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# Worker visibility and firms' retention policies

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## Abstract

In the last two decades, the widespread use of web-based social networks has led to a higher visibility of workers to the labor market. We theoretically and experimentally analyze the consequences of such increased labor market transparency for the efficiency of job assignments, the wages of workers, and firm profits. Our theoretical results show that higher visibility of workers increases the efficiency of job assignments, leads to a redistribution of income between workers of different ability, and increases overall surplus. Our experimental findings generally support the theoretical results with the exception that increased visibility leads to higher worker turnover such that surplus does not increase.

## 1 | INTRODUCTION

Human resources belong to the most important factors that guarantee long-term success of firms (e.g., Baron & Kreps, 1999; Lazear & Gibbs, 2009). One of a firm's primary goals is therefore to hire and retain workers of high ability. However, once workers are successful on their job, they might receive poaching offers from other firms (Kim, 2014; Lazear, 1986). For a worker, the likelihood of receiving an outside offer crucially depends on the extent to which alternative employers are aware of his existence and performance, that is on how *visible* he is to the labor market. Worker visibility is closely related to search costs in the labor market, as low search costs lead to more search for better employer–worker matches. In the last decade, digitalization in general and the widespread use of web-based social networks like LinkedIn, ResearchGate, and XING, in particular, have drastically reduced search costs for employers and employees (Goldfarb & Tucker, 2019), and therefore substantially increased the visibility of a firm's workers to potential competitors (Buettner, 2017; Mukherjee & Vasconcelos, 2018).<sup>1</sup>

In this paper, we analyze and experimentally test a stylized labor market model to discuss the implications of higher worker visibility on the firms' optimal retention policies, firm profits, and overall efficiency. The corresponding results do not only address consequences of technological change in the labor market but may also lead to new insights into differences in the retention policies across firms or industries that systematically differ in worker visibility. A number of additional factors affect worker visibility *across firms*. For example, firms might differ in their corporate culture. While some firms have a strict understanding of hierarchy such that only executives represent the firm's interests in the public, others might implement a more liberal culture such that also nonexecutives frequently act as public representatives of the firm. Similarly, worker visibility might also systematically vary *across industries*. In industries in which teamwork plays an important role when dealing with key customers, such as advertising or consulting, results

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are often presented by teams of executives and nonexecutives so that the latter are more visible than in industries without teamwork at the top.

We build on the seminal paper by Waldman (1984), who differentiates between executive and nonexecutive jobs. The setting by Waldman assumes asymmetric employer information, that is, only the worker's current employer knows his ability while all alternative employers can only observe his job assignment (for similar settings, see e.g., Dato et al., 2016; DeVaro & Waldman, 2012; Gürtler & Gürtler, 2015; Owan, 2004; Waldman, 1984; Zabojnik & Bernhardt, 2001). Importantly, in the setting of Waldman (1984) workers are perfectly visible both on executive and on nonexecutive jobs. We extend this model by allowing for workers on executive jobs (e.g., a CEO) to be more visible than workers on nonexecutive jobs (e.g., their assistants), that is, the existence of the former is observed with a higher probability by alternative employers than the existence of the latter.

This extension of the framework seems natural because executives appear on the Internet more prominently than nonexecutives. According to Flyverbom (2016) and Flyverbom et al. (2016), executives have to be visible to key customers and other stakeholders implying that they appear on the organizational chart of a corporation, typically including a picture and their CV. Non-executives, however, are often not individually visible on the organizational chart but rather subsumed under labels such as "support" or "service" (Lawton, 2016). In many professional careers, employees thus become visible at the time when being promoted out of a group to a position with personnel responsibilities. For example, in a sales division, members of the salesforce become more visible when they become a sales manager, and in project management a team member becomes more visible when being appointed to the position of the project manager.

In the following, we will analyze how an increase in the general degree of worker visibility affects firms' retention policies. As executives are already highly visible due to their high position on the hierarchical ladder, we assume that an increase in the general degree of worker visibility enhances the visibility of nonexecutives more strongly as compared to executives. In a first step, we show that irrespective of the degree of worker visibility the firm's job-assignment decision will follow a cut-off strategy in equilibrium such that it assigns a worker to the nonexecutive job at the low hierarchy level if and only if his ability is below a certain threshold. Furthermore, the equilibrium cut-off is inefficiently high, that is the current employer's promotion rate is inefficiently low.

The analysis of our theoretical model yields three main results. First, we show that higher worker visibility induces the current employer to adjust the promotion cut-off downward, leading to a less inefficient promotion policy. Intuitively, higher visibility makes it less attractive for the current employer to inefficiently assign a worker to the low hierarchy level for reducing his probability of being poached. Consider, for example, the two polar cases of zero and full visibility at the low hierarchy level. If a worker at the lower hierarchy level is completely invisible to alternative employers, the current employer will intensely use inefficient job assignment to prevent poaching offers. If, however, the worker is fully visible at the low hierarchy level, inefficient job assignment is ineffective to hide a worker and is, thus, only used to prevent a positive signal on the worker's unobservable ability.

Second, in our stylized model, increased worker visibility leads to an income redistribution between workers of different ability. Due to the decrease of the equilibrium cut-off, workers of intermediate ability are promoted to the executive job instead of being inefficiently assigned to the nonexecutive job. Workers with high ability, who will be promoted regardless of the exact degree of visibility, suffer from an increase in visibility. As they are now pooled with workers of intermediate ability at the executive job, their expected ability from the perspective of alternative employers decreases and so does their equilibrium wage. For workers with low ability, whose job assignment is not affected, the increase in visibility has a direct positive and an indirect negative effect on the expected wage. The direct positive effect originates from the fact that they are visible and receive poaching offers more often. Accordingly, the current employer has to match poaching offers more often, which leads to a higher expected wage. As they are no longer pooled with intermediate ability types, however, alternative employers expect workers at the nonexecutive job to be less able, which leads to a lower retention wage in equilibrium. Overall, this negative effect turns out to be second order such that workers with low ability benefit from an increase in visibility. Workers of intermediate ability, who are promoted to the executive job as a result of the increase in visibility, benefit the most. First, they are assuredly visible on the executive job such that they always receive a positive wage. Second, they are pooled with workers of high ability instead of being pooled with workers of low ability on the nonexecutive job. Accordingly, their wage on the executive job is higher than on the nonexecutive job. Overall, income is redistributed from workers of high ability to their counterparts with low and intermediate ability. As workers with intermediate ability benefit the most, the income effect is nonmonotonic in ability.

Third, current employers will earn lower profits if workers become more visible to the labor market, because higher worker visibility leads to more poaching by alternative employers and, thus, higher wage costs. While current employers suffer from the increased wage payments, the overall surplus produced by the workers rises as a consequence of more efficient job assignment. As the overall surplus increases but firm profits decrease, it is also clear that workers on average benefit from higher visibility. Thus, increases in visibility, for example due to digitalization, may also lead to a redistribution of income from employers to workers.

All three results provide testable predictions about the implications of higher worker visibility on firms' retention policies. The second part of our paper tests these predictions by conducting a laboratory experiment. The degree of worker visibility in the field depends on an unmanageable variety of factors, and the resulting optimal mix of job assignment and retention wage offers will be inherently correlated with the firm's structure, its job offers, and the pool of workers it has employed. A laboratory setting, however, enables us to exogenously manipulate worker visibility, which allows us to identify causal implications of changes in the visibility of workers. For this purpose, we build upon a simple experimental labor market with one subject being in the role of a current employer and two subjects being in the role of alternative employers, who can poach the current employer's worker.<sup>2</sup> We differentiate between two treatments, which concentrate on the two polar cases of our model setup. In *invisibility*, workers on nonexecutive jobs are observed by alternative employers with probability zero, that is workers cannot be poached. In *visibility*, workers on nonexecutive jobs are perfectly visible for alternative employers. In both treatments, assignment of a worker to the executive job makes the worker perfectly visible for alternative employers.

The experimental results are generally in line with the derived theoretical hypotheses. Concerning our finding on the optimal promotion policy, in both *invisibility* and *visibility* the vast majority of current employers uses a cut-off rule to determine job assignment. In line with our first main theoretical result, this cut-off is significantly lower in *visibility* compared to *invisibility*. Hence, increased visibility leads to less inefficient job assignments in our experimental labor market. Second, we observe a heterogeneous treatment effect with respect to workers' income which is nonmonotonic. The income of low ability types significantly increases from *invisibility* to *visibility*. The same is true for workers of intermediate ability. However, the beneficial effect for their income is significantly larger than the effect for workers of low ability. On the contrary, we observe that workers of high ability earn less in *visibility* than in *invisibility*. Finally, we hypothesized that increased visibility improves overall surplus. This hypothesis is not supported by the experimental findings.

We discuss our results and conduct several robustness checks in Section 6. We show that the missing relationship between visibility and surplus in the experimental data can be traced back to the occurrence of turnover. In our setting, workers can rely on firm-specific human capital such that they are more productive at their current employer compared to alternative employers. While theory therefore predicts that, in equilibrium, workers should stay with their current employer, we find substantial turnover in both treatments. Observed turnover is higher in *visibility* than in *invisibility*. As a consequence, increased visibility of workers yields a more inefficient assignment of workers across firms which can offset the positive surplus effects from less inefficient job assignment within firms. In our data, these two effects cancel out each other. Interestingly, the increase in turnover does not only decrease overall surplus but also reduces the earnings of alternative employers. In *visibility*, where turnover is high, they seem to suffer from a phenomenon similar to the winner's curse: on average they realize negative profits in case of winning the wage competition for the worker.<sup>3</sup> Invisibility of workers reduces their opportunity to engage in such wage competitions and thereby alleviates the associated negative profits.

As we concentrate on the two polar cases of our model setup in the main treatments, we consider an additional experimental setting in which nonexecutives are observable by alternative employers with probability 0.5 in Section 6.3 as a first robustness check. The corresponding results corroborate the findings from our main experiment. Second, we endogenize visibility in a modified version of our theoretical model in Section 6.4 by allowing workers to invest in their visibility. We show that an increase in the endogenously acquirable visibility negatively affects the promotion cut-off, which reiterates the effect of exogenous visibility. Furthermore, our results reveal that, contrary to exogenous visibility, an increase in endogenous visibility might be surplus-decreasing.

Our approach analyzes the impact of increased worker visibility on firms' optimal retention policies to shield workers from poaching offers by alternative employers. Thereby, it complements a number of papers that address employee poaching but focus on wage rises as the key instrument to retain workers. The seminal paper by Waldman (1984) and the subsequent papers building on it (e.g., Dato et al., 2016; DeVaro & Waldman, 2012; Ghosh & Waldman, 2010; Gürtler & Gürtler, 2015; Waldman, 1996; Waldman & Zax, 2016) consider asymmetric employer learning where poaching firms are less informed about a worker's ability compared to the worker's current employer.<sup>4</sup>

We complement these papers by introducing worker visibility to the setting, that is that the firm's job assignment directly impacts the visibility of the worker to the outside labor market. Similarly, Picariello (2017) does not only focus on wage rises but also analyzes job assignment as a means to reduce the threat of poaching offers. In his model of symmetric employer learning, jobs differ in the extent to which a worker acquires firm-specific human capital. Firms may then inefficiently assign a worker to the job with more firm-specific human capital to avoid a high outside option and, hence, to retain him at a lower cost. Due to the presence of firm-specific human capital, in all these papers poaching offers are typically not successful in equilibrium. In the models by Lazear (1986) and Bernhardt and Scoones (1993), poaching can be successful as the poached worker can be more productive at the alternative employer. Kim (2014) builds on Lazear (1986) and shows that poaching can be even successful if it does not lead to a better match.

There are also parallels with the literature that focuses on the limited visibility of workers. In their theoretical analysis, Milgrom and Oster (1987) study how exogenously disadvantaged workers may be discriminated against in the promotion process if their ability is less obvious to alternative employers than the ability of advantaged workers. Such discrimination has been empirically documented for women by Frederiksen and Kato (2011) and Cassidy et al. (2016), and for non-Whites by DeVaro et al. (2012). Invisibility of a worker in our context differs from the invisibility of a worker's *ability* discussed in Milgrom and Oster (1987), because it leads to less visibility of workers in the literal sense, that is, they are less likely to receive poaching offers. The papers by Koch and Peyrache (2011) and Bar-Isaac and Levy (2019) analyze how the firm can choose the organizational design and the task allocation among workers to vary their visibility. Contrary to our study, their focus lies on the workers' implicit effort incentives from career concerns.

The paper is organized as follows. The next section introduces our model setup. Section 3 derives the corresponding equilibrium and shows how increased worker visibility affects job assignment, wages, and surplus. Section 4 describes the experimental design. We present our experimental findings in Section 5 and discuss our empirical and theoretical findings in Section 6. Section 7 concludes.

## 2 | THE MODEL

To analyze the impact of the degree of visibility on job assignment, wages, and firm profits, we consider a stylized labor market setting that builds upon the seminal contribution of Waldman (1984). There are  $n > 2$  firms and one worker. Each player has a working life of two periods. In the *first period*, the worker is assumed to be employed by firm 1 and to have ability  $A$  that is uniformly distributed over the interval  $[0, \bar{A}]$  with  $\bar{A} > 0$ . While the worker and the current employer, firm 1, learn the ability of the worker after the first period, firms 2, ...,  $n$  only know the distribution of the worker's ability during the whole game. Hence, there is asymmetric employer information. The current employer uses the first period not only to screen the worker, but also for training purposes. For simplicity, the worker is assumed to produce zero output in period one.

In the *second period*, the worker may become visible to firms 2, ...,  $n$ . In that case, all  $n$  firms compete for his services as all have to fill vacant positions. The current employer can either assign the worker to job 0 at a low hierarchy level (nonexecutive job) or promote him to job 1 on a higher hierarchy level (executive job). Formally, the worker's output at the current employer on job 1 is described by the production function<sup>5</sup>

$$y^1 = (1 + s) \cdot (d_1 + c_1 \cdot A).$$

If the worker is not promoted by the current employer, output on job 0 is given by

$$\tilde{y}^1 = (1 + s) \cdot (d_0 + c_0 \cdot A),$$

where  $0 < c_0 < c_1$  and  $d_0 \geq d_1 \geq 0$ . The assumption  $c_0 < c_1$  ensures that output generated on job 0 depends on the ability of the worker to a lower degree than output on job 1. For example, we can imagine that decisions of a project manager affect firm output more strongly than the decisions of his subordinates. Consequently, the manager's ability should be more important for firm output than his subordinates' abilities. Furthermore, we allow for a situation in which the worst ability type is more productive on job 0 at the low hierarchy level compared to working on job 1 at the higher hierarchy level, which is captured by the assumption  $d_0 \geq d_1$ . Similar to Waldman (1984), we assume that the worker has accumulated firm-specific human capital during the first period, which is reflected by the parameter  $s > 0$ . For the alternative employers—firms  $i = 2, \dots, n$ —the output of a worker of ability  $A$  is given by<sup>6</sup>



$$y^i = d_1 + c_1 \cdot A.$$

Thus, due to firm-specific human capital the worker is more productive at the current employer than at the alternative employers.

We introduce variation in the degree of visibility between the two hierarchy levels by assuming that a promoted worker is perfectly visible, whereas not promoting a worker impedes his visibility to alternative employers. As an example, we can think of an employee who works with several colleagues in project management. In case of promotion to the position of the project manager, the employee becomes personally responsible for the success or failure of specific projects (e.g., building a large factory or a library in due time and at the scheduled costs). At the new position of a project manager, the employee then becomes more visible to alternative employers, even more so when the media report about the progress of his projects. Our model captures such situations in a stylized form. We assume that a worker on job 1 is perfectly visible and can always be poached by alternative employers while a worker on job 0 can only be poached with probability  $v$ . With the remaining probability  $1 - v$ , the worker is invisible for alternative employers, and he only receives the wage offer of the current employer. Let the binary random variable  $V$ , which takes a value of one with probability  $v$  and a value of zero otherwise, indicate whether or not a worker on job 0 is visible to alternative employers.

To guarantee equilibrium existence and that at least the most able worker type is promoted, we assume a moderate impact of specific human capital and that the difference in productivity of the two jobs is not prohibitively large:

### Assumption 1.

- (i)  $\frac{c_1 \bar{A}}{2d_1} > s > \frac{d_0 + c_0 \bar{A}}{(c_1 - c_0)\bar{A} - (d_0 - d_1)}$ ,
- (ii)  $3c_0 \geq c_1$ .

Qualitatively, Assumption 1(i) states that the effect of firm-specific human capital on productivity is neither negligible nor uncommonly large relative to other factors influencing productivity. This assumption is in line with the results of Kwon and Meyersson Milgrom (2014), who analyze Swedish employer–employee matched data and conclude that firm-specific human capital is typically as valuable as occupation-specific human capital. Among many others, work supervision, production engineering, management of inventory and sales are occupations for which the importance of firm- and occupation-specific human capital is shown to be similar.<sup>7</sup> Part (ii) of Assumption 1 presumes that the differences in productivity of the two jobs are not prohibitively large, which reflects the idea that the two jobs are on adjacent positions along a given career ladder.

