specific human capital. On the other, with up-or-out the worker leaves if not promoted, which means the value of the worker's firm-specific human capital is more likely to be lost with up-or-out. In turn, this cost is lower when firm-specific human capital is low. The result is that standard promotion practices are used when firm-specific human capital is high because that means low promotion distortions associated with standard promotion practices and high turnover costs associated with up-or-out. But when specific human capital is low up-or-out is employed because that means high promotion distortions associated with standard promotion practices and low turnover costs associated with up-or-out.

Our second analysis incorporates effort. We first discuss that, as in our first analysis, standard promotion practices are chosen when firm-specific human capital is high while up-or-out is chosen when it is low. In addition to the reasons given for this result above, there are now new factors associated with

effort provision. For example, suppose there is a small amount of firm-specific human capital and standard promotion practices are employed. Then the extra wage associated with a promotion is frequently larger than the extra output, so the probability of promotion is small and the incentives for effort are low. In contrast, since with up-or-out the period-1 employer can only keep the worker via a promotion, given little firm-specific human capital up-or-out results in a higher probability of promotion and higher incentives.

Similar to the tournament approach, we then allow firms when hiring in period 1 to commit to a wage floor for a worker assigned to the high-level job in period 2. This leads to the second main result which is related to an argument that first appeared in Prendergast (1993) (see Section 4 for a discussion). That is, given this extra assumption, up-or-out contracts are preferred if the two jobs are very similar and effort provision is important. The logic follows. On the one hand, even with the ability to commit to a wage floor the outcome given standard promotion practices when jobs are very similar is poor. Even with a wage floor, if jobs are very similar standard promotion practices result in a zero probability of promotion and as a result young-worker effort is at its minimum level. On the other hand, suppose jobs are very similar and the period-1 employer uses up-or-out. Then committing to a wage floor means a positive probability of turnover which, in turn, increases young-worker effort. In turn, as long as effort provision is sufficiently important, the result is that up-or-out is preferred.

These results match up well with where we typically see up-or-out in real-world settings. Consider, for example, academia. Before and after the tenure decision the nature of the job is pretty much the same in that in both cases the job consists of research, teaching, and administrative work. In addition, although there is some firm-specific human capital such as the human capital associated with collaborating with specific coauthors who might be more difficult to work with after a move, this type of human capital is quite limited. Hence, the fact that academia is typically characterized by up-or-out is consistent with our theoretical predictions. In Section 5 we discuss the case of academia in more detail and also discuss evidence concerning large law firms.

As indicated earlier, our approach is similar to that in Zabochnik and Bernhardt (2001). But there are also important differences. First, Zabochnik and Bernhardt focus on human-capital investments while we focus on effort choice. Second, in Zabochnik and Bernhardt's analysis each firm is characterized by a single job so promotions have no role in allocation, while in our model promotion means assignment to a higher level job. Third, the analyses focus on different issues. Zabochnik and Bernhardt's focus is on

explaining the firm-size-wage effect and inter-industry wage differences. In contrast, our approach is focused on assignment distortions and effort choice and how the approach can be used to explain differences between the use of standard promotion practices and up-or-out.

Another related paper is Kahn and Huberman's (1988) classic analysis of up-or-out. In Kahn and Huberman's analysis, up-or-out is used to avoid a double moral-hazard problem in which firms promote too few workers and workers underinvest in firm-specific human capital. There are some similarities between our paper and Kahn and Huberman's analysis which we discuss in detail in Section 4, but it is useful pointing out here that an important difference involves the prediction concerning how firm-specific human capital should affect the use of up-or-out. Specifically, our analysis predicts that up-or-out will be employed when firm-specific human capital is unimportant while Kahn and Huberman's analysis predicts up-or-out will be associated with high levels of firm-specific human capital.

In addition to contributing to the literature on up-or-out, the paper also addresses a puzzle first identified in Baker, Jensen, and Murphy (1988). They asked, why are promotions used for incentives rather than having incentives solely provided through monetary-based awards? In other words, given promotions are also used to allocate workers to jobs, having promotions serve an incentive role would seem to create inefficiencies because the two roles will sometimes conflict. We follow Zbojnik and Bernhardt (2001) in arguing that promotions are used to provide incentives because signaling means incentives are an inherent part of the promotion process. Note that a different explanation for the Baker, Jensen, and Murphy puzzle is found in Fairburn and Malcomson (2001). Their focus is influence activities. In their argument monetary incentives are subject to influence activities, and the negative effects of influence activities can be reduced by tying incentives to promotions because the assignment role of promotions reduces the firm's willingness to base rewards on anything other than performance.

Finally, it is worth noting that the definition of a promotion here is different than that used in most of the tournament literature. In most tournament papers a promotion means an increase in the wage, but there is no change in the tasks performed. In contrast, consistent with most of the literature on promotions as signals and papers where promotions are used primarily to efficiently match workers with jobs, in our model a promotion is associated with assignment to a different job or set of tasks.⁵

⁵ The only relevant empirical work we are familiar with is Pergamit and Veum (1999). In their study of young workers approximately seventy percent of promoted workers were given additional responsibilities in their current job or position or were moved to a different job or position.

2. MODEL

We consider a two-period model with free entry, identical firms, and labor as the only input. Without loss of generality, we assume a single worker referred to as young in period 1 and old in period 2. The worker's innate ability is denoted θ and can be either high or low, i.e., $\theta \in \{\theta_L, \theta_H\}$ and $\theta_H > \theta_L > 0$. At the beginning of period 1, all firms and the worker know the worker is of innate ability θ_H with probability p and θ_L with probability $1-p$, where $\Theta = p\theta_H + (1-p)\theta_L$. We also define effective ability, where the worker's effective ability in period t , η_t , is given by $\eta_1 = \theta$ in period 1 and $\eta_2 = \theta k$, $k > 1$, in period 2.

A firm consists of two jobs, denoted 1 and 2. If the worker is assigned to job j in period 1, then the worker produces

$$(1) \quad y_{j1} = [d_j + c_j(\eta_1 + e_1 + \varepsilon_1)],$$

while if the worker is assigned to job j in period 2 then production equals

$$(2) \quad y_{j2} = (1+s)[d_j + c_j(\eta_2 + e_2 + \varepsilon_2)].$$

In (1) and (2) d_j and c_j are constants known to all labor-market participants, e_t is the worker's period- t effort choice, ε_t is a noise term drawn from a normal distribution with mean zero and variance σ_ε^2 , and s equals S , $S \geq 0$, if the worker did not switch employers and zero otherwise. Effort choice is anywhere in the interval $[0, e_H]$, where there is disutility from effort. Specifically, $\alpha g(e_t)$ is the disutility from effort in period t , where $g(0) = 0$, $g'(0) = 0$, and $g'(e) > 0$, $g''(e) > 0$ for all $e > 0$. In this specification α captures the sensitivity of effort choice to incentives and, in particular, higher α lowers this sensitivity and thus frequently reduces effort. For example, if $\alpha = \infty$, then effort always equals zero.

The worker's output in each period is privately observed by the worker's current employer. In addition, the job assignment offered to the worker in period 2 by the period-1 employer is public information. The result is that a promotion at the beginning of period 2 serves as a signal of ability. We also assume the worker's effort choice in each period is privately known by the worker. Note, since the period-1 employer observes the worker's period-1 output, at the beginning of period 2 the firm will have an updated belief concerning the worker's effective ability which will be a function of that period-1

output. As discussed below, in period 1 the worker is assigned to job 1. Thus, we let $\eta_2^e(y_{11})$ denote the worker's period-2 expected effective ability as a function of period-1 output.⁶

Because of the last-period problem, in our analysis the worker's effort choice in period 2 always equals zero. Given this, let η' be the value for effective ability that satisfies equation (3).

$$(3) \quad d_1 + c_1 \eta' = d_2 + c_2 \eta'$$

We assume $c_2 > c_1 > 0$ and $d_2 < d_1$, i.e., as in Rosen (1982) output increases more quickly with ability in the high-level job. Thus, the (second-best) efficient assignment rule for period 2 is to assign the worker to job 1 if $\eta_2^e(y_{11}) < \eta'$ and to job 2 if $\eta_2^e(y_{11}) > \eta'$.

Firms and the worker are risk neutral with a zero rate of discount and there is no cost to the worker from changing firms or to firms from hiring or firing. Additionally, throughout most of the analysis we assume wages are determined by spot-market contracting. Further, since the worker's output is privately observed by the current employer rather than being publicly observed and verifiable, the spot-market wage is determined prior to production rather than a wage that depends on realized output.

At the beginning of period 1, each firm chooses whether to offer standard promotion practices or up-or-out. All firms then simultaneously offer a period-1 wage. The worker then chooses to work at the firm that offers the highest expected lifetime utility, where utility in each period equals the wage minus disutility from effort. If multiple firms are tied at this highest lifetime utility, the worker chooses randomly among these firms. The worker then chooses an effort level, the value for ε_1 is realized, and at the end of the period the period-1 employer privately observes the period-1 output. Note that because of competition across firms, the period-1 wage satisfies a zero-expected-profit condition.

At the beginning of period 2, the period-1 employer offers a job assignment for period 2 or fires the worker, where this decision is publicly observed. Further, we assume the firm does not retain the worker if it anticipates the worker leaving with probability one during the wage-determination process. This assumption is consistent with the existence of a small cost of retaining the worker in the case the worker subsequently leaves. We also assume the initial employer can make a wage counteroffer. That is, if the worker was not fired, then after this initial stage all firms simultaneously offer the worker a period-2

⁶ Note that we do not present an explicit formula here for these revised beliefs unlike in the related analysis of Holmstrom (1982). None of our results are more clearly explained by the introduction of such an explicit formula.

wage and then the period-1 employer makes a wage counteroffer. If the worker was fired, then the period-1 employer does not make an initial offer or a counteroffer.

After wages are offered, the worker then chooses to work at the firm from which he or she anticipates receiving the highest period-2 utility. If multiple firms are tied at this highest utility, the worker chooses randomly among these firms unless one was the worker's period-1 employer, in which case the worker remains with that firm. This tie-breaking rule is equivalent to assuming an infinitesimally small moving cost. For parameterizations characterized by $S=0$ we also assume that in period 2 the period-1 employer matches the best wage offer of potential employers when the firm is indifferent between matching and not matching. Finally, the worker then chooses a period-2 effort level, the value for ε_2 is realized, and at the end of period 2 the period-2 employer privately observes the worker's period-2 output. The time line of events for this model is pictured in Figure 1.

Golan (2005) employs a counteroffer specification similar to the one we employ and finds that, in contrast to the results in a number of papers such as Waldman (1984) and Bernhardt (1995), the promotion process is efficient even though a promotion serves as a signal of worker ability. But in Golan's model output in the low-level job is independent of ability. Our analysis shows that, even with the assumption that the period-1 employer can make a wage counteroffer in period 2, promotions are inefficient as in earlier analyses of promotion signaling once output on the low-level job is assumed to be positively related to worker ability.

