Management Science

Publication details, including instructions for authors and subscription information:
http://pubsonline.informs.org

Publicizing Performance

Günter Strobl, Edward D. Van Wesep,

To cite this article:
Günter Strobl, Edward D. Van Wesep, (2013) Publicizing Performance. Management Science 59(4):918-932. http://dx.doi.org/10.1287/mnsc.1120.1620

MANAGEMENT SCIENCE
Vol. 59, No. 4, April 2013, pp. 918–932
ISSN 0025-1909 (print) | ISSN 1526-5501 (online)

http://dx.doi.org/10.1287/mnsc.1120.1620

Publicizing Performance

Günter Strobl, Edward D. Van Wesep
Kenan-Flagler Business School, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina 27599
{strobl@unc.edu, vanwesep@unc.edu}

In most employment relationships, the employee's performance at the firm is privately, not publicly, observed. Firms can reward successful employees by publicizing their abilities, for example, via a job title, a glowing letter of recommendation, or a resume-worthy award. Firms that establish reputations for hiring young workers and promoting those who succeed lose good workers to competitors but can pay less to young, inexperienced workers in exchange. We find in a general equilibrium setting that firms with reputations for publicizing performance are able to pay less to employees at every level of tenure and thus earn economic profit, but that these firms will never be the most productive in the economy. For such equilibria to exist, the worker–firm match must be important, suggesting that this practice takes place only in human-capital-intensive industries.

Key words: publicizing performance; compensation; hidden information; matching
History: Received August 4, 2011; accepted May 24, 2012, by Wei Xiong, finance. Published online in *Articles in Advance* September 11, 2012.

1. Introduction

Firms often do not attempt to keep their best employees hidden. Indeed, they often do just the opposite, by giving good employees impressive sounding job titles and awards and, if asked, providing good letters of recommendation. This behavior is puzzling, because it makes it easier for competitors to poach a firm's best employees. In this paper we show that this behavior can be optimal, because a worker will work for lower wages when young in exchange for the promise that her performance—good or bad—will be publicized when she is older.

Although this trade-off seems intuitive, it is often not in a firm's interest to keep its end of the bargain. In fact, two economic conditions must be satisfied for the preceding argument to hold. The first is that the match of workers to firms must be important. In our model, worker ability and firm productivity are complementary, so if a worker's type is known, she can match better with an employer. So long as she captures a sufficient fraction of the additional surplus, the expected wage of a worker is greater if her type is public knowledge. She is willing, therefore, to "pay" for a credible public statement of her skill by accepting a lower wage from a firm promising to promote her if and only if she is high quality. The second condition is that there must be enough high-productivity firms in the economy to absorb workers that are known to be high quality. This ensures that wages for talented workers are bid up so that they capture the aforementioned additional surplus from better matching.

Given that these two conditions are met, the economy can support an equilibrium in which some firms find it optimal to publicize performance. We show that these firms cannot be the most productive in the economy. The benefit of publicizing performance is a reduction in wages, the amount of which is independent of firm quality.[1] The cost is to risk either (i) losing a talented older employee or (ii) employing an untalented younger employee. In either case, the cost is greater for a more productive firm. Therefore, more productive firms will focus on employing workers known to be talented, and less productive firms will accept the task of evaluating and publicizing employees' abilities. Firms with a reputation for publicizing employee performance profit from that reputation via lower wage bills but earn less than more productive firms that focus on hiring the best employees available. Firms with a reputation for publicizing performance earn profits greater than equally productive firms with no such reputation, because wages are always lower at reputable firms than at nonreputable firms, for all levels of employee tenure.[2]

[1] The amount the worker is willing to "pay" to have her performance revealed depends only upon how that information affects her future income, not on her current employer.

[2] As we discuss in §3, we use the term "reputation" to interpret the firms' equilibrium strategies in the repeated game. Low-productivity firms are identical, except insofar as workers believe that they will honor implicit contracts. Firms that have done so in the past are said to have a reputation for doing so, whereas firms that have not are said to have no reputation. This use of the term follows Mailath and Samuelson (2006) as well as some recent literature in this field (e.g., Mukherjee 2010).

The idea that firms that publicize their workers' abilities risk losing them—or being forced to match their enhanced outside options—has been the seed of a large body of literature, with Waldman (1984) and Greenwald (1986) being seminal.[3] Waldman (1984) analyzes a problem in which task assignment is observable to outsiders, so firms assigning workers to jobs efficiently must pay more to prevent competitors from hiring away their more talented employees. This causes inefficient task assignment at the margin and can even cause complete pooling of workers into one task. A large line of literature builds on this idea: many of the papers analyze unexpected ways that this signaling problem can manifest.[4]

This research assumes that there is some productivity benefit stemming from a promotion—the observable job title is necessarily connected to the less-than-observable job function. Some recent work, this paper included, allows the job title and the job function to be separated. In a sense, this work extends the idea that publicizing performance improves the match of workers to firms by noting that the best match may be outside the firm and noting that, even in this case, publicizing performance can be ideal. Mukherjee (2008b), for example, shows that when wages are driven by outside offers, publicizing performance can induce greater worker effort. Mukherjee (2008a) offers a model wherein publicizing a worker's type improves efficiency but increases the wage risk for the worker (without disclosure, worker type is unknown to outside firms and so does not affect pay). The optimal disclosure policy trades off this benefit and cost.

Our paper departs from this literature in two ways. First, we focus on the question of when and if publicizing performance can directly substitute for pay and take seriously the fact that promotions can be cheap talk. Most papers in this literature define the public signal of employee performance to be an action with real consequences, such as her assigned tasks, and the question is therefore whether the benefit from the action exceeds the additional cost to retain the worker once her type is revealed. We instead ask whether a manager can use this signal, often seen as a liability, to her advantage, that is, whether cheap talk can substitute for pay. Furthermore, it is not clear that internal firm activities are in fact observable to outsiders in practice, so the cheap talk setting is a critical addition to the literature. Mukherjee (2008a, b) delinks the signal from actions but allows the firm to commit to report the truth. Because the performance of most employees is often unverifiable, commitment is often infeasible in practice. As we show in §5, a lack of commitment has a significant effect on the distribution of rents between firms and workers, increasing profit at reputable firms at the expense of workers and economic efficiency.

Second, we employ a general equilibrium matching model, which is necessary to answer questions of (i) which economic conditions are necessary for some firms to be able to substitute job titles for pay, (ii) which firms we should expect to publicize performance in equilibrium, and (iii) how rents are divided among firms and workers. This model also allows us to map the flow of workers through firms in an economy and compare wages, firm value, and profits at firms employing differing promotional strategies. We derive useful empirical implications that cannot be obtained with the partial equilibrium models used in prior work.

To establish these results, we analyze a labor market model in which firms are infinitely lived and are of either high or low quality. Workers are two-period lived, are of either high or low ability, and exist in overlapping generations. A young worker is unaware of her ability, but both she and her employer learn of that ability once she has worked at the firm for one period. Importantly, firms that do not employ a particular employee cannot directly observe that employee's ability. There is a continuum of both firms and workers of all types, and all parties wish to maximize expected payoffs. Wages and the match of employer to employee are endogenous.

Worker and firm type are complementary in the production process, so it is efficient to match good workers to good firms. This provides an opportunity for firms with low productivity to hire young workers, observe their abilities, and broadcast those abilities through cheap talk. This allows some more productive firms to focus on only hiring older workers that they know to be of high quality, which increases social welfare. The reward for low-productivity firms who publicize performance is that young workers wish to work for them in the hope that they may be promoted and earn higher wages when old, at a better firm.

Firms with a reputation for publicizing performance also bear a cost, in that they lose good workers who move up and out of the firm. We show that so long as there are not too many firms with such reputations, and so long as the efficiency gains from

[3] See Oyer and Schaefer (2011) for a discussion of this literature and how it fits into the broader field of personnel economics.

[4] Bernhardt and Scoones (1993), for example, analyzed the effect on the distribution of wages between good and bad workers. A variety of papers have examined how this insight affects the promotional culture at a firm, that is, whether firms use "up-or-out" or more standard promotional rules (e.g., Waldman 1990, Ghosh and Waldman 2010). An alternative line of literature has introduced additional complexity into the models to improve the empirical accuracy of the Waldman (1984) model's predictions (e.g., Bernhardt 1995, Gibbons and Waldman 1999).

assigning good workers to high-productivity firms are sufficiently high, the benefit exceeds the cost, and there is an equilibrium in which reputations are maintained. If there are too many reputable firms, the supply of revealed good workers exceeds the demand from high-quality firms that can hire them, and bargaining power over wages for good workers shifts from workers to firms. This reduces wages for high-ability employees and therefore reduces the ex ante value for an employee of having her performance publicized. This increases the wages that reputable firms must pay young workers and decreases the benefit of maintaining a reputation for accurately publicizing performance. Therefore, the number of reputable firms is bounded above, and their job openings for young workers are always exceeded by the number of young employees who must find work. Empirically speaking, it seems likely that firms that are known to publicize performance will be those that are most able to accurately gauge that performance and those that are visible both to other employers and to employees.