The game in period two can be described by a sequence of four events. First, at *date 1*, the current employer observes the worker's ability  $A$  and, thereafter, assigns the worker to job  $j \in \{0, 1\}$ . If the current employer is indifferent between the two job assignments, she is assumed to promote the worker to job 1. At *date 2*, the random variable  $V$  is realized, and alternative employers observe the job assignment  $j$  of the current employer if the worker is visible, that is if  $j = 1$  or  $V = 1$ . At *date 3*, firms compete for the worker by offering nonnegative wages.<sup>8</sup> If the current employer has assigned the worker to job 0 and  $V = 0$ , only she can submit a wage offer as the worker is invisible to alternative employers. If either the worker has been assigned to job 1 or  $V = 1$ , all firms are aware of the worker and simultaneously post wage offers. At *date 4*, the worker chooses the highest wage offer. If no alternative employer offered a strictly higher wage than the current employer, the worker is assumed to stay with his current employer. However, if poaching wage offers strictly dominate the current employer's wage for at least one alternative employer  $i \neq 1$ , the worker will switch to employer  $i$  with the highest poaching offer. If there are several poaching firms that offer the highest wage, the worker will pick one of them at random. The profit of the firm that employs the worker is given by output minus wage offer, whereas all other firms make zero profits.

In this game, a strategy of the current employer consists of two components: first, a mapping that specifies for every worker ability  $A$  a job assignment  $j \in \{0, 1\}$ , second, a mapping  $w_1 : [0, \bar{A}] \times \{0, 1\} \times \{0, 1\} \rightarrow \mathbb{R}_0^+$  that specifies a wage for every possible combination of worker ability, job assignment and realization of  $V$ . In the same spirit, a strategy of alternative employer  $i \neq 1$  is given by a mapping  $w_i : \{0, 1\} \rightarrow \mathbb{R}_0^+$  that specifies a poaching offer for every observed job assignment.<sup>9</sup>

To rule out multiplicity of equilibria, we impose the assumption that besides being poached, the worker might leave his current employer for exogenous reasons if he was visible to the alternative employers (e.g., the worker is in conflict with his direct superior).<sup>10</sup> Formally, we assume that with some small probability  $\gamma$  the worker leaves the current

employer after wage offers have been posted. In this event, the worker completely ignores the current employer's wage offer so that only the wage offers of the alternative employers are relevant for him. However, in the equilibrium analysis, we consider the limit case  $\gamma \rightarrow 0$ .<sup>11</sup>

The assignment to job 1 will be efficient if the worker generates (weakly) higher output on job 1 than on job 0 or, equivalently, if the worker's ability  $A$  (weakly) exceeds

$$A^* = \frac{d_0 - d_1}{c_1 - c_0}. \tag{1}$$

We assume that efficiency requires to assign at least the most able worker to job 1.

**Assumption 2.**  $A^* \in [0, \bar{A})$ .

### 3 | OPTIMAL JOB ASSIGNMENT

In this section, we derive the current employer's optimal job assignment and the equilibrium wage of the worker. In particular, we are interested in how these characteristics of a firm's personnel policy depend on the degree of visibility of a nonpromoted worker. For this purpose, we study perfect Bayesian equilibria of the game described in the previous section. For the analysis, we consider a situation in which  $\gamma$ , the probability of the worker leaving his current employer for exogenous reasons, is equal to zero. In principle, there may emerge multiple equilibria in this situation. To derive concise testable predictions for our laboratory experiment, we focus on the unique equilibrium outcome that is compatible with the idea that there is an infinitesimally small chance that the worker leaves his current employer for exogenous reasons. Although we consider the equilibrium outcome for  $\gamma \rightarrow 0$ , all our results qualitatively also hold for the case of  $\gamma$  being small but strictly positive. We obtain the following first result:<sup>12</sup>

**Proposition 1.** *Suppose  $\gamma \rightarrow 0$ . In any perfect Bayesian equilibrium, the worker will be assigned to job 1 if and only if  $A \geq A^+$  where  $A^+ > A^*$ . The promotion cut-off  $A^+$  strictly decreases with  $v$ . The worker stays with the current employer and earns wage*

$$w_1(A, j, V) = \begin{cases} d_1 + c_1 \frac{A^+ + \bar{A}}{2} & \text{if } A \geq A^+ \\ \left( d_1 + c_1 \frac{A^+}{2} \right) \cdot V & \text{if } A < A^+. \end{cases}$$

In equilibrium, job assignment is inefficient, that is the promotion cut-off  $A^+$  satisfies  $A^+ > A^*$ . The more visible the worker, the less inefficient will be the current employer's optimal promotion policy. To disentangle the effect of visibility on job assignment from the effects of asymmetric employer information and productivity differences between the two jobs, we distinguish between three different groups within the set of ability types  $A \in [0, A^+)$ , which are assigned to job 0. The least able workers with  $A \leq A^*$  are assigned to job 0 because of their corresponding productivity advantage. If all workers are visible, there is a set of workers with ability above  $A^*$  that are also assigned to job 0. Suppose the cut-off for  $v = 1$  is denoted by  $\underline{A}^+$ : The proof of Proposition 1 shows that  $\underline{A}^+ > A^*$ . All workers with ability  $A \in [A^*, \underline{A}^+]$  are assigned to job 0, because asymmetric information implies that poaching offers for workers on job 1 are considerably higher than for workers on job 0. Thus, it is more costly to retain a worker on job 1 so that the current employer optimally assigns those ability types to job 0 that are only slightly more productive on job 1. This effect has been highlighted in the seminal paper by Waldman (1984). Finally, if  $v < 1$ , the cut-off  $A^+$  is strictly higher than  $\underline{A}^+$ . Hence, all workers with ability  $A \in [\underline{A}^+, A^+)$  are assigned to job 0 solely because of invisibility. Therefore, the most able workers on job 0 are those that receive this job due to their limited visibility on job 0. This new effect has not been addressed in the previous literature on asymmetric employer information.

We now turn to the analysis of the impact of visibility on equilibrium wages. An increase in  $v$  has a direct income effect for the worker. As indicated above, this effect crucially depends on the worker's ability. There are three groups of worker types that have to be distinguished. Consider workers of *intermediate ability* first. The optimal job assignment for these worker types crucially depends on the magnitude of  $v$ : they are assigned to job 0 at the low hierarchy level before the increase in  $v$ , but are promoted to job 1 if the visibility of a worker on job 0 is sufficiently large. Higher

visibility affects their wage positively for two reasons: due to being promoted to job 1, (a) they always receive a positive wage, and (b) they are now pooled with the most able worker types.

Workers with *low ability* are assigned to job 0 before and after the increase of  $v$ . Their income effect is determined by the following trade-off. On the one hand, they benefit as they are more likely to be visible to alternative employers and, accordingly, receive a positive wage from the current employer. On the other hand, they suffer from higher visibility, because the most able types that were assigned to job 0 before the increase in  $v$  are now promoted to job 1. This implies that the expected ability of a worker on job 0 and, hence, the willingness to pay of alternative employers decreases. The negative effect, however, is second order and dominated by the direct positive income effect.

Finally, consider workers with *high ability* (i.e., workers with  $A$  sufficiently close to  $\bar{A}$ ). They are promoted before and after an increase in  $v$ . As a consequence of the increase in  $v$ , the current employer additionally promotes workers with intermediate ability such that the expected ability and the equilibrium wage of a worker on job 1 is lower due to the increase in  $v$ . The following proposition summarizes our findings.

**Proposition 2.** *Suppose  $\gamma \rightarrow 0$ . Let  $v$  increase from  $v_L$  to  $v_H$  and denote the corresponding cut-offs by  $A_L^+$  and  $A_H^+$ . Then, the income effect  $\Delta w(A)$  of a worker with ability  $A$  is given by:*

$$\Delta w(A) = \begin{cases} d_1(v_H - v_L) + \frac{c_1}{2}[v_H A_H^+ - v_L A_L^+] & \text{if } A < A_H^+ \\ d_1(1 - v_L) + \frac{c_1}{2}(\bar{A} + A_H^+ - v_L A_L^+) & \text{if } A_H^+ \leq A < A_L^+ \\ -\frac{c_1}{2}(A_L^+ - A_H^+) & \text{if } A \geq A_L^+, \end{cases}$$

where  $\Delta w(A) > 0$  if and only if  $A < A_L^+$ . Moreover,  $\Delta w(A)$  is largest for  $A_H^+ \leq A < A_L^+$ .

Proposition 2 emphasizes two effects of higher visibility on wages. First, there is a nontrivial redistribution effect across worker types. Intermediate and less able workers benefit from higher visibility, whereas high-ability workers suffer from it. Second, the income effect is nonmonotonic. In particular, intermediate ability types benefit from higher visibility more strongly than low ability types.

Finally, firm profits are affected by the degree of visibility as well. Obviously, alternative employers make zero profits irrespective of the degree of visibility as the worker always stays with the current employer. The expected profit of the current employer before learning the worker type is affected by an increase in  $v$  in two ways. On the one hand, expected wage payments increase, because the probability that a worker is invisible and can be retained with a zero wage decreases. On the other hand, an increase in  $v$  induces the current employer to lower the cut-off  $A^+$ . Hence, she attenuates the inefficiency in job assignment, resulting in higher expected output for the firm. However, the latter effect is second order and, thus, dominated by the negative first effect such that the current employer suffers from higher visibility.

In our setting, the surplus that is to be divided between the worker and the current employer is identical to the worker's realized output. Higher visibility increases this output, because it triggers less inefficient job assignment. Taken together with the negative effect of an increase in  $v$  on expected firm profits, it directly follows that from an ex ante perspective, that is, before the ability type is realized, the worker benefits from higher visibility on job 0. Hence, higher visibility is not only surplus-increasing but also induces a redistribution of income from the current employer to the worker.<sup>13</sup>

**Proposition 3.** *Suppose  $\gamma \rightarrow 0$ . The expected surplus and the expected wage of the worker increase in  $v$ , whereas the current employer's expected profit is decreasing in  $v$ . The profit of alternative employers is zero.*

Propositions 1–3 yield the following three testable predictions for the experiment in the second part of our paper. First, higher visibility causes a decrease in the equilibrium cut-off. Second, it induces a nonmonotonic income effect. Third, surplus and the worker's average wage increase as a consequence of higher visibility, whereas firm profits decrease.

## 4 | EXPERIMENTAL DESIGN

To test the predictions from the model of Section 3, we use an experimental labor market that resembles the model setup. At the beginning of the experiment, groups of three players are formed: one player is in the role of the current



employer, and the other two players represent alternative employers. The worker, however, is played by a computer that always chooses the highest available wage offer. This allows us to abstract from social preferences towards the worker and thus to identify the effect of changes in worker visibility as cleanly as possible. Each firm receives an endowment of 150 points. For the experimental labor market we choose a calibration of exogenous model parameters that fulfills Assumptions 1 and 2 and for which worker output is easy to calculate for subjects. In particular, we implement  $s = 1.5$ ,  $d_1 = 0$ ,  $c_1 = 12$ ,  $d_0 = 38$ ,  $c_0 = 4$ , and  $\bar{A} = 20$ . Hence, the output of a worker of ability  $A$  on job 1 is given by  $y = 12A$  for an alternative employer and by  $y = 30A$  for the current employer. If the current employer assigns the worker to job 0, his output is given by  $y = 95 + 10A$ . Consistent with the equilibrium analysis, we choose  $\gamma = 0$ , that is in the experiment the worker does not leave the current employer for exogenous reasons.

We consider two different treatment conditions, *invisibility* and *visibility*. In *invisibility*, the game proceeds in the following three stages. First, the ability of the worker is randomly drawn from the set  $\{0, 1, \dots, 19, 20\}$ , where each realization is equally likely. At the second stage, the current employer decides about the job assignment. At this stage of the experiment, we use the strategy method.<sup>14</sup> Hence, the current employer decides on the job assignment for every possible ability level  $A$  before she is informed about the worker's ability. The application of the strategy method enables us to elicit the entire promotion strategy and not only the job assignment for the actually realized ability type. Once the current employer has decided about job assignments, she is informed about the actual ability of the worker and the job assignment for this ability type is implemented. Meanwhile, that is before the alternative employers are informed about the actual job assignment, we elicit their beliefs about worker ability for both possible job assignments of the current employer. For this purpose, every alternative employer states a point belief  $\hat{A}_j$  about the ability of the worker for the case that he is assigned to job  $j = 0$  as well as for the case that he is assigned to job  $j = 1$ . Alternative employers are informed that only the belief stated for the actual job assignment of the current employer is relevant for their payoff: given the actual job assignment  $j$ , the payoff is given by  $200 - 10 \times |\hat{A}_j - A|$  points, such that the payoff is decreasing in the distance between actual and estimated ability.<sup>15</sup> As alternative employers state the beliefs before being informed about job assignment, this procedure incentivizes both beliefs.

At the third stage, alternative employers are informed about the actual job assignment of the current employer but not about the actual ability of the worker. All firms then offer wages to the worker if the current employer has assigned him to job 1. If, however, the current employer assigns the worker to job 0, the worker is invisible and alternative employers are not able to post a wage offer, which corresponds to  $v = 0$ . The payoff of the firm offering the highest wage is given by the initial endowment plus the output of the worker minus the wage offer. All other firms keep their initial endowment. At the end of the game, each firm is informed about all wage offers in the group, the actual ability of the worker and its own payoff.

The *visibility* treatment is identical to the *invisibility* treatment, except for the fact that now the worker is always visible for all firms irrespective of the job assignment. Hence, in the experiment we consider the two polar cases  $v = 0$  (*invisibility*) and  $v = 1$  (*visibility*).

In the instructions, we used a neutral framing, that is, value-laden terms like “worker,” “employer,” or “poaching” were not used. Subjects completed a short quiz before each session started to check their understanding of the instructions. As additional controls, we elicited subjects' risk attitude, cognitive reflection score, and competitiveness after the experiment. Risk attitude was measured using the incentivized elicitation of Dohmen et al. (2011b).<sup>16</sup> The cognitive reflection score is elicited according to the procedure proposed by Frederick (2005).<sup>17</sup> We measured competitiveness using an unincentivized survey question.<sup>18</sup> The share of male subjects was 47% and subjects were on average 22.8 years old with an average risk score of 4.11, a CRT score of 1.66, and a competitiveness score of 5.48. The experiment was conducted in the BonnEconLab at the University of Bonn, programmed in z-tree (Fischbacher, 2007), and subjects were invited via the online recruiting system “hroot” (Bock et al., 2014). Most of the subjects were students from various fields of the University of Bonn. Overall, we conducted four sessions of the experiment, two for each treatment, with 24 subjects per session. Subjects interacted for three trial rounds and 15 payoff relevant rounds. In each session, they were randomly assigned to four matching groups with six participants each. In each round, three players within one matching group were randomly grouped to play the game described above. Moreover, roles were also randomly assigned within each of these groups in every period. This procedure yields eight independent observations per treatment for the nonparametric tests reported below. At the end of each session, one round was randomly selected to determine the subjects' payoffs. The points earned by a subject in this round were converted to Euros according to 20 points = 1 euro. Session duration was approximately 100 min and subjects earned 22.14 euros (approx. 25.02 USD) on average.

## 5 | EXPERIMENTAL RESULTS

This section provides the experimental test of the hypotheses on the consequences of changes in worker visibility for job assignment, wages and the distribution of the overall surplus.

### 5.1 | The impact of worker visibility on job assignment

Our theoretical findings predict that the current employer assigns the worker to the two jobs according to a cut-off rule. As we use the strategy method when eliciting job assignment in our experiment, we are able to directly check if subjects use cut-off strategies. Over both treatments, the vast majority of job assignments is indeed implemented by a cut-off rule (93.13%).<sup>19</sup> Furthermore, the relative frequency of cut-off decisions is not substantially different between *visibility* and *invisibility* (92.92% vs. 93.33%;  $p = 1.000$ , Fisher's exact).<sup>20</sup>

Our focus is, however, on how job assignment is affected by worker visibility. As depicted by Figure 1, there is a strong treatment difference in the cut-offs being employed. While the average cut-off is 12.93 in *invisibility*, it decreases to 6.32 in *visibility*. The difference in cut-offs is highly significant ( $p < .01$ , the Wilcoxon rank-sum test [WRT]). In line with the discussion in Section 3, we will sometimes refer to the workers that are not promoted in both treatments, that are only promoted in *visibility*, and that are always promoted, as being of low, intermediate, and high ability, respectively. The result shows that less visibility on lower hierarchy levels leads employers to significantly shift their job assignment. Compared to *visibility*, current employers on average assign twice as many worker types to job 0 in *invisibility*. In particular, they assign workers to job 0 that would have been more productive on job 1.<sup>21</sup>

We will now compare the observed cut-offs to the theoretical predictions. Given the parameters chosen in the experiment, the equilibrium cut-offs are 16 in *invisibility* and 11 in *visibility*. In both treatments, the experimentally observed average cut-off is significantly lower than the predicted cut-off ( $p < .01$ ,  $t$ -test). In the following, we will show that the elicited controls help to explain the difference between theoretically predicted and experimentally observed cut-offs. First, regression results displayed in Table 1 indicate that cut-off decisions are not associated with the individual levels of competitiveness and risk aversion. Second, when pooling the data of both treatments, the CRT score is positively related to the average cut-off set by an individual. As the experimentally observed average cut-off is in between the efficient cut-off  $A^* = 5$  and the theoretically predicted cut-off, subjects with a low CRT score tend to choose cut-offs closer to the efficient cut-off, whereas subjects with a high CRT score choose cut-offs closer to the theoretical prediction.

