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ORIGINAL ARTICLE

The Impact of Job Similarity Along the Career Path on the Firm's Promotion Strategy

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Abstract Firms use job promotions to incentivize hard work from low-level employees and to sort employees according to their skills. Since these two functions are often in conflict, a firm's promotion strategy tries to balance them. Our model extends prior research by identifying job similarity between current and future job as a driver of a firm's promotion strategy. When compensation costs are high or external hiring options poor, then higher job similarity leads to fewer internal promotions. Otherwise, higher job similarity can lead to more internal promotions. These results help to explain why firms with different structures or from different industries apply different promotion strategies.

Keywords Job promotion · Internal hiring · Job similarity · Labor market · Work incentives

1 Introduction

Promotions are an integral part of organizations. Typically, they serve two functions simultaneously. First, they motivate employees. With the exception of higher-ranking managers, promotions are the predominant tool to incentivize high effort from the workforce. The difference in wage between job levels is usually large enough such that even a small probability of promotion results in a significant increase in expected

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future compensation if the candidate provides high effort.[1] Second, promotions serve to sort workers according to their abilities. Higher-skilled employees are assigned a more important job to more effectively use the better skill.[2] These two functions of job promotions can be in conflict with each other. More internal promotions help to motivate workers, because they increase the chances of receiving a prize. However, if a better qualified external candidate is available and the internal worker is still promoted, the vacancy is not filled in the best possible way.

In this context, we extend prior literature by emphasizing the importance of job similarity in this trade-off. Many organizations require a vastly different skill set from their employees on each level along the career path, for example, the Big 4 audit networks. At the entry-level, audit assistants are mostly responsible for structured auditing tasks. When employees rise up in ranks, the tasks evolve to managing the younger staff, and eventually as they become partners the core competence is to acquire and maintain clients. Another feature of the Big 4 audit networks, which arises endogenously in our model, is the up-or-out culture. Auditors either receive a promotion or leave the company (Kornberger et al. 2011). Law firms and the consulting industry have a similar structure. In contrast, a sales representative, who is promoted to deal with more important clients, can use a similar skill set as before the promotion.

We analyze how job similarity along the career path affects a firm's decision to promote internally versus to hire externally. A higher job similarity between the entry-level and managerial job increases the informativeness of the internal workers' past performance about their potential managerial performance.[3] Intuitively, one might think that a high degree of job similarity leads to more internal promotions. As we explain in the following, this is not necessarily the case. We analyze a setting in which the firm determines a performance threshold, above which an internal worker would be promoted. If the firm decreases the threshold, the likelihood of internal promotions increases. The possibility of a promotion is the only tool to incentivize high effort from a worker in the first period. The firm is implicitly bound to the threshold, because workers in future periods would no longer trust the firm after a deviation. After the first period, the firm must replenish a managerial position with either an internal or an external candidate.

The key trade-off depends on the firm's compensation costs relative to the importance and quality of external hiring options. When compensation costs are a top priority, for example in labor-intensive industries such as auditing or consulting, the firm has a strong incentive to partially substitute compensation costs with a higher likelihood of promotion for the internal candidates. Thus, absent any new information, the firm focuses more on the incentive function than on the sorting function of promotion. If the firm learns that its best worker is worse than the external candidate, it faces costs of still promoting the internal worker. Higher job similarity increases

[1] See, e.g. Lazear and Rosen (1981); Malcomson (1984); Rosen (1986).

[2] See, e.g. Sattinger (1975); Rosen (1978); Waldman (1984), and a survey on both functions Gibbons and Waldman (1999).

[3] Througout the paper, we use the terms "managerial job" and "entry-level job" to refer to a higher-level and lower-level job, respectively. However, the analysis is applicable to non-managerial promotion as well.

the costs since the inferior entry-level performance is more likely to translate into inferior upper-level performance. Therefore, the firm counteracts by increasing the promotion threshold, which reduces the likelihood of an internal promotion.