We establish that two types of equilibria are possible in which firms publicize performance to reduce wages. In both, young workers are hired, their skills are learned, and their abilities are publicized by firms with a reputation for doing so. In the first type of equilibrium, which we call a *publicizing equilibrium*, workers who are not promoted are retained by the firm. In the second type of equilibrium, which we call an *up-or-out equilibrium*, workers who are not promoted are fired. Both promotional cultures are common in practice. Up-or-out cultures are well established in many industries, such as academia, consulting, and law. Levin and Tadelis (2005) argued that promotional cultures in which (some) unpromoted workers are retained are increasingly common as well.

Wages at each stage of an employee's tenure at a reputable firm are lower than wages paid by firms with no reputation. They are lower initially because young workers hope to profit from being identified as good midcareer, thus earning more when old. Wages are lower for older workers because they are revealed to be of low quality (they are not promoted), whereas older workers at firms with no reputation are, on average, of average quality.

The remainder of this paper is organized as follows. Section 2 presents the economic setting. Section 3 develops a trigger-strategy equilibrium of the repeated game when only short-term wage contracts are allowed. It provides necessary and sufficient conditions for the existence of publicizing equilibria and discusses their welfare implications. Section 4 studies the effects of a richer contractual environment and discusses an alternative equilibrium featuring firms that employ up-or-out promotional cultures. Section 5 discusses the impact of commitment on our results. Section 6 discusses empirical implications of the model. Section 7 concludes.

2. The Model

We analyze a general equilibrium model with a continuum of firms that live for an infinite number of periods and are of either high or low quality. Firm quality is denoted by $\tau \in \{\tau^H, \tau^L\}$, where $\tau^H > \tau^L$. The measure of high-quality firms is λ^H, and we assume that there is free entry into the set of low-quality firms; that is, the technology that makes a firm high quality is not freely available, so high-quality firms are in limited supply, whereas low-quality firms can be freely set up.[5] Each firm has *at most one worker*, and each period firm profit is $\tau\theta - w$, where w is the wage paid to the worker, and θ denotes the worker's ability.[6]

Workers live for two periods in overlapping generations and are of either high or low ability: $\theta \in \{\theta^H, \theta^L\}$, where $\theta^H > \theta^L$. A continuum of workers with measure one is born each period, with a fraction $\gamma \in (0, 1)$ being of high quality. All parties discount at rate $\beta \in (0, 1)$. For simplicity, we assume that a worker's utility is her discounted expected wage.

Firm quality is common knowledge, whereas worker ability is unknown to all players at birth. Employers of any given worker, as well as the worker herself, learn her skill in the period of employment. After working for a firm when young, a worker will acquire firm-specific human capital, and her productivity—if she stays with the same firm—is θ^H regardless of whether she is a high or low type. If she leaves the firm, her productivity is her type θ.

Each period, workers are matched to firms. Formally, we define a match as follows.

Definition 1. A *match* is a one-to-one mapping of workers to firms and a wage to be paid by each firm to its matched worker.

Although we do not explicitly model the process by which workers move from one firm to another, we require that a match be stable (Gale and Shapley 1962) in that, once workers are matched to firms and wages are agreed upon, no worker–firm pair could separate from its assigned partners and agree upon a mutually beneficial wage.[7] Each of the periods in our model

[5] Low-quality firms will therefore earn zero economic profit unless they have reputations for publicizing performance.

[6] If the firm is unable to hire, its payoff is zero.

[7] The process by which workers and firms match, and the effect of this process on the labor market and broader economy, has been studied extensively (e.g., Michelacci and Suarez 2004). See Mortensen and Pissarides (1999) for an excellent review.

represents a significant fraction of a person's life, so only a stable match is plausible.

Definition 2. A match is *stable* if no worker and firm that are *not* matched together can agree to a wage that earns both parties higher expected payoffs if they pair together at that wage, rather than with their assigned partners.

As will become clear below, the requirement of a stable match does not entirely pin down wages in our economy. Because workers acquire firm-specific skills, it is often the case that it is efficient for them to remain with their initial employers. The rent from the efficient relationship must be split. To stack the deck against finding equilibria in which skilled workers are promoted, we assume that firms have all the bargaining power, thus maximizing the temptation to hide a good employee's skill rather than promoting her.

Assumption 1. *When there is a surplus for a worker and a firm to split, the firm has all the bargaining power and receives the entire surplus.*

If equilibria exist under this assumption, they will also exist when employees have more bargaining power.

2.1. Discussion of Assumptions

Before studying equilibria of the infinite-horizon repeated game, we discuss the implications of the above assumptions. Our story is that some firms can have reputations for promoting talented workers, knowing full well that promoted workers have better outside options and will be hired by competitors. Firms do this because a good reputation will allow them to underpay young workers. For young workers to accept underpayment, they must receive more pay when old, on average, if their type has been publicized, so the match of worker to firm must be important. We make matching important by assuming complementarity between labor and capital, which is both natural and sufficient. Our specification of firm profit is the simplest one that possesses complementarity. We also need workers' concern for their future selves to be important, so workers must live for at least two periods. For firms to care about a worker's past success, workers must vary in endowed ability, so we use a hidden information rather than hidden action setup.

Our model is only interesting if firms with reputations for promoting good workers face a tension between promoting (and losing) good workers and reneging on the implicit contract by retaining good workers. Unless retaining low types is sometimes optimal, a worker that is not promoted and is retained must be interpreted by outsiders as a high type: retention and promotion would send the same signal of employee ability. We therefore need some reason why firms may wish to retain workers with low general skills. The most natural, we believe, is that workers acquire firm-specific skills during their tenures.[8] We make the simplest possible modeling choices: (i) firm-specific skills equate the productivity of low- and high-ability workers to the high type's productivity without firm-specific skills, and (ii) firm-specific skills are acquired with certainty. Neither of these assumptions is necessary, but they considerably simplify the analysis.

3. Equilibria with Simple Wage Contracts

In this section, we focus on simple one-period wage contracts that specify the fixed amount that a worker is to be paid if she works for a firm in a particular period. We discuss in greater detail the benefits and costs of alternative contractual forms in §4, but we exclude, for now, multiperiod and incentive contracts. There may be implicit guarantees of promotion for success, but these are noncontractible. We search for *publicizing equilibria*, in which

(i) high-quality firms hire young workers (and always retain them when they age) or old workers who have been promoted by reputable firms;

(ii) low-quality firms lacking a reputation hire young workers and retain them when old; and

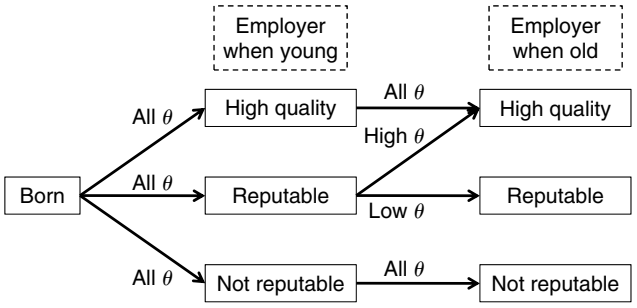
(iii) low-quality firms with a reputation hire young workers and promote those who turn out to be of high ability, and retain low-ability workers without promoting them.

Figure 1 shows the flow of workers through employers during their lives. In the proposed equilibrium, wages will be largely determined by the workers' and firms' outside options. Our requirement of a stable match in each period pins down wages in many cases, and our assumption of full bargaining power for the firm pins down wages in the remainder, making the solution analytically tractable.

In a publicizing equilibrium, some low-quality firms take actions that are not Nash equilibria of the stage game: in a one-shot game, promoting, and hence losing, high-ability workers leads to a lower payoff for firms. In the repeated game, incentives to choose these actions are created by attaching less favorable continuation payoffs to deviations. As is common in this literature, firms that choose these actions are interpreted as maintaining a reputation for doing so, with a punishment-triggering deviation interpreted as

[8] This assumption also reduces the cost to the firm of losing good workers, because its expected payoff from drawing a new worker is higher, increasing the set of parameter values permitting an equilibrium.