A plausible explanation for this finding is that the efficient cut-off constitutes a focal point. Promoting efficiently is arguably the most plausible focal point because of two reasons. First, the instructions to the experiment inform subjects about the productivity of each ability type on both jobs. Accordingly, the first idea that comes to mind when contemplating which assignment strategy to choose appears to be to assign each ability type to its output-maximizing task.

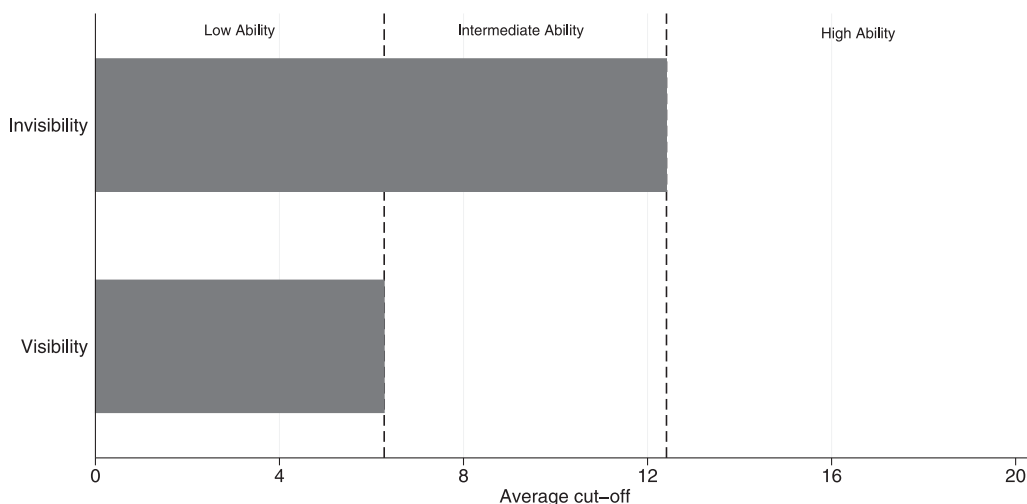


FIGURE 1 The average promotion cut-offs across treatments

**TABLE 1** Determinants of cut-off decision of current employers

	Cut-off		
	(1) Pooled data	(2) Visibility	(3) Invisibility
CRT	1.648 <sup>***</sup> (0.422)	0.959 <sup>***</sup> (0.241)	0.530 (0.671)
Risk attitude	0.599 (0.344)	0.377 (0.298)	0.938 (0.590)
Competitiveness	-0.0531 (0.131)	-0.0923 (0.110)	0.100 (0.231)
Constant	4.520 <sup>**</sup> (2.017)	3.800 <sup>***</sup> (1.066)	7.340 <sup>*</sup> (3.207)
N	93	47	46
R <sup>2</sup>	0.162	0.207	0.090

Note: Reported standard errors (in parentheses) account for potential clustering on the matching-group level.

\* $p < .1$ .

\*\* $p < .05$ .

\*\*\* $p < .01$ .

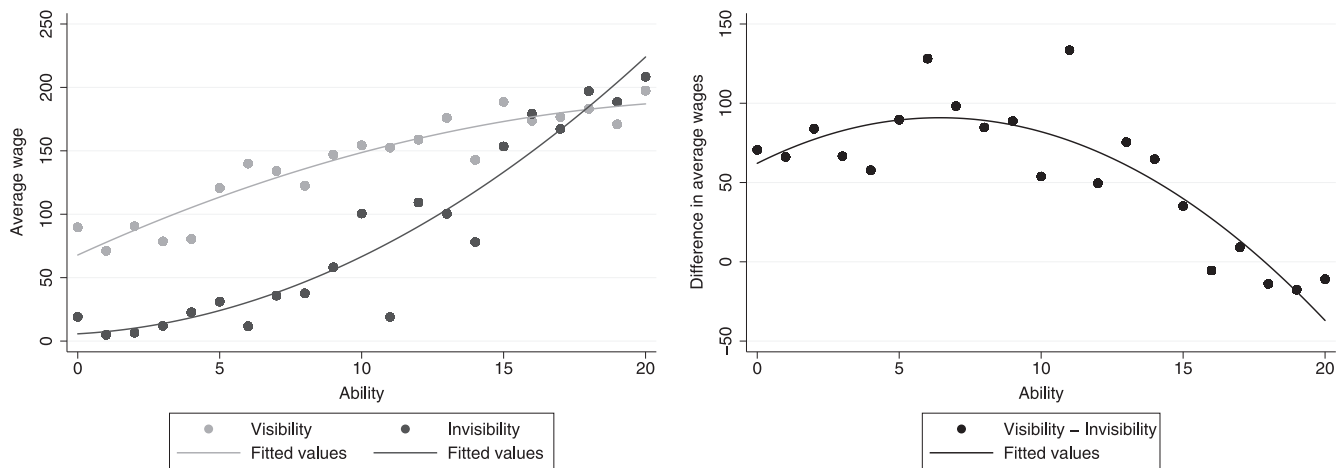
Second, the motive of efficient promotion pins down an assignment strategy that is independent of the behavior of alternative employers and, hence, easily deduced without having to form beliefs about the behavior of alternative employers. If this assertion is true, subjects with higher cognitive reflection should be more likely to resist sticking to the focal point and thus to adopt an inefficiently high cut-off.

Interestingly, the deviation from the equilibrium cut-off is significantly larger in *visibility* than in *invisibility* ( $p < .01$ , WRT). This finding is intuitively plausible as the efficient cut-off should be a stronger focal point in *visibility* than in *invisibility*, where the possibility to hide a worker creates a strong incentive to deviate from efficient job assignment. In line with this intuition, the impact of the CRT score on the adopted cut-off is only significant in *visibility* but not in *invisibility* (see Columns (2) and (3) of Table 1). Overall, limited cognitive reflection ability of subjects provides a plausible explanation for (a) observed cut-offs being lower than predicted ones, and (b) the difference being larger in *visibility* than in *invisibility*.

## 5.2 | The income effects of worker visibility

We now turn to the resulting consequences of worker visibility for wages. To provide a first overview of the data, the left panel of Figure 2 displays how average wages depend on ability for both treatments. While average wages appear to be convex in ability in *invisibility*, there is a weakly concave relation in *visibility*.<sup>22</sup> This difference in curvatures of the two graphs in the left panel of Figure 2 hints at the nonmonotonic income effect suggested by Proposition 2. Asserting this evidence, the right panel of Figure 2 plots the difference between the two curves in the left panel. This difference is the income effect of worker visibility for workers of different ability. The figure suggests a positive income effect for low ability workers. For workers of intermediate ability the income effect is also positive and even stronger. In contrast, the income effect decreases for high ability workers such that it even becomes negative for workers of very high ability.

To statistically demonstrate the nonmonotonicity of the heterogeneous treatment effect, we employ the model shown in Table 2. Columns (1) and (2) estimate a quadratic model for both treatments separately. The estimates pick up the suggested shape of wage payments in the left panel of Figure 2. In particular, the estimates for *visibility* show that wages increase in ability almost linearly. If anything there is a small negative quadratic component indicating a concave shape. In contrast, the model reveals a strongly convex relationship between wages and ability for the *invisibility* treatment. To show how the income effect of visibility differs across different levels of worker ability, Column (3) pools the data from both treatments. Moreover, we add a treatment dummy and allow for an interaction of the treatment



**FIGURE 2** The left panel shows average wages for workers with different ability for both treatments. The right panel shows the differences in wages across treatments for different worker types

effect with worker ability. To accommodate the nonlinearity of the income effect, we also allow for an interaction of the treatment effect with ability squared, that is we allow the effect of ability on wages to have different curvatures in both treatments. In line with Proposition 2, we find the following three patterns. First, the estimated coefficient of the treatment dummy is significantly positive. Hence, the income effect is positive for workers of very low ability. Second, the coefficient of the linear interaction term is positive and highly significant such that there is a positive slope of the income effect for low ability workers, that is, the income effect is even more positive for workers of intermediate ability. Third, the coefficient of the quadratic interaction term is negative and highly significant. The positive slope of the income effect thus at least attenuates for workers of higher ability. Importantly, a closer look at the coefficients reveals that the quadratic model predicts a nonmonotonic relationship. In particular, the slope for the income effect is predicted to be negative for all workers with ability above 7. In fact, the quadratic model even predicts a negative income effect for all workers with ability above 18. The income effect of these workers is indeed negative and significantly different from zero ( $p = .087$ ,  $t$ -test). To show robustness of our findings, in Columns (4) and (5), we add our measures for cognitive reflection ability, risk attitude, and competitiveness as well as controls for age, gender, and mathematical ability. There is no systematic impact of these personal characteristics on the realized wage and, most importantly, the impact on size and significance of the treatment dummy and the interaction terms is negligible.<sup>23</sup>

### 5.3 | The surplus effects of worker visibility

The redistribution effects of worker visibility directly pose the question how it influences the income distribution between firms and workers as well as overall surplus. Proposition 3 states that we expect firms to suffer from increases in worker visibility while workers should benefit. To investigate this hypothesis, Figure 3 shows the average income of workers and the average profit of firms that employ a worker.<sup>24</sup> While those firms that fill their vacancy realize an average profit of 181.86 in *invisibility*, they only make an average profit of 122.73 in *visibility*. This decrease in profits due to worker visibility is significant ( $p = .0357$ , WRT).

The decrease in profits of current and alternative employers comes along with income improvements for workers. In particular, average wages are significantly lower in *invisibility* compared to *visibility* ( $p < .01$ , WRT). Hence, as predicted by theory, workers on average benefit from visibility. Therefore, the redistribution of income across workers that we identified in Sections 3 and 5.2 is not a zero sum transaction from the workers' perspective.

Finally, Proposition 3 predicts that worker visibility additionally increases overall surplus because it causes less inefficient job assignment. As outlined in Section 5.1, we do find that job assignment is less inefficient if workers are visible on both jobs. However, the overall surplus does not significantly increase over treatments. If anything, the overall surplus is slightly lower in *visibility* than in *invisibility*, with the difference being insignificant ( $p = .8336$ , WRT). Hence, our experimental results do not confirm the prediction that worker visibility is surplus-enhancing. In Section 6.2, we discuss various explanations for this finding.

**TABLE 2** Determinants of wages across treatments

	Realized wage				
	(1) Visibility	(2) Invisibility	(3) All	(4) All	(5) All
Ability	10.91 <sup>***</sup> (2.701)	−0.969 (2.810)	−0.969 (2.718)	−0.797 (2.797)	−0.904 (2.591)
Ability squared	−0.226 <sup>*</sup> (0.113)	0.619 <sup>***</sup> (0.136)	0.619 <sup>***</sup> (0.132)	0.608 <sup>***</sup> (0.137)	0.620 <sup>***</sup> (0.126)
Visibility			54.00 <sup>***</sup> (15.57)	49.26 <sup>***</sup> (14.74)	45.90 <sup>***</sup> (13.99)
Visibility × Ability			11.87 <sup>***</sup> (3.769)	11.63 <sup>***</sup> (3.824)	12.01 <sup>***</sup> (3.773)
Visibility × Ability squared			−0.845 <sup>***</sup> (0.171)	−0.821 <sup>***</sup> (0.177)	−0.842 <sup>***</sup> (0.173)
CRT				−4.445 (2.683)	−3.906 (2.861)
Risk attitude				−5.212 <sup>*</sup> (2.483)	−5.606 <sup>*</sup> (2.694)
Competitiveness				−0.542 (1.001)	0.00802 (1.018)
Constant	58.01 <sup>***</sup> (15.26)	4.012 (5.119)	4.012 (4.950)	37.64 <sup>***</sup> (11.63)	79.22 <sup>***</sup> (21.41)
Controls	No	No	No	No	Yes
<i>N</i>	240	240	480	480	480
<i>R</i> <sup>2</sup>	0.444	0.602	0.599	0.608	0.614

Note: OLS estimates; reported standard errors (in parentheses) account for potential clustering on the matching-group level. Visibility is equal to one for the visibility treatment and zero otherwise. Columns (1)–(2) report estimates for both treatments separately. Columns (3)–(5) pool the data. Controls include gender, age, and the last math grade.

\* $p < .1$ .

\*\* $p < .05$ .

\*\*\* $p < .01$ .

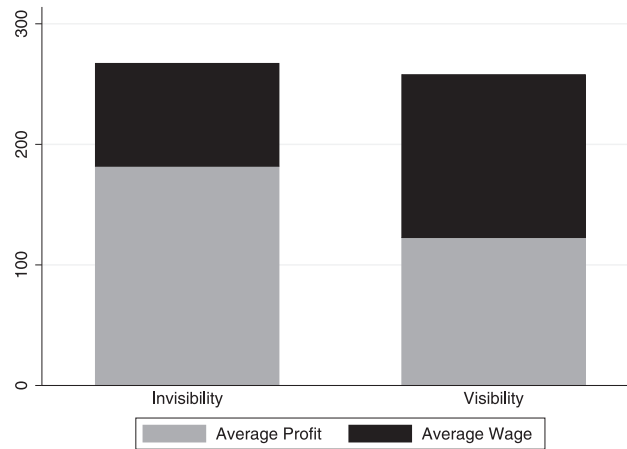
## 6 | DISCUSSION OF RESULTS

### 6.1 | Turnover

Recall that in equilibrium alternative employers correctly anticipate the cut-off adopted by the current employer and offer a wage equal to their maximum willingness to pay. The current employer, in turn, knows that alternative employers hold rational expectations and matches the correctly anticipated wage offers by alternative employers. Hence, the theoretical prediction is that both types of employers offer the same wage, which is equal to the maximum willingness to pay of the alternative employers. Accordingly, the worker stays with the current employer.

However, in our experiment, wage offers of the current and alternative employers are not always identical and, hence, subjects do not always play mutual best responses. In particular, we frequently observe that the current employer does not offer the highest wage, which implies successful poaching by alternative employers. In fact, 19.6% of all workers leave their current employer. As alternative employers can poach workers if they are assigned to job 0 only in *visibility*, we observe successful poaching by an alternative employer more often in *visibility* than in *invisibility* (28.3% vs. 10.8%;  $p = .0225$ , WRT). One might therefore infer that alternative employers benefit from higher visibility because they achieve to fill their vacancies. It turns out, however, that this is not the case. On the contrary, both current and



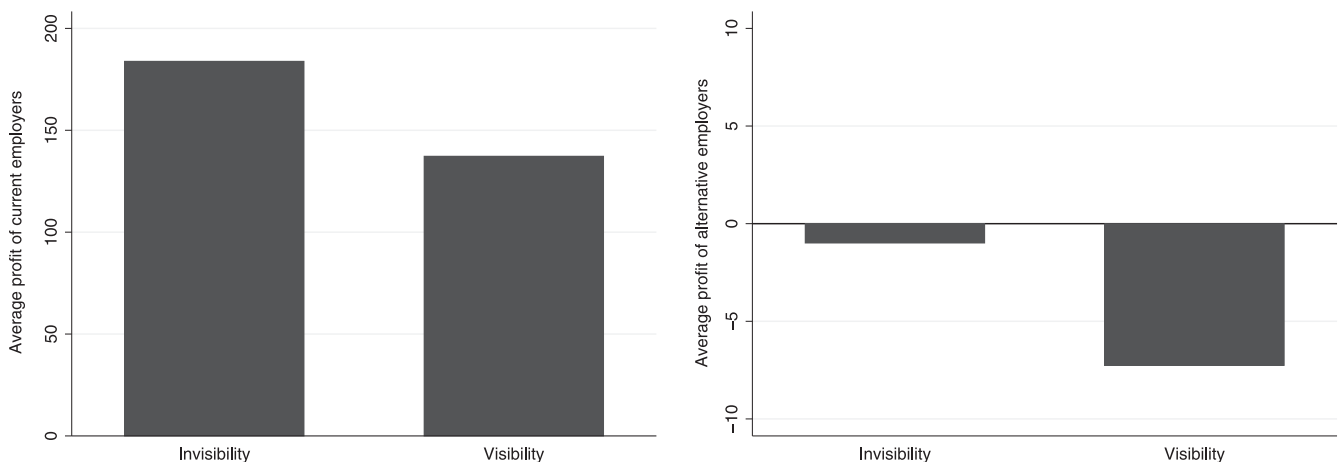


**FIGURE 3** Average profits of firms employing a worker and average wages of workers by treatments

alternative employers suffer from worker visibility. The left panel of Figure 4 depicts the average profit of current employers in both treatments. It becomes apparent that, just as predicted by theory, they realize on average lower profits in *visibility* compared to *invisibility* ( $p = .0274$ , WRT). The right panel of Figure 4 shows the average profits of alternative employers in each treatment. In contrast to current employers, they realize on average negative profits when they hire a worker. This finding suggests that they fall victim to a winner's curse like phenomenon.<sup>25</sup> Worker visibility makes alternative employers more prone to this kind of winner's curse. As a consequence, alternative employers, in analogy to current employers, earn significantly lower average profits in *visibility* compared to *invisibility* ( $p = .0587$ , WRT). Hence, both firm types in our experiment suffer from worker visibility.