Contrary, the skills of the external candidates could be so good that the benefits of hiring externally outweigh the compensation costs arising from the moral hazard problem. Thus, absent any new information, the firm focuses less on the motivation function than on the sorting function of promotion. More information conveyed by high job similarity allows the firm to sufficiently update its prior beliefs about the managerial skills of internal workers, enabling internal workers to compete with external candidates. If the firm learns that the entry-level performance of its best worker is high, then this will more likely convert into superior upper-level performance with high job similarity. Therefore, higher job similarity lowers the promotion threshold, which increases the likelihood for an internal promotion.

In addition to the monopolistic firm, we analyze a scenario in which we endogenize the outside hiring option by introducing demand-side competition on the labor market. Competition changes the setup by offering the opportunity to hire personnel from outside the firm whose performance in period one can be observed. We find that competition always increases the value of the outside option. Hence, internal promotion becomes less frequent, but firm value increases.

Our results can help firms to improve their promotion decisions by highlighting job similarity as an important factor to learn about the potential performance of lower-level workers in higher-level jobs. Firms have some control over job similarity. For example, they can create more similarity by allocating more responsibilities to entry-level workers. This practice increases firm value because firms learn more about their workers' skills. However, the implications for the frequency of internal promotion differ depending on the characteristics of firms: If compensation costs are small, internal promotion becomes more likely, if compensation costs are large, external hiring becomes more likely.

As pointed out at the beginning, the conflict between motivating and sorting agents is known in the literature. Most related, Chan (1996); Waldman (2003), and Tsoulouhas et al. (2007) focus on internal promotions and show that it can be optimal for the firm to commit to internal promotions (handicap external candidates). In these studies, workers have one relevant skill level for both the low-level and the high-level task. We contribute to the literature by showing that the optimal promotion policy depends crucially on the similarity between the tasks, which can increase or decrease the promotion threshold.

Prendergast (1993) and Ghosh and Waldman (2010) also analyze job similarity but with different focus. Prendergast (1993) shows that the jobs need to be sufficiently different to incentivize workers to acquire specific knowledge for the job after promotion. Ghosh and Waldman (2010) find that job similarity causes up-or-out contracts to be more efficient than standard promotion practice to remain in the job if not promoted. Our paper uses up-or-out contracts as well, but our results remain unchanged if the worker were to remain in the company.[4]

[4] In our model, commitment occurs implicitly, not contractually, since the workers can observe the firm's past hiring practice. In contrast, commitment to future wages is not possible in the career concern literature

Comparable to our use of job similarity, Cremer (1995) is interested in the past performance of an agent. He analyzes a principal's choice of monitoring which generates information relevant for the CEO's replacement. In this context, the principal is willing to forego information by the installation of a weaker monitoring system. As in our paper, additional information can be detrimental for the agents if the principal discovers below-average performance. Different to us, we also consider the positive impact of more information when the firm discovers above-average performance. In addition, job similarity as the source of information in our paper is outside the control of the principal.

Our paper is also related to the peter principle, which states that workers are promoted until they cannot meet the requirements of the job anymore (Peter and Hull 1969). Several studies draw on this topic as well (e.g. Fairburn and Malcomson 2001; Lazear 2004). In our model, below-average workers might be promoted to the higher-level job when compensation costs are a top priority for the firm. Then, the firm is willing to lower the promotion threshold in order to be able to cut down compensation premia. This result offers an additional explanation for the peter principle.

We further provide a number of empirically testable predictions and explanations for existing findings. For example, Bidwell (2011) finds in one investment banking firm that workers, who are promoted in the same department, show a higher subsequent performance than workers, who are transferred and promoted. He attributes the finding to the benefit of internal learning. Alternatively, it is also consistent with our prediction. Suppose that (1) promotions within the department offer more job similarity than a promotion with transfer, and (2) compensation is a top priority in investment banking firms, then job similarity increases the performance threshold to be promoted. Therefore, workers that are promoted within the department have higher average skills than transferred workers.