Figure 1 Flow of Workers Through Employers in a Publicizing Equilibrium



Notes. Workers are indifferent to their match when young, and the average worker quality at each firm is equal because worker type is unknown. Nonreputable and high-quality employers hide their good employees by not assigning prestigious titles and retain all old employees. Reputable firms promote good workers, who are then hired by high-quality firms. Low-ability employees remain with the reputable firm.

the loss of a firm's reputation.[9] Because a worker's ability is not known to outsiders, deviations from the equilibrium strategies described above are not directly observable. Thus, reputations must be built on whether a firm tends to promote people in general. Firms that do not promote workers must be punished with a loss of reputation, but nonpromotion happens on the equilibrium path.[10]

In each period, each firm has one worker, either retained from the prior period or newly hired. Although there is a continuum of firms and workers, the promotion decisions of each firm are discrete and observable. We solve for equilibria in which any firm that does not promote N consecutive workers enters a punishment phase, that is, it loses its reputation for X periods. Figure 2 shows the structure of this equilibrium. A firm is known to have refused to promote i workers since the last promoted worker. If it chooses to promote the next worker, then the counter resets to zero; otherwise, it increases by one. If the counter reaches N, the firm is punished by a loss of its reputation for X periods, at which point the counter resets to zero.

In this setup, a firm could clearly keep from being punished by workers by promoting bad workers periodically. In practice, the firm must establish a reputation both with workers (for promoting high types) and with high-quality firms (for *only* promoting high types). For the sake of simplicity, we have chosen to focus on the former: we assume that if a low-ability worker is promoted and hired by another firm—which then observes the employee's ability—the hiring firm will make the deviation public, and the promoting firm will lose its reputation permanently. The assumption that one incorrectly promoted worker triggers a complete loss of reputation for the promoting firm may be extreme, but it has two advantages over plausible alternatives. First, it allows us to focus only on the reputation of the firm vis-à-vis workers. Second, it allows us to assume a continuum of firms of each type, which permits us to pin down wages and match firms to workers precisely and simply. Although this assumption can be relaxed in a model with a finite number of firms and workers, additional assumptions would be necessary to make the model tractable.[11]

An equilibrium, which we formally define below, is an allocation of workers to firms as described above, along with a set of wages (w_1^{NR}, w_2^{NR}, w_1^{R}, w_2^{R}, w_1^{H}, w_2^{H}, $w_2^{H,\text{old}}$) that clear the market and allow the match to be stable. Superscripts NR, R, and H refer to the wage offered by nonreputable low-quality firms, reputable low-quality firms, and high-quality firms, respectively, to workers who are young (subscript 1) or old (subscript 2). The wage $w_2^{H,\text{old}}$ is paid by high-quality firms that hire good, old workers who were promoted at reputable firms when young. Because only low-quality firms may have a reputation for promoting high-ability workers in our model, we will henceforth drop the qualifier "low-quality" for these firms and refer to them as "reputable" and "nonreputable" firms instead. In a *publicizing equilibrium*, these wages must satisfy the following constraints:

(1) Indifference constraints for firms

(a) Nonreputable firms must earn zero profit when hiring young workers because there is free entry:

$$\tau^L\bar{\theta}+\beta\tau^L\theta^H = w_1^{NR}+\beta w_2^{NR}, \tag{1}$$

where $\bar{\theta}=\gamma\theta^H+(1-\gamma)\theta^L$ is average worker ability.

(b) High-quality firms must be indifferent between their assigned actions, that is, between hiring young workers and hiring old workers known to be good.[12] Let V^H denote the value of a high-quality firm

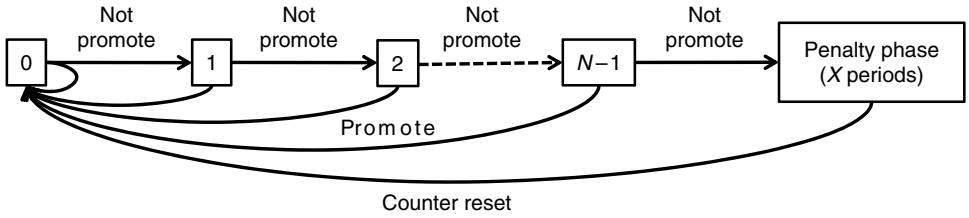
[9] As pointed out by Mailath and Samuelson (2006), in these types of games the link between past behavior and expectations of future behavior is an equilibrium phenomenon. The notion of reputation is used to interpret equilibrium strategies, rather than affecting the set of equilibria. This is in contrast to the "adverse selection approach" to reputations introduced by Kreps and Wilson (1982) and Milgrom and Roberts (1982) in which incomplete information about players' characteristics places constraints on the set of possible equilibria.

[10] This loss of reputation on the equilibrium path follows the structure and intuition of Green and Porter (1984).

[11] In a model with a finite number of employers in a given industry, an alternative assumption would be that if firm A hires a promoted worker from firm B who turns out to be bad, then firm A will refuse to hire workers from firm B in the future. Of course, such a mechanism would not impose a penalty on falsely promoting firms in a model with a continuum of firms.

[12] This constraint implicitly assumes that the number (or, to be precise, the measure) of high-quality firms hiring workers exceeds that of promoted workers in each period. We address this issue in our formal definition of a publicizing equilibrium.

Figure 2 Trigger-Strategy Equilibrium



Notes. A firm with a reputation, at any given time, has retained i consecutive employees since last promoting—and losing—one. The firm may promote its next young employee, in which case i resets to zero, or may retain the employee by not promoting her. In this case, i increases by one. If i reaches N, then the firm is punished by potential young workers with a loss of its reputation for X periods, at the end of which time i resets to 0.

in need of a worker. The value of hiring an old worker who is known to be good is then

$$\tau^H\theta^H - w_2^{H,\text{old}} + \beta V^H, \tag{2}$$

and the value of hiring a young worker is

$$\tau^H\bar{\theta} - w_1^H + \beta(\tau^H\theta^H - w_2^H) + \beta^2 V^H. \tag{3}$$

For high-quality firms to be indifferent between these two actions, both expressions must be equal to V^H. Thus, we have

$$\frac{\tau^H\theta^H - w_2^{H,\text{old}}}{1-\beta} = \frac{\tau^H\bar{\theta} - w_1^H + \beta(\tau^H\theta^H - w_2^H)}{1-\beta^2}. \tag{4}$$

(2) Incentive constraints for firms

(a) High-quality firms

(i) A high-quality firm must prefer to hire a good old worker rather than an old worker of low or unknown ability. It could hire a low-ability worker by offering a wage w_2^R to an unpromoted worker at a reputable firm. In equilibrium, unpromoted workers are known to be of low ability and would be willing to switch at that wage. Thus, we must have

$$\tau^H\theta^H - w_2^{H,\text{old}} \geq \tau^H\theta^L - w_2^R. \tag{5}$$

It could hire a worker of unknown ability by offering w_2^{NR} to any old worker at a nonreputable firm. Because titles at nonreputable firms are unrelated to ability, there is no additional information that an outside firm has access to once a worker is old. This incentive constraint requires that

$$\tau^H\theta^H - w_2^{H,\text{old}} \geq \tau^H\bar{\theta} - w_2^{NR}. \tag{6}$$

(ii) A high-quality firm that has hired a young worker must prefer to keep her when she is old:

$$\tau^H\theta^H - w_2^H + \beta V^H \geq V^H. \tag{7}$$

(b) Nonreputable firms

(i) Nonreputable firms must not be able to earn a positive profit by hiring old workers from reputable firms, other nonreputable firms, or high-quality firms:

$$\tau^L\theta^L \leq w_2^R, \tag{8}$$

$$\tau^L\bar{\theta} \leq w_2^{NR}, \tag{9}$$

$$\tau^L\bar{\theta} \leq w_2^H. \tag{10}$$

(ii) Nonreputable firms must prefer to keep their workers when they are old:

$$\tau^L\theta^H \geq w_2^{NR}. \tag{11}$$

(c) Reputable firms

(i) Reputable firms must prefer to promote high-ability workers. Let $V(i)$ denote the value of a reputable firm that has not promoted i consecutive workers *at the time that it is hiring a new worker*. If it promotes a high-ability worker, its counter resets and its value is $V(0)$, because it is now hiring a new worker and there have been $i=0$ workers hired since its last promotion. If it does not promote the worker, it receives a profit of $\tau^L\theta^H - w_2^R$, but its counter increases by one. Therefore, promotion is always preferable if

$$V(0) \geq \tau^L\theta^H - w_2^R + \beta V(i+1), \quad \text{for all } i \in \{0,\ldots,N-1\}. \tag{12}$$

(ii) Reputable firms must prefer to retain unpromoted workers rather than firing them:

$$\tau^L\theta^H - w_2^R + \beta V(i) \geq V(i), \quad \text{for all } i \in \{0,\ldots,N-1\}. \tag{13}$$

This inequality is reversed when we consider up-or-out equilibria in §4.3.