We focus on parameterizations that satisfy equations (4) and (5).

$$(4) \quad d_1 + c_1(\Theta + e_H) > d_2 + c_2(\Theta + e_H)$$

$$(5) \quad \theta_L k < \eta' < \theta_H k$$

Along with the fact that there is no difference in the rate of learning across jobs, equation (4) ensures that in period 1 the worker is assigned to job 1. Equation (5) tells us that the efficient probability of promotion is between zero and one.

We focus on Perfect Bayesian Equilibria where beliefs concerning off-the-equilibrium path actions are consistent with each such action being taken by the type with the smallest cost of choosing that action. As a result, our analysis is frequently characterized by a winner's curse result similar to that

found in Milgrom and Oster (1987), i.e., in period 2 firms other than the period-1 employer are only willing to offer the worker a wage equal to the expected productivity at such a firm consistent with the lowest ability level corresponding to the worker's job assignment. In our model, in contrast to that of Milgrom and Oster, this winner's curse result is not an immediate implications of restricting the analysis to Perfect Bayesian equilibria both because we incorporate firm-specific human capital which is not part of their analysis, and because in our model a promotion signals high ability while in their model a promotion means ability becomes public knowledge. Note further that our assumption concerning off-the-equilibrium path actions is basically equivalent to the notion of a Proper Equilibrium first discussed in Myerson (1978).⁷

Finally, when a firm employing standard promotion practices hires the worker in period 1 it means there is no restriction concerning how the firm will treat the worker in period 2. Hence, at the beginning of period 2 the firm can assign the worker to job 1, to job 2, or fire the worker. In contrast, if the worker is hired under an up-or-out contract, then in period 2 the worker cannot be assigned to job 1 by the period-1 employer.

3. ANALYSIS WITHOUT EFFORT CHOICE

This section considers what happens when effort is not a factor. To investigate this issue we assume $\alpha=\infty$, i.e., disutility from effort is infinitely high. As a result, equilibrium effort is always zero and we thus ignore equilibrium effort choice throughout the section. Note that the analysis would be unchanged if we alternatively assumed $\alpha<\infty$ but instead directly assumed $e_1=0$. In the first subsection we analyze what happens when all firms employ standard promotion practices and when all firms employ up-or-out contracts. In the second subsection firms choose which type of contract to offer.

⁷ A related issue concerns how sensitive are our results to the counteroffer specification. That is, what would happen to equilibrium behavior if the wage-setting process was as in Waldman (1984) where there are no counteroffers? In that specification there is no winner's curse result, i.e., in the absence of turnover potential employers in period 2 are willing to pay the worker up to the productivity associated with the average ability corresponding to the worker's signal rather than the minimum productivity associated with the signal. Our preliminary analysis of that case suggests results are similar when a pure strategy equilibrium exists, but when S is sufficiently small there is no pure strategy equilibrium so results are quite different.

Some Preliminary Results

We start with a benchmark analysis which concerns what happens given standard promotion practices if output is publicly observable. In this case, given the information available, at every date the worker is assigned to jobs and switches employers in the efficient fashion. To be more specific, the equilibrium and the logic behind the equilibrium are as follows. First, given our parameter restrictions, the worker is assigned to job 1 in period 1 because that assignment yields higher expected output. Second, because $S \geq 0$, in period 2 the period-1 employer matches the wage offered by other firms and the worker stays with the period-1 employer.⁸ Thus, if $S > 0$, the period-1 employer earns rents in period 2. Third, because of these rents and that the period-1 wage is determined by a zero-expected-profit condition, the period-1 wage exceeds the period-1 expected output when $S > 0$. Fourth, the worker's job assignment in period 2 is efficient, i.e., in period 2 the worker is assigned to job 1(2) if $\eta_2^e < (\geq) \eta^1$.⁹ The logic is that, because output is publicly observable, in period 2 potential employers learn nothing by observing the worker's job assignment. This means the worker's job assignment has no effect on the wage offers of potential employers, so the period-2 assignment is efficient. In other words, since the firm's period-2 profit equals the worker's productivity minus the wage paid and the wage is independent of the worker's job assignment, the firm assigns the worker to the job that maximizes productivity.

The main lesson here is that, if output is publicly observable, then standard promotion practices yield that job assignments and turnover decisions are efficient. But as we will show this is not the case once output is privately observed by the worker's current employer. In that case, similar to the result in Waldman (1984), the probability of promotion is too low because the period-1 employer wants to avoid sending the positive signal about ability associated with promotion.

Suppose firms employ standard promotion practices and the worker's output is privately observed by the current employer. We start with preliminary results. First, as in the benchmark case, in period 1 the worker is assigned to job 1. Second, the wage paid when the worker is young, w_1^S , is above period-1 expected output and is such that the period-1 employer earns zero expected profits from the hire. This

⁸ For the case $S=0$, this result also depends on the assumptions that in period 2 the worker remains with the period-1 employer if period-2 wages are the same and that in period 2 the period-1 employer matches the best wage offer of potential employers when the firm is indifferent between matching and not matching.

⁹ To simplify descriptions of behavior, throughout the paper we assume that in period 2 the worker is assigned to job 2 by the period-1 employer whenever the firm is indifferent between assigning the worker to jobs 1 and 2.

now arises because of firm-specific human capital as in the benchmark case and additionally because of information rents the period-1 employer earns in period 2.

We now formally state what happens in this case. Below $w_2^S(y_{11})$ is the wage paid to the worker in period 2 when the worker is old as a function of period-1 output. Formal proofs are in the Appendix.¹⁰

Proposition 1: Let $\alpha=\infty$. If firms employ standard promotion practices, then there exists a value η^{S+} , $\eta^{S+}>\eta'$, such that i) through iii) describe equilibrium behavior.

- i) If $\eta_2^e(y_{11})\geq\eta^{S+}$, then in period 2 the worker is promoted, remains at the period-1 employer, and is paid $w_2^S(y_{11})=d_2+c_2\eta^{S+}$.
- ii) If $\eta_2^e(y_{11})<\eta^{S+}$, then in period 2 the worker is not promoted, remains at the period-1 employer, and is paid $w_2^S(y_{11})=d_1+c_1\theta_Lk$.
- iii) In period 1 the worker is assigned to job 1 and is paid $w_1^S>d_1+c_1\Theta$.

Proposition 1 tells us that, if output is privately observed by the current employer and firms employ standard promotion practices, then there is a critical value, η^{S+} , that determines period-2 behavior. If η_2^e is above this value, then the worker is promoted and stays with the period-1 employer. If it is below, then the worker is not promoted but again stays with the period-1 employer. Further, in each case the wage equals the productivity at another firm corresponding to the lowest expected effective ability associated with the same labor-market signal. For example, if the worker is not promoted, the wage equals the worker's productivity given the worker has innate ability θ_L and is assigned to job 1 at a different firm. The logic is as follows. In equilibrium the period-1 employer always matches the wage offer of other firms and the worker never leaves. But in the case of the off-the-equilibrium path action that the worker does leave, given assumptions made previously, other potential employers would believe the worker's innate ability is the lowest value possible given the worker's job assignment. So other firms offer a wage equal to the worker's productivity at one of these other firms given this lowest value for innate ability and the period-1 employer in making a counteroffer just matches this wage.

The proposition also shows there is a distortion concerning the promotion decision. That is, since $\eta^{S+}>\eta'$, the probability of promotion is lower than is efficient. The logic here is the basic logic concerning

¹⁰ We focus on the unique equilibrium characterized by a zero probability of the worker being fired. This is the only equilibrium if S is sufficiently large. We prove this in the proof of Proposition 1.

promotion serving as a signal. Because promoting the worker signals the worker is high ability, a promotion is accompanied by a large wage increase in order to stop the worker from being bid away. In turn, because of the large wage increase, in period 2 the period-1 employer only assigns the worker to job 2 if the worker's productivity in job 2 significantly exceeds productivity in job 1. Note, it is possible that this signaling effect is so strong that the probability of promotion equals zero. We come back to this issue later when we discuss contract choice.

We now consider the model under the assumptions $\alpha=\infty$ and firms offer up-or-out contracts. Similar to the previous analysis, we begin by describing a benchmark analysis that concerns what happens when output is publicly observable. The benchmark equilibrium is as follows. First, given our parameter restrictions, it is again the case that in period 1 the worker is assigned to job 1. Second, as opposed to the previous benchmark analysis, because with up-or-out only promoted workers can be retained, there is now turnover. In particular, the worker is retained in period 2 when $\eta_2^e \geq \eta^{U*}$ and fired when $\eta_2^e < \eta^{U*}$, where η^{U*} satisfies $(1+S)[d_2+c_2\eta^{U*}]=[d_1+c_1\eta^{U*}]$ which implies $\eta^{U*} < (=)\eta'$ if $S > (=)0$. The logic here is that potential employers are willing to pay the worker $\max\{d_1+c_1\eta_2^e, d_2+c_2\eta_2^e\}$, so the period-1 employer only retains the worker when the worker's job-2 productivity at the firm is greater than or equal to this value. Third, because of period-2 rents, in period 1 the worker is again paid more than his or her output.

Taken together, our two benchmark analyses tell us that, given publicly observable output, there is no role for up-or-out in our model. To see this, compare the two benchmark analyses when $S>0$. With standard promotion practices, job assignments and turnover decisions are both efficient. In contrast, with up-or-out, neither is efficient.¹¹ For example, because of firm-specific human capital, efficiency requires the worker to never move in period 2. But the restriction that the initial employer cannot assign the worker to job 1 causes the firm to sometimes fire the worker. Also, because the initial employer can only keep the worker by assigning him or her to job 2, there is a higher probability of assignment to job 2 than is efficient. In turn, these inefficiencies mean that the worker's expected lifetime utility is higher in the earlier benchmark case rather than here. In other words, if firms could offer either standard promotion

¹¹ To be precise, under up-or-out turnover and job assignments are not first-best efficient but they are second-best efficient, i.e., they are efficient given that in period 2 only expected effective ability is known and the worker can only be assigned to job 1 by changing employers.

practices or up-or-out, the worker would always choose a firm offering standard promotion practices.¹²

We now consider what happens given only up-or-out is offered and output is privately observed by the worker's current employer. There are two preliminary results here that are the same as in the analogous analysis concerning standard promotion practices. First, in period 1 the worker is assigned to job 1. Second, the period-1 wage paid when the worker is young, denoted w_1^U , is above the worker's period-1 expected output.

We now formally state what happens in this case. Below $w_2^U(y_{11})$ is the wage paid to the worker in period 2 when the worker is old as a function of period-1 output.

Proposition 2: Let $\alpha = \infty$. If firms employ up-or-out contracts, then there exists a value η^{U+} , $\eta^{U+} \leq \eta'$ ($\eta^{U+} < \eta'$ if $S > 0$) such that i) through iii) describe equilibrium behavior.

- i) If $\eta_2^e(y_{11}) \geq \eta^{U+}$, then in period 2 the worker is promoted, remains at the period-1 employer, and is paid $w_2^U(y_{11}) = d_1 + c_1 \eta^{U+}$.
- ii) If $\eta_2^e(y_{11}) < \eta^{U+}$, then in period 2 the worker is fired, is assigned to job 1 by the new employer, and is paid $w_2^U(y_{11}) = d_1 + c_1 E(\theta)k$, where $E(\theta)$ is the expected innate ability of the worker when fired.¹³
- iii) In period 1 the worker is assigned to job 1 and is paid $w_1^U > d_1 + c_1 \Theta$.