A possible explanation for the observed behavioral patterns in our experiment is that, on the one hand, current employers tremble sometimes, which induces them to offer too low wages such that the worker is poached by alternative employers. On the other hand, some alternative employers might have cursed beliefs a la Eyster and Rabin (2005), that is, they do not fully account for the fact that current employers condition their promotion strategy on private information about the worker's ability. As a consequence, alternative employers sometimes outbid current employers.

Note that the frequency of turnover decreases from 28% in the first to 16% in the last period. According to the results displayed in Column (3) in Table B1, there is a weakly significant negative time trend in turnover. Estimations for each treatment separately (Columns (1) and (2)) reveal that the effect is mainly driven by a significant negative time trend in *visibility*. In *invisibility*, the frequency of turnover is rather stable over time at around 10%. These results indicate that



**FIGURE 4** The left panel shows average profits of current employers for both treatments. The right panel depicts the corresponding profits for alternative employers

subjects, especially in *visibility*, learn to avoid inefficient turnover to some extent. Nevertheless, turnover also occurs frequently even in late periods of both treatments.

## 6.2 | Why is surplus not increasing in visibility?

This section discusses potential driving forces behind the finding that surplus is identical across treatments in our experimental labor market. In both treatments, abilities are drawn from a uniform distribution. The distributions of actually realized abilities in the two treatments, however, are not exactly identical.<sup>26</sup> To rule out that differences in the distributions of realized abilities affect the following results, we run our analysis conditional on ability by adding ability fixed effects to the regressions. Conditional on worker ability, the first column of Table B2 replicates the result that surplus in *visibility* is not significantly different from the surplus in *invisibility*.

There are two plausible explanations for the lack of a surplus effect, both of which are connected to the fact that we frequently observe successful poaching by alternative employers in both treatments. First, alternative employers only operate by means of job 1 and are not able to assign a successfully poached worker to job 0. In particular, alternative employers might prefer to assign the worker to job 0 if they poach a worker of presumably low ability. These worker types, however, are typically assigned to job 0 by their current employers and can therefore only be poached in *visibility*. As a consequence, surplus might be artificially low in *visibility* which counteracts the prediction that worker visibility improves surplus. To shed some light on this explanation, we calculated the hypothetical surplus for the case in which alternative employers can also produce by means of job 0 and assign a worker to that job if and only if he was poached from job 0.<sup>27</sup> The results displayed in Column (2) of Table B2 reveal that the impact of this exercise is negligible as the hypothetical surplus also does not differ significantly across treatments. While these findings suggest that the lack of a job 0 for alternative employers are not driving our results on surplus, note that the analysis ignores potential equilibrium effects that arise because alternative employers are willing to increase their wage offers and therefore equilibrium cut-offs change.

Second, it could also be the case that turnover itself is responsible for the result on surplus. Since turnover occurs more frequently in *visibility* than in *invisibility* and is clearly surplus-decreasing due to firm-specific human capital, the negative effect of turnover on surplus is more pronounced in *visibility* than in *invisibility*. To shed some light on whether turnover has caused the missing relationship between visibility and surplus, we calculated a second hypothetical surplus for the case in which the worker always stays with the current employer. This approach eliminates any inefficiency due to turnover. As shown in Column (3) of Table B2, the hypothetical surplus without turnover is indeed significantly higher in *visibility* compared to *invisibility*. The result demonstrates that turnover plays a crucial role in preventing the predicted relation between visibility and surplus.<sup>28</sup>

## 6.3 | Robustness of empirical results

The experiments conducted for the main part of the paper represent the two polar cases for the level of visibility  $v$ . In particular, the worker is either fully visible to all alternative employers or not visible at all if he is assigned to job 0. While the comparison of these parameter constellations is informative, visibility in real employment situations is rather a continuous than a binary variable and observed levels of visibility will often be intermediate, that is, there is a chance that alternative employers learn about the existence of a particular worker but it is not certain. We, therefore, conducted additional sessions of our lab experiment to analyze the extent to which our results also hold if outcomes under partial visibility are compared to the outcomes in the extreme cases. The sessions in the new treatment (*partial visibility*) were identical to the sessions described in Section 4 except for the level of visibility, which was set to  $v = \frac{1}{2}$ . Hence, the worker became visible to alternative employers with 50% probability if he was assigned to job 0. The level of visibility was common knowledge for all subjects.

Figure B1 in Appendix B depicts the average levels of the cut-offs in all three treatments. As predicted by Proposition 1, the promotion cut-off in *partial visibility* is in between the cut-offs in *invisibility* and *visibility*. The job assignment strategy in *partial visibility* is significantly different from the corresponding strategy in *visibility* ( $p < .01$ , WRT) as well as the one in *invisibility* ( $p = .012$ , WRT). These findings suggest that there is indeed a strictly monotone relationship between the visibility of workers and their job assignment.

Recall that the curvature of the wage pattern is clearly convex in *invisibility* as indicated by a highly significant positive effect of squared ability, whereas it appears to be concave in *visibility* due to a weakly significant negative effect

of squared ability. In *partial visibility*, the effect of squared ability is negative as in *visibility*, but it is not significant (see the first column of Table B3. Hence, the convexity of the wage pattern attenuates gradually when visibility increases, although the wage pattern in *partial visibility* resembles the one in *visibility* (see Figure B2 in Appendix B). Rerunning the analysis from Table 2 confirms this observation (see Columns (2) and (3) of Table B3. Although the signs of the coefficients of the interaction terms are in line with the theoretical prediction, we do not find a significant difference between the wage patterns in *visibility* and *partial visibility*. When comparing *partial visibility* and *invisibility*, however, our results provide strong evidence for the predicted nonmonotonic income effect of higher visibility: (a) the treatment dummy for *partial visibility* is positive and highly significant, (b) the interaction with ability is positive and highly significant, and (c) the interaction with squared ability is negative and highly significant.

Finally, we can also investigate the surplus and profit consequences due to partial visibility of workers.<sup>29</sup> Corroborating our earlier results, overall surplus is not significantly different across the three treatments ( $p = .5698$ , Kruskal-Wallis-test). While profits in *partial visibility* are significantly lower than in *invisibility* ( $p < .01$ , WRT), they are not significantly different from the case of full visibility. To understand why profits in *partial visibility* and *visibility* are not significantly different, it is helpful to have a closer look at how turnover differs across treatments. While turnover in *partial visibility* is in between the levels in *visibility* and *invisibility*, it is much closer to the corresponding level in *visibility*. In particular, turnover is significantly smaller in *invisibility* than in *partial visibility* ( $p < .01$ , WRT) but not significantly different between *visibility* and *partial visibility* ( $p > .9$ , WRT). These results suggest that, although the efficiency of promotion strategies is lower in *partial visibility* than in *visibility* the persistent turnover prevents profits to increase substantially.

Overall, the data thus suggest that the inefficiency in job assignment indeed monotonically decreases in worker visibility. However, the corresponding effects on firm profits and wage patterns seem to be particularly pronounced if the level of visibility is low to start with. At the same time, the response in wages and profits due to further increases in worker visibility seem to attenuate if the level of worker visibility is high for all competing firms.

## 6.4 | Endogenous visibility

The model described in Section 2 postulates that worker visibility is affected by job assignment but abstracts from the possibility that workers may endogenously invest in their visibility (e.g., sending out CVs to alternative employers or intensifying activities in web-based social networks). In the following modified version of the original model, we will allow for such investments and derive two results. First, an increase in the endogenously acquirable visibility negatively affects the equilibrium promotion cut-off. This finding reiterates our earlier result on the effects of visibility on job assignment. Second, contrary to an increase in exogenous visibility, an increase in endogenous visibility might be surplus-decreasing.

We consider our original model for the special case  $\nu = 0$  such that the exogenous probability that a worker becomes visible after being assigned to job 0 is zero. We endogenize visibility by introducing a new date 2.5, at which the worker has to choose between two alternatives. The first alternative, labeled  $e_L$ , corresponds to a choice of low productive but high nonproductive self-sponsoring effort, whereas the second alternative, labeled  $e_H$ , mirrors high productive but low self-sponsoring effort. Specifically, a worker choosing  $e_L$  realizes output  $\pi > 0$  with probability  $p_L \in (0, 1)$  and zero output with probability  $1 - p_L$ . Additionally, given he was assigned to job 0, he will become visible for alternative employers with probability  $\hat{\nu} \in (0, 1)$ .<sup>30</sup> After choosing  $e_H$ , the probability to realize  $\pi$  is  $p_H > p_L$ , but the worker will remain invisible on job 0. We assume  $e_L$  to be costless, whereas  $e_H$  comes at effort cost  $\kappa > 0$ .<sup>31</sup> In case of indifference, the worker is assumed to choose  $e_H$ .

The worker's effort choice is a hidden action. As the realized output, which accrues to the current employer, is observable and verifiable, the current employer may incentivize the worker to choose  $e_H$  by offering payments contingent on job assignment and output.<sup>32</sup> We assume that the worker is protected by limited liability such that the corresponding payments have to be nonnegative. Hence, the current employer will offer the worker on job  $j$  a bonus  $b(j) \geq 0$  for the case of realized output  $\pi$ , and a zero payment if zero output is realized. To ensure interior solutions and make the moral-hazard problem meaningful, we impose two technical assumptions:

### Assumption 3.

- (i)  $\frac{c_1 \bar{A}}{2} > \frac{p_L}{p_H - p_L} d_1$
- (ii)  $\pi \cdot p_H - \kappa > \pi \cdot p_L$

Assumption 3 (i) ensures that the equilibrium promotion cut-off is strictly positive, whereas Assumption 3(ii) states that  $e_H$  is efficient. When solving the modified game, we focus on cut-off equilibria, that is on equilibria where the current employer assigns all ability types lower than  $A^+$  to job 0, and promotes all other ability types to job 1:

**Proposition 4.** *Suppose  $\gamma \rightarrow 0$ . There exist  $\underline{\pi}$  and  $\bar{\pi}$  with  $0 < \underline{\pi} < \bar{\pi}$ , and  $\bar{v}$  such that:*

- (1) *For  $\pi < \underline{\pi}$ , only  $e_L$  being implemented at both jobs can be supported in equilibrium.*
- (2) *For  $\underline{\pi} \leq \pi < \bar{\pi}$ , there can only exist equilibria in which (a)  $e_H$  is implemented at job 1, and (b)  $e_L$  ( $e_H$ ) is implemented at job 0 if and only if  $\hat{v} > (<)\bar{v}$ .*
- (3) *For  $\pi \geq \bar{\pi}$ , only  $e_H$  being implemented at both jobs can be supported in equilibrium.*

*In any equilibrium, the promotion cut-off strictly decreases with  $\hat{v}$ .*

To delineate the intuition underlying this result, note first that implementing  $e_H$  at job 0 is more costly for the current employer than implementing the same effort at job 1. As compared to job 1, the worker additionally benefits from choosing  $e_L$  at job 0 due to the increase in his visibility to alternative employers. Accordingly, at job 0 the current employer has to offer higher-powered incentives to implement  $e_H$  than at job 1.

For  $\pi < \underline{\pi}$ , the worker's output in case of success is so small that the current employer prefers to implement  $e_L$  at job 1. For the reason just explained, the current employer then prefers implementation of  $e_L$  all the more at job 0. For  $\underline{\pi} \leq \pi < \bar{\pi}$ , output  $\pi$  is sufficiently large such that the current employer prefers to induce  $e_H$  at job 1. Implementation of effort at job 0 depends on  $\hat{v}$ : the larger the probability of becoming visible, the more the worker will be tempted to choose  $e_L$  so that the additional cost of implementing  $e_H$  increases with  $\hat{v}$ . Hence, there exists a critical value,  $\bar{v}$ , so that the employer implements  $e_L$  at job 0 but  $e_H$  at job 1 if and only if  $\hat{v}$  is above  $\bar{v}$ . Finally, for  $\pi \geq \bar{\pi}$ , the output  $\pi$  is high enough such that the current employer prefers to implement  $e_H$  even at job 0 and is willing to offer high-powered incentives to prevent poaching.

Note that there is the same inverse relationship between  $\hat{v}$  and the promotion cut-off  $A^+$  as we derived in the main model in terms of exogenous visibility. This result holds irrespective of whether the current employer prefers to implement  $e_L$  or  $e_H$  at job 0. First, given  $e_L$  is implemented, a larger threat of actual poaching offers is associated with an increase in  $\hat{v}$ . The current employer more often has to match poaching offers such that the expected retention wage increases. As a consequence, assigning a worker to job 0 becomes less attractive and the promotion cut-off decreases. Second, even if the threat of poaching offers is eliminated as the current employer implements  $e_H$  at job 0, an increase in  $\hat{v}$  makes assignment of a worker to job 0 less attractive. Although there is no need for the current employer to pay a retention wage (the worker does not receive any poaching offers), it becomes more costly to implement  $e_H$ . This is true because an increase in  $\hat{v}$  makes self-sponsoring effort more effective and, hence, the choice of  $e_L$  more attractive for the worker. Accordingly, the current employer has to offer higher-powered incentives to implement  $e_H$ .

The effect of an increase in  $\hat{v}$  on surplus in the modified model is ambiguous, which is in contrast to the effect of  $v$  in the original model. Surplus in the modified setup depends, next to ability-dependent output, also on the introduced effort-dependent output. An increase in  $\hat{v}$  affects surplus via (a) the effect on the job assignment cut-off, and (b) the effect on effort implementation. First, the proof of Proposition 4 shows that the equilibrium cut-off can be inefficiently low: it might be very attractive for the current employer to promote even low ability types to job 1 as implementation of  $e_H$  is cheaper. As the equilibrium cut-off decreases in  $\hat{v}$ , an increase in visibility then leads to lower surplus via an even stronger inefficiency in job assignment. Second, as an increase in  $\hat{v}$  makes it more attractive for the current employer to implement  $e_L$  at job 0, an increase in  $\hat{v}$  might cause implementation of the inefficient effort  $e_L$  at job 0. Via these two channels, surplus might actually decrease in  $\hat{v}$ .

## 7 | CONCLUSION

In this paper, we analyzed the consequences for firms' optimal retention policies if workers become more visible to the labor market. As a direct consequence, withholding efficient promotions to decrease the workers' visibility becomes less effective. Thus, the rise of worker visibility increases the efficiency of job assignments within firms. We successfully tested this theoretical result by a laboratory experiment. Our theoretical and experimental results also show that increased visibility of workers leads to a redistribution of income between workers of different abilities, and between

workers and firms. In particular, our results suggest that earnings of firms and high income workers will be redistributed to workers of low and intermediate ability.

While most theoretical predictions are corroborated in the experimental test, there are also some interesting exceptions. Particularly, we find a substantial amount of turnover, which is increasing in worker visibility, and that surplus is identical across treatments. It turns out that these results seem to be interlinked. On the one hand, higher visibility leads to a larger surplus due to a less inefficient job-promotion policy. On the other hand, higher turnover destroys firm-specific human capital, which reduces the surplus. Both findings can be embedded as an equilibrium outcome of our model if we allow the worker to leave the current employer with a positive probability for reasons that are exogenous to his ability and wage, for example, the current employer does not make an appropriately high wage offer or the employee moves for personal reasons.<sup>33</sup>

While the data of our experiment strongly suggest that turnover is responsible for the result that surplus does not increase with visibility, they do not allow to identify why turnover frequently occurs. It would therefore be an interesting avenue for future research to discriminate between possible drivers of turnover. On the one hand, turnover could be driven by naivete of alternative or current employers when trying to correctly anticipate the behavior of their opponents, for example, they have cursed beliefs. On the other hand, the presence of turnover could be based on nonstandard preferences of alternative employers that lead to excessively high poaching offers, for example, joy of winning or status concerns (Altmann et al., 2012; Astor et al., 2013; Dohmen et al., 2011a; Sheremeta, 2010).

Our approach delineates the impact of exogenously given differences in worker visibility on a firm's personnel strategy. In practice, however, the level of worker visibility is partly also endogenously determined. In particular, workers can send out CVs to alternative employers and firms may reduce their workers' exposure to other firms. We briefly discussed the first issue and found that higher endogenous visibility can reduce the overall surplus if the workers' activities to increase visibility lead to a waste of productive working time. For future research, it would be interesting to enrich our framework for studying how differences in exogenous worker visibility affect both firms' and workers' choices to endogenously influence worker visibility.

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## ENDNOTES

<sup>1</sup>According to Ter Hoeven et al. (2019), “a common observation in the digital age is that new technologies are making people's behaviors, decisions, and preferences more visible.”