The remaining paper is organized as follows. Sect. 2 describes the model, Sect. 3 includes our benchmark case without a moral hazard problem, as well as the main analysis, Sect. 4 provides our extension in a competitive labor market setting, Sect. 5 presents empirical predictions and discusses the robustness of our model, and Sect. 6 concludes.

2 Model

Consider an overlapping-generations setting with one risk-neutral, infinitely lived firm[5] and many risk-neutral two-period lived workers i. The discount factor is δ.

Timing: There are infinitely countable dates, $t = \{0, 1, 2, ...\}$. At any point in time t, the organization is staffed with members of two generations. There are two newly-born workers who live for two periods and work in entry-level jobs and one

(e.g., Gibbons and Murphy 1992; Holmstrom 1999; Autrey et al. 2007. For example, Gibbons and Murphy (1992) assume linear short-term contracts instead to incentivize high effort.

[5] Because the firm is risk-neutral, differences in uncertainty about a worker's skill are not relevant in our setting.

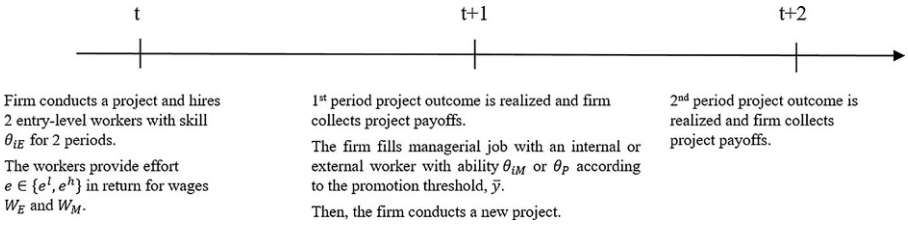

Fig. 1 Timeline

older worker who lives for one more period and does a managerial job. Workers have knowledge of observable events that happened in the past, i.e. the promotion practice in previous periods. After signing the contract, the agents can exert costly effort. At the end of any period, the project outcomes are publicly realized and expectations of workers' skills are updated. Then, at $t + 1$, the older worker retires and the firm has to hire a new manager. This can be achieved through internal promotion or an external hire. The younger workers who are not promoted leave the company.[6] The timing is summarized in Fig. 1.

Effort: After signing a contract at t, each worker i takes an unobservable effort choice $e_{it} \in \{e^l, e^h\}$, which can either be high or low. High effort improves the project outcome (specifics below), while low effort does not, i.e. $e^l = 0$. Also, we assume that $e^h < 1$ to guarantee a solution. Effort is costly, $v(e_{it})$. The cost of high effort is $v(e^h) = k$, while the cost of low effort is normalized to zero, i.e. $v(e^l) = 0$, without loss of generality. As will become clear below, the effort choice in the second period is always low, and hence we exclude the time subscript, when it is without ambiguity. Let k be small enough such that the firm finds it optimal to incentivize high effort in the first period.

Skills: Each worker has two skills $\theta_{iE}, \theta_{iM} \sim U(0,1)$, which are unknown to all parties.[7] The first one, θ_{iE}, is relevant for the entry-level job, the second one, θ_{iM}, is relevant for the managerial position. The joint distribution of the skills depend on the job similarity, ρ. With probability ρ, it is true that entry-level skills perfectly predict managerial skills, $\theta_{iE} = \theta_{iM}$ and with probability $(1 - \rho)$, θ_{iM} is drawn independently. Thus, the correlation coefficient between skills is $\rho \in (0,1]$, and for all $j \neq i$ it is true that $(\theta_{iE} - \theta_{jE}) * \rho = E[\theta_{iM}|\theta_{iE}] - E[\theta_{jM}|\theta_{jE}]$. For more similar jobs, the expected difference in managerial skill levels is bigger than for less similar jobs, holding the difference in low-level skill constant (compare for example

[6] It is optimal for the firm to hire newly-born workers for the entry-level job. As will become clear below, it is not possible to incentivize older workers to provide high effort.