Proposition 2 tells us that, if output is privately observed by the current employer and firms employ up-or-out, then there is a critical value, η^{U+} , that determines behavior in period 2. If η_2^e is above the critical value then the worker is promoted and stays with the period-1 employer, while if η_2^e is below this value then the worker is fired and is assigned to job 1 by the new employer. In other words, because the firm is contractually obligated to only retain a promoted worker, for sufficiently low values for η_2^e the worker is fired rather than retained and the new employer then assigns the worker to the low-level job.

¹² As indicated, this argument holds when $S > 0$. If $S = 0$, standard promotion practices and up-or-out are equally efficient. Therefore, in that case equilibrium behavior is consistent with the worker in period 1 choosing a firm that offers standard promotion practices and choosing a firm that offers up-or-out.

¹³ The wage here equals $d_1 + c_1 E(\theta)k$ rather than $d_1 + c_1 \theta_L k$ because there is no winner's curse when the worker is fired. That is, because in this case the worker leaves the period-1 employer at the beginning of period 2, competition between potential employers means the period-2 wage must satisfy a zero-expected-profit condition. Hence, this wage reflects the average effective ability of the worker when firing occurs rather than the minimum effective ability consistent with the labor-market signal.

Note that, as discussed further below, the proposition does not preclude the possibility that the probability of promotion equals one.

One interesting aspect of Proposition 2 is that $\eta^{U+} \leq \eta'$, where $\eta^{U+} < \eta'$ if $S > 0$. This result states that, if anything, the probability of assignment to job 2 is too high. This stands in contrast to the Proposition 1 result that this probability was too low. The logic follows. Given standard promotion practices, this probability was too low because firms want to avoid sending the positive signal associated with a promotion. With up-or-out, however, the only way to avoid sending the positive signal is by firing the worker. But if the worker is fired the period-1 employer earns zero profits in period 2. So the period-1 employer retains and promotes the worker whenever it earns positive expected period-2 profits which, in turn, yields $\eta^{U+} \leq \eta'$. Note also that this explains why the wage given promotion is $d_1 + c_1 \eta^{U+}$ rather than $d_2 + c_2 \eta^{U+}$. That is, given $\eta^{U+} < \eta'$, it is more efficient for another firm hiring a worker whose expected effective ability is η^{U+} to assign the worker to job 1 rather than job 2.¹⁴

Note that one interpretation of $\eta^{U+} < \eta'$ is that the probability of retention is too high, i.e., the worker is sometimes retained and promoted when assignment to job 1 is more efficient. However, this is not our preferred interpretation. This interpretation focuses on η^{U+} being lower than the critical value, η' . Our preferred interpretation takes into account the second-best nature of the problem. In this setting retention means assignment to job 2, so assignment to job 1 means switching employers and losing the value of the worker's accumulated firm-specific human capital. Thus, since η^{U+} satisfies $(1+S)[d_2 + c_2 \eta^{U+}] = d_1 + c_1 \eta^{U+}$, it is the optimal critical value given this constraint.¹⁵

Choosing a Contract Type

This subsection shows our first main result. That is, up-or-out contracts are employed when firm-specific human capital is low while standard promotion practices are employed when it is high.

To build intuition for this result, we first discuss how the cutoff values for η vary with the level of firm-specific human capital. Suppose first that all firms employ standard promotion practices and $\eta' < \eta^{S+} < \theta_H k$ (we know $\eta' < \eta^{S+}$ from Proposition 1). Then η^{S+} is the value for η such that in period 2 the

¹⁴ If $S=0$, then $\eta^{U+} = \eta'$ and $d_1 + c_1 \eta^{U+} = d_2 + c_2 \eta^{U+}$.

¹⁵ η^{U+} is defined by this equation as long as $\eta^{U+} > \theta_L k$. For some parameterizations $\eta^{U+} = \theta_L k$ in which case the condition $(1+S)[d_2 + c_2 \eta^{U+}] \geq d_1 + c_1 \eta^{U+}$ must be satisfied. However, even in this case η^{U+} is the optimal critical value given the constraint that retention means assignment to job 2.

period-1 employer is indifferent between assigning the worker to job 1 and assigning the worker to job 2. Given Proposition 1, this condition is given by equation (6).

$$(6) \quad (1+S)[d_1+c_1\eta^{S^+}]-[d_1+c_1\theta_L k]=(1+S)[d_2+c_2\eta^{S^+}]-[d_2+c_2\eta^{S^+}]$$

Rearranging yields equation (7).

$$(7) \quad S[d_1+c_1\theta_L k]+(1+S)c_1(\eta^{S^+}-\theta_L k)=S[d_2+c_2\theta_L k]+Sc_2(\eta^{S^+}-\theta_L k)$$

Given $d_1+c_1\theta_L k > d_2+c_2\theta_L k$, if $Sc_2 < (1+S)c_1$ then (7) cannot be satisfied which contradicts $\eta' < \eta^{S^+} < \theta_H k$.

Hence, since from Proposition 1 we know $\eta' < \eta^{S^+} \leq \theta_H k$, if S is sufficiently small it must be that $\eta^{S^+} = \theta_H k$, i.e., no one is promoted. Further, equation (6) can also be used to show that η^{S^+} falls with S when it is above this range (see the proof of Proposition 3).

We show the case $\eta' < \eta^{S^+} < \theta_H k$ graphically in Figure 2, where the solid line is the left-hand side of equation (6), the dashed line is the right-hand side, and the intersection is η^{S^+} . Substituting $\eta^{S^+} = \eta'$ into equation (6) yields that the left-hand side of the equation is strictly greater than the right-hand side. Thus, for the curves to intersect as in the figure at a value $\eta' < \eta^{S^+} < \theta_H k$ it must be the case that $Sc_2 > (1+S)c_1$ (since Sc_2 is the slope of the dashed line and $(1+S)c_1$ is the slope of the solid line). If $Sc_2 < (1+S)c_1$, then the solid line would be everywhere above the dashed line, i.e., for any η_2^e , $\eta' < \eta_2^e < \theta_H k$, the profit associated with leaving the worker in job 1 would be above the profit associated with promoting the worker, so the worker would never be promoted. In this case we say $\eta^{S^+} = \theta_H k$.¹⁶

A more intuitive way of understanding why a large value for S is needed to have a positive probability of promotion is as follows. As η^{S^+} is increased, profit from a marginal worker in job 1 goes up by $(1+S)c_1$. But as η^{S^+} is increased, profit from a marginal worker in job 2 goes up by Sc_2 since the increase in productivity, $(1+S)c_2$, is partially offset by the increase in the wage, c_2 . To keep η^{S^+} below its

¹⁶ One possible confusion here is that, if $S=0$, equations (6) and (7) seem to be satisfied at $\eta^{S^+} = \theta_L k$. But this reasoning is incorrect. Equations (6) and (7) hold given the restriction that η^{S^+} is above η' as was derived in Proposition 1. Without imposing this restriction, (6) defines η^{S^+} if $\eta' < \eta^{S^+} < \theta_H k$ while $(1+S)[d_1+c_1\eta^{S^+}]-[d_1+c_1\theta_L k] = (1+S)[d_2+c_2\eta^{S^+}]-[d_1+c_1\eta^{S^+}]$ defines η^{S^+} if $\theta_L k \leq \eta^{S^+} \leq \eta'$. The logic for the case $\theta_L k \leq \eta^{S^+} \leq \eta'$ is that, because of the winner's curse and that an η^{S^+} worker is efficiently assigned to job 1, the wage offered by other firms when the worker is assigned to job 2 by the period-1 employer equals the productivity of an η^{S^+} worker assigned to job 1 rather than job 2 at one of these other firms. Analysis of this pair of conditions yields $\eta^{S^+} = \theta_H k$ if $S=0$.

maximum possible value requires S to be sufficiently large that the profit increase from a marginal worker in job 2 as η^{S+} is increased, Sc_2 , exceeds the profit increase from a marginal worker in job 1 as η^{S+} is increased, $(1+S)c_1$.

Now suppose all firms employ up-or-out contracts and $\eta^{U+} > \theta_L k$. Then η^{U+} is the value for η such that in period 2 the worker's period-1 employer is indifferent between firing the worker and assigning the worker to job 2. Given Proposition 2, this condition is captured by equation (8).

$$(8) \quad (1+S)[d_2+c_2\eta^{U+}]-[d_1+c_1\eta^{U+}]=0$$

When S is small equation (8) yields that η^{U+} is close to η' ($\eta^{U+}=\eta'$ when $S=0$). But satisfying (8) requires η^{U+} to fall without bound as S grows. Since this cannot happen, $\eta^{U+}=\theta_L k$ for S sufficiently large, i.e., the probability of retention is one. Further, equation (8) can also be used to show that η^{U+} falls with S when it is below this range (see the proof of Proposition 3).

We now have the following. When S is small the inefficiencies associated with up-or-out are small both because little human capital is lost when turnover occurs and job assignments are close to efficient. But the inefficiencies associated with standard promotion practices are high because the probability of period-2 misassignment is high. In contrast, these results are reversed when S is high.

These results lead us to Proposition 3.¹⁷

Proposition 3: If $\alpha=\infty$ and holding all other parameters fixed, if both standard promotion practices and up-or-out contracts are available, then there exists a largest value S^+ and a smallest value S^{++} , $0 < S^+ \leq S^{++} < \infty$, such that in period 1 the worker chooses a firm that employs up-or-out if $S < S^+$ while the choice is a firm that employs standard promotion practices if $S > S^{++}$. Also, η^{U+} is weakly decreasing with S for $S < S^+$, while η^{S+} is weakly decreasing with S for $S > S^{++}$.

¹⁷ As was true for Proposition 1 (see footnote 10), for the proof of Proposition 3 we rely on the assumption that given standard promotion practices the equilibrium that results is the unique equilibrium characterized by a zero probability of the worker being fired. However, in terms of the main results in the proposition this assumption is not necessary. This is straightforward for the result that for sufficiently large S the worker chooses standard promotion practices since, as discussed in the proof of Proposition 1, for sufficiently large S there is a unique equilibrium in the standard promotion practices case. But it is also true for the result that for sufficiently small S the worker chooses up-or-out. The logic here is that the inefficiencies associated with up-or-out go to zero as S goes to zero, but even focusing on the "best" equilibrium given standard promotion practices inefficiencies do not go to zero as S goes to zero.

Proposition 3 follows from the above discussion and competition. Because of competition, firms earn zero expected profits and the worker receives all the surplus. As a result, in period 1 the worker chooses an employer for whom the contract minimizes the inefficiencies associated with employment. This, in turn, means the worker chooses a firm that employs up-or-out when S is low because the inefficiencies associated with up-or-out are smaller when S is small, while standard promotion practices are chosen when S is high because in that case standard promotion practices are associated with smaller inefficiencies.