(iii) Reputable firms must prefer not to retain promoted workers. After promoting a worker, the firm's counter will reset to zero regardless of whether or not the worker stays with the firm. Therefore, if the firm is willing to pay a wage of $w_2^{H,\text{old}}$ to retain her, it earns a profit of $\tau^L\theta^H - w_2^{H,\text{old}}$. Thus, we have

$$V(0) \geq \tau^L\theta^H - w_2^{H,\text{old}} + \beta V(0). \tag{14}$$

(iv) Reputable firms must have positive value, thus ensuring that they prefer to pursue their assigned strategy rather than take an action that is assigned to or ruled out for a nonreputable firm:

$$V(i) \geq 0, \quad \text{for all } i \in \{0, \ldots, N-1\}. \tag{15}$$

(3) Indifference constraints for workers

For the match of workers to firms to be stable, young workers must be indifferent between working for reputable firms, nonreputable firms, and high-quality firms. They earn $w_1^{NR} + \beta w_2^{NR}$ at nonreputable firms, so we have

$$w_1^R + \beta\left(\gamma w_2^{H,\,\text{old}} + (1-\gamma) w_2^R\right) = w_1^{NR} + \beta w_2^{NR}, \tag{16}$$

$$w_1^H + \beta w_2^H = w_1^{NR} + \beta w_2^{NR}. \tag{17}$$

We can now formally define a *publicizing equilibrium* as follows.

Definition 3. A *publicizing equilibrium* is a set of reputable firms, a match of workers to firms in each period, a set of wages, a grace period (of length N), a punishment phase (of length X), and beliefs such that the following conditions hold.

(a) Worker–firm match:

(i) High-quality firms are matched to young workers—in which case they are matched to the same worker the following period—or old workers that have been promoted by reputable firms.

(ii) Nonreputable firms are matched to young workers and are matched to the same worker the following period.

(iii) Reputable firms in the grace period are matched to young workers. If their worker turns out to be of low ability, the firm is matched to the same worker the next period. If their worker turns out to be of high ability, the firm is matched to a new young worker next period. Reputable firms not in the grace period—that is, in the punishment phase—are matched to young workers and are matched to the same worker the following period. If the punishment phase has an odd number of periods, reputable firms are not matched with a worker in the final period of the punishment phase.[13]

(b) The set of reputable firms is such that the measure of promoted workers in each period is less than the measure of high-quality firms.

(c) Wages satisfy conditions (1)–(17).

(d) Public signals ("promotions"):

(i) Reputable firms with a young employee make public statement m^H (i.e., "promote the employee") if she is of high ability and m^L (i.e., do not "promote the employee") if she is of low ability.

(ii) High-quality firms assigned to a new old worker make statement m^H if the employee is of high ability and m^L if the employee is of low ability.

(e) Beliefs:

(i) Workers and firms believe that a reputable firm states m^a if its worker is of ability θ^a, $a \in \{H, L\}$, and the firm's counter is less than N, and that messages are "pure babbling" if the firm is in the punishment phase.

(ii) Workers and firms believe that a firm's messages are "pure babbling" if a high-quality firm has ever stated m^L after being matched to a worker about whom the firm had previously stated m^H.

(iii) All other messages from reputable and high-quality firms, and messages from nonreputable firms, are perceived as "pure babbling."

By restricting the set of reputable firms, condition (b) of the above definition ensures that all promoted workers can be absorbed by high-quality firms. If this were not the case, promoted workers would compete away any surplus that they extract from high-quality firms, and the wage paid by these firms would drop to the wage level that reputable firms pay to unpromoted workers. Thus, reputable firms would not be able to underpay young workers and hence would not benefit from having a reputation for promoting high-ability workers. A sufficient (but not necessary) condition for (b) is that the measure of high-quality firms exceeds the measure of reputable firms, λ^R, multiplied by the fraction of high-ability workers, that is, $\lambda^H > \gamma\lambda^R$. This follows from the fact that, in any given period, there are at most $\gamma\lambda^R$ promoted workers. Of course, this maximum number of promoted workers will only be reached if all reputable firms hire young workers in a particular period.

The above constraints are not sufficient to entirely pin down wages in our economy. Because old workers acquire firm-specific human capital, their value to outside firms is lower than that to the original employer. This means that there is surplus that must be divided between the parties. Equilibrium wages therefore depend on the relative bargaining power of firms and workers. Interestingly, the more surplus the worker gets when she is old, the easier it is to sustain an equilibrium in which reputable firms promote good workers and do not promote bad ones. This is because the value of retaining a good worker—and therefore the temptation for a firm to deviate from the equilibrium strategy—is decreasing in the worker's bargaining power. When the worker has full bargaining power, reputation becomes irrelevant because firing the worker is always optimal. To stack the deck as much as possible against *publicizing equilibria*, Assumption 1 states that the firm possesses full bargaining power. This maximizes the temptation to retain good workers instead of promoting them.

[13] Note that, because they earn zero profit in the punishment phase, reputable firms are indifferent as to whether or not they are matched with workers.

This assumption, combined with our constraints above, pins down equilibrium wages for any publicizing equilibrium. Because the firm has full bargaining power, wages of retained workers in period two equal each worker's outside option. Because young workers at nonreputable and high-quality firms are not identified ex post by promotion, they are, on average, of average ability. Retained workers at reputable firms are identified through nonpromotion as low ability, and their outside options are accordingly limited. Equations (8) to (10) then imply that

$$w_2^R = \tau^L \theta^L, \tag{18}$$

$$w_2^{NR} = \tau^L \bar{\theta}, \tag{19}$$

$$w_2^H = \tau^L \bar{\theta}. \tag{20}$$

The above wages for old workers of low or unknown ability are the minimum wages such that nonreputable firms cannot earn a positive profit by hiring these types of worker (see the constraints in (8) to (10)). As we will see, this means that neither high-quality nor reputable firms have an incentive to employ these workers at these wages.

The wage of young workers hired by nonreputable firms is determined by the zero-profit condition in (1). Substituting Equation (19) into this condition yields

$$w_1^{NR} = \tau^L \bar{\theta} + \beta \tau^L (\theta^H - \bar{\theta}). \tag{21}$$

Nonreputable firms earn rents from old workers. Competition then forces them to pay young workers more than their expected productivity so that they do not earn economic profit.

The wage paid to a young worker by a high-quality firm can be found by combining Equations (17), (19), (20), and (21):

$$w_1^H = \tau^L \bar{\theta} + \beta \tau^L (\theta^H - \bar{\theta}). \tag{22}$$

Because workers are indifferent between joining nonreputable firms and high-quality firms when young, and because these two types of firms pay the same wage to old workers they retain, the wage paid to young workers by these firms must also be the same.

High-quality firms may also hire old workers who have been promoted and are therefore known to be good. Their wages can be found by combining Equation (4) with Equations (20) and (22):

$$w_2^{H,\,\mathrm{old}} = \tau^L \theta^H + \frac{1-\gamma}{1+\beta} \Delta\tau \, \Delta\theta, \tag{23}$$

where $\Delta\tau = \tau^H - \tau^L$ and $\Delta\theta = \theta^H - \theta^L$. This wage clearly exceeds the wage that old workers with high ability would earn at nonreputable firms, or at their initial employers, which is given by $\tau^L \theta^H$. It therefore also satisfies the constraint in (14).

The final wage to be determined is that paid by reputable firms to young workers. Equations (16), (18), (21), and (23) yield

$$w_1^R = w_1^{NR} - \frac{\beta}{1-\beta} \gamma(1-\gamma) \Delta\tau \, \Delta\theta. \tag{24}$$

The above discussion establishes the following result.

Proposition 1. *When a publicizing equilibrium exists, the wages are uniquely determined by Equations* (18) *to* (24).

Comparing the equilibrium wages paid by reputable and nonreputable firms, we have the following result.