[7] Using a uniform distribution, effort can be observable for extreme realizations. When skill is low and the worker puts in low effort, the firm can detect that low effort was provided. This is not a problem in our model because promotion will not be achieved when this effect is in play.

Arya and Mittendorf 2011). Basically, with greater correlation, the information that is learned, makes for a better predictor. It follows that

$$E[\theta_{iM}|\theta_{iE}] = \rho\theta_{iE} + (1-\rho)E[\theta_{iM}] = \frac{1}{2} + \rho\left(\theta_{iE} - \frac{1}{2}\right). \tag{1}$$

Projects: Each worker is in charge of a project. Project outputs are uncorrelated, observable, but non-contractible: $y_{it} = \theta_{it} + e_{it}$. The revenue of one unit of output for the entry-level job is normalized to one. The revenue of one unit of output of the managerial job is $\lambda > 1$, which is greater than one to express the higher productivity of the managerial task.

Managerial hiring decision: At $t + 1$, after observing project outputs, the firm hires a one-period old worker for the managerial job. The firm, at $t + 1$, can freely choose which worker to put into the managerial position, and is not in any way contractually committed to promote internally or hire externally. As we will show, the firm may play a threshold strategy $\overline{y}$ such that it promotes internally, if at least one of the two workers' outputs exceeds the threshold. If none of the workers exceed $\overline{y}$, then the firm picks a worker that was self-employed in the initial period. The explicit output threshold can be converted into an implicit skill threshold,

$$\overline{\theta} = \overline{y} - e^h, \tag{2}$$

because the firm knows, in equilibrium, that workers chose high effort.

For all employed workers, the expected skill level can be updated. The expected skill level for self-employed workers available at $t + 1$ for the managerial position shall be θ_P.[8] If $\theta_P = 0.5$, the expected skill level of the self-employed workers is equal to the unconditional ex-ante skill of the cohort employed in the firm at time t. However, we also allow deviations from the unconditional skill, i.e. $\theta_P \neq 0.5$. These can occur simply because the cohort of self-employed people in period $t + 1$ differs from period t. Other factors might also increase the mean to $\theta_P > 0.5$, such as higher experience in the external candidates. Similarly, a preference for internal candidates on average, that is $\theta_P < 0.5$, might occur if hiring costs for external candidates such as time and resources spent searching are included.[9] Alternatively, we show in Sect. 4 how information about the external hiring option can be generated endogenously.

[8] We do not assume that the firm can update its expectations about θ_P before the promotion decision. Our results do not change even if the firm receives more information about θ_P. When the ex-post observed quality of the external candidate is high, the ex-post threshold for internal promotion will be higher and vice versa. However, this effect has no impact on the internal workers' decisions. The risk-neutral internal worker only cares about their ex-ante promotion probability when deciding whether to accept the offer and to provide high effort.

[9] As long as the number of available outside talent is large, variance can be neglected (due to the law of large numbers).

Contracting: Since output is assumed to be non-contractible and effort is unobservable, the firm can only offer a flat wage in each period.[10] Thus, a contract has the following vector form: $c = (W_E, W_M)$, where W_E describes the wage paid in the initial period to a hired entry-level worker, and W_M describes the wage paid in the following period to a hired managerial-level worker. Workers can choose not to work for the company, both at t, and at $t + 1$ ("no-slave condition"). Their reservation utility outside of the firm is $\overline{U}$ per period. We assume that the firm cannot renegotiate on the contract by threatening to fire the employee and rehiring her to the managerial job for $\overline{U}$. Furthermore, to keep the model simple, we exogenously assume that if a firm hires externally for the managerial job, it has to pay at least W_M to this external worker as well.[11] We further focus on promotion-based compensation contracts only. We follow Baker et al. (1988), who state that promotions rather than monetary awards are often used in organizations to incentivize workers.[12]