One question of interest is how would results change if firm-specific human capital entered the production function additively rather than multiplicatively, i.e., the worker's period-2 output in job j in the no-turnover case equals $S+[d_j+c_j(\eta_2+e_2+\varepsilon_2)]$. Our analysis of this case yields that results would be similar to those found in Proposition 3. Specifically, up-or-out is employed when S is low while depending on the parameterization either type of contract can be employed when S is high. The logic is that with this specification and standard promotion practices no one is promoted independent of S , so the magnitude of the inefficiencies associated with standard promotion practices is independent of S . But, as above, with up-or-out inefficiencies still increase with S . So when S is small up-or-out is employed because inefficiencies are smaller with up-or-out, but when S is large either contract can be optimal depending on whether the constant inefficiencies associated with standard promotion practices are larger or smaller than the inefficiencies associated with up-or-out when S is large.

4. ANALYSIS WITH EFFORT CHOICE

This section analyzes the model when effort is a factor, i.e., $\alpha < \infty$. For most of the analysis we also assume that e_H is above the first-best period-1 effort level, but sufficiently low that in period 1 it is more efficient for the worker to choose the maximum effort rather than the minimum effort. The formal condition that ensures this is $c_1 e_H - \alpha g(e_H) > 0$.¹⁸

We start by discussing equilibrium behavior first when firms are restricted to only offering standard promotion practices and second when firms are restricted to only offering up-or-out.¹⁹ In each

¹⁸ Further, in this section we also assume that $g(e)$ is sufficiently convex that under both up-or-out and standard promotion practices there is a unique period-1 effort level.

¹⁹ Because with only small modifications Propositions 1, 2, and 3 of the previous section hold when $\alpha < \infty$, in order to save space we informally discuss these two cases below and also how contract choice depends on the magnitude of firm-specific human capital. Formal analyses can be found in Ghosh and Waldman (2006).

case results are similar to those found in the previous section, except that period-1 effort is now above the minimum value and, further, can be either above, below, or equal to the efficient level. That results are similar to those found earlier means that given standard promotion practices there is still a critical value η^{S+} , $\eta^{S+} > \eta'$, such that in period 2 the worker is promoted when $\eta_2^e \geq \eta^{S+}$ and not promoted when $\eta_2^e < \eta^{S+}$. While with up-or-out there is a critical value η^{U+} , $\eta^{U+} \leq \eta'$, such that in period 2 the worker is retained and promoted when $\eta_2^e \geq \eta^{U+}$ and fired when $\eta_2^e < \eta^{U+}$.

In this model the return to the worker to increasing effort in period 1 is that this improves the probability of promotion in period 2. To be more precise, consider for example what happens when firms employ standard promotion practices. In that case the return to the worker for exerting effort is that increasing effort increases output and thus improves the period-1 employer's belief in period 2 concerning the worker's effective ability. In turn, if this belief is pushed above η^{S+} , then the worker benefits because he or she is promoted and receives the higher wage associated with promotion. Further, since there is nothing in this mechanism that ties the effort choice to the first-best level, depending on the parameterization, effort can be above, below, or equal to the first-best level.²⁰

Note that these results are related to results in Holmstrom (1982). Holmstrom investigated a model with symmetric learning and a single job. He found that, because high effort improves beliefs about a worker's ability, workers exert high effort early on in order to improve beliefs and earn higher wages. In our analysis each type of contracting choice results in an asymmetric-learning variant of this argument. In our analysis the worker exerts effort when young in order to improve the current employer's belief concerning the worker's ability. The return is an increased probability the worker will be promoted and, in turn, receive a higher wage because the promotion signal increases other firms' willingness-to-pay for the worker's services.

We now turn to the choice of a contractual form when both standard promotion practices and up-or-out contracts are available. Our first result is that, as we found earlier, standard promotion practices are employed when firm-specific human capital is high while up-or-out is employed when it is low. In addition to the reasons given for this result previously, there is now the additional factor that when

²⁰ The argument in the up-or-out contracts case is similar. Again, by increasing his or her effort level the worker increases output produced, and this improves the employer's belief in the following period concerning the worker's expected effective ability. In turn, if this belief is pushed above η^{U+} , then the worker benefits because he or she is retained and promoted and receives the higher wage associated with retention.

specific human capital is high standard promotion practices yield higher period-1 effort, while when it is low up-or-out yields higher period-1 effort.²¹

The logic for this result is that the equilibrium assignments derived in Section 3 interact with effort choice to create another reason why standard promotion practices are used when S is high and up-or-out when S is low. When S is high the worker is always retained under up-or-out so effort incentives are low, while with standard promotion practices the worker is only sometimes promoted so effort incentives are higher. So when S is high effort incentives favor standard promotion practices. In contrast, when S is low the worker is never promoted under standard promotion practices so effort incentives are low, but the worker is retained with a probability between zero and one under up-or-out so effort incentives are higher. So when S is low effort incentives favor up-or-out.

We now consider how contract choice depends on the similarity of the two jobs, where our focus is on what happens when the two jobs become very similar. We conduct two analyses of this issue. In the first we consider this issue in our basic set-up, while in the second we give firms some commitment ability concerning period-2 wages. Note that the first of these analyses does not depend on effort choice being part of the model. In other words, results like those we derive in Proposition 4 below also hold for the model analyzed in Section 3 (see footnote 23 for a brief discussion). We put off looking at the issue of job similarity till the current section so that the two analyses of job similarity appear together.

Our focus is on an increase in c_1 and decrease in d_1 , holding other parameters fixed, such that η' is unchanged. That is, the parameters associated with job 1 are changed so that the two jobs become more similar in terms of the incremental productivity associated with extra ability, i.e., $c_2 - c_1$ falls, but the period-2 efficient assignment rule is unchanged. As indicated, we start with our basic model. In Lemma 1 we begin with preliminary results concerning what happens given standard promotion practices and what happens given up-or-out when $c_2 - c_1$ is very small. Note, below a normalized increase in c_1 refers to an increase in c_1 and decrease in d_1 such that the efficient assignment rule is unchanged, i.e., η' is unchanged. Also, below e_1^S refers to period-1 effort choice given standard promotion practices, while e_1^U refers to period-1 effort choice given up-or-out.

²¹ Note that an important assumption for this result to hold is that $c_1 e_H - \alpha g(e_H) > 0$. The role of the assumption $c_1 e_H - \alpha g(e_H) > 0$ is to ensure that even if period-1 effort exceeds the efficient level it is still superior to the minimum effort level. That is, as long as this condition is satisfied, the increase in effort that occurs in moving from standard promotion practices to up-or-out when S is sufficiently small (or moving from up-or-out to standard promotion practices when S is sufficiently large) must be welfare enhancing.

Lemma 1: Holding all other parameters fixed, if firms employ standard promotion practices and there is a normalized increase in c_1 such that $c_2 - c_1$ is sufficiently small, then $\eta^{S^+} = \theta_H k$ and $e_1^S = 0$. Holding all other parameters fixed and suppose $S > 0$, if firms employ up-or-out contracts and there is a normalized increase in c_1 such that $c_2 - c_1$ is sufficiently small, then $\eta^{U^+} = \theta_L k$ and $e_1^U = 0$.

The logic here is as follows. Consider first standard promotion practices. As c_1 rises and $c_2 - c_1$ approaches zero, the lost productivity from any misassignment approaches zero. The result is that the signaling cost associated with promoting the worker means the period-1 employer will promote the worker with zero probability for $c_2 - c_1$ sufficiently small. In turn, if there is a zero probability of promotion, then there is no incentive for the worker to provide effort in period 1 so $e_1^S = 0$.

Now consider up-or-out. As before, as c_1 rises and $c_2 - c_1$ approaches zero, the lost productivity from any misassignment approaches zero. The result is that the return in terms of firm-specific human capital associated with retaining the worker means the period-1 employer retains the worker with probability one for $c_2 - c_1$ sufficiently small. In turn, if the probability of being fired equals zero, then there is no incentive for the worker to provide effort in period 1 so $e_1^U = 0$.²²

We now consider how the choice of contract type depends on the similarity of the two jobs. Suppose each firm has the option of employing either contract type and c_1 and d_1 vary so that η' is unchanged but $c_2 - c_1$ becomes very small. The above analysis tells us that the equilibrium contract type depends on which job the worker is more productive on average in period 2. That is, standard promotion practices are employed if in period 2 the worker is more productive on average in job 1, while up-or-out is employed if it is instead job 2. The logic follows immediately from Lemma 1. As $c_2 - c_1$ becomes very small, under standard promotion practices the worker is retained with probability one, assigned to job 1, and $e_1^S = 0$, while under up-or-out the worker is retained, assigned to job 2, and $e_1^U = 0$. Clearly, which contract is more efficient depends on which job the worker is more productive on average in period 2.

We formalize this argument in Proposition 4.

²² If $S = 0$, this logic does not hold because then there is no return in terms of firm-specific human capital of retaining the worker with the result that $\eta^{U^+} = \eta'$ and $e_1^U > 0$ even when $c_2 - c_1$ is very small. In turn, this means that if $S = 0$, then up-or-out is employed if $c_2 - c_1$ is very small. This is because up-or-out has a more efficient assignment in period 2 and higher period-1 effort.

Proposition 4: Holding all other parameters fixed and suppose $S > 0$, if there is a normalized increase in c_1 such that $c_2 - c_1$ is sufficiently small, then standard promotion practices are employed when $(1+S)[d_1 + c_1\Theta k] > (1+S)[d_2 + c_2\Theta k]$, up-or-out is employed when $(1+S)[d_2 + c_2\Theta k] > (1+S)[d_1 + c_1\Theta k]$, and either type of contract is consistent with equilibrium behavior when $(1+S)[d_1 + c_1\Theta k] = (1+S)[d_2 + c_2\Theta k]$.²³

Our last analysis extends the above analysis by introducing a promotion wage floor. That is, when offering a period-1 contract a firm commits to a lower bound on the wage it pays in period 2 if the worker is assigned to job 2.²⁴ This approach is similar to the approach taken in analyses such as Lazear and Rosen (1981) and Kahn and Huberman (1988). In contrast to those analyses, however, we assume commitment to a wage floor rather than a specific wage. We believe this is more realistic since mutually beneficial renegotiation would turn a commitment to a wage into a commitment to a wage floor.

Given this additional assumption, consider first what happens when all firms offer standard promotion practices. In this case the ability to commit to a promotion wage floor does not change the analysis. That is, if $c_2 - c_1$ is sufficiently small, it is still the case that the probability of promotion is zero and as a result $e_1^S = 0$. The reason is that it is the signaling aspect of promotion that results in a zero probability of promotion, and introducing the ability to commit to a promotion wage floor does not allow firms to lower high promotion wages due to signaling.

Now consider the case in which all firms offer up-or-out contracts. Here the ability to commit to a promotion wage floor substantially changes the analysis. As described above, when $c_2 - c_1$ is very small, in the absence of promotion wage floors the probability of retention and promotion equals one and $e_1^U = 0$. By committing to a promotion wage floor, however, a firm can stop this from occurring. By committing to a promotion wage floor above the wage offers of other firms the firm can reduce the probability of retention below one. In turn, this increases e_1^U above zero. Further, as long as effort provision is sufficiently important, i.e., α is sufficiently small, this will be the equilibrium outcome.