<sup>2</sup>For papers that use similar laboratory settings to depict a labor market see Falk and Fehr (2003); Fehr and Falk (1999); Brown et al. (2004); Altmann et al. (2014); Dato et al. (2016).

<sup>3</sup>See, for example, Perri (1995) and Lazear and the Gibbs (2009, pp. 89–96), for more detailed investigations of the winner's curse in labor markets.

<sup>4</sup>Gibbons and Waldman (1999, 2006) consider symmetric employer learning and possible poaching.

<sup>5</sup>In analogy to the seminal contribution of Waldman (1984) and subsequent papers building on it (e.g., DeVaro & Waldman, 2012; Gürtler & Gürtler, 2015; Owan, 2004; Waldman & Zax, 2016), we assume linear production functions (and uniformly distributed ability). In Appendix C, we show how the qualitative results of our model generalize in a setup with a broader class of production functions and distributions of ability.

<sup>6</sup>Thus, we follow the simplifying assumption of the theoretical paper by Mukherjee and Vasconcelos (2018) that the alternative employers only have a vacancy at the higher hierarchy level.

<sup>7</sup>To some extent, the assumption restricts the types of occupations whose characteristics are in line with our setup. For instance, Kwon and Meyerson Milgrom (2014) show that firm-specific human capital seems to be of minor importance for occupations such as financial administration, management of production, transportation, and maintenance work.

<sup>8</sup>Assuming nonnegative wages in our setup corresponds to imposing the assumption of a zero reservation wage.

<sup>9</sup>In principle, also alternative employers could condition their wage offer on the realization of  $V$ . Since there is no additional information in this realization, however, they will not make use of this possibility in equilibrium.

<sup>10</sup>This assumption reflects a situation in which an invisible worker cannot generate any outside offers. Hence, his only option is to stay at the current employer even if there is a conflict with his superior. The following results also hold in a situation in which a worker may also leave the current employer for exogenous reasons if he is invisible.



<sup>11</sup>While all of our results qualitatively also hold for the case of  $\gamma$  being positive but small, we choose to analyze the case of  $\gamma \rightarrow 0$  to be consistent with the literature. In particular, the seminal paper by Waldman (1984) does not allow workers to leave their current employer for exogenous reasons.

<sup>12</sup>All proofs are relegated to Appendix A.

<sup>13</sup>As already established by Waldman (1984), in a two-period setting with ex ante identical firms and worker production in each period, competition for the worker at the beginning of the first period leads to zero expected profits of firms irrespective of the degree of visibility. Hence, higher visibility would not yield a redistribution of income between firms and workers. However, all effects with regard to job assignment and income would not be affected as long as the current employer learns her worker's ability only after the first period.

<sup>14</sup>The strategy method was introduced by Selten (1967). Brandts and Charness (2011) survey applications of the strategy method in lab experiments.

<sup>15</sup>For clarification, suppose  $A = 12$  and the current employer has decided to assign that ability type to job 1, that is  $j = 1$ : if  $\hat{A}_0 = 6$  and  $\hat{A}_1 = 14$ , then  $\hat{A}_1$  is the relevant belief and the payoff is given by  $200 - 10 \times |14 - 12| = 180$ .

<sup>16</sup>Subjects had to make 10 decisions between a safe payment and a lottery, with the amount of the safe payment increasing after every decision. The score is then given by the number of decisions in favor of the lottery, such that a higher value of the measure corresponds to a higher willingness to take risks.

<sup>17</sup>The score is given by the number of correct answers to the three questions, such that a higher score indicates a higher ability to reflect on a question.

<sup>18</sup>The competitiveness score is given by the answer on a 10-point Likert scale to the following question: "How important is it for you to win a competition in the absence of monetary incentives?" Again, a higher value corresponds to a higher degree of competitiveness.

<sup>19</sup>The frequency of cut-off decisions is high throughout the entire experiment. However, subjects seem to learn that it is optimal to adopt a cut-off rule as the relative frequency of cut-off decisions is increasing over time and exceeds 96% in the last three periods.

<sup>20</sup>The deviations from the cut-off strategies do not exhibit a systematic pattern. In particular, most subjects that do not implement a cut-off rule change between the assignment of job 0 and 1 at least three times over the range of all worker abilities.

<sup>21</sup>Assigning each worker to his output-maximizing job in our experiment would imply to assign all workers with ability larger than five to job 1. Note that the average cut-off in *visibility* is significantly higher than five ( $p = .0138$ ,  $t$ -test), which nicely corresponds to the theoretical result that, even under full visibility, some worker types should be inefficiently assigned to job 0.

<sup>22</sup>A closer inspection of Figure 2 reveals that, contrary to the theoretical prediction, wages in *invisibility* are increasing in ability even for workers with rather low ability. In the experiment, also workers of low ability sometimes get promoted and earn above zero wages in *invisibility*. In particular, the likelihood of being promoted is an increasing function of ability, which explains this difference between theoretically predicted and observed wage patterns.

<sup>23</sup>The missing relationship between CRT scores and the wages offered by employers might seem surprising given that we do find that CRT scores are related to promotion cut-offs. However, controlling for the ability of the worker it is hard to detect a focal point for the wage. Raising the wage offer always entails a trade-off between higher wage costs and an increased likelihood of employing the worker.

<sup>24</sup>The profit of a firm is given by production output minus wage. Hence, the endowment is not included in profits.

<sup>25</sup>The winner's curse is a well documented finding from auctions for items of unknown value. The successful bidder fails to internalize that, given he is selected as the winner, he has received the most (over-)optimistic signal with respect to the value of the good. Accordingly, he does not adjust his bid downward and wins the auction but may realize a negative profit. See also Perri (1995) for the winner's curse in the labor market.

<sup>26</sup>The average ability in *invisibility* is 10.53 compared to 9.82 in *visibility*. A Kruskal-Wallis equality-of-populations rank test reveals that the distributions are not significantly different from each other ( $p = .1886$ ).

<sup>27</sup>Given the parameter values chosen in the experiment, output for the alternative employers of a worker of ability  $A$  on job 0 is given by  $d_0 + c_0 \cdot A = 38 + 4A$ .

<sup>28</sup>Section 6.1 showed that turnover is decreasing over time. This time trend is significantly more pronounced in *visibility* than in *invisibility* (see Column (4) of Table B1). As the difference in turnover across treatments, hence, shrinks over time, our results suggest that the positive relationship between visibility and surplus might actually emerge with more experienced decision makers.

<sup>29</sup>The results are depicted in Figure B3 in Appendix B.

<sup>30</sup>A worker on job 1 is visible anyway such that self-sponsoring effort cannot further increase the probability to become visible.

<sup>31</sup>We impose the assumption that productive effort is more exhausting than nonproductive effort. Our qualitative results, however, will also hold for  $\kappa \rightarrow 0$ , which resembles a situation in which both types of effort are similarly exhausting but the worker has to decide how to allocate a fixed amount of working time to different activities.

<sup>32</sup>Alternatively, we could assume that productive effort together with ability leads to a performance measure that is observable but unverifiable. In that case, explicit incentives cannot be installed but implicit incentives in form of career concerns may work, as the alternative employers update their ability beliefs according to observed performance.

<sup>33</sup>In our model, this corresponds to the case of  $\gamma$  being strictly positive instead of letting it converge to zero. In fact, all proofs in Appendix A also hold for positive but small  $\gamma$ .

<sup>34</sup>The proof proceeds similarly to the proof of Proposition 2 in Dato et al. (2016).

<sup>35</sup>The denominator is positive due to Assumption 1(i).

<sup>36</sup>Recall that the denominator of the expression in the first line is positive due to Assumption 1(i).

<sup>37</sup>In the given constellation,  $A^+ > 0$ . That  $A^+ < \bar{A}$  holds, can again be shown in analogy to Step 2 in the proof of Proposition 1.

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## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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## APPENDIX A: PROOFS

*Proof of Proposition 1.*<sup>34</sup> To simplify notation, we skip the argument  $V$  in the current employer's strategy. We focus on the equilibrium behavior of the  $n$  firms given that the worker is visible, as the outcome for an invisible worker is straightforward. Let  $w_1(A, j)$ ,  $w_2(j)$ , ...,  $w_n(j)$  denote the wages offered by firms 1, ...,  $n$  in equilibrium after the current employer, firm 1, has assigned the worker of ability  $A \in [0, \bar{A}]$  to job  $j \in \{0, 1\}$ . In addition, we define

$$\mathcal{A}^j := \{A \in [0, \bar{A}] \mid w_1(A, j) \geq \max\{w_2(j), \dots, w_n(j)\}\} \quad (\text{A1})$$

$$\mathcal{A}_{\emptyset}^j := \{A \in [0, \bar{A}] \mid w_1(A, j) < \max\{w_2(j), \dots, w_n(j)\}\}, \quad (\text{A2})$$

with the sets  $\mathcal{A}^1$ ,  $\mathcal{A}_{\emptyset}^1$ ,  $\mathcal{A}^0$ ,  $\mathcal{A}_{\emptyset}^0$  representing a partition of the set of possible worker abilities,  $[0, \bar{A}]$ . Finally, let  $P(\mathcal{A}) = \text{prob}(A \in \mathcal{A})$  for  $\mathcal{A} \subseteq [0, \bar{A}]$ .

*Step 1:*  $\mathcal{A}_{\emptyset}^1 = \emptyset$ .

Suppose, in contradiction, that  $\mathcal{A}_{\emptyset}^1 \neq \emptyset$ , that is, there exist ability types that are assigned to job  $j = 1$  instead of  $j = 0$  and for which firm 1 is outbid in the wage competition. Regarding the equilibrium wage offer by firm  $i = 2, \dots, n$ , we must have

$$\begin{aligned}
w_i(1) &\leq \frac{P(\mathcal{A}_\emptyset^1)}{P(\mathcal{A}_\emptyset^1) + \gamma P(\mathcal{A}^1)} \left( d_1 + c_1 E[A|A \in \mathcal{A}_\emptyset^1] \right) \\
&+ \frac{\gamma P(\mathcal{A}^1)}{P(\mathcal{A}_\emptyset^1) + \gamma P(\mathcal{A}^1)} (d_1 + c_1 E[A|A \in \mathcal{A}^1]) =: \eta(\mathcal{A}^1, \mathcal{A}_\emptyset^1),
\end{aligned} \tag{A3}$$

for otherwise one of firms  $2, \dots, n$  makes strictly negative expected profits. Now, consider an ability type  $A' \in \mathcal{A}_\emptyset^1$  with  $A' \geq E[A|A \in \mathcal{A}_\emptyset^1]$ . Because

$$\begin{aligned}
&\lim_{\gamma \searrow 0} (1+s)[d_1 + c_1 A'] - \eta(\mathcal{A}^1, \mathcal{A}_\emptyset^1) \\
&= (1+s)[d_1 + c_1 A'] - \left( d_1 + c_1 E[A|A \in \mathcal{A}_\emptyset^1] \right) > 0,
\end{aligned} \tag{A4}$$

for  $\gamma \searrow 0$  firm 1 strictly profits from deviating by offering  $\tilde{w}_1 = \eta(\mathcal{A}^1, \mathcal{A}_\emptyset^1)$  to ability type  $A'$  and retain this type. Thus,  $\mathcal{A}_\emptyset^1 \neq \emptyset$  is not true in equilibrium. ||

*Step 2:*  $\mathcal{A}^1 \neq \emptyset$ .

Let, in contradiction,  $\mathcal{A}^1 = \emptyset$ . By Step 1, this implies that all ability types  $A \in [0, \bar{A}]$  are assigned to job  $j = 0$ . No firm  $i = 2, \dots, n$  will ever offer more than  $d_1 + c_1 \bar{A}$ . As Assumption 1(i) implies that  $s \cdot (d_1 + c_1 \bar{A}) > (1+s) \cdot (d_0 + c_0 \bar{A})$ , implying that

$$s(d_1 + c_1 \bar{A}) > \max\{(1+s)(d_0 + c_0 \bar{A}) - v \max\{w_2(0), \dots, w_n(0)\}, 0\}, \tag{A5}$$

the current employer can strictly profitably deviate by assigning type  $\bar{A}$  to job  $j = 1$  and offering  $\tilde{w}_1 = d_1 + c_1 \bar{A}$ . ||

*Step 3:* If  $A' \in \mathcal{A}^1$ , then  $A'' \in \mathcal{A}^1$  for all  $A'' > A'$ .

Let, in contradiction,  $A' \in \mathcal{A}^1$  and  $A'' \notin \mathcal{A}^1$  for  $0 \leq A' < A'' \leq \bar{A}$ . First, suppose that  $A'' \in \mathcal{A}_\emptyset^0$ . Since type  $A'$  is retained by firm 1, we must have  $(1+s)(d_1 + c_1 A') - w_1(A', 1) \geq 0$ , for otherwise firm 1 could profitably deviate by making a zero wage offer to type  $A'$ . As  $A'' > A'$ , we have  $(1+s)(d_1 + c_1 A'') - w_1(A'', 1) > 0$ , such that firm 1 could strictly profitably deviate by assigning type  $A''$  to job  $j = 1$  and retaining him by offering  $w_1(A'', 1)$ . Next, suppose that  $A'' \in \mathcal{A}^0$ . This job assignment cannot be optimal as  $y^1 - \tilde{y}^1$  strictly increases with  $A$ . ||

Steps 2 and 3 together imply that  $\mathcal{A}^1$  is an interval with  $\bar{A}$  as upper limit.

*Step 4:* If  $A' \in \mathcal{A}^0$ , then  $A'' \in \mathcal{A}^0$  for all  $A'' > A'$  with  $A'' \notin \mathcal{A}^1$ .

Let, in contradiction,  $A' \in \mathcal{A}^0$  and  $A'' \in \mathcal{A}_\emptyset^0$  with  $0 \leq A' < A'' < \bar{A}$ . However, if  $A' \in \mathcal{A}^0$  is optimal for the current employer, the same must be true for  $A''$  as  $\tilde{y}^1$  strictly increases with  $A$ . ||

To sum up, also the sets  $\mathcal{A}^0$  and  $\mathcal{A}_\emptyset^0$  are intervals.

*Step 5:*  $\mathcal{A}^1 \neq [0, \bar{A}]$ .

Let, in contradiction,  $\mathcal{A}^0 = \mathcal{A}_\emptyset^0 = \emptyset$ . The Bertrand nature of wage competition requires that  $\max\{w_2(1), \dots, w_n(1)\} = d_1 + c_1 \frac{\bar{A}}{2}$ . Firm 1 will make negative expected profits with the lowest ability type  $A = 0$  if

$$(1+s)d_1 - \left( d_1 + c_1 \frac{\bar{A}}{2} \right) < 0, \tag{A6}$$

which holds by Assumption 1(i). Hence, firm 1 would have a profitable deviation. ||

*Step 6:* Either  $\mathcal{A}^0 \neq \emptyset$  and  $\mathcal{A}_\emptyset^0 = \emptyset$ , or  $\mathcal{A}^0 = \emptyset$  and  $\mathcal{A}_\emptyset^0 \neq \emptyset$ .

Let, in contradiction,  $\mathcal{A}^1, \mathcal{A}^0, \mathcal{A}_\emptyset^0 \neq \emptyset$  in equilibrium. The Bertrand nature of wage competition requires that  $w_1(A', 0) < \max\{w_2(0), \dots, w_n(0)\} = \eta(\mathcal{A}^0, \mathcal{A}_\emptyset^0) = w_1(A'', 0)$  for  $A' \in \mathcal{A}_\emptyset^0$  and  $A'' \in \mathcal{A}^0$ , such that firms

2, ..., n make zero expected profits. By Step 4, we know that  $A' < A''$ . As  $\lim_{\gamma \searrow 0} \eta(\mathcal{A}^0, \mathcal{A}_\emptyset^0) = d_1 + c_1 E[A | A \in \mathcal{A}_\emptyset^0]$ , for  $\gamma \searrow 0$  firm  $i$  with  $w_i(0) = \min\{w_2(0), \dots, w_n(0)\}$  has a strictly profitable deviation: if offering  $\tilde{w}_i(0) = d_1 + c_1 E[A | A \in \mathcal{A}_\emptyset^0] + \varepsilon$  with  $\varepsilon \searrow 0$ , firm  $i$  will obtain a worker of type  $A \in \mathcal{A}^0 \cup \mathcal{A}_\emptyset^0$  for sure and make expected profits of  $P(\mathcal{A}^0)c_1(E[A | A \in \mathcal{A}^0] - E[A | A \in \mathcal{A}_\emptyset^0]) - P(\mathcal{A}^0 \cup \mathcal{A}_\emptyset^0)\varepsilon > 0$ . ||

Step 7:  $\mathcal{A}_\emptyset^0 = \emptyset$ .