3 Analysis

3.1 Benchmark: No Moral Hazard

In this section, we describe a special case of our general model, where the cost of effort is zero, $k = 0$. Therefore, moral hazard and the motivation function of promotions are not an issue and the firm can solely focus on the sorting function. The game condenses to a one-shot game with two periods. The firm can simply pay the reservation utility in both periods since the workers will choose high effort voluntarily. Hence, the firm's only decision is to select a candidate for the managerial position from either the firm's own talents or the external pool of self-employed workers. It promotes internally, if the best-performing internal worker's output θ_{iE} satisfies:

$$\frac{1}{2} + \rho\left(\theta_{iE} - \frac{1}{2}\right) \geq \theta_P, \tag{3}$$

[10] These assumptions are consistent with the prior literature such as Holmstrom (1999) and Waldman (2003).

[11] Empirical studies show that the managerial wage can be higher for external hires compared to internally promoted managers (Bidwell 2011; Murphy and Zabojnik 2007; Palomino and Peyrache 2013). We fix the wage for an external hire to the managerial wage W_M that the firm would have paid an internally promoted worker, if it had promoted internally. The results remain qualitatively unchanged as long as this wage is higher than the reservation utility.

[12] There are several arguments why this could be the case. Fairburn and Malcomson (2001) post that bonuses are subject to influencing activities. Using promotions as incentive can reduce the influencing activity. Zabojnik and Bernhardt (2001) state that promotions are used because signaling means incentives are a substantial part of the promotion process.

which can be rearranged to

$$\theta_{iE} \geq \overline{\theta}_B = \frac{1}{2} + \frac{\theta_P - \frac{1}{2}}{\rho}. \tag{4}$$

$\overline{\theta}_B$ describes the skill threshold an internal worker has to exceed in order to be promoted. The effect of job similarity on this threshold is summarized in the following Lemma:

Lemma 1 *(i) If $\theta_P = 0.5$, then job similarity between the entry-level job and the job after promotion (ρ) does not affect the firm's promotion decision.*

(ii) If $\theta_P > 0.5$, then a higher degree of job similarity (ρ) leads to a higher likelihood for internal promotions ($\overline{\theta}_B$ decreases).

(iii) If $\theta_P < 0.5$, then a higher degree of job similarity (ρ) leads to a lower likelihood for internal promotions ($\overline{\theta}_B$ increases).

When $\theta_P = 0.5$, then job similarity affects expected managerial skills, but it does not affect the ranking between internal and external candidates. If an entry-level worker performs above (below) average, the managerial skill is also above (below) average in expectation. Thus, the firm always promotes an internal worker with $\theta_{iE} \geq 0.5$ and job similarity is not relevant for the promotion decision.

This intuition changes, when $\theta_P \neq 0.5$. In case (ii), the external candidates are better qualified on average for the managerial job than the internal workers, $\theta_P > 0.5$. Thus, a below average worker is never promoted. However, even internal workers better than average face a disadvantage compared to the external pool. If the correlation is low, the firm is unsure whether the entry-level performance translates to better performance at the managerial task, which impedes the internal workers' ability to exceed the desired threshold. Therefore, higher job similarity increases the chances of being promoted. On the contrary, internal workers in case (iii) are certainly promoted with above average performance since $\theta_P < 0.5$. When the worker performs below average on the entry-level, the firm expects below average on the managerial tasks as well. Hence, low correlation helps the internal candidate since entry level performance is not directly transferable into managerial performance. In this scenario, job similarity decreases the chances of being promoted.

3.2 Main Results

We now turn the focus to the main setting of the paper, when there is a moral hazard problem, i.e. the cost of high effort is positive, $k > 0$. Any contract offered to prospective entry-level employees at t needs to satisfy two conditions. First, the participation constraint, which ensures that workers find it optimal to accept the contract. Second, the incentive constraint to ensure that the workers find it optimal to choose work rather than shirk. For both constraints, workers' beliefs about the firm's promotion strategy matter. For simplicity, we restrict attention to trigger strategies. This means that workers believe that the firm will stick to its promised threshold strategy $\overline{y}$, as long as the firm has never deviated from it in the past. If the firm

deviated in the past, then workers believe that the firm will play the one-shot optimal threshold $\overline{\theta}_B$ described in the benchmark section above.