²³ Note that, if $c_1 = c_2$, then either type of contract can be employed since $(1+S)[d_1 + c_1\Theta k] = (1+S)[d_2 + c_2\Theta k]$. Also, as indicated above, Proposition 4 also holds for the case analyzed in the previous section which is what happens when $\alpha = \infty$. The logic is that when $\alpha = \infty$ effort always equals zero which is also the result here when $\alpha < \infty$ but $c_2 - c_1$ is sufficiently small.

²⁴ Introducing the ability to commit to a wage floor when the worker is promoted does not change the qualitative results found above concerning firm-specific human capital. That is, up-or-out would still be preferred given a small amount of firm-specific human capital and standard promotion practices would still be preferred given the degree of firm-specific human capital is large.

We now translate these findings into what happens when firms can offer either contract type and firms can commit to a promotion wage floor. If α is sufficiently small and $c_2 - c_1$ is sufficiently small, then up-or-out will be preferred. The logic here follows immediately from the above discussion. Given standard promotion practices, if $c_2 - c_1$ is sufficiently small, then the probability of promotion is zero and $e_1^S = 0$. On the other hand, given up-or-out, these two parameter restrictions result in a probability of retention and promotion below one and $e_1^U > 0$. In turn, with α sufficiently small period-1 effort is sufficiently important that $e_1^U > e_1^S$ must make up-or-out the preferred choice.

We formalize this discussion in Proposition 5.²⁵

Proposition 5: Suppose firms can offer either standard promotion practices or up-or-out contracts, and firms can commit to a promotion wage floor. Holding all other parameters fixed, if α is sufficiently small and there is a normalized increase in c_1 such that $c_2 - c_1$ is sufficiently small, then the worker chooses a firm that employs up-or-out.

The logic here is similar to an informal discussion in Prendergast (1993). In his formal analysis, Prendergast considers a standard-promotion-practices setting in which firms commit to a wage for promoted workers and workers invest in firm-specific human capital in order to increase their chances for promotion. In his setting, if jobs are similar, then the probability of promotion falls and young workers invest less. Prendergast's informal argument is that, when jobs are similar, firms employ up-or-out in order to increase the incentive for young workers to invest. His logic is that up-or-out increases the probability an old worker will be assigned to the high-level job by eliminating the firm's ability to assign old workers to the low-level job (this part of Prendergast's argument builds on Kahn and Huberman (1988) which is discussed in detail in the next section). Thus, up-or-out will be used to increase the incentive for young workers to invest.

Our argument in Proposition 5 is similar to Prendergast's discussion. In both cases, under standard promotion practices the probability of promotion is low when jobs are similar, and this reduces the effectiveness of standard promotion practices because of a reduction in young-worker incentives.

²⁵ For this proposition we impose the extra assumption that the upper bound on effort, e_H , is "high." See the Appendix for a discussion. Note also that for this proposition we no longer assume that e_H necessarily exceeds the first-best-efficient effort level. This is because, as α falls to zero, the unconstrained first-best-efficient period-1 effort level goes to infinity.

Further, when this is the case up-or-out becomes attractive because up-or-out increases the probability of promotion and thus increases young-worker incentives. Where the arguments differ is in the prediction on the “other” dimension, i.e., how does firm-specific human capital affect the use of up-or-out. In Prendergast’s discussion the degree of firm-specific human capital is endogenous and up-or-out is used to increase investments in firm-specific human capital. The natural interpretation of Prendergast’s discussion, therefore, is up-or-out should be used when firm-specific human capital is important. In contrast, in our analysis the degree of firm-specific human capital is given exogenously, up-or-out is used to increase effort incentives rather than incentives to invest in specific capital, and up-or-out is used when this exogenous parameter is small. That is, opposite of Prendergast’s prediction, our prediction is that up-or-out should be used when firm-specific human capital is unimportant.

We now summarize this section’s results. First, as we found in the previous section, firms employ up-or-out when firm-specific human capital is low and standard promotion practices when it is high. Second, given our basic specification and jobs that are sufficiently similar, standard promotion practices are preferred if in period 2 the worker is more productive on average in job 1 while up-or-out is preferred if it is job 2. Third, if firms can commit to a promotion wage floor, then up-or-out is preferred if jobs are sufficiently similar and effort provision is sufficiently important.

5. DISCUSSION

In previous sections we derived conditions in which standard promotion practices are likely to prevail and conditions in which up-or-out contracts are likely to prevail. This section discusses two related issues. First, we discuss the extent to which our theoretical results are consistent with real-world observations. Second, we compare and contrast our theoretical approach to up-or-out contracts with other approaches that appear in the literature.

Are the Predictions Correct?

This subsection discusses whether our theoretical results are consistent with real-world observations. Since most real-world settings are characterized by standard promotion practices, our focus is on whether real-world settings characterized by up-or-out are consistent with our results. In particular, given our belief that in the real world firms can commit to promotion wage floors when such commitment

improves worker utility, our focus is on whether up-or-out is more common when there is little firm-specific human capital and when low- and high-level jobs are similar.

We focus on two industries in which up-or-out is common – academia and law.²⁶ We begin with academia. The standard employment contract for tenure-track (but not tenured) faculty typically includes a date by which the faculty member must be promoted or the individual is forced to leave. For example, at Cornell an individual hired straight out of graduate school with his or her degree in hand must receive a promotion to associate professor with tenure by the end of the individual's sixth year, where if this is not achieved then the individual is given a one-year terminal contract and must leave the university at the end of the terminal contract.²⁷

We believe that academia is characterized by little firm-specific human capital and similar jobs, and thus that up-or-out is common in academia is consistent with our analysis. Consider first firm-specific human capital. Academia is clearly characterized by some firm-specific human capital, but we believe it is quite limited. For example, one of the authors is a faculty member at Cornell's B-school and visited for two years at the University of Chicago's B-school. The courses he taught had to be changed somewhat because Cornell employs a semester system while Chicago uses quarters, but the changes required were easy to implement. Also, coauthoring with Cornell faculty became somewhat more difficult, but he quickly established a coauthorship with a faculty member at Chicago. Or overall, both in terms of that specific transition and we believe more generally, the main activities involved in being a faculty member – research and teaching – are associated with little firm-specific human capital.

Now consider whether in academia low- and high-level jobs are similar. There are clearly some differences between the job description of a typical assistant professor and that of a typical associate or full professor. For example, a typical associate or full professor spends more time advising graduate students and mentoring junior faculty. Similarly, senior faculty tend to spend more time on various department and university committees. But this is mostly an issue of time allocation rather than distinct differences in the tasks performed by junior and senior faculty. Interestingly, there are distinct

²⁶ The military also employs up-or-out, but we feel the military is a special case and that the use of up-or-out there is likely driven by factors other than the ones we focus on in this paper. See Asch and Warner (2001) for a discussion and analysis of the use of up-or-out in the military.

²⁷ In this paper we do not try to provide an explanation for why academia is characterized by tenure. See, for example, Carmichael (1988) for an analysis of this issue.

differences in the tasks associated with being a senior faculty member and being the chair of a department or a dean. But, consistent with our theory, up-or-out does not apply to those promotions.²⁸

As a final point concerning academia, there is one aspect of academia that may be problematic for our approach. In our analysis all learning is asymmetric, but most real-world settings are likely characterized by a mix of asymmetric and symmetric learning.²⁹ For example, in the case of academia everyone can observe citations and journal publications, but an assistant professor's current employer likely has better information about work habits, raw intellectual ability, and collegiality. Although we do not investigate the issue formally here, our conjecture is that standard promotion practices should be more common in settings where learning is mostly symmetric. The reason is that when learning is mostly symmetric the misassignment of old workers to jobs given standard promotion practices should be small, so one of the advantages of employing up-or-out should also be small. This, in turn, is potentially important for understanding the use of up-or-out in academia since it seems to us that symmetric learning is more important in academia than in many other industries. But at this point our thoughts concerning symmetric learning are just a conjecture, so further research along this line seems warranted.

We now turn to the legal profession. For most of the twentieth century large law firms employed an up-or-out employment system. Specifically, most large firms hired their associates directly out of law school, where these individuals worked on a probationary basis for a fixed period varying typically between six and ten years. At the end of the period associates were then considered for promotion to partner, where a rejection meant the worker had to leave the firm.

That up-or-out was common in large law firms is consistent with our argument. As discussed by Galanter and Palay (1991) and Kronman (1993), while up-or-out was dominant corporations typically employed these firms for routine activities such as commercial contracts, bank loans, and general business

²⁸ One related question is, why is up-or-out not used in European universities? There are many differences between US and European academic practices and our conjecture is that some of these differences have effects on the incentives to employ up-or-out. For example, especially relative to Continental Europe, US universities typically put a higher weight on publishing than their European counterparts. In turn, if a higher weight on publishing means effort provision by young workers is more important in the US, then Proposition 5 is consistent with up-or-out being used in the US but not in Europe. But this is just a possibility and, along with some other ideas mentioned in the Conclusion, the issue of up-or-out being common in the US but not in Europe is one that deserves further attention.

²⁹ Previous papers that explore symmetric learning include Harris and Holmstrom (1982), Farber and Gibbons (1996), and Gibbons and Waldman (1999b,2006). The only previous paper that we are familiar with that mixes symmetric and asymmetric learning in the manner we have in mind is Kahn (2007). Other related analyses include Lazear (1986), Waldman (1990), and Pinkston (2009).

advice. In such a setting it is likely that, consistent with our theoretical predictions, firm-specific human capital is limited and low- and high-level jobs are similar. On the one hand, if lawyers mostly provided routine legal advice and general business advice, then human capital developed over time should be equally valuable at many firms, i.e., little of the human capital would be firm specific. On the other hand, the provision of routine information and business advice suggests no clear division between associates and partners, but rather each is doing similar tasks and providing similar services.

Interestingly, since the early 1980s the situation has changed. Many large law firms now have permanent workers that are not partners (see again Galanter and Palay (1991) and also Gorman (1999)). In some firms these workers hold titles such as senior attorney that distinguish them from the probationary workers still called associates, while in other firms they are formally called associates while informally permanent associates to distinguish them from their probationary colleagues. Of most interest, however, is that in the typical firm that employs such workers, these positions are staffed both by former probationary associates who have been rejected for partner and by workers hired directly into the positions. In other words, these firms have clearly moved away from up-or-out.

Gorman (1999) attempts to identify the factors that caused this move away from up-or-out, where much of her analysis is consistent with our formal theoretical approach. Her first hypothesis concerns the idea that over time work at large law firms has moved away from the routine legal advice described above towards work that is more complex and knowledge-intensive, where one reason this has occurred is that routine work is now typically handled by in-house legal departments. Her argument is that this increased complexity has resulted in a substantial increase in the firm specificity of human capital, and, consistent with our analysis, this increased specificity has caused firms to move away from up-or-out. Her reasoning for why added complexity increases firm specificity is that increased complexity causes workers to develop skills specific to the firm's particular production processes and to build ties to others in the organization who can provide critical information.