Suppose otherwise, that is  $\mathcal{A}_\emptyset^0 \neq \emptyset$ , which (by Step 6) implies  $\mathcal{A}^0 = \emptyset$ . It then follows that there exists  $\tilde{A} \in (0, \bar{A})$  such that  $\mathcal{A}_\emptyset^0 = [0, \tilde{A}]$  and  $\mathcal{A}^1 = [\tilde{A}, \bar{A}]$ . The Bertrand nature of wage competition requires  $w_1(A', 0) < \max\{w_2(0), \dots, w_n(0)\} = d_1 + c_1 \frac{\tilde{A}}{2}$  for all  $A' \in \mathcal{A}_\emptyset^0$ . For firm 1 not to have a profitable deviation for some type  $A \in \mathcal{A}_\emptyset^0$  by matching the offer of firms 2, ..., n and retaining the worker,

$$(1 + s)(d_0 + c_0 \tilde{A}) - v \left( d_1 + c_1 \frac{\tilde{A}}{2} \right) \leq 0 \tag{A7}$$

needs to hold, which can be rewritten as  $[2(1 + s)c_0 - vc_1]\tilde{A} \leq 2[vd_1 - (1 + s)d_0]$ . Note that the right-hand side is negative. The left-hand side, however, is positive because  $2(1 + s)c_0 > c_1 \Leftrightarrow s > \frac{c_1}{2c_0} - 1$  holds according to Assumption 1(i):

$$\frac{d_0 + c_0 \tilde{A}}{(c_1 - c_0)\tilde{A} - (d_0 - d_1)} > \frac{c_1}{2c_0} - 1 \Leftrightarrow \frac{2d_1c_0 + c_1(d_0 - d_1) + \tilde{A}c_1(3c_0 - c_1)}{2c_0((c_1 - c_0)\tilde{A} - d_0 + d_1)} > 0$$

is true due to Assumptions 1(ii) and 2. Thus, condition (A7) does not hold. ||

Step 8:  $\mathcal{A}^0 = [0, A^+) \neq \emptyset$  with  $A^+ > A^*$ .

From the previous steps, it follows that in any perfect Bayesian equilibrium there exists  $A^+ \in (0, \bar{A})$  such that  $\mathcal{A}^0 = [0, A^+)$  and  $\mathcal{A}^1 = [A^+, \bar{A}]$ . Concerning the critical ability type  $A^+$ , firm 1 has to be indifferent between assigning this type to job  $j = 0$  and retaining him, or assigning this type to job  $j = 1$  and retaining him. The Bertrand nature of wage competition implies that  $\max\{w_2(0), \dots, w_n(0)\} = (d_1 + c_1 \frac{A^+}{2}) = w_1(A', 0)$  for  $A' \in \mathcal{A}^0$  and  $\max\{w_2(1), \dots, w_n(1)\} = (d_1 + c_1 \frac{A^+ + \bar{A}}{2}) = w_1(A'', 1)$  for  $A'' \in \mathcal{A}^1$ . Hence,

$$(1 + s)(d_1 + c_1 A^+) - \left( d_1 + c_1 \frac{A^+ + \bar{A}}{2} \right) = (1 + s)(d_0 + c_0 A^+) - v \left( d_1 + c_1 \frac{A^+}{2} \right)$$

must hold, which can be rewritten to<sup>35</sup>

$$A^+ = \frac{2(1 + s)(d_0 - d_1) + 2(1 - v)d_1 + c_1 \bar{A}}{2(1 + s)(c_1 - c_0) - (1 - v)c_1}.$$

The cut-off  $A^+$  is decreasing in  $v$  with  $A^+ = A^* + \frac{c_1 \bar{A}}{2(1 + s)(c_1 - c_0)}$  for  $v = 1$ . □

*Proof of Proposition 2.* Worker types  $A \geq A_L^+$  are assigned to task 1 before and after the increase of  $v$ . They receive the wage  $d_1 + c_1 \frac{A_L^+ + \bar{A}}{2}$  under  $v_L$  but the wage  $d_1 + c_1 \frac{A_H^+ + \bar{A}}{2}$  under  $v_H$  with the former being the larger one as  $\partial A^+ / \partial v < 0$ . The wage difference describes the income effect summarized in the proposition.

Worker types  $A$  with  $A_H^+ \leq A < A_L^+$  are assigned to task 0 before and to task 1 after the increase of  $v$ . They receive the expected wage  $v_L \left( d_1 + c_1 \frac{A_L^+}{2} \right)$  before the increase and the wage  $d_1 + c_1 \frac{A_H^+ + \bar{A}}{2}$  after the increase with



$$v_L \left( d_1 + c_1 \frac{A_L^+}{2} \right) < d_1 + c_1 \frac{A_H^+ + \bar{A}}{2}$$

as  $A_L^+ < A_H^+ + \bar{A}$ . The wage difference is summarized in the proposition.

Finally, consider the set of worker types that are assigned to task 0 before and after the increase of  $v$ , that is,  $A < A_H^+$ . According to Proposition 1, their expected wage for a given cut-off  $A^+$  amounts to

$$v \left( d_1 + c_1 \frac{A^+}{2} \right) = v \frac{2(1+s)(c_1(d_1 + d_0) - 2d_1c_0) + c_1^2 \bar{A}}{2[2(1+s)(c_1 - c_0) - (1-v)c_1]}.$$

Differentiating with respect to  $v$  yields

$$\frac{1}{2} [(1+2s)c_1 - 2c_0(1+s)] \frac{2(1+s)[c_1(d_1 + d_0) - 2d_1c_0] + c_1^2 \bar{A}}{[2(1+s)(c_1 - c_0) - (1-v)c_1]^2},$$

which—as  $c_1(d_1 + d_0) > 2d_1c_0$ —will be positive if and only if

$$(1+2s)c_1 > 2c_0(1+s) \Leftrightarrow s > \frac{2c_0 - c_1}{2(c_1 - c_0)}. \quad (\text{A8})$$

Since

$$\begin{aligned} \frac{d_0 + c_0 \bar{A}}{(c_1 - c_0) \bar{A} - (d_0 - d_1)} &> \frac{2c_0 - c_1}{2(c_1 - c_0)} \\ \Leftrightarrow \frac{c_1(d_1 + d_0) - 2d_1c_0 + \bar{A}c_1(c_1 - c_0)}{2(c_1 - c_0)[(c_1 - c_0) \bar{A} - (d_0 - d_1)]} &> 0 \end{aligned} \quad (\text{A9})$$

is true as  $\bar{A} > A^*$ , Assumption 1(i) implies condition (A8) so that

$$v_L \left( d_1 + c_1 \frac{A_L^+}{2} \right) < v_H \left( d_1 + c_1 \frac{A_H^+}{2} \right).$$

The positive wage difference is summarized as income effect in the proposition.  $\square$

*Proof of Proposition 3.* For all ability types  $A > A^*$ ,  $\tilde{y}^1 < y^1$ . As  $A^+ > A^* \quad \forall v \in [0, 1]$  and  $A^+$  is strictly decreasing in  $v$ , the change in job assignment induced by an increase in  $v$  leads to a higher expected output and thereby to a higher expected surplus.

The expected profit of the current employer is given by

$$\begin{aligned} &P(A < A^+) [(1+s)(d_0 + c_0 E[A|A < A^+]) - v(d_1 + c_1 E[A|A < A^+])] \\ &+ P(A \geq A^+) [(1+s)(d_1 + c_1 E[A|A \geq A^+]) - (d_1 + c_1 E[A|A \geq A^+])]. \end{aligned}$$

Inserting for the conditional means leads to

$$\frac{A^+}{\bar{A}} \left( (1+s)d_0 - vd_1 + [(1+s)c_0 - vc_1] \frac{A^+}{2} \right) + \left( 1 - \frac{A^+}{\bar{A}} \right) s \left( d_1 + c_1 \frac{A^+ + \bar{A}}{2} \right).$$

For the derivative with respect to  $v$  we obtain

$$\frac{1}{\bar{A}} \frac{\partial A^+}{\partial v} [(1+s)d_0 - (v+s)d_1 - [(v+s)c_1 - (1+s)c_0]A^+] - \left( d_1 + c_1 \frac{A^+}{2} \right) \frac{A^+}{\bar{A}}.$$

Inserting for  $A^+$  and

$$\frac{\partial A^+}{\partial v} = - \frac{2(1+s)[(d_1 + d_0)c_1 - 2d_1c_0] + \bar{A}c_1^2}{[2(1+s)(c_1 - c_0) - (1-v)c_1]^2}$$

yields<sup>36</sup>

$$\frac{\{2(1+s)[(d_1 + d_0)c_1 - 2d_1c_0] + \bar{A}c_1^2\} \{4(1+s)(c_1 - c_0)[(1+s)(d_0 - d_1) + (1-v)d_1] + \bar{A}(1-v)c_1^2\}}{2\bar{A}[2(1+s)(c_1 - c_0) - (1-v)c_1]^3},$$

which is strictly negative.

The expected wage of the worker is given by expected output minus expected profit of the current employer. As the former is increasing in  $v$  whereas the latter is decreasing, the expected wage of the worker is increasing in  $v$ .

As we know from Proposition 1, the worker always stays with the current employer in equilibrium so that the other employers have zero expected profits.  $\square$

*Proof of Proposition 4.* In a cut-off equilibrium, the current employer promotes all ability types  $A$  to job 1 that are weakly larger than a certain cut-off  $A^+$ , and assigns the lower ability types to job 0. At date 3, due to the Bertrand nature of wage competition, the alternative employers will offer the wage  $d_1 + c_1 \frac{A^+}{2}$  to the worker if he is assigned to job 0 and becomes visible, whereas they offer the wage  $d_1 + c_1 \frac{A^+ + \bar{A}}{2}$  if the worker is promoted to job 1. The current employer anticipates the alternative employers' poaching wages and offers the wage  $d_1 + c_1 \frac{A^+}{2}$  to a visible worker on job 0 but a zero wage to an invisible one. If the worker has been promoted to job 1, the current employer's wage offer will be  $d_1 + c_1 \frac{A^+ + \bar{A}}{2}$ . In any case, the worker stays with the current employer.

At date 2.5, the current employer chooses the bonus  $b(j)$ , and the worker either exerts high productive effort  $e_H$  (and low nonproductive effort) or low productive effort  $e_L$  (and high nonproductive effort). As ability does not influence the outcome at Stage 2.5, the current employer implements the same effort level for all ability types that are assigned to a specific job. We start with the analysis of job 1. If the current employer wants to implement  $e_H$ , the bonus  $b(1)$  has to satisfy

$$p_H \cdot b(1) - \kappa \geq p_L \cdot b(1) \Leftrightarrow b(1) \geq \frac{\kappa}{p_H - p_L}$$

so that the optimal bonus is given by  $b^*(1) = \frac{\kappa}{p_H - p_L}$ . The current employer's expected profit is

$$\left( \pi - \frac{\kappa}{p_H - p_L} \right) \cdot p_H + y^1 - \left( d_1 + c_1 \frac{A^+ + \bar{A}}{2} \right).$$

If the current employer wants to implement  $e_L$ , he will offer the optimal bonus  $b^*(1) = 0$  and his expected profit is given by

$$\pi \cdot p_L + y^1 - \left( d_1 + c_1 \frac{A^+ + \bar{A}}{2} \right).$$

Thus, the current employer will prefer  $e_H$  to  $e_L$  iff

$$\begin{aligned} & \left( \pi - \frac{\kappa}{p_H - p_L} \right) \cdot p_H + y^1 - \left( d_1 + c_1 \frac{A^+ + \bar{A}}{2} \right) \\ & \geq \pi \cdot p_L + y^1 - \left( d_1 + c_1 \frac{A^+ + \bar{A}}{2} \right) \Leftrightarrow \pi \geq \frac{p_H \kappa}{(p_H - p_L)^2}. \end{aligned} \tag{A10}$$

Next, job 0 is considered. If the current employer wants to implement  $e_H$ , the worker will remain invisible and the current employer has to offer a bonus  $b(0)$  that satisfies

$$\begin{aligned} p_H \cdot b(0) - \kappa &\geq p_L \cdot b(0) + \hat{v} \cdot \left( d_1 + c_1 \frac{A^+}{2} \right) \\ \Leftrightarrow b(0) &\geq \frac{\kappa + \hat{v} \cdot \left( d_1 + c_1 \frac{A^+}{2} \right)}{p_H - p_L}. \end{aligned}$$

Due to the tie-breaking rule, the optimal bonus is  $b^*(0) = [\kappa + \hat{v} \cdot (d_1 + c_1 \frac{A^+}{2})] / (p_H - p_L)$  and the current employer's expected profit is

$$\left( \pi - \frac{\kappa + \hat{v} \cdot \left( d_1 + c_1 \frac{A^+}{2} \right)}{p_H - p_L} \right) \cdot p_H + \tilde{y}^1.$$

If, however, the current employer wants to implement  $e_L$ , the worker will become visible with probability  $\hat{v}$ . In that case, the optimal bonus is  $b^*(0) = 0$  and the current employer's expected profit is

$$\pi \cdot p_L + \tilde{y}^1 - \hat{v} \cdot \left( d_1 + c_1 \frac{A^+}{2} \right).$$

Comparing both expected profits shows that the current employer will prefer  $e_H$  to  $e_L$  iff

$$\begin{aligned} \left( \pi - \frac{\kappa + \hat{v} \cdot \left( d_1 + c_1 \frac{A^+}{2} \right)}{p_H - p_L} \right) \cdot p_H + \tilde{y}^1 &\geq \pi \cdot p_L + \tilde{y}^1 - \hat{v} \cdot \left( d_1 + c_1 \frac{A^+}{2} \right) \Leftrightarrow \\ \pi &\geq \frac{p_H \kappa + p_L \hat{v} \left( d_1 + c_1 \frac{A^+}{2} \right)}{(p_H - p_L)^2}. \end{aligned} \tag{A11}$$

This condition can be rewritten as

$$A^+ \leq \frac{2}{c_1} \left( \frac{\pi (p_H - p_L)^2 - p_H \kappa}{p_L \hat{v}} - d_1 \right) =: \Omega(\hat{v}).$$

We have to differentiate between two scenarios: First, suppose that the current employer implements  $e_H$  at job 1 because condition (A10) is satisfied. In that case, it is not clear whether the current employer wants to implement  $e_H$  at job 0 as well. Suppose that the current employer prefers the high productive effort for job 0 as  $A^+ \leq \Omega(\hat{v})$ . Then, the equilibrium cut-off is determined by the condition that the current employer is indifferent between assigning ability type  $A^+$  to job 1 or to job 0:

$$\begin{aligned} (1 + s)(d_1 + c_1 A^+) + \left( \pi - \frac{\kappa}{p_H - p_L} \right) \cdot p_H - \left( d_1 + c_1 \frac{A^+ + \bar{A}}{2} \right) \\ = (1 + s)(d_0 + c_0 A^+) + \left( \pi - \frac{\kappa + \hat{v} \cdot \left( d_1 + c_1 \frac{A^+}{2} \right)}{p_H - p_L} \right) \cdot p_H \Leftrightarrow \end{aligned}$$

$$A^+ = \frac{(1 + s)(d_0 - d_1) + \left(1 - \frac{p_H \hat{v}}{p_H - p_L}\right) d_1 + \frac{c_1}{2} \bar{A}}{(1 + s)(c_1 - c_0) - \frac{1}{2} \left(1 - \frac{p_H \hat{v}}{p_H - p_L}\right) c_1}. \tag{A12}$$

The technical assumption  $\frac{c_1}{2} \bar{A} > \frac{p_L}{p_H - p_L} d_1$  guarantees that the numerator is positive even for the worst case of  $\hat{v} \rightarrow 1$ . The denominator will be positive if

$$(1 + s)(c_1 - c_0) > \frac{c_1}{2} \Leftrightarrow s > \frac{c_1}{2(c_1 - c_0)} - 1 = \frac{c_0 - \frac{c_1}{2}}{(c_1 - c_0)}, \tag{A13}$$

which is true as according to Assumption 1(i):

$$s > \frac{c_0 + \frac{d_0}{\bar{A}}}{(c_1 - c_0) - \frac{d_0 - d_1}{\bar{A}}} > \frac{c_0 - \frac{c_1}{2}}{c_1 - c_0}.$$

Hence,  $A^+ > 0$ . Moreover,  $A^+ < \bar{A}$ , which can be shown in analogy to Step 2 in the proof of Proposition 1: Suppose, to the contrary, that  $A^+ \geq \bar{A}$  so that even the highest ability type is not promoted to job 1. The alternative employers will never offer a wage that is higher than  $d_1 + c_1 \bar{A}$ . As Assumption 1(i) implies that  $s(d_1 + c_1 \bar{A}) > (1 + s)(d_0 + c_0 \bar{A})$ , the inequality

$$\begin{aligned} & s(d_1 + c_1 \bar{A}) + \left( \pi - \frac{\kappa}{p_H - p_L} \right) \cdot p_H \\ & > (1 + s)(d_0 + c_0 \bar{A}) + \left( \pi - \frac{\kappa + \hat{v} \cdot \left( d_1 + c_1 \frac{A^+}{2} \right)}{p_H - p_L} \right) \cdot p_H \Leftrightarrow \\ & s(d_1 + c_1 \bar{A}) > (1 + s)(d_0 + c_0 \bar{A}) - \frac{p_H \hat{v} \cdot \left( d_1 + c_1 \frac{A^+}{2} \right)}{p_H - p_L} \end{aligned}$$

is true so that the current employer can increase expected profits by promoting at least the highest ability type and offering the wage  $d_1 + c_1 \bar{A}$ .