It is easy to show that the off-equilibrium strategy (when the firm deviated at least once in the past) is a stable sub-equilibrium. In this case, the firm has no incentive to deviate from the one-shot optimal threshold $\overline{\theta}_B$. Any deviation will lower firm profits in the current period (due to a decrease in the expected skill of the manager), while future firm profits are unaffected. Future employees will not change their beliefs about the firm's strategy, regardless of the firm's actions.

Returning to the equilibrium path, let $\Pr(\text{Prom}|e^h, \overline{y})$ be the probability that the worker exceeds the performance threshold and is promoted given high effort. Then, the participation constraint for each worker reads

$$W_E + \delta \Pr\left(\text{Prom}|e^h, \overline{y}\right) W_M + \delta \left(1 - \Pr\left(\text{Prom}|e^h, \overline{y}\right)\right) \overline{U} - k \geq (1+\delta)\, \overline{U}, \quad (5)$$

where $\Pr\left(\text{Prom}|e^h, \overline{y}\right) = \frac{1-\overline{\theta}^2}{2}$.

$\Pr(\text{Prom}|e^h, \overline{y})$ consists of two parts. The worker needs to beat the threshold, which he accomplishes with probability $(1 - \overline{\theta})$. Additionally, conditional on beating the threshold, he needs to beat the other internal worker, which he accomplishes with probability $\frac{(1+\overline{\theta})}{2}$.

If the worker accepts the contract, then he receives the guaranteed flat entry-level wage W_E in the first period. In the second period, he receives the managerial wage W_M, if he is awarded the promotion, and obtains the reservation utility $\overline{U}$ otherwise. Since the worker chooses high effort (see incentive constraint below) in equilibrium, he suffers the cost of high effort k. If the worker rejects the contract, he receives the reservation utility in both periods.

The other constraint is the incentive constraint to ensure that the workers find it optimal to choose work rather than shirk:

$$\begin{aligned} &W_E + \delta \Pr\left(\text{Prom}|e^h, \overline{y}\right) W_M + \delta \left(1 - \Pr\left(\text{Prom}|e^h, \overline{y}\right)\right) \overline{U} - k \\ &\geq W_E + \delta \Pr\left(\text{Prom}|e^l, \overline{y}\right) W_M + \delta \left(1 - \Pr\left(\text{Prom}|e^l, \overline{y}\right)\right) \overline{U}. \end{aligned} \quad (6)$$

Regardless of the effort decision, each worker always receives the flat entry-level wage W_E. However, high effort e^h increases the chances for a promotion because $\Pr(\text{Prom}|e^h) > \Pr(\text{Prom}|e^l)$. First, with higher effort, the chances of beating the performance threshold $\overline{y}$ increase. Second, the chances of outperforming the other worker increase. In return, workers incur the cost of high effort k.

In the optimal solution, (5) and (6) will hold with equality. Thus, we have two equations and can solve for the two wage payments:

$$W_M = \overline{U} + \tau \quad (7)$$

$$W_E = \overline{U} - \Pr\left(\text{Prom}|e^h, \overline{y}\right) \tau + k, \quad (8)$$

$$\text{where } \tau = \frac{k}{\delta\left(\Pr\left(\text{Prom}|e^h, \overline{y}\right) - \Pr\left(\text{Prom}|e^l, \overline{y}\right)\right)} = \frac{k}{\delta e^h \left(1 - \frac{e^h}{2}\right)}.$$

The managerial wage includes a surcharge τ on top of the reservation utility to motivate high effort from a worker. τ increases in the disutility from high effort (k increases) and decreases in the effort's impact on the probability of being promoted ($\Pr(\text{Prom}|e^h, \overline{y}) - \Pr(\text{Prom}|e^l, \overline{y})$ or e^h increase). Hence, it essentially captures the size of the moral hazard problem. Since the surcharge is paid in the second period, it also contains the discount factor, δ. Higher patience leads to a lower surcharge.