Corollary 1. *In any publicizing equilibrium, a firm with a reputation for promoting high-ability workers pays less to its workers at every level of tenure than a firm lacking such a reputation.*

Corollary 1 shows that, compared to firms without a reputation for promoting skilled workers, firms that have such a reputation are able to pay less to workers at all levels of tenure. Reputable firms benefit by underpaying young workers, because these workers are willing to accept lower wages in the short term in exchange for higher long-term wages if they are later promoted. Reputable firms also benefit by paying lower wages to old workers who they retain, because other firms know that these workers are not generally skilled.

It is easily verified that the wages specified above satisfy all the constraints, except the incentive constraints of reputable firms in (12) and (13), which state that reputable firms must prefer to promote high-ability workers and must prefer to retain old workers rather than fire them, respectively. The latter constraint essentially differentiates between equilibria in which reputable firms keep old workers and in which they have an up-or-out promotional culture. We discuss this in greater detail in §4.3. To determine whether these constraints hold, we must first determine the value of a reputable firm.

3.1. The Value of Reputable Firms

The value of a reputable firm with $i \in \{0, \ldots, N-1\}$ consecutive nonpromotions is defined by the following recursive equation:

$$V(i) = \tau^L \bar{\theta} - w_1^R + \beta\big(\gamma V(0) + (1-\gamma)(\tau^L \theta^H - w_2^R + \beta V(i+1))\big). \tag{25}$$

The firm's expected profit from hiring a young worker (of unknown ability) is equal to $\tau^L \bar{\theta} - w_1^R$. With probability γ, the worker is of high ability. In this case, the worker is promoted after the first period, and the counter resets to zero. With probability $1-\gamma$,

the worker is of low ability and will be retained when old. In this case, the firm earns a profit of $\tau^L\theta^H - w_2^R$, and the counter increases by one.[14]

After N consecutive nonpromotions, however, the firm is punished by losing its reputation for X periods, during which it has to pay the higher wages of a nonreputable firm to its workers and hence makes zero profit.[15] Thus, we have

$$V(N) = \beta^X V(0). \tag{26}$$

The following proposition shows that the value of a reputable firm is proportional to its expected savings from underpaying a worker relative to the surplus that she generates. These expected savings, which we denote by π, equal $\tau^L\bar{\theta} - w_1^R$ for a young worker and $\tau^L\theta^H - w_2^R$ for an old worker of low ability that has been retained (which happens with probability $1-\gamma$). Thus, we have

$$\pi = \tau^L\bar{\theta} - w_1^R + \beta(1-\gamma)(\tau^L\theta^H - w_2^R) \tag{27}$$

$$= \frac{\beta}{1-\beta}\,\gamma(1-\gamma)\,\Delta\tau\,\Delta\theta. \tag{28}$$

Comparing the above expression to Equation (24) shows that these expected savings are equal to the difference in wages that reputable and nonreputable firms pay to young workers. This is due to the zero-profit condition for nonreputable firms.

Proposition 2. *When a publicizing equilibrium exists, the value of a reputable firm with i consecutive nonpromotions is given by*

$$V(i) = \frac{1}{\zeta^i}\left(\frac{1-\zeta^N-(1-\zeta^i)(1-\zeta^N\beta^X)}{(1-\zeta)(1-\zeta^N\beta^X)-\beta\gamma(1-\zeta^N)}\right)\pi, \quad \text{for all } i \in \{0,\ldots,N\}, \tag{29}$$

where $\zeta = \beta^2(1-\gamma)$.

The incentive constraint in (15) requires the value of reputable firms to exceed that of nonreputable firms at all times. Although not obvious from the above expression, this is indeed the case.

Corollary 2. *When a publicizing equilibrium exists, the value of a reputable firm is strictly positive.*

We conclude this section by deriving comparative static results for the value of a reputable firm with respect to the variables i, X, and N.

[14] Note that $V(i)$ is defined as the value of a firm with i consecutive nonpromotions at the time that it hires a new employee. It is unnecessary to define firm value at the start of a period in which it retains its worker.

[15] The number of periods, X, can be even or odd. If X is even, then the firm simply hires $X/2$ workers for two periods each. If X is odd, then it hires $(X-1)/2$ workers for two periods each and "sits out" the final period before recovering its reputation. Either way, it has zero profit during the punishment phase.

Corollary 3. *When a publicizing equilibrium exists, the value of a reputable firm is*

(i) *decreasing in the number of consecutive nonpromotions, i;*

(ii) *decreasing in the length of the punishment phase, X; and*

(iii) *increasing in the length of the grace period, N.*

Corollary 3 shows that the value of a firm's reputation decreases in i, the number of consecutive workers that have not been promoted. This is intuitive: as the firm approaches a punishment phase, it becomes less valuable. The value also decreases in the length of the punishment phase, X: the longer the firm is forced to pay its workers the higher wages of a nonreputable firm, the lower is its expected net present value. It increases in the length of the grace period, N, because a longer grace period means that the next punishment phase is, on average, further away.

3.2. Existence of Publicizing Equilibria

Having determined the value of a reputable firm, we are now in a position to establish the existence of *publicizing equilibria*. We start with the incentive constraint in (12), which ensures that reputable firms optimally choose to promote high-ability workers. Using the equilibrium wages derived above and the result that $V(i)$ is decreasing in i, this constraint can be written as

$$V(0) \geq \tau^L\Delta\theta + \beta V(1). \tag{30}$$

To further simplify this inequality, note that the recursive definition of $V(i)$ in Equation (25) implies that[16]

$$V(0) = \frac{1}{1-\beta\gamma}\big(\pi + \beta^2(1-\gamma)V(1)\big), \tag{31}$$

which allows us to rewrite the above incentive constraint as

$$V(0) \leq \frac{1}{1-\beta}\big(\pi - \beta(1-\gamma)\tau^L\Delta\theta\big). \tag{32}$$

Because the value of a reputable firm is increasing in the length of the grace period, N, and decreasing in the length of the punishment phase, X, a necessary condition for an equilibrium to exist is that the above inequality holds for $N=1$ and $X\to\infty$:

$$\frac{\pi}{1-\beta\gamma} \leq \frac{1}{1-\beta}\big(\pi - \beta(1-\gamma)\tau^L\Delta\theta\big), \tag{33}$$

which is equivalent to

$$\frac{\tau^H}{\tau^L} \geq \frac{1-\beta+\beta\gamma(\beta-\gamma)}{\beta\gamma(1-\gamma)} \equiv \underline{r}_\tau. \tag{34}$$

[16] See also Equation (42) in the proof of Proposition 2.

For our proposed equilibrium to exist, we must also assure that reputable firms retain employees that they do not promote. Substituting the equilibrium wage w_2^R into the incentive constraint in (13) yields

$$V(i) \leq \frac{\tau^L \Delta\theta}{1-\beta}. \tag{35}$$

Because $V(i)$ is decreasing in i, reputable firms always prefer to keep old workers rather than fire them when

$$V(0) \leq \frac{\tau^L \Delta\theta}{1-\beta}. \tag{36}$$

Using again the fact that the lowest possible value for $V(0)$ is achieved by setting N equal to one and letting X go to infinity, we find that another necessary condition for a publicizing equilibrium to exist is

$$\frac{\pi}{1-\beta\gamma} \leq \frac{\tau^L \Delta\theta}{1-\beta}. \tag{37}$$

This condition can be written as

$$\frac{\tau^H}{\tau^L} \leq \frac{1-\beta\gamma^2}{\beta\gamma(1-\gamma)} \equiv \bar{r}_\tau. \tag{38}$$

The following proposition shows that the two constraints derived above are not only necessary but also sufficient for the existence of publicizing equilibria.

Proposition 3. *Publicizing equilibria exist if and only if* $\underline{r}_\tau \leq \tau^H/\tau^L \leq \bar{r}_\tau$, *where* $\underline{r}_\tau$ *and* $\bar{r}_\tau$ *are defined by Equations* (34) *and* (38), *respectively; that is, they exist as long as the productivity of high-quality firms, compared to that of low-quality firms, is neither too high nor too low.*

Proposition 3 shows that publicizing equilibria exist for intermediate values of the productivity ratio τ^H/τ^L. When this ratio is too low, workers receive little value from the prospect of working at a high-quality firm when old, so they are willing to forgo little in terms of wages when young. This reduces the value of maintaining a reputation to a low enough point that it is outweighed by the value of retaining good workers. On the other hand, when the ratio is very high, workers can be underpaid so much when young that reputable firms never want to retain old workers, regardless of their abilities. They are therefore happy to promote good workers (who are then poached) and fire bad workers. These firms have an up-or-out promotional culture, though in practice even the promoted workers leave the firm. We discuss this further in §4.3.