A second hypothesis concerns client relationships.³⁰ Here she first points out that partly because routine work is now typically handled by in-house legal departments, client relationships have become less close over time. That is, corporations are more likely to search for a law firm as demands arise, rather than employing a single firm for all of their needs. She then argues that, as client relationships

³⁰ Gorman's third major hypothesis concerns changing social norms, but since this hypothesis is unrelated to our theoretical analysis we skip that part of her analysis.

have become less important, law firms have moved towards more bureaucratic structures with different departments specializing in various areas of the law such as tax, litigation, and real estate. Then, when a client retains a firm, individuals from the different departments are combined into a temporary team with a partner in charge who serves mostly a coordination role. The final step of her argument is that this has caused a move away from up-or-out because, according to Pfeffer and Baron (1988), bureaucratic structures favor permanent employment relationships. But an alternative interpretation is that this reorganization of work has made low- and high-level jobs less similar, and following our theoretical analysis this is what has contributed to the move away from up-or-out.³¹

Gorman also provides an empirical test based on cross-sectional data drawn from the 1996-1997 *National Directory of Legal Employers*. She finds evidence that supports the two hypotheses discussed above. Specifically, up-or-out is less common both in firms where work is more complex and in firms where client relationships are less important. Although these findings are not direct evidence in favor of our theory, we do find the evidence suggestive. That is, since Gorman connects more complexity to a larger role for firm-specific human capital and weaker client relationships to less similar low- and high-level jobs, we feel that her empirical findings are suggestive of our theoretical approach.

Alternative Theories for Up-Or-Out

This subsection compares and contrasts our explanation for up-or-out with alternative explanations. The argument closest to ours is Kahn and Huberman's (1988) classic analysis of up-or-out. In that analysis workers choose whether or not to invest in firm-specific human capital, but directly contracting on the investment is not feasible. They first identify a double-moral-hazard problem that results in underinvestment. That is, ex post firms do not reward old workers who invested when young, and anticipating this workers underinvest. They then show that firms can avoid this underinvestment by

³¹ One could argue that a weakening of client relationships should result in less firm-specific human capital and that our theory then predicts a decrease in the use of up-or-out. However, we believe this argument is incorrect. It is easy to construct examples in which weak client relationships mean a high level of firm-specific human capital rather than a low level. For example, consider firm A, worker B, and client C, where C is currently A's client. Further, assume that C prefers A by an amount Δ if B is retained, but if B is fired and takes his or her knowledge of C to a rival then C prefers A by an amount $\Delta/2$, i.e., there is a weak client relationship in the sense that half of C's preference for A disappears if the single worker B leaves the firm. Then B's knowledge of C is very valuable to A because retaining the worker allows the firm to charge a premium equal to Δ rather than $\Delta/2$, but of no value to other firms because C remains with A even if B moves to a rival. In other words, B's knowledge of C can be regarded as purely firm-specific human capital since it has significant value to A and no value to other firms.

committing to up-or-out and a high retention wage. Committing in this way results in firms only retaining old workers who invested when young, and knowing this workers invest.³²

Our argument is similar to Kahn and Huberman's in terms of the basic role played by up-or-out. In each case standard promotion practices result in too few promotions which, in turn, results in inefficiently small incentives for young workers, where this occurs because firms have an incentive to retain old workers but keep them in the low-level/low-paying job. However, the basic modeling approach is quite different across the two papers. In Kahn and Huberman's analysis there is no uncertainty concerning worker ability and the incentive problem focused on concerns a worker's choice of whether or not to invest in firm-specific human capital. In contrast, here there is uncertainty and asymmetric learning and the incentive problem concerns young-worker effort.

The other major difference between the papers is the different predictions concerning when up-or-out is likely to be used. Related to our earlier discussion of Prendergast (1993), the natural interpretation of Kahn and Huberman's analysis is that up-or-out should be employed when firm-specific human capital is important, while our analysis predicts the opposite. As discussed above, we believe the empirical evidence is more consistent with our prediction.

Another related analysis appears in Gordanier (2006). Similar to our approach, Gordanier focuses on a tournament explanation for the use of up-or-out, but he does not employ the promotion-as-signal hypothesis. Also, another difference is that in Gordanier's model each young worker knows his or her own ability with certainty. In Gordanier's model up-or-out has the disadvantageous feature that young workers with a low probability of promotion provide no effort, while allowing non-promoted workers to be retained reduces this problem. Gordanier further argues that his theory explains the recent move away from up-or-out by law firms. Specifically, he argues that the increased emphasis on technical skills has made low effort on the part of young workers more costly, so firms have moved away from up-or-out to strengthen incentives. Note that although there are similarities between Gordanier's analysis and ours, his paper does not capture the main predictions we focus on which are that up-or-out is more likely when firm-specific human capital is unimportant and jobs are very similar.

³² Waldman (1990) extends the Kahn and Huberman argument to the case of general-human-capital investment by incorporating the promotion-as-signal hypothesis. Also, Oosterbeek, Sloof, and Sonnemans (2007) provide experimental evidence that supports the Kahn and Huberman analysis, although in their experimental setting what we call standard promotion practices do better than predicted by Kahn and Huberman.

A different approach to up-or-out contracts is found in Demougin and Siow (1994) (see also O’Flaherty and Siow (1995)). In their model, the low-level job, in addition to being used for production, is used both to learn about a worker’s suitability for promotion to the high-level job and to train workers for the high-level job. They show there are two possible equilibria in their setting. In an up-or-out equilibrium, all low-level positions are staffed by young workers and any worker not promoted is eventually fired. In what they call a fast-track equilibrium, only some low-level positions are staffed by “trainees” and some workers, possibly all, who are never promoted remain with the firm.

They derive two predictions concerning up-or-out, i.e., up-or-out is more likely when demand is low and/or growth in demand is high. Low demand generates up-or-out because then worker productivity is low relative to workers’ alternative wages, so the firm minimizes the number of workers in the low-level position by only using low-level positions for training and learning. High growth generates up-or-out because then there is a large return to training and identifying future managers, so all low-level positions are staffed by young workers. Turning to Gorman’s (1999) analysis discussed earlier, the evidence concerning these predictions is mixed. Gorman finds that firm growth is positively related to the use of up-or-out. But she also finds that establishments with a high business volume employ up-or-out more often which suggests that demand is positively not negatively related to the use of up-or-out.

Finally, a number of papers have argued that up-or-out is closely tied to the partnership form of organization. For example, Levin and Tadelis (2005) argue that partnerships arise when firms have greater ability to identify worker ability than clients and partnership is then employed to ensure high-quality workers and high-quality output. They further argue that up-or-out is employed in combination with partnerships because up-or-out reinforces retention of only the highest ability workers.³³ We find the idea of a connection between partnerships and up-or-out to be interesting. However, we do not think the Levin and Tadelis argument matches well with Gorman’s findings discussed previously. For example, it seems likely that increased complexity would cause worker ability to become more important. Thus, the Levin and Tadelis argument suggests a positive correlation between increased complexity and the use of up-or-out, but as discussed earlier Gorman finds a negative relationship.

³³ See also Morrison and Wilhelm (2004) and Rebitzer and Taylor (2007) for arguments that relate the use of up-or-out to the partnership form of organization.

6. CONCLUSION

There is an extensive theoretical literature focused on how the promotion process works in both firms characterized by standard promotion processes and those characterized by up-or-out. Despite this extensive literature, however, only a few papers have considered the factors that determine the choice between standard promotion practices and up-or-out. This paper investigates this issue by building a model that combines asymmetric learning and tournament theory similar to the analysis in Zabochnik and Bernhardt (2001). In our model a promotion signals high ability and the result is that promotions are accompanied by large wage increases. In turn, the possibility of receiving this large wage increase serves as an incentive for young-worker effort.

Our analysis yields a number of factors that help determine the choice between standard promotion practices and up-or-out. Our main result is that up-or-out is employed when the degree of firm-specific human capital is low while standard promotion practices are employed when it is high. We also find that, if firms can commit to a promotion wage floor and effort provision is important, then up-or-out is preferred when low- and high-level jobs are very similar. Further, we feel these results are of interest because they match up well with where one typically sees up-or-out. For example, up-or-out is common in academia where firm-specific human capital is limited and low- and high-level jobs are similar. Also, this perspective helps explain the move away from up-or-out in large law firms in that descriptions of recent changes at these firms suggests a growing importance of firm-specific human capital and reduced similarity between low- and high-level jobs.

There are a number of directions in which our analysis could be extended. Three are as follows. First, in our analysis promotions provide incentives for effort, while in the related analyses of Kahn and Huberman (1988), Prendergast (1993), and Zabochnik and Bernhardt (2001) promotions provide incentives for investments in human capital. We have done some preliminary analysis of a model closely related to ours in which the worker chooses how much to invest in firm-specific human capital and found results similar to those discussed above. We find these preliminary results suggestive, but believe a more complete analysis investigating the robustness of our results to this type of setting is warranted.

Second, in our analysis all firms have access to the same production technology and there is a single worker. As a result, we are unable to directly address why in some real-world industries there is a mix of firms some of which employ standard promotion practices and others that employ up-or-out. An interesting extension, therefore, would be to incorporate sufficient firm and worker heterogeneity that

equilibrium behavior is characterized by such a mix. Third, as discussed earlier, it would be worthwhile extending our analysis by adding an element of symmetric learning to the analysis. For example, as also mentioned earlier, one interesting question that could be addressed is how does changing the degree to which information is public versus private affect the incentives for firms to choose up-or-out.

APPENDIX

Proof of Proposition 1: As indicated in footnote 10, our focus in Proposition 1 is the unique equilibrium in which the worker is never fired. Such an equilibrium always exists and, as argued at the end of the proof, this is the only equilibrium if S is sufficiently large.

Since $\alpha = \infty$, effort always equals zero. Given this, we start with period 2. Consider first wages. Because the initial employer can make counteroffers and beliefs concerning off-the-equilibrium path actions are consistent with each such action being taken by the type with the smallest cost of choosing that action, other firms are willing to offer a worker assigned to job j the worker's minimum possible output at one of these other firms which is based on when the initial employer assigns the worker to job j in equilibrium. In turn, given the tie-breaking rule assumed, the initial employer just matches these offers and then the worker stays with the initial employer.

Now consider job assignments. Since output rises faster with effective ability on job 2 than on job 1, there must be a value η^{S^+} such that the worker is assigned to job 1 (job 2) if $\eta_2^e(y_{j1}) < (\geq) \eta^{S^+}$ (see footnote 9), where the worker was assigned to job j in period 1. In turn, given earlier results, the wage paid to the worker is given by $d_1 + c_1 \theta_L k$ ($\max \{d_1 + c_1 \eta^{S^+}, d_2 + c_2 \eta^{S^+}\}$) if $\eta_2^e(y_{j1}) < (\geq) \eta^{S^+}$.