For the existence of a cut-off equilibrium in which the current employer implements high productive effort at job 0, the promotion cut-off  $A^+$  in Equation (A12) must satisfy  $A^+ \leq \Omega(\hat{v})$ , which can be rewritten as

$$\begin{aligned} & \left[ (1 + s)((d_0 - d_1) + (c_1 - c_0) \frac{2}{c_1} d_1) + \frac{c_1}{2} \bar{A} - \frac{\pi p_H (p_H - p_L)^2 - p_H^2 \kappa}{(p_H - p_L) p_L} \right] c_1 p_L \hat{v} \\ & \leq (2(1 + s)(c_1 - c_0) - c_1)(\pi(p_H - p_L)^2 - p_H \kappa). \end{aligned}$$

The right-hand side is positive because (A10) is satisfied. The left-hand side can be negative if  $\pi$  is sufficiently large. In that case, the inequality clearly holds and there do not exist cut-off equilibria in which the current employer implements low productive effort at job 0. Otherwise, cut-off equilibria in which  $e_H$  is implemented at job 0 can only exist if

$$\hat{v} \leq \frac{(2(1 + s)(c_1 - c_0) - c_1)(\pi(p_H - p_L)^2 - p_H \kappa)}{\left[ (1 + s)((d_0 - d_1) + (c_1 - c_0) \frac{2}{c_1} d_1) + \frac{c_1}{2} \bar{A} - \frac{\pi p_H (p_H - p_L)^2 - p_H^2 \kappa}{(p_H - p_L) p_L} \right] c_1 p_L} =: \bar{\hat{v}}.$$

Now, suppose  $A^+ > \Omega(\hat{v})$  so that the current employer implements  $e_L$  at job 0. Again, the equilibrium cut-off is determined by the current employer being indifferent between assigning ability type  $A^+$  to job 1 or to job 0:

$$\begin{aligned} & (1+s)(d_1 + c_1 A^+) + \left( \pi - \frac{\kappa}{p_H - p_L} \right) \cdot p_H - \left( d_1 + c_1 \frac{A^+ + \bar{A}}{2} \right) \\ & = (1+s)(d_0 + c_0 A^+) + \pi \cdot p_L - \hat{v} \cdot \left( d_1 + c_1 \frac{A^+}{2} \right) \Leftrightarrow \\ & \left[ (1+s)(c_1 - c_0) - (1 - \hat{v}) \frac{c_1}{2} \right] A^+ \\ & = (1+s)(d_0 - d_1) + (1 - \hat{v})d_1 - (p_H - p_L)\pi + \frac{p_H \kappa}{p_H - p_L} + \frac{c_1 \bar{A}}{2}. \end{aligned}$$

The left-hand side of the last equality is strictly positive as (A13) holds. The right-hand side will be negative if  $\pi$  is too large (which can even happen under  $A^+ > \Omega(\hat{v})$ ). In that case, cut-off equilibria in which the current employer implements  $e_L$  at job 0 do not exist. Otherwise, such equilibria can only exist if the cut-off  $A^+$  satisfies<sup>37</sup>

$$\begin{aligned} A^+ & = \frac{(1+s)(d_0 - d_1) + (1 - \hat{v})d_1 - (p_H - p_L)\pi + \frac{p_H \kappa}{p_H - p_L} + \frac{c_1 \bar{A}}{2}}{(1+s)(c_1 - c_0) - (1 - \hat{v}) \frac{c_1}{2}} > \Omega(\hat{v}) \Leftrightarrow \\ & \left[ (1+s) \left( (d_0 - d_1) + (c_1 - c_0) \frac{2}{c_1} d_1 \right) + \frac{c_1 \bar{A}}{2} - \frac{\pi p_H (p_H - p_L)^2 - p_H^2 \kappa}{(p_H - p_L) p_L} \right] c_1 p_L \hat{v} \\ & > (2(1+s)(c_1 - c_0) - c_1)(\pi(p_H - p_L)^2 - p_H \kappa). \end{aligned}$$

As the right-hand side is positive, cut-off equilibria in which  $e_L$  is implemented at job 0 cannot exist if the left-hand side is negative. Otherwise, such equilibria can only exist if

$$\hat{v} > \frac{(2(1+s)(c_1 - c_0) - c_1)(\pi(p_H - p_L)^2 - p_H \kappa)}{\left[ (1+s) \left( (d_0 - d_1) + (c_1 - c_0) \frac{2}{c_1} d_1 \right) + \frac{c_1 \bar{A}}{2} - \frac{\pi p_H (p_H - p_L)^2 - p_H^2 \kappa}{(p_H - p_L) p_L} \right] c_1 p_L} = \bar{v}.$$

Second, suppose that the current employer implements  $e_L$  at job 1 because condition (A10) is violated. As a direct implication, condition (A11) is violated as well so that the current employer also implements  $e_L$  at job 0. In equilibrium, the promotion cut-off is then described by

$$\begin{aligned} & (1+s)(d_1 + c_1 A^+) + \pi \cdot p_L - \left( d_1 + c_1 \frac{A^+ + \bar{A}}{2} \right) \\ & = (1+s)(d_0 + c_0 A^+) + \pi \cdot p_L - \hat{v} \cdot \left( d_1 + c_1 \frac{A^+}{2} \right) \Leftrightarrow \\ & A^+ = \frac{(1+s)(d_0 - d_1) + (1 - \hat{v})d_1 + \bar{A} \frac{c_1}{2}}{(1+s)(c_1 - c_0) - \frac{1 - \hat{v}}{2} c_1}, \end{aligned}$$

which is exactly the cut-off from our original model with  $v = \hat{v}$ . □



## APPENDIX B: ADDITIONAL ESTIMATES

TABLE B1 Turnover over period by treatments

	Turnover			
	(1) Visibility	(2) Invisibility	(3) All	(4) All
Period	-0.0118** (0.00483)	-0.00179 (0.00421)	-0.00681* (0.00335)	-0.00234 (0.00335)
Visibility				0.257** (0.0974)
Period × Visibility				-0.0100* (0.00571)
Job 1				0.125** (0.0491)
Constant	0.413*** (0.0906)	0.128** (0.0368)	0.271*** (0.0599)	0.0815** (0.0345)
N	240	240	480	480
R <sup>2</sup>	0.013	0.001	0.005	0.080

Note: Reported standard errors (in parentheses) account for potential clustering on the matching-group level. [Correction added on 25 Nov 2020, after first online publication: the significance value \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$  were corrected to \* $p < .1$ , \*\* $p < .05$ , \*\*\* $p < .01$ ]

\* $p < .1$ .

\*\* $p < .05$ .

\*\*\* $p < .01$ .

TABLE B2 Effect of visibility on surplus with ability fixed-effects

	(1) Surplus (Ability FE)	(2) Surplus both jobs (Ability FE)	(3) Surplus no turnover (Ability FE)
Visibility	9.428 (9.196)	11.22 (8.697)	24.85*** (6.589)
Constant	260.1*** (4.588)	260.2*** (4.339)	282.8*** (3.287)
N	447	447	447

Note: Reported standard errors (in parentheses) account for potential clustering on the matching-group level. [Correction added on 25 Nov 2020, after first online publication: the significance value \* $p < .01$  was corrected to \*\*\* $p < .01$ ]

\*\*\* $p < .01$ .

TABLE B3 Determinants of wages across treatments

	Realized wage		
	(1) PV	(2) PV and invisibility	(3) PV and visibility
Ability	10.30*** (2.425)	-0.969 (2.718)	10.91*** (2.612)
Ability squared	-0.175 (0.128)	0.619*** (0.132)	-0.226* (0.109)
PV		44.73*** (12.26)	-9.267 (18.54)

(Continues)

TABLE B3 (Continued)

	Realized wage		
	(1) PV	(2) PV and invisibility	(3) PV and visibility
PV × Ability		11.27 <sup>***</sup> (3.589)	-0.604 (3.510)
PV × Ability squared		-0.794 <sup>***</sup> (0.181)	0.0514 (0.165)
Constant	48.75 <sup>***</sup> (11.59)	4.012 (4.950)	58.01 <sup>***</sup> (14.76)
N	240	480	480
R <sup>2</sup>	0.286	0.508	0.345

Note: OLS estimates; reported standard errors (in parentheses) account for potential clustering on the matching-group level. PV is equal to one for the *partial visibility* treatment and zero otherwise. Column (1) reports estimates for the *partial visibility* treatment. Column (2) pools the data of the partial visibility and the invisibility treatment, whereas Column (3) pools the data of the partial visibility and the visibility treatment. [Correction added on 25 Nov 2020, after first online publication: the significance value \**p* < .01, \*\**p* < .1, \*\*\**p* < .05 were corrected to \**p* < .1, \*\**p* < .05, \*\*\**p* < .01]

\**p* < .1.  
 \*\**p* < .05.  
 \*\*\**p* < .01.

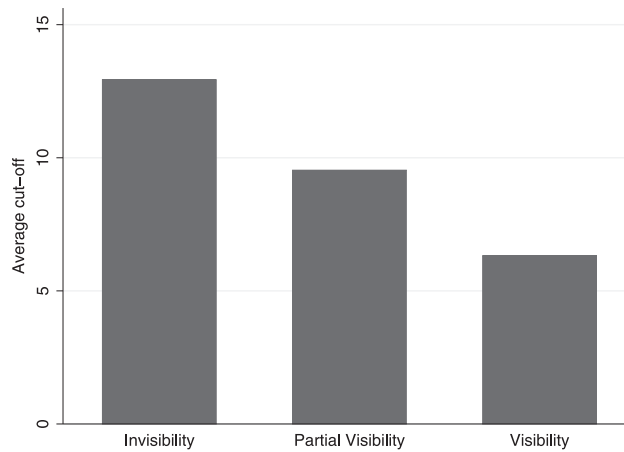


FIGURE B1 The average promotion cut-offs across treatments

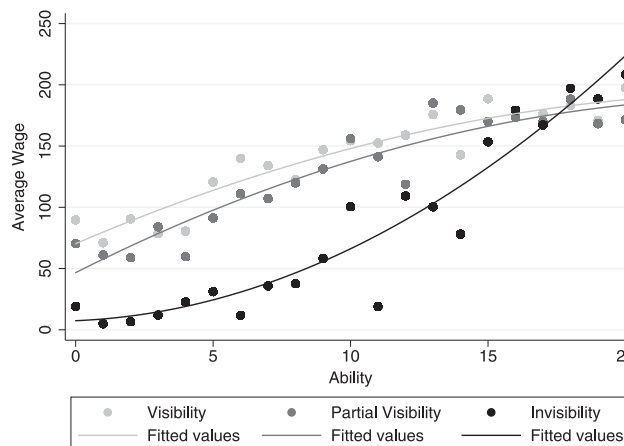
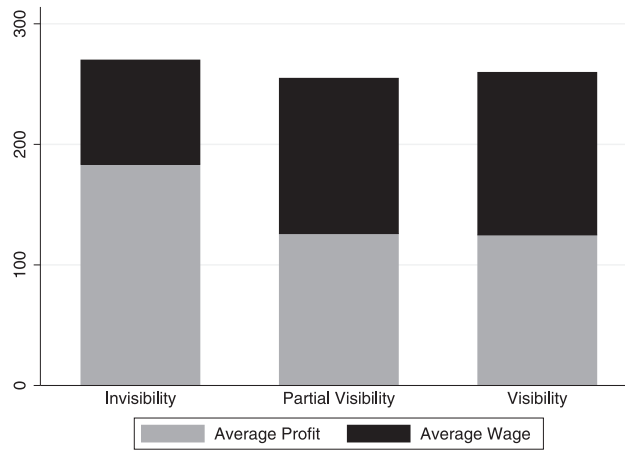


FIGURE B2 Average wages for workers with different ability for all treatments



**FIGURE B3** Average profits of firms employing a worker and average wages of workers by treatments

**APPENDIX C: GENERALIZED SETUP**

For a generalization of Proposition 1, we introduce the following modified assumptions.  $A$  is distributed between 0 and  $\bar{A}$  according to some continuously differentiable probability distribution  $g(A)$ . The production functions of the current employer for the two jobs 1 and 0 are given by

$$y^1 = (1 + s) \cdot (d_1 + f_1(A))$$

and

$$\tilde{y}^1 = (1 + s) \cdot (d_0 + f_0(A)),$$

respectively, whereas the worker's output at firms  $i = 2, \dots, n$ , which only offer job 1, is given by

$$y^i = d_1 + f_1(A).$$

$f_1$  and  $f_0$  are assumed to be twice continuously differentiable, increasing and concave functions of  $A \in [0, \bar{A}]$  with  $f_1(0) = f_0(0) = 0$  and  $f_1'(A) > f_0'(A)$  for all  $A \in (0, \bar{A})$ , implying that  $f_1(A) - f_0(A)$  is an increasing function. Again, we assume that  $d_0 \geq d_1 \geq 0$ . The modified Assumptions 1 and 2 read as follows:

**Assumption C1.**

- (i)  $\frac{E[f_1(A)]}{d_1} > s > \frac{d_0 + f_0(\bar{A})}{f_1(\bar{A}) - f_0(\bar{A}) - (d_0 - d_1)}$ ,
- (ii)  $(1 + s)(d_0 + f_0(A)) > d_1 + f_1(A)$  for all  $A \in [0, \bar{A}]$ .

**Assumption C2.**  $A^*$  being implicitly defined by  $f_1(A^*) - f_0(A^*) = d_0 - d_1$  satisfies  $A^* < \bar{A}$ .

The general framework leads to the following findings for the promotion cut-off:

**Proposition C1.** *Suppose  $\gamma \rightarrow 0$ . In any perfect Bayesian equilibrium, there exists a cut-off  $A^+ \in (A^*, \bar{A})$  so that the worker will be assigned to job 1 if and only if  $A \geq A^+$ . The worker stays with the current employer and earns the wage*

$$w_1(A, j, V) = \begin{cases} d_1 + E[f_1(A)|A \geq A^+] & \text{if } A \geq A^+ \\ \{d_1 + E[f_1(A)|A < A^+]\} \cdot V & \text{if } A < A^+ \end{cases}$$

*Proof.* The proof uses the same definitions as the proof of Proposition 1.

*Step 1:*  $\mathcal{A}_\emptyset^1 = \emptyset$ .

Suppose, in contradiction, that  $\mathcal{A}_\emptyset^1 \neq \emptyset$ , that is, there exist ability types that receive job  $j = 1$  instead of  $j = 0$  and for which firm 1 is outbid in the wage competition. Regarding the equilibrium wage offer by firm  $i = 2, \dots, n$ , we must have

$$w_i(1) \leq \frac{P(\mathcal{A}_\emptyset^1)}{P(\mathcal{A}_\emptyset^1) + \gamma P(\mathcal{A}^1)} \left( d_1 + E[f_1(A) | A \in \mathcal{A}_\emptyset^1] \right) + \frac{\gamma P(\mathcal{A}^1)}{P(\mathcal{A}_\emptyset^1) + \gamma P(\mathcal{A}^1)} (d_1 + E[f_1(A) | A \in \mathcal{A}^1]) =: \eta(\mathcal{A}^1, \mathcal{A}_\emptyset^1), \quad (\text{C1})$$

for otherwise one of firms  $2, \dots, n$  makes strictly negative expected profits. Consider ability type  $A' \in \mathcal{A}_\emptyset^1$  with  $f_1(A') \geq E[f_1(A) | A \in \mathcal{A}_\emptyset^1]$ . As

$$\lim_{\gamma \searrow 0} (1+s)[d_1 + f_1(A')] - \eta(\mathcal{A}^1, \mathcal{A}_\emptyset^1) = (1+s)[d_1 + f_1(A')] - \left( d_1 + E[f_1(A) | A \in \mathcal{A}_\emptyset^1] \right) > 0, \quad (\text{C2})$$

for  $\gamma \searrow 0$  it is strictly profitable for firm 1 to deviate by offering  $\tilde{w}_1 = \eta(\mathcal{A}^1, \mathcal{A}_\emptyset^1)$  to type  $A'$  and retain this ability type. Thus,  $\mathcal{A}_\emptyset^1 \neq \emptyset$  is not compatible with equilibrium. ||

*Step 2:*  $\mathcal{A}^1 \neq \emptyset$ .

Suppose, in contradiction, that  $\mathcal{A}^1 = \emptyset$ . By Step 1, this implies that firm 1 assigns all types  $A \in [0, \bar{A}]$  to job  $j = 0$ . No firm  $i = 2, \dots, n$  will ever offer more than  $d_1 + f_1(\bar{A})$ . As Assumption C1(i) implies that

$$s(d_1 + f_1(\bar{A})) > \max\{(1+s)(d_0 + f_0(\bar{A})) - v \max\{w_2(0), \dots, w_n(0)\}, 0\}, \quad (\text{C3})$$

firm 1 can strictly profitably deviate to assigning ability type  $\bar{A}$  to job  $j = 1$  and offering  $\tilde{w}_1 = d_1 + f_1(\bar{A})$ . ||

*Step 3:* If  $A' \in \mathcal{A}^1$ , then  $A'' \in \mathcal{A}^1$  for all  $A'' > A'$ .