The above discussion reveals that equilibria in which reputable firms promote high-ability workers—and either retain low-ability workers (publicizing equilibria) or fire them (up-or-out equilibria)—exist as long as the ratio of firm productivities exceeds $\underline{r}_\tau$. The following corollary shows how this minimum productivity ratio varies with the agents' discount rate β and the fraction of high-ability workers γ.

Corollary 4. *The minimum productivity ratio* $\underline{r}_\tau$ *necessary for the existence of publicizing equilibria is*

(i) *decreasing in the discount rate* β *and*

(ii) *decreasing in the fraction of high-ability workers* γ *for low values of* γ *and increasing for high values of* γ.

The first result is rather intuitive. In line with standard results in the reputation literature, as actors that possess reputations become more patient, they are more willing to forgo current gains to maintain a reputation.

The effect of the fraction of talented workers in the population on the existence of publicizing equilibria is more complicated. Because of the fact that we employ a general equilibrium framework, changes in parameters can be felt through multiple channels. Higher values of γ increase the wage paid by nonreputable firms, because average worker quality is higher and the zero-profit condition thus implies higher wages. But these higher wages offered by nonreputable firms do not necessarily translate into higher wages paid by reputable firms. Because workers have a higher likelihood of being promoted and earning high pay late in life, reputable firms can afford to underpay young workers to a greater extent as γ increases. The tension between these two effects can be seen from the derivative of w_1^R with respect to γ:

$$\frac{dw_1^R}{d\gamma} = \tau^L(1-\beta)\Delta\theta - \frac{\beta}{1+\beta}(1-2\gamma)\Delta\tau\Delta\theta. \tag{39}$$

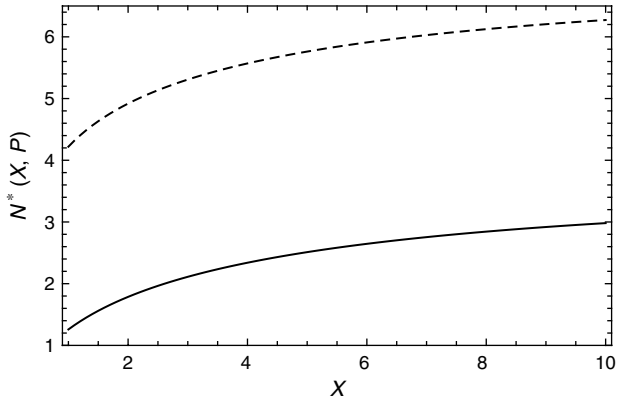
For $\gamma > 1/2$, this expression is clearly positive; for small values of γ, however, it can be negative. Given this ambiguous effect of γ on wages, it should not be surprising that the effect on the existence of a publicizing equilibrium is ambiguous as well.

Our analysis so far has focused on parameter values that ensure the existence of publicizing equilibria. We now turn to a characterization of the set of equilibria that exist for a given set of parameter values. Publicizing equilibria are defined by two quantities: the length of the grace period, N, and the length of the punishment phase, X. If an equilibrium exists, then for a given X and parameter set $P = (\theta^L, \theta^H, \tau^L, \tau^H, \beta, \gamma)$, there is a maximum length of the grace period $N^*(X, P)$ that is consistent with equilibrium behavior. Any grace period $N \leq N^*(X, P)$, paired with X, will also yield equilibrium behavior, as will any $X' > X$, paired with $N \leq N^*(X, P)$. For any set of parameter values P, the set of equilibrium pairs (X, N) is thus fully characterized by the function $N^*(X, P)$.

The comparative static results on the value of a reputable firm in Corollary 3 immediately imply the following result.

Proposition 4. *The maximum grace period consistent with a publicizing equilibrium is weakly increasing in the length of the punishment phase.*

Figure 3 Set of Publicizing Equilibria in the (X, N) Space



Notes. This figure shows the maximum length of the grace period, $N^*(X, P)$, as a function of the length of the punishment phase, X. The parameter values used in the figure are $\beta = 0.9$, $\gamma = 0.5$, $\theta^L = 1$, $\theta^H = 2$, $\tau^L = 1$, $\tau^H = 10$ (solid line), and $\tau^H = 13$ (dashed line).

Figure 3 plots the set of equilibria in the (X, N) space for the parameter values $\beta = 0.9$ and $\gamma = 0.5$. Consistent with our above discussion, we find that the maximum grace period increases in the productivity ratio τ^H/τ^L for any given length of the punishment phase.

3.3. Social Welfare

If social welfare is utilitarian—that is, the social welfare function is equally weighted—then, in this model, social welfare equals total production. Because worker ability and firm productivity are complementary, welfare is maximized when there are as many reputable firms as possible (i.e., when λ^R is set to the maximum value satisfying condition (b) in Definition 3).

To see this, note that if there are no reputable firms, then workers are randomly assigned to high- and low-quality firms when young, and they stay with their initial employers when old. This is a lower bound on social welfare. The existence of reputable firms allows high-quality firms to hire good workers more frequently than they otherwise could, whereas low-quality firms, including reputable ones, hire more young workers. Of course, a reputable firm is not serving its purpose of improving the allocational efficiency of labor when it is in the punishment phase. So total production is maximized when the number of reputable firms that are in the grace period is maximized.

There are potentially many publicizing equilibria, each associated with a value of N and X. Social welfare is maximized when N is maximized and X is minimized. A higher value of N decreases the likelihood that a firm enters the punishment phase, and a lower value of X reduces the time spent in the punishment phase, given that it is entered. Welfare is maximized, therefore, when N and X are on the boundary of permissible equilibria shown in Figure 3. Of course, because punishments occur on the equilibrium path, the first-best outcome under perfect information can never be achieved.[17]

4. Alternative Contracts and Equilibria

In this section, we discuss alternative contractual arrangements that can improve social welfare, but note that their usefulness is typically not robust to various alternative assumptions about the information structure of the economy.

4.1. Screening/Incentive Contracts

One might imagine that screening contracts could induce good workers to self-select to high-quality firms. A high-quality firm could offer a contract to an old worker specifying higher pay for higher output. If workers learn their types when young, low-ability workers would value such offers less than high-ability workers. This is a standard screening result: sufficiently strong incentives can screen for more skilled workers. However, these contracts are also subject to the standard limitations on screening contracts; namely, they are useless when workers do not know their types (the screen must be a self-selection) or when output is not verifiable. This latter issue is critical for any contract whose payments depend on output. In many—if not most—contracting situations, output is not verifiable and therefore cannot be contracted upon. In our simple model, output results from one worker working at one firm, so output would potentially be verifiable, but in practice, firms with many workers suffer from this problem.

4.2. Long-Term Contracts

Long-term contracts could also induce the first-best outcome. Firms could simply offer a contract guaranteeing lifetime employment that specifies a high wage when the worker is old but allows the worker to unilaterally cancel employment. For example, the second-period wage promised to a worker could equal $\tau^L\theta^H$, leaving zero profit in that period for low-quality firms that retain workers. In exchange for the promise of a high wage when old, workers would be willing to accept a lower wage when young. Because profit from employing an old worker is zero, firms would prefer that old workers leave so that they could hire a new young worker: promoting old workers would be incentive compatible.[18]

[17] This phenomenon is not unique to our setting but arises more generally in games with imperfect public monitoring (Mailath and Samuelson 2006).

[18] The incentive, in fact, would be for firms to promote low-ability workers just to be rid of them. Because these false promotions

Such long-term contracts are reminiscent of the optimal "wage–tenure contract" in frictional labor markets with on-the-job search (e.g., Burdett and Coles 2003, Stevens 2004, Shi 2009, Burdett and Coles 2010). In an environment in which workers—both employed and unemployed—search for better paying job opportunities, firms post upward sloping wage–tenure profiles to reduce the quit probability of their employees. In contrast, backloading wages in our model increases the workers' separation probability by giving firms an incentive to promote—and consequently lose—skilled workers.

In theory, long-term contracts would allow the economy to achieve the first-best outcome, but in practice there are difficulties. The most important one concerns moral hazard: if we were to add even a small amount of moral hazard to the problem, then lifetime employment would cease to be a solution. The guarantee of both employment and a high wage when old would preclude the firm from offering proper incentive pay if output is verifiable. If output were not verifiable, then firing would be the only available source of incentives, implying that a long-term contract would clearly be suboptimal. There are many reasons why we do not see many lifetime employment contracts, and moral hazard is but one, but the idea that firms could commit to promoting good workers because they actually prefer that their workers be poached seems like a stretch in any case.