Now consider η^{S^+} . Suppose $\theta_L k < \eta^{S^+} < \theta_H k$. Then η^{S^+} is the value for η_2^e such that the firm is indifferent between assigning the worker to jobs 1 and 2. In this case η^{S^+} satisfies (A1).

$$(A1) \quad (1+S)[d_1 + c_1 \eta^{S^+}] - [d_1 + c_1 \theta_L k] = (1+S)[d_2 + c_2 \eta^{S^+}] - \max \{d_1 + c_1 \eta^{S^+}, d_2 + c_2 \eta^{S^+}\}$$

Suppose $\eta^{S^+} = \eta'$. Then (A1) reduces to $d_1 + c_1 \theta_L k = d_1 + c_1 \eta^{S^+}$, which implies $\eta^{S^+} = \theta_L k$ and thus contradicts our supposition that $\eta^{S^+} = \eta'$. Suppose $\eta^{S^+} < \eta'$. Then (A1) reduces to (A2).

$$(A2) \quad (1+S)[d_2 + c_2 \eta^{S^+}] - (1+S)[d_1 + c_1 \eta^{S^+}] = [d_1 + c_1 \eta^{S^+}] - [d_1 + c_1 \theta_L k]$$

But if $\eta^{S^+} < \eta'$, the left-hand side of (A2) is strictly negative while the right-hand side is positive so we have a contradiction. Thus, if $\theta_L k < \eta^{S^+} < \theta_H k$, then $\eta^{S^+} > \eta'$ which means $\max \{d_1 + c_1 \eta^{S^+}, d_2 + c_2 \eta^{S^+}\} = d_2 + c_2 \eta^{S^+}$.

Now suppose $\eta^{S^+} = \theta_L k$. Consider the return to promoting the worker when $\eta_2^e = \theta_L k + \gamma$, γ small. The extra productivity associated with such a promotion equals $[d_2 + c_2(\theta_L k + \gamma)] - [d_1 + c_1(\theta_L k + \gamma)]$ which is strictly negative for γ close to zero. We assume that, starting from a situation in which $\eta^{S^+} = \theta_L k$, when the off-the-equilibrium path event of the worker not being promoted is observed by the market the inference

is that the worker's expected effective ability is $\theta_L k$ (this follows from our assumption concerning off-the-equilibrium path actions). The extra cost of promoting the worker in this case is therefore zero. Thus, since the extra productivity of promotion is less than the extra cost, the firm will promote the worker so we have a contradiction. Hence, $\eta^{S^+} > \eta'$.

Now consider period-1 job assignments and wages. Given that from above we know the period-1 employer earns positive expected profits in period 2, competition means that the period-1 wage must exceed period-1 expected productivity. We also know that, given $d_1 + c_1(\Theta + e_H) > d_2 + c_2(\Theta + e_H)$ and that in our specification the rate of learning is independent of job assignment, in period 1 the worker is assigned to job 1. Combining this result with the previous result yields $w_1^{S^+} > d_1 + c_1\Theta$.

We now argue that, if S is sufficiently large, there does not exist an equilibrium in which the worker is ever fired. Suppose the probability of firing is strictly positive and the lowest value for η_2^e associated with retention means assignment to job 1. Using the same logic as above, if this is the case there must exist a critical value, call it η^{S^*} , such that the worker is fired if $\eta_2^e(y_{j1}) < \eta^{S^*}$ and retained if $\eta_2^e(y_{j1}) > \eta^{S^*}$. Suppose $\eta^{S^*} \leq \eta'$. Then the retention wage equals $d_1 + c_1\eta^{S^*}$. But given this wage, the period-1 employer could keep the worker if expected effective ability equals $\eta^{S^*} - \gamma$, γ small, and earn strictly positive profits which is a contradiction. Suppose $\eta^{S^*} > \eta'$. Then the retention wage equals $d_2 + c_2\eta^{S^*}$. Suppose S is such that $(1+S)[d_1 + c_1\theta_H k] > [d_2 + c_2\theta_H k]$. Given this condition, the period-1 employer could keep the worker if expected effective ability equals $\eta^{S^*} - \gamma$, γ small, and earn strictly positive profits which is a contradiction. Hence, if S is sufficiently large, there cannot be an equilibrium in which the probability of firing is strictly positive and the lowest value for η_2^e associated with retention means assignment to job 1. Finally, a similar argument yields that, if S is sufficiently large, there also cannot be an equilibrium in which the probability of firing is strictly positive and the lowest value for η_2^e associated with retention means assignment to job 2.

Proof of Proposition 2: Since $\alpha = \infty$, effort always equals zero. Given this, we start with period 2.

Consider first wages. Using an argument similar to one in the proof of Proposition 1, if the worker is retained, the worker's wage equals the worker's minimum possible output at a firm other than the period-1 employer which is based on when the period-1 employer retains the worker. When the worker is not retained, competition across firms means the worker is paid expected output at one of these other employers.

Now consider under what circumstances the worker is retained. Since output on job 2 rises with effective ability, there must be a value η^{U^+} such that the worker is retained (not retained) if $\eta_2^e(y_{j1}) \geq (<) \eta^{U^+}$, where the worker was assigned to job j in period 1. In turn, given earlier results, the wage paid to the worker when retained is given by $\max\{d_1 + c_1\eta^{U^+}, d_2 + c_2\eta^{U^+}\}$ while the worker's wage when he or she is fired equals $\max\{d_1 + c_1E(\theta^-)k, d_2 + c_2E(\theta^-)k\}$ (see footnote 13).

Now consider η^{U+} . If $\theta_L k < \eta^{U+} < \theta_H k$, then η^{U+} is the value for η_2^e such that the firm is indifferent between retaining and firing the worker. Thus, in this case η^{U+} satisfies (A3).

$$(A3) \quad (1+S)[d_2+c_2\eta^{U+}] - \max\{d_1+c_1\eta^{U+}, d_2+c_2\eta^{U+}\} = 0$$

Suppose $\eta^{U+} \geq \eta'$. Then (A3) reduces to $S[d_2+c_2\eta^{U+}] = 0$ which is a contradiction for $S > 0$. Thus, if $\theta_L k < \eta^{U+} < \theta_H k$ and $S > 0$, then $\eta^{U+} < \eta'$ which, in turn, means $\max\{d_1+c_1\eta^{U+}, d_2+c_2\eta^{U+}\} = d_1+c_1\eta^{U+}$. For $S=0$, (A3) yields $\eta^{U+} = \eta'$ and we again have $\max\{d_1+c_1\eta^{U+}, d_2+c_2\eta^{U+}\} = d_1+c_1\eta^{U+}$.

Now suppose $\eta^{U+} = \theta_H k$. Consider the return to retaining the worker when $\eta_2^e = \theta_H k - \gamma$, γ small. The productivity associated with such a retention equals $(1+S)[d_2+c_2\theta_H k - \gamma]$. We assume that, starting from a situation in which $\eta^{U+} = \theta_H k$, when the off-the-equilibrium path event of the worker being retained is observed by the market the inference is that the worker's expected effective ability is $\theta_H k$ (this follows from our assumption concerning off-the-equilibrium path actions). Thus, the cost of retaining the worker is $[d_2+c_2\theta_H k]$. For γ sufficiently small the productivity associated with retaining the worker in this case exceeds the cost of retention, so the firm will retain the worker which is a contradiction. Hence, $\eta^{U+} < \eta'$ and the wage paid when the worker is retained equals $d_1+c_1\eta^{U+}$.

Finally, given from above we know that the period-1 employer earns positive expected profits in period 2, using an argument similar to one in the proof of Proposition 1 yields that in period 1 the worker is assigned to job 1 and $w_1^U > d_1+c_1\Theta$.

Proof of Proposition 3: Suppose first only standard promotion practices are employed. In Proposition 1 we showed $\eta' < \eta^{S+} \leq \theta_H k$. Suppose $\eta' < \eta^{S+} < \theta_H k$. Since $\eta^{S+} > \eta'$, (A1) can be rewritten as equation (6) in the text because $\eta^{S+} > \eta'$ yields $d_2+c_2\eta^{S+} > d_1+c_1\eta^{S+}$. Suppose $S c_2 \leq (1+S)c_1$. Given $d_1+c_1\theta_L k > d_2+c_2\theta_L k$, we now have that (6) cannot be satisfied so we have a contradiction. Thus, it cannot be the case that $\eta' < \eta^{S+} < \theta_H k$ which, given we know $\eta' < \eta^{S+} \leq \theta_H k$, means $\eta^{S+} = \theta_H k$. That is, if $S c_2 \leq (1+S)c_1$, then $\eta^{S+} = \theta_H k$. But this means there must exist a largest value for S , call it $S^{S'}$, such that $\eta^{S+} = \theta_H k$ for all $S \leq S^{S'}$.

Now consider values S_1 and S_2 , $S_1 > S_2 > S^{S'}$, and let $\eta^{S+}(S)$ give equilibrium values for η^{S+} as a function of S . Given $\eta^{S+}(S_2) < \theta_H k$ and $d_2+c_2\eta^{S+}(S_2) > d_1+c_1\eta^{S+}(S_2)$, (A1) yields (A4).

$$(A4) \quad (1+S_2)[d_1+c_1\eta^{S+}(S_2)] - [d_1+c_1\theta_L k] = (1+S_2)[d_2+c_2\eta^{S+}] - [d_2+c_2\eta^{S+}(S_2)]$$

In turn, (A4) yields (A5).

$$(A5) \quad S_2[d_1+c_1\theta_L k] + (1+S_2)(\eta^{S+}(S_2) - \theta_L k) = S_2[d_2+c_2\theta_L k] + S_2 c_2(\eta^{S+}(S_2) - \theta_L k)$$

Dividing by S_2 and rearranging terms yields (A6).

$$(A6) \quad (\eta^{S+}(S_2) - \theta_L k)[(c_1/S_2) - (c_2 - c_1)] = [d_2+c_2\theta_L k] - [d_1+c_1\theta_L k]$$

Since the right-hand side of (A5) is negative, we have that $(c_1/S_2) - (c_2 - c_1) < 0$. Suppose now S increases from S_2 to S_1 . The right-hand side of (A5) is unchanged while $(c_1/S_1) - (c_2 - c_1) < (c_1/S_2) - (c_2 - c_1)$. For (A6) to still hold we now have that $\eta^{S+}(S_1) - \theta_L k < \eta^{S+}(S_2) - \theta_L k$ or $\eta^{S+}(S_1) < \eta^{S+}(S_2)$. Also, equation (A6) tells us that $\eta^{S+}(S)$ is a continuous function of S , so $\eta^{S+}(S)$ must approach $\theta_H k$ as S approaches $S^{S'}$ from above.

Now suppose firms only offer up-or-out contracts. Given our finding that $\eta^{U+} \leq \eta'$, (A3) can be rewritten as equation (8) in the text. Consider the value for S , call it $S^\#$, such that $(1+S^\#)[d_2+c_2\theta_Lk]-[d_1+c_1\theta_Lk]=0$. Then clearly (8) will not be satisfied with $\eta^{U+} > \theta_Lk$ for any $S \geq S^\#$. But this means there must exist a smallest value for S , call it $S^{U'}$, such that $\eta^{U+} = \theta_Lk$ for all $S \geq S^{U'}$.