The implied skill level to be promoted $\overline{\theta}$ does not affect the managerial wage. The reason is that effort has a constant effect on the worker's promotion probability.[13] The firm's promotion strategy, however, affects the entry-level wage via the participation constraint. If a worker anticipates a higher probability of receiving a promotion because the firm chooses a lower performance threshold $\overline{y}$, then the managerial wage has a stronger impact on the worker's decision making (i.e. career concerns are higher). The firm can, of course, anticipate this behavior and offer both workers a lower entry-level wage, who still find it optimal to accept the offer.

Contrary, if $\overline{y}$ is higher, the workers care less about the managerial wage because they find it unlikely that they will receive it in the future and the firm increases W_E. This increase also causes the total compensation cost to rise because the firm has to pay the same managerial wage regardless of outcome. Even if the firm ultimately hires the external candidate, it still needs to pay the managerial wage.

It is further noteworthy that neither W_E nor W_M depend on the correlation coefficient ρ. Hence, the cost of compensation does not (directly) depend on job similarity.

Next, we analyze the firm's optimal promotion strategy. Its expected short-term profit from one generation of workers on the equilibrium path can be expressed as

$$\begin{aligned}\overline{V}(\overline{y}) =& 2\left(\frac{1}{2} + e^h\right) + \delta\lambda\left(\overline{\theta}^2\theta_P + \left(1-\overline{\theta}^2\right)E\left[\theta_{iM}|\max_{i}[\theta_{iE}] > \overline{\theta}\right]\right) \\ & - 2W_E - \delta W_M.\end{aligned} \tag{9}$$

The expected short-term profit is determined by two major factors: the skill of the employed workers and the cost of compensation. The first summand displays the output in the first period. Each worker generates cash flow of $0.5 + e^h$. The second term displays the value of the output in the second period. Since there is only a flat wage in the second period, the manager cannot be induced to provide high effort. Thus, only the managerial skill contributes towards output. There are two possibilities. First, none of the internal entry-level workers exceed $\overline{y}$. In this case, which occurs with probability $\overline{\theta}^2$ (i.e. $(\overline{y} - e^h)^2$, see Eq. 2), the firm hires an external worker, whose expected skill level is θ_P. Second, at least one of the workers exceeds $\overline{y}$, and the firm promotes the best-performing internal worker. In this case, job similarity between the entry-level and managerial job ρ matters due to the possibility to update skills. If the similarity is low, then the firm learns

[13] The constant effect of effort is driven by the uniform distribution. Using a standard normal distribution and assuming that $\overline{\theta} > 0$, an increase in the threshold would decrease the chance that effort makes a difference in the promotion decision, thus causing the managerial wage to rise.

little about the worker's expected managerial skill level. Even though the firm can perfectly infer the worker's entry-level skill due to a lack of noise, the entry-level skill provides only limited information about the managerial skill, which is relevant for the firm's decision.

As a next step, we determine the firm's optimal promotion threshold. We insert (2), (4), (7), and (8) into (9) and take the first derivative of (9) with respect to $\overline{y}$:

$$\overline{y} = \max \left[\underbrace{\frac{1}{2} + \frac{\theta_P - \frac{1}{2}}{\rho}}_{\overline{\theta}_B} + e^h - \frac{\tau}{\delta\lambda\rho}, e^h \right]. \tag{10}$$

The benchmark threshold, $\overline{\theta}_B$, from (4) builds the foundation for (10). As discussed in Sect. 3.1, $\overline{\theta}_B$ describes the optimal threshold when the firm only focuses on the sorting function of promotion. In addition, the optimal threshold accounts for the anticipated effort level, e^h, as well as the relative importance of the incentive problem in relation to the importance of the sorting problem, $\frac{\tau}{\delta\lambda\rho}$.