4.3. Up-or-Out Promotional Cultures

In §3, we focused on publicizing equilibria in which reputable firms promote workers with high ability and retain those with low ability. However, as the incentive constraint in (13) shows, firms may prefer to get rid of old workers, regardless of their ability, if the benefit from hiring young workers is sufficiently high. This would result in an up-or-out promotional culture in which strong performers are promoted and weak performers are fired. The flow of workers through employers in this case is shown in Figure 4.

Up-or-out equilibria exist when $V \geq \tau^L \Delta\theta/(1-\beta)$, where V denotes the value of a reputable firm at the time that it hires a new worker. This follows immediately from the incentive constraint in (13) when the inequality sign is reversed and the wage paid by reputable firms to retained workers given by Equation (18). The value of a reputable firm is straightforward to calculate in this case. The firm *has no incentive not to promote a good worker*, because it wishes to fire bad workers anyway, and all types have the same firm-specific skills when old. Hence, there is no value function to iteratively define: the firm simply earns a profit of $\tau^L\bar{\theta} - w_1^R$ in every period.[19] The value of a reputable firm is thus given by

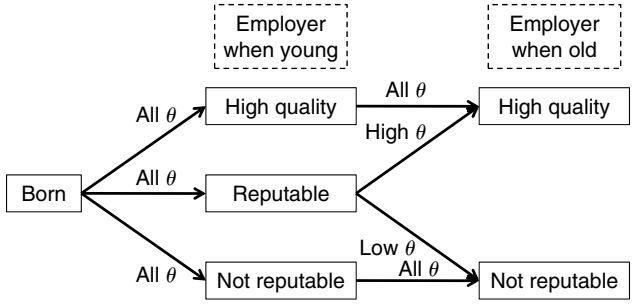
$$V = \frac{\tau^L\bar{\theta} - w_1^R}{1-\beta}, \tag{40}$$

and we have the following result.

Proposition 5. *Equilibria with an up-or-out promotional culture exist if*

$$\tau^L\Delta\theta + \beta\tau^L(\theta^H - \bar{\theta}) \leq \frac{\beta}{1-\beta}\,\gamma(1-\gamma)\Delta\tau\Delta\theta. \tag{41}$$

Figure 4 **Flow of Workers Through Employers in an Up-or-Out Equilibrium**



Notes. Workers are indifferent to their match when young, and the average worker quality at each firm is equal because worker type is unknown. Nonreputable and high-quality employers hide their good employees by not assigning prestigious titles and retain all old employees. Reputable firms promote good workers, who are then hired by high-quality firms. Low-ability employees are fired and move to nonreputable firms.

5. The Effect of Commitment

We have assumed thus far that firms are unable to commit to publicly disclosing worker performance. In this section, we discuss the differences that would result from allowing firms to commit.

In the publicizing equilibrium identified in §3, reputable firms earn an economic profit. If commitment to publicize performance were therefore possible, other low-quality firms would thus commit and earn economic profit themselves. This would increase the fraction of known high-ability workers, potentially up to γ. If γ is greater than the measure of high-quality firms, then all high-quality firms would hire (old) high-ability workers, but some high-quality workers would remain with their initial employers.

In our publicizing equilibrium, there are too many high-quality firms chasing too few workers known to be of high ability, driving up wages for these workers. Their high wages allow publicizing firms to pay low

would be observed and announced by the high-quality firm hiring these workers, reputable firms would have the proper incentive to promote a worker if and only if she is of high ability.

[19] Note that w_1^R is the same as before. Because old workers at reputable firms are paid their outside option, $\tau^L\theta^L$, whether or not they are retained, young workers are indifferent as to the firm's promotional culture.

wages to young workers, in exchange for offering the workers a chance at high wages when old. In the commitment case, however, the excess of workers known to be of high ability will decrease these wages, thus eliminating the economic profit earned by firms committing to publicize performance. Indeed, because there is free entry of low-quality firms, their economic profit must equal zero. The fact that our model is a general, rather than partial, equilibrium therefore reverses the impact of commitment on firm profit. Beginning with our equilibrium from §3, allowing an additional firm to commit would indeed increase its profit (by an identical amount to the increase in social welfare from improved matching), but allowing every firm to commit would cause the profit to be competed away.

Social welfare, however, is maximized when commitment is possible. The allocation of workers to jobs is efficient, in that either all workers known to be of high ability have jobs at high-quality firms, or all workers at high-quality firms are of high ability. Rents to low-quality firms are lower, in that economic profit is positive in the no-commitment case and is zero when commitment is possible. High-quality firms are better off with commitment, because they pay lower wages to better workers. Workers are better off with commitment as well, ex ante, because any reduction in wages from high-quality firms is more than made up by an increase in wages when young.

The flow of workers through the economy in the commitment case is similar to the one depicted in Figure 1, except that (i) the number of old workers moving to high-quality firms is higher, and (ii) high-quality firms may not hire young workers.

6. Empirical Predictions

Our model provides a number of empirical predictions concerning the use of promotions, letters of recommendation, "employee of the month" awards, and other public statements of employee performance.

First, we show in Proposition 3 that the matching problem must be significant in a given labor market for firms to be able to profit from publicizing performance. Holding θ^H/θ^L constant, the importance of matching can be measured by τ^H/τ^L. If τ^H/τ^L is too low, the welfare gain from better matching is too small to overcome the benefit for a firm of hiding its better workers. It seems likely matching is more important for high human capital employees; this means that firms employing lawyers, researchers, etc., are probably more likely to publicize performance than are firms employing construction workers, assembly-line workers, etc.

Second, in a publicizing equilibrium, the highest-quality firms will not publicize performance. Firms that get the most incremental value from hiring better workers will simply hire workers known to be high quality. Firms that get less incremental value from hiring better workers can earn higher profit from evaluating the quality of younger workers and revealing that quality publicly. This should all be considered with the caveat that these reputations are within industry or job class. For example, many top consulting firms are "high quality" in a standard colloquial sense, but many, if not most, consultants at those firms could earn higher pay with less work as managers at client firms. Indeed, a large majority of people who become consultants at top firms leave for higher pay at client firms before reaching partner as a consultant. Apparently, client firms get greater incremental value from having a more talented worker than do the consulting firms, and are therefore able to pay more to lure away workers.

Third, in a publicizing equilibrium, reputable firms will lose more employees to competitors and experience greater employee turnover. Although empiricists observing higher turnover could naively attribute this to firms' lower pay, in this model both lower pay and higher turnover stem from the implicit contract.

Fourth, we show in Corollary 1 that firms possessing reputations pay less than their peers of equal quality to employees at all levels of tenure with the firm. We are able to pin down wages for most workers without reference to bargaining power, but where it is relevant we stacked the deck against finding our equilibrium by giving bargaining power to the firm. Had we chosen a different assumption regarding bargaining power, the lifetime earnings profile of workers would have looked somewhat different. For example, we could have given bargaining power to the firms but only so long as wages cannot decrease for a worker who remains at her firm. Had we used this assumption, we would have shown that most workers would have flat wages over a lifetime, but those who are promoted and later hired by high-quality firms would experience rising wages over their lives. This seems more consistent with reality but is really unrelated to the model. Regardless, the difference between wages paid by reputable and nonreputable firms to employees at all levels of tenure would remain, as would the fact that promoted workers would have lower initial wages and more rapidly increasing wages over their lives.

7. Conclusion

We show that a firm's promise to publicize employee performance, in the form of a promotion, letter of recommendation, or "employee of the month" award—or lack thereof—can sometimes be used as a substitute for pay. Insofar as these signals convey valuable

information to outsiders regarding an employee's ability, firms willingly endow their best workers with improved outside options and must either pay more to compensate or be satisfied to lose such employees. We show that this cost of publicizing performance can become a benefit: a firm with a reputation for promoting good workers is an appealing initial employer for a young worker hoping to advance her career quickly. She will accept a lower wage when young in the hope of earning a higher wage from a different firm when older.

Two conditions on the economy must be satisfied for firms to be able to do this. First, worker–firm matching must be important. In our model this is achieved by making worker ability and firm type complementary in the production process: if workers' types are known, they can be matched to the appropriate jobs, maximizing economic efficiency. We show that equilibria exist only for sufficiently high values of τ^H/τ^L, a measure of this complementarity. Second, there must be a sufficient number of high-productivity firms to absorb talented workers. If so, then competition over these workers drives up their wages, thereby increasing the discount young workers are willing to accept to work at a "reputable" firm that agrees to publicize their performance.