Now consider values S_3 and S_4 , $S_3 < S_4 < S^{U'}$. Also, let $\eta^{U+}(S)$ give equilibrium values for η^{U+} as a function of S . Given $\eta^{U+}(S_3) > \theta_Lk$ and $\eta^{U+}(S_3) < \eta'$, (A3) yields (A7).

$$(A7) \quad (1+S_3)[d_2+c_2\eta^{U+}(S_3)]-[d_1+c_1\eta^{U+}(S_3)]=0$$

In turn, (A7) yields (A8).

$$(A8) \quad S_3[d_2+c_2\eta^{U+}(S_3)]+(c_2-c_1)(\eta^{U+}(S_3)-\theta_Lk)=[d_1+c_1\theta_Lk]-[d_2+c_2\theta_Lk]$$

Suppose now S increases from S_3 to S_4 . Since the right-hand side of (A8) is unchanged, for (A8) to still hold we now have that $\eta^{U+}(S_4) < \eta^{U+}(S_3)$. Also, equation (A8) tells us that $\eta^{U+}(S)$ is a continuous function of S , so $\eta^{U+}(S)$ must approach θ_Lk as S approaches $S^{U'}$ from below.

Now suppose firms can offer either standard promotion practices or up-or-out contracts. Because competition across firms means all firms earn zero profits in equilibrium, the worker receives any surplus in equilibrium. This means the worker will choose the contract that maximizes efficiency, or equivalently, social surplus. Consider first low values for S . From above we know that, as S approaches zero, up-or-out has a more efficient assignment of old workers to jobs and the inefficiency loss due to the misassignment of old workers to firms goes to zero. Thus, there must exist a largest value S^+ such that up-or-out is chosen for all $S < S^+$. Further, from above we also know that η^{U+} must be weakly decreasing with S in this range. Now consider high values for S . From above, we know that as S approaches ∞ standard promotion practices have a more efficient assignment of old workers to both firms and jobs. Thus, there must exist a smallest value S^{++} such that standard promotion practices are chosen for all $S > S^{++}$. Further, from above we also know that η^{S+} must be weakly decreasing with S in this range.

Proof of Lemma 1: Consider first standard promotion practices. Using arguments similar to those in the proof of Proposition 1 we know that, if $Sc_2 \leq (1+S)c_1$, then $\eta^{S+} = \theta_Hk$. Hence, a normalized increase in c_1 that makes c_2-c_1 sufficiently small, i.e., makes $Sc_2 \leq (1+S)c_1$, will result in $\eta^{S+} = \theta_Hk$. But given the noise term in equation (2) has a normal distribution, this means the worker's wage in period 2 is independent of his or her output in period 1, so there is no return for the worker in period 1 to exert effort. Hence, since effort is costly, in period 1 the worker chooses $e_1^S = 0$. Now consider up-or-out contracts. In the limit, as c_2-c_1 goes to zero a normalized increase in c_1 causes the difference $[d_2+c_2\theta_Hk]-[d_1+c_1\theta_Lk]$ to approach zero. Given this, (8) tells us that given $S > 0$ a normalized increase in c_1 that causes c_2-c_1 to become sufficiently small will result in $\eta^{U+} = \theta_Lk$. But again given the noise term in equation (2) has a normal distribution this means the worker's wage in period 2 is independent of period-1 output, so there is no return for the worker in period 1 to exert effort. Hence, since effort is costly, in period 1 the worker chooses $e_1^U = 0$.

Proof of Proposition 4: As argued earlier, the worker chooses the contract that maximizes social surplus. From Lemma 1 we know that a normalized increase in c_1 that makes $c_2 - c_1$ sufficiently small results in $\eta^{S+} = \theta_H k$, $e_1^S = 0$, $\eta^{U+} = \theta_L k$, and $e_1^U = 0$. In other words, the only difference from an efficiency standpoint between the two contracts is that in period 2 with probability one the worker is assigned to job 1 under standard promotion practices and assigned to job 2 under up-or-out. But this means the worker chooses standard promotion practices when the worker in period 2 is more productive on average on job 1, i.e., $(1+S)[d_1 + c_1 \theta k] > (1+S)[d_2 + c_2 \theta k]$, while the worker chooses up-or-out when he or she in period 2 is more productive on job 2, i.e., $(1+S)[d_2 + c_2 \theta k] > (1+S)[d_1 + c_1 \theta k]$. Further, when in period 2 the worker is equally productive at the two jobs, i.e., $(1+S)[d_1 + c_1 \theta k] = (1+S)[d_2 + c_2 \theta k]$, both types of contract are consistent with equilibrium behavior.

Proof of Proposition 5: Consider first the case of standard promotion practices. As shown in the proof of Lemma 1, as $c_2 - c_1$ gets sufficiently small, in the absence of wage floors the high wage associated with a promotion stops any promotions from occurring. Imposing a wage floor for old workers assigned to job 2 does not affect this result. Hence, now that such a wage floor is possible it is still the case that $\eta^{S+} = \theta_H k$ and $e_1^S = 0$.

Now consider up-or-out contracts when $S > 0$. As shown in the proof of Lemma 1, as $c_2 - c_1$ gets sufficiently small, in the absence of wage floors $\eta^{U+} = \theta_L k$ and $e_1^U = 0$. Further, given the counteroffer assumption, the wage associated with being retained equals $d_1 + c_1 \theta_L k$ while the expected productivity associated with retaining the worker when the worker's expected effective ability is $\theta_L k$ equals $(1+S)[d_2 + c_2 \theta_L k]$ which is necessarily greater than $d_1 + c_1 \theta_L k$ for $c_2 - c_1$ sufficiently small. Suppose the firm commits to a promotion wage floor equal to $(1+S)[d_2 + c_2 \theta_L k] + \gamma$, $\gamma > 0$ but small. Then in period 2 the worker will be retained with probability less than one which, in turn, means that period-1 effort will be above the minimum value.

Now consider e_1^U in more detail. e_1^U will be a decreasing function of α where, if unconstrained, e_1^U grows without bound for α sufficiently close to zero. Given the upper bound on effort choice, we have that for α sufficiently small e_1^U equals this upper bound and also equals the first-best choice of e_1 (this follows from the unconstrained value for the first best which is defined by $\alpha g'(e) = c_1$ going to ∞ as α goes to zero). Further, if this upper bound is sufficiently large as is assumed in footnote 25, then the higher effort associated with up-or-out means these contracts will be preferred for α sufficiently small.

Now consider up-or-out contracts when $S = 0$. In this case equation (8) tells us that $\eta^{U+} = \eta'$ and, since the probability of retention is between zero and one, $e_1^{U+} > 0$ even without a promotion wage floor. Hence, using the same argument as above yields that, when $S = 0$, if $c_2 - c_1$ is sufficiently small then the higher effort associated with up-or-out means these contracts will be preferred for α sufficiently small.

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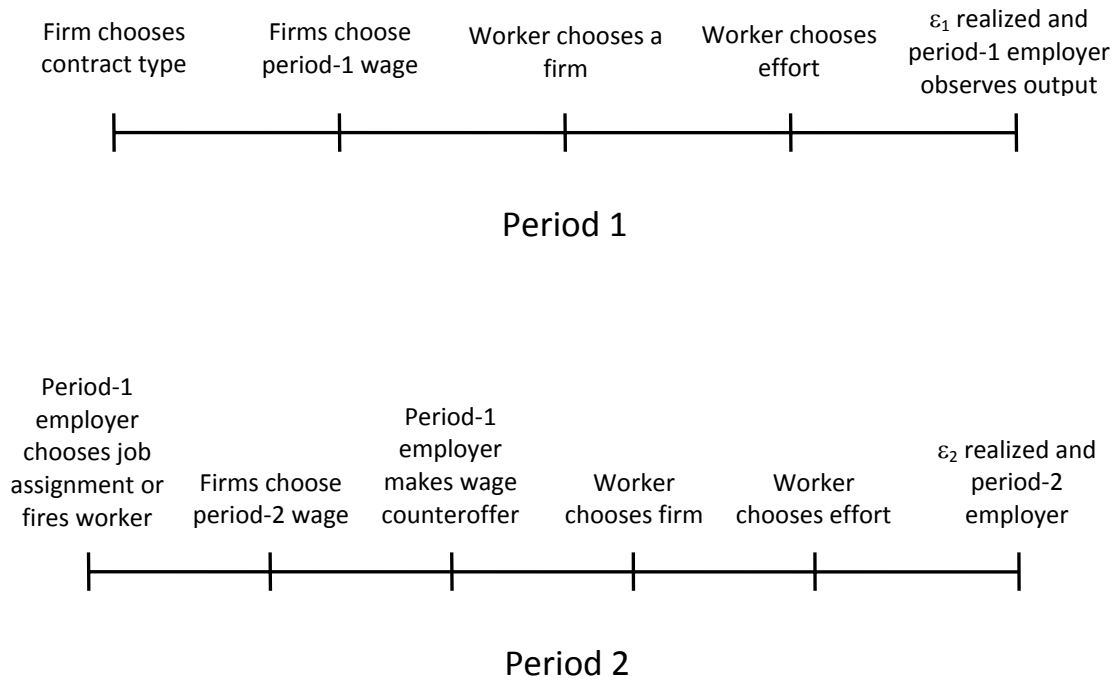


Figure 1: Time line

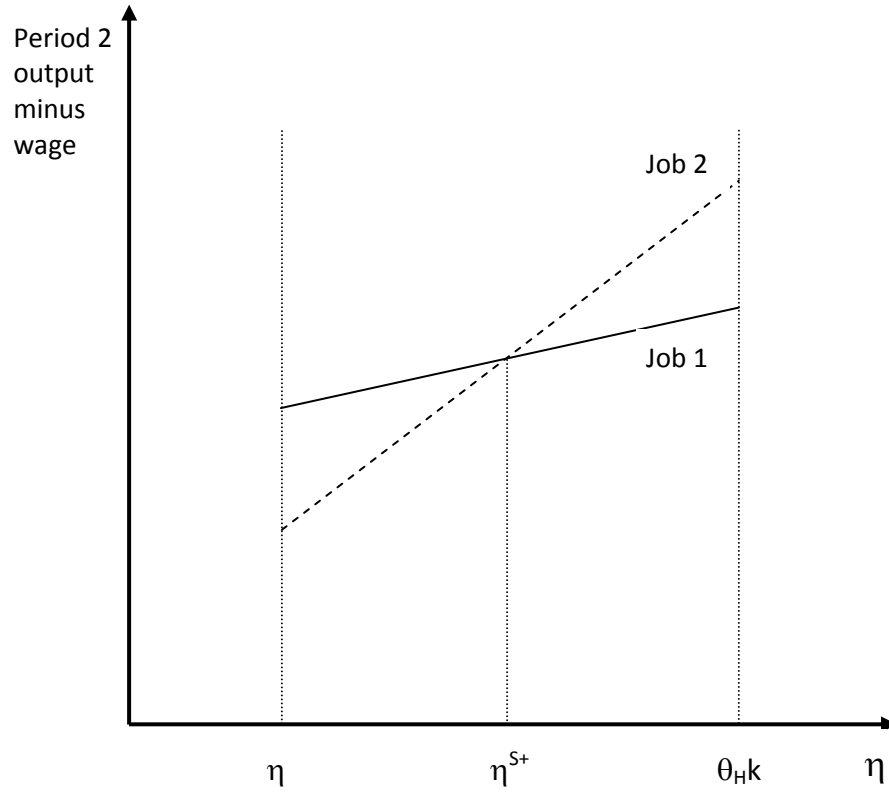


Figure 2: Standard promotion practices assignment rule