It remains to be shown that this threshold is a stable equilibrium. After all, the firm can increase its expected short-term profit by deviating from the equilibrium path and choosing the one-shot optimal threshold $\overline{\theta}_B$. However, future firm profits will be lower because the firm will be forced to play the off-equilibrium path strategy $\overline{\theta}_B$. Workers, after the first deviation, will then correctly anticipate the firm's choice of $\overline{\theta}_B$, which leads to lower future profits. A stable equilibrium is guaranteed as long as the firm is patient enough and discounts future profits with a discount rate δ greater than some threshold δ^*.

In a next step, we analyze the impact of our main variable, ρ, on the promotion threshold from (10), which leads to the following proposition:

Proposition 1 *For a sufficiently patient firm, $\delta \geq \delta^*$, a higher degree of job similarity (ρ increases)*

(i) leads to a higher likelihood of internal promotion ($\overline{y}$ decreases), if compensation costs are small, $\tau < \delta\lambda(\theta_P - 0.5)$,

(ii) leads to a lower likelihood of internal promotion ($\overline{y}$ increases), if compensation costs are large, $\tau > \delta\lambda(\theta_P - 0.5)$,

(iii) does not affect the likelihood of internal promotion, if $\tau = \delta\lambda(\theta_P - 0.5)$.

If $\delta < \delta^*$, then the firm will choose the one-shot optimal threshold $\overline{\theta}_B$.

The influence of job similarity on the promotion decision can be explained by the interplay between the importance of the managerial position, λ, the external hiring option, θ_P, and the compensation surcharge, τ. The managerial importance, λ, determines the impact of the sorting function of promotions. We show in Lemma 1 that more precise information either helps the firm to identify an above-average worker, if $\theta_P > 0.5$, or it helps to identify a below-average worker, if $\theta_P < 0.5$. The former case constitutes a benefit of job similarity and decreases the promotion threshold [see Lemma 1 (ii)], while the latter constitutes a cost and increases the promotion threshold [see Lemma 1 (iii)].

In contrast, the compensation surcharge, τ, describes the cost of the incentive function. If this surcharge is high, the firm prefers to substitute the high monetary reward for the managerial position with a high likelihood for the entry-level workers to be promoted. However, more precise information could reveal a below-average entry-level worker, which renders the substitution less attractive. Thus, higher job similarity highlights expected costs of internal promotion and increases the promotion threshold.

When compensation costs are small, $\tau < \delta\lambda(\theta_P - 0.5)$, the firm reacts more sensitively to the impact of job similarity on the sorting function compared to the incentive function. This scenario only arises if the external talent pool is above average, $\theta_P > 0.5$. In this scenario, the firm is concerned about falsely promoting an unsuitable candidate (type II error) and tightens the promotion criteria when job similarity is low. The contrary is true when compensation costs are large, $\tau > \delta\lambda(\theta_P - 0.5)$. Then, higher job similarity reduces the likelihood of falsely dismissing a suitable candidate (type I error). The firm can tighten the promotion criteria to avoid the costs of promoting a below-average worker.

When $\tau = \delta\lambda(\theta_P - 0.5)$, the forces of sorting and incentive function balance each other and job similarity does not influence the firm's promotion strategy, similar to Lemma 1 part (i). In the benchmark case described in Lemma 1, $\theta_P = 0.5$ marks the point, where job similarity has no effect on the promotion strategy. This is now different since the existence of the moral hazard problem creates a preference for the internal candidates. Therefore, given that the average skill of the external pool equals the ex-ante skill of the firm's entry-level worker cohort, $\theta_P = 0.5$, the promotion threshold is below average performance and job similarity always increases the threshold as in part (ii) of the proposition.

As stated before, these trade-offs arise only if the firm is sufficiently patient, $\delta \geq \delta^*$. If the firm is less concerned about future profits, $\delta < \delta^*$, it deviates from the threshold, $\overline{y}$, and sticks to the benchmark threshold, $\overline{\theta}_B$, instead. Then, job similarity affects the likelihood of a promotion as described in Lemma 1.

From (10), we can also derive the following Corollary.

Corollary 1