Firms that publicize performance, although "low quality" in a productivity sense, earn a significant economic profit that can approach the profit of high-quality firms. We also show that if the social benefit of proper matching is high enough, firms may adopt an up-or-out promotional culture in which workers who are not promoted are fired. In this case, firms earn such high rents by underpaying young workers seeking a stamp of approval that it is never in their interest to retain older workers.

Although our model ignores many issues in compensation theory that have been identified in previous work, we believe that publicizing performance is an important way that firms reward employees in practice and that empirical predictions arising from the theory we present accord well with observation.

Acknowledgments

The authors thank Samuel Lee, Wei Xiong (the department editor), an anonymous referee, and seminar participants at the University of Houston, the University of North Carolina, and the 2011 European Finance Association meeting for helpful comments and suggestions.

Appendix

Proof of Proposition 1. This result follows immediately from our discussion preceding Proposition 1 in the text. □

Proof of Corollary 1. Equations (18) and (19) immediately imply that firms with reputations pay less to old workers. That these firms pay less to young workers as well follows from Equation (24), which states that $w_1^R < w_1^{NR}$. □

Proof of Proposition 2. Substituting the equilibrium wages w_1^R and w_2^R into Equation (25) yields

$$V(i) = \pi + \beta\gamma V(0) + \beta^2(1-\gamma)V(i+1). \tag{42}$$

This recursive equation can be written as

$$V(0) = (\pi + \beta\gamma V(0))\sum_{j=0}^{i-1}\zeta^j + \zeta^i V(i), \tag{43}$$

where $\zeta = \beta^2(1-\gamma)$. Thus, the value of a reputable firm can be expressed in terms of $V(0)$ as

$$V(i) = \frac{(1-\zeta-\beta\gamma(1-\zeta^i))V(0) - (1-\zeta^i)\pi}{(1-\zeta)\zeta^i}. \tag{44}$$

Combining the boundary condition in (26) with the expression derived above, we have

$$V(0) = \frac{1-\zeta^N}{(1-\zeta)(1-\zeta^N\beta^X) - \beta\gamma(1-\zeta^N)}\,\pi. \tag{45}$$

Finally, substituting this expression into Equation (44) yields the expression for $V(i)$ stated in the proposition. □

Proof of Corollary 2. From the proof of Proposition 2, we know that

$$V(0) = \frac{1-\zeta^N}{(1-\zeta)(1-\zeta^N\beta^X) - \beta\gamma(1-\zeta^N)}\,\pi. \tag{46}$$

Clearly, $\pi > 0$ and $\zeta^N < 1$ for any $N \geq 1$. The denominator of $V(0)$ is positive as well, because

$$\begin{aligned}
&(1-\zeta)(1-\zeta^N\beta^X) - \beta\gamma(1-\zeta^N)\\
&\quad\geq (1-\zeta)(1-\zeta^N) - \beta\gamma(1-\zeta^N) &(47)\\
&\quad= (1-\zeta^N)(1-\beta^2(1-\gamma)-\beta\gamma) &(48)\\
&\quad> (1-\zeta^N)(1-\beta) &(49)\\
&\quad> 0. &(50)
\end{aligned}$$

This implies that $V(i) > 0$ for all $i \in \{0, \ldots, N\}$. □

Proof of Corollary 3. These comparative static results follow immediately from the expression of $V(i)$ derived in Proposition 2. □

Proof of Proposition 3. Our discussion in §3.2 shows that if the two constraints in (34) and (38) are met, then there always exists a set of reputable firms, a match of workers to firms, a set of wages, an N (length of the grace period), and an X (length of the punishment phase) that satisfy the conditions in Definition 3 required for a publicizing equilibrium. Thus, we are left to show that the upper bound on the productivity ratio always exceeds the lower bound:

$$\begin{aligned}
\bar{r}_\tau - \underline{r}_\tau &= \frac{1-\beta\gamma^2}{\beta\gamma(1-\gamma)} - \frac{1-\beta+\beta\gamma(\beta-\gamma)}{\beta\gamma(1-\gamma)} &(51)\\
&= \frac{1-\beta\gamma}{\gamma(1-\gamma)} &(52)\\
&> 0. &(53)
\end{aligned}$$

This proves that $\bar{r}_\tau$ exceeds $\underline{r}_\tau$ for all possible values of β and γ. □

Proof of Corollary 4. The first result follows immediately from the derivative of the lower bound $\underline{r}_\tau$ with respect to β, which is always negative:

$$\frac{d\underline{r}_\tau}{d\beta} = -\frac{1-\beta^2\gamma}{\beta^2\gamma(1-\gamma)} < 0. \tag{54}$$

As for the second result, the derivative of $\underline{r}_\tau$ with respect to γ is given by

$$\frac{d\underline{r}_\tau}{d\gamma} = -\frac{(1-\beta)(1-\gamma(2-\beta\gamma))}{\beta\gamma^2(1-\gamma)^2}. \tag{55}$$

This expression converges to $-\infty$ as $\gamma \to 0$ and to $+\infty$ as $\gamma \to 1$. □

Proof of Proposition 4. From corollary 3, we know that $V(i)$ is increasing in N and decreasing in X. Thus, the implicit function theorem immediately implies that $N^*(X, P)$ is increasing in X for all parameter values P. □

Proof of Proposition 5. This sufficient condition for the existence of up-or-out equilibria follows immediately from the value of a reputable firm given by Equation (40) and the incentive constraint $V \geq \tau^L \Delta\theta/(1-\beta)$, which ensures that the firm prefers to fire unpromoted workers. □

References

Bernhardt D (1995) Strategic promotion and compensation. *Rev. Econom. Stud.* 62:315–339.

Bernhardt D, Scoones D (1993) Promotion, turnover, and preemptive wage offers. *Amer. Econom. Rev.* 83:771–791.

Burdett K, Coles M (2003) Equilibrium wage-tenure contracts. *Econometrica* 71:1377–1404.

Burdett K, Coles M (2010) Wage/tenure contracts with heterogeneous firms. *J. Econom. Theory* 145:1408–1435.

Gale D, Shapley LS (1962) College admissions and the stability of marriage. *Amer. Math. Monthly* 69:9–14.

Ghosh S, Waldman M (2010) Standard promotion practices versus up-or-out contracts. *RAND J. Econom.* 41:301–325.

Gibbons R, Waldman M (1999) A theory of wage and promotion dynamics inside firms. *Quart. J. Econom.* 114:1321–1358.

Green EJ, Porter RH (1984) Noncooperative collusion under imperfect price information. *Econometrica* 52:87–100.

Greenwald BC (1986) Adverse selection in the labour market. *Rev. Econom. Stud.* 53:325–347.

Kreps DM, Wilson R (1982) Reputation and imperfect information. *J. Econom. Theory* 27:253–279.

Levin J, Tadelis S (2005) Profit sharing and the role of professional partnerships. *Quart. J. Econom.* 120:131–171.

Mailath GJ, Samuelson L (2006) *Repeated Games and Reputations* (Oxford University Press, Oxford, UK).

Michelacci C, Suarez J (2004) Business creation and the stock market. *Rev. Econom. Stud.* 71:459–481.

Milgrom P, Roberts J (1982) Predation, reputation, and entry deterrence. *J. Econom. Theory* 27:280–312.

Mortensen DT, Pissarides CA (1999) New developments in models of search in the labor market. Ashenfelter O, Card D, eds. *Handbook of Labor Economics*, Vol. 3, Chap. 39 (North Holland, Amsterdam), 2567–2627.

Mukherjee A (2008a) Career concerns, matching, and optimal disclosure policy. *Internat. Econom. Rev.* 49:1211–1250.

Mukherjee A (2008b) Sustaining implicit contracts when agents have career concerns: The role of information disclosure. *RAND J. Econom.* 39:469–490.

Mukherjee A (2010) The optimal disclosure policy when firms offer implicit contracts. *RAND J. Econom.* 41:549–573.

Oyer P, Schaefer S (2011) Personnel economics: Hiring and incentives. Ashenfelter O, Card D, eds. *Handbook of Labor Economics*, Vol. 4, Chap. 20. (North Holland, Amsterdam), 1769–1823.

Shi S (2009) Directed search for equilibrium wage-tenure contracts. *Econometrica* 77:561–584.

Stevens M (2004) Wage-tenure contracts in a frictional labour market: Firms' strategies for recruitment and retention. *Rev. Econom. Stud.* 71:535–551.

Waldman M (1984) Job assignments, signalling, and efficiency. *RAND J. Econom.* 15:255–267.

Waldman M (1990) Up-or-out contracts: A signaling perspective. *J. Labor Econom.* 8:230–250.