Suppose, in contradiction, that  $A' \in \mathcal{A}^1$  and  $A'' \notin \mathcal{A}^1$  for  $0 \leq A' < A'' \leq \bar{A}$ . First, suppose that  $A'' \in \mathcal{A}_\emptyset^0$ . As type  $A'$  is retained by firm 1, we must have  $(1+s)(d_1 + f_1(A')) - w_1(A', 1) \geq 0$ , for otherwise firm 1 could profitably deviate by making a zero wage offer to type  $A'$ . With  $A'' > A'$ , we have  $(1+s)(d_1 + f_1(A'')) - w_1(A', 1) > 0$ , such that firm 1 could strictly profitably deviate by assigning type  $A''$  to job  $j = 1$  and retaining him by offering  $w_1(A', 1)$ . Next, suppose that  $A'' \in \mathcal{A}^0$ . For firm 1 not to have a profitable deviation, the following two conditions must hold:

$$(1+s)(d_1 + f_1(A')) - w_1(A', 1) \geq (1+s)(d_0 + f_0(A')) - v w_1(A'', 0) \quad (\text{C4})$$

$$(1+s)(d_1 + f_1(A'')) - w_1(A', 1) \leq (1+s)(d_0 + f_0(A'')) - v w_1(A'', 0). \quad (\text{C5})$$

A necessary condition for (C4) and (C5) to be jointly satisfied, however, is  $f_1(A') - f_0(A') \geq f_1(A'') - f_0(A'')$  implying  $A' \geq A''$ —a contradiction. ||

Steps 2 and 3 together imply that  $\mathcal{A}^1$  is an interval with  $\bar{A}$  as maximum. We proceed by characterizing  $\mathcal{A}^0$  and  $\mathcal{A}_\emptyset^0$  in a similar fashion.

*Step 4:* If  $A' \in \mathcal{A}^0$ , then  $A'' \in \mathcal{A}^0$  for all  $A'' > A'$  with  $A'' \notin \mathcal{A}^1$ .

Suppose in contradiction that  $A' \in \mathcal{A}^0$  and  $A'' \in \mathcal{A}_\emptyset^0$  with  $0 \leq A' < A'' < \bar{A}$ . For firm 1 not to have a profitable deviation, the following two conditions must hold:

$$(1+s)(d_0 + f_0(A')) - v w_1(A', 0) \geq 0 \quad (\text{C6})$$

$$(1 + s)(d_0 + f_0(A'')) - vw_1(A', 0) \leq 0. \quad (\text{C7})$$

A necessary condition for (C6) and (C7) to be jointly satisfied, however, is  $A' \geq A''$ —a contradiction. ||

Thus, also the sets  $\mathcal{A}^0$  and  $\mathcal{A}_\emptyset^0$  are intervals.

Step 5:  $\mathcal{A}^1 \neq [0, \bar{A}]$ .

Suppose, in contradiction, that  $\mathcal{A}^0 = \mathcal{A}_\emptyset^0 = \emptyset$ . The Bertrand nature of wage competition dictates that  $\max\{w_2(1), \dots, w_n(1)\} = d_1 + E[f_1(A)]$ . Then firm 1 makes negative expected profits with the lowest ability type  $A = 0$  because

$$(1 + s)d_1 - (d_1 + E[f_1(A)]) < 0, \quad (\text{C8})$$

which holds by Assumption C1(i). Thus, firm 1 would have a profitable deviation. ||

Step 6: Either  $\mathcal{A}^0 \neq \emptyset$  and  $\mathcal{A}_\emptyset^0 = \emptyset$ , or  $\mathcal{A}^0 = \emptyset$  and  $\mathcal{A}_\emptyset^0 \neq \emptyset$ .

First, suppose, in contradiction, that in equilibrium  $\mathcal{A}^1, \mathcal{A}^0, \mathcal{A}_\emptyset^0 \neq \emptyset$ . The Bertrand nature of wage competition dictates that  $w_1(A', 0) < \max\{w_2(0), \dots, w_n(0)\} = \eta(\mathcal{A}^0, \mathcal{A}_\emptyset^0) = w_1(A'', 0)$  for  $A' \in \mathcal{A}_\emptyset^0$  and  $A'' \in \mathcal{A}^0$ , such that firms 2, ...,  $n$  make zero expected profits. By Step 4, we know that  $A' < A''$ . As  $\lim_{\gamma \searrow 0} \eta(\mathcal{A}^0, \mathcal{A}_\emptyset^0) = d_1 + E[f_1(A)|A \in \mathcal{A}_\emptyset^0]$ , for  $\gamma \searrow 0$  firm  $i$  with  $w_i(0) = \min\{w_2(0), \dots, w_n(0)\}$  has a strictly profitable deviation: when offering  $\tilde{w}_i(0) = d_1 + E[f_1(A)|A \in \mathcal{A}_\emptyset^0] + \varepsilon$  with  $\varepsilon \searrow 0$ , firm  $i$  obtains a worker of type  $A \in \mathcal{A}^0 \cup \mathcal{A}_\emptyset^0$  for sure and makes expected profits of  $P(\mathcal{A}^0)(E[f_1(A)|A \in \mathcal{A}^0] - E[f_1(A)|A \in \mathcal{A}_\emptyset^0]) - P(\mathcal{A}^0 \cup \mathcal{A}_\emptyset^0)\varepsilon > 0$ . ||

Step 7:  $\mathcal{A}_\emptyset^0 = \emptyset$ .

Suppose otherwise, that is,  $\mathcal{A}_\emptyset^0 \neq \emptyset$ , which (by Step 6) implies  $\mathcal{A}^0 = \emptyset$ . It then follows that there exists  $\tilde{A} \in (0, \bar{A})$  such that  $\mathcal{A}_\emptyset^0 = [0, \tilde{A})$  and  $\mathcal{A}^1 = [\tilde{A}, \bar{A}]$ . The Bertrand nature of wage competition requires  $w_1(A', 0) < \max\{w_2(0), \dots, w_n(0)\} = d_1 + E[f_1(A)|A < \tilde{A}]$  for all  $A' \in \mathcal{A}_\emptyset^0$ . For firm 1 not to have a profitable deviation for some ability type  $A \in \mathcal{A}_\emptyset^0$  by matching the offer of firms 2, ...,  $n$  and retaining the worker,

$$(1 + s)(d_0 + f_0(\tilde{A})) - v(d_1 + E[f_1(A)|A < \tilde{A}]) \leq 0 \quad (\text{C9})$$

needs to hold, which, however, contradicts Assumption C1(ii). ||

Step 8:  $\mathcal{A}^0 = [0, A^+) \neq \emptyset$  with  $A^+ > A^*$ .

From the previous steps, it follows that in any perfect Bayesian equilibrium there exists  $A^+ \in (0, \bar{A})$  such that  $\mathcal{A}^0 = [0, A^+)$  and  $\mathcal{A}^1 = [A^+, \bar{A}]$ . Consider the critical ability type  $A^+$ : firm 1 has to be indifferent between assigning this type to job  $j = 0$  and retaining him, or assigning this type to job  $j = 1$  and retaining him. The Bertrand nature of wage competition implies that  $\max\{w_2(0), \dots, w_n(0)\} = d_1 + E[f_1(A)|A < A^+] = w_1(A', 0)$  for  $A' \in \mathcal{A}^0$  and  $\max\{w_2(1), \dots, w_n(1)\} = d_1 + E[f_1(A)|A \geq A^+] = w_1(A'', 1)$  for  $A'' \in \mathcal{A}^1$ . Hence, we must have

$$\begin{aligned} (1 + s)(d_1 + f_1(A^+)) - (d_1 + E[f_1(A)|A \geq A^+]) \\ = (1 + s)(d_0 + f_0(A^+)) - v(d_1 + E[f_1(A)|A < A^+]). \end{aligned} \quad (\text{C10})$$

Since (C10) can be rewritten as

$$f_1(A^+) - f_0(A^+) - (d_0 - d_1) = \frac{(1 - v)d_1 + E[f_1(A)|A \geq A^+] - vE[f_1(A)|A < A^+]}{1 + s} \quad (\text{C11})$$

with the right-hand side being strictly positive and the left-hand side being increasing in  $A^+$ , from Assumption C2 we know that  $A^+ > A^*$ .  $\square$

Proposition C1 shows that, as in the linear model, the promotion cut-off used by the current employer in equilibrium is inefficiently large so that too few worker types are assigned to the executive job 1. Furthermore, due to firm-



specific human capital the current employer's willingness to pay for the worker is always larger than that of the alternative employers. Consequently, there is no turnover in equilibrium and the better informed current employer just matches the anticipated poaching offers of the alternative employers.

As the equilibrium cut-off is implicitly characterized by (C10) with

$$E[f_1(A)|A < A^+] = \frac{\int_0^{A^+} f_1(A)g(A)dA}{\int_0^{A^+} g(A)dA} \quad \text{and}$$

$$E[f_1(A)|A \geq A^+] = \frac{\int_{A^+}^{\bar{A}} f_1(A)g(A)dA}{\int_{A^+}^{\bar{A}} g(A)dA},$$

we obtain the following result:

**Proposition C1.** *Take any sequence  $(s^n, d_1^n)$  such that  $\lim_{n \rightarrow \infty} s^n = \infty$  and  $d_1^n s^n < E[f_1(A)]$  for all  $n$ . Then, there exists  $\bar{n}$  such that for all  $n > \bar{n}$  it holds that  $\frac{dA^+}{dv} < 0$ .*

*Proof.* Implicit differentiation of (C10) yields

$$\frac{dA^+}{dv} = -\frac{\frac{1}{1+s}[d_1 + E[f_1(A)|A < A^+]]}{f_1'(A^+) - f_0'(A^+) - \frac{1}{1+s} \cdot \Omega}$$

with

$$\Omega := \frac{-f_1(A^+) \int_{A^+}^{\bar{A}} g(A)dA + \int_{A^+}^{\bar{A}} f_1(A)g(A)dA}{\left(\int_{A^+}^{\bar{A}} g(A)dA\right)^2} g(A^+) - v \cdot \frac{f_1(A^+) \int_0^{A^+} g(A)dA - \int_0^{A^+} f_1(A)g(A)dA}{\left(\int_0^{A^+} g(A)dA\right)^2} g(A^+).$$

Hence,  $\frac{dA^+}{dv} < 0 \Leftrightarrow 1 + s - \frac{\Omega}{f_1'(A^+) - f_0'(A^+)} > 0$ . This inequality will be fulfilled for large  $n$ . In particular, Assumption C1 ensures that  $A^+ \in (A^*, \bar{A})$  for all  $n$ . Therefore, the right-hand side of (C11) is well defined and converges to zero for  $n \rightarrow \infty$ . As a consequence,  $\lim_{n \rightarrow \infty} A^+ = A^*$ , which implies that  $\lim_{n \rightarrow \infty} \Omega \neq \infty$  such that  $\lim_{n \rightarrow \infty} 1 + s - \frac{\Omega}{f_1'(A^+) - f_0'(A^+)} > 0$ . Hence, there exists  $\bar{n}$  such that for all  $n > \bar{n}$  the derivative of  $A^+$  with respect to  $v$  is negative.  $\square$

In analogy to the setup with linear production functions and uniformly distributed ability, the impact of firm-specific human capital needs to be sufficiently large for the equilibrium cut-off to strictly decrease in  $v$ . In particular, assuming  $d_1$  to be sufficiently low ensures that such high values of  $s$  are compatible with Assumption C1(i)—the counterpart of Assumption 1(i) in our linear model. This aspect ensures that the current employer strictly reacts to higher visibility by making less use of hiding the worker on the non-executive job.

**Proposition C2.** Suppose  $\gamma \rightarrow 0$ . Let  $v$  increase from  $v_L$  to  $v_H$  and denote the corresponding cut-offs by  $A_L^+$  and  $A_H^+$ . Then, the income effect  $\Delta w(A)$  of a worker with ability  $A$  is given by:

$$\Delta w(A) = \begin{cases} v_H\{d_1 + E[f_1(A)|A < A_H^+]\} - v_L\{d_1 + E[f_1(A)|A < A_L^+]\} & \text{if } A < A_H^+ \\ d_1 + E[f_1(A)|A \geq A_H^+] - v_L\{d_1 + E[f_1(A)|A < A_L^+]\} & \text{if } A_H^+ \leq A < A_L^+ \\ E[f_1(A)|A \geq A_H^+] - E[f_1(A)|A \geq A_L^+] & \text{if } A \geq A_L^+, \end{cases}$$

where  $\Delta w(A) < 0$  if  $A \geq A_L^+$ . Moreover,  $\Delta w(A) > 0$  and largest if  $A_H^+ \leq A < A_L^+$ .

*Proof.* Worker types  $A \geq A_L^+$  are assigned to task 1 before and after the increase of  $v$ . They receive the wage  $d_1 + E[f_1(A)|A \geq A_L^+]$  under  $v_L$  but the wage  $d_1 + E[f_1(A)|A \geq A_H^+]$  under  $v_H$ . Accordingly, the income effect is given by  $E[f_1(A)|A \geq A_H^+] - E[f_1(A)|A \geq A_L^+] < 0$  as  $\partial A^+ / \partial v < 0$ . Worker types  $A$  with  $A_H^+ \leq A < A_L^+$  are assigned to task 0 before and to task 1 after the increase of  $v$ . They receive the expected wage  $v_L\{d_1 + E[f_1(A)|A < A_L^+]\}$  before the increase and the wage  $d_1 + E[f_1(A)|A \geq A_H^+]$  after the increase. The income effect is given by

$$d_1 + E[f_1(A)|A \geq A_H^+] - v_L\{d_1 + E[f_1(A)|A < A_L^+]\},$$

which is positive as  $E[f_1(A)|A < A_L^+] \leq E[f_1(A)] < E[f_1(A)|A \geq A_H^+]$ .

Finally, consider the set of worker types that are assigned to task 0 before and after the increase of  $v$ , that is,  $A < A_H^+$ . Their expected wage for a given  $v_K$  with  $K \in \{L, H\}$  is  $v_K\{d_1 + E[f_1(A)|A < A_K^+]\}$  such that the income effect associated with an increase from  $v_L$  to  $v_H$  is given by

$$v_H\{d_1 + E[f_1(A)|A < A_H^+]\} - v_L\{d_1 + E[f_1(A)|A < A_L^+]\},$$

which is smaller than  $\Delta w(A)$  for  $A_H^+ \leq A < A_L^+$ . □

Without imposing further assumptions on the curvature of the production function, the probability distribution of the ability types, and the magnitude of the relevant parameters like  $v_L$  and  $v_H$ , the sign of the income effect for workers with ability  $A < A_H^+$  is ambiguous. Importantly, however, the income effect is always smaller than the corresponding income effect for workers with ability  $A_H^+ \leq A < A_L^+$  such that the income effect remains to be nonmonotonic in ability also in our generalized setup.

**Proposition C3.** Suppose  $\gamma \rightarrow 0$ . The expected surplus and the expected wage of the worker increase in  $v$ . The profit of alternative employers is zero.

*Proof.* For all ability types  $A > A^*$  the inequality  $\tilde{y}^1 < y^1$  holds. As  $A^+ > A^* \quad \forall v \in [0, 1]$  and  $A^+$  is strictly decreasing in  $v$ , the change in job assignment induced by an increase in  $v$  leads to a higher expected output and thereby to a higher expected surplus.

The expected wage of the worker is given by

$$\begin{aligned} G(A^+) \cdot v \cdot (d_1 + E[f_1(A)|A < A^+]) + [1 - G(A^+)] \cdot (d_1 + E[f_1(A)|A \geq A^+]) \\ = [1 - (1 - v)G(A^+)]d_1 + v \cdot \int_0^{A^+} f_1(A)g(A)dA + \int_{A^+}^{\bar{A}} f_1(A)g(A)dA. \end{aligned}$$

Differentiating with respect to  $v$  yields



$$G(A^+)d_1 + \int_0^{A^+} f_1(A)g(A)dA - (1 - v)g(A^+)\frac{\partial A^+}{\partial v}[f_1(A^+) + d_1],$$

which is positive as  $\partial A^+/\partial v < 0$ . □

As in the linear model, both the expected surplus and the expected wage are increasing with worker visibility. The effect on the current employer's expected profit, however, is ambiguous in equilibrium. On the one hand, the current employer benefits from a more efficient promotion cut-off. On the other hand, she suffers from the redistribution effect that leads to a higher expected wage for the worker. Which of these effects dominates will depend on the specification of  $g(A)$ , the distribution of worker abilities.

To sum up, although the generalized setup does not allow to replicate all findings for the linear model, the main results—an inefficiently large promotion cut-off that decreases with worker visibility, a nonmonotonic income effect from increased visibility, and increased expected surplus and wage from increased visibility—are still valid in our generalized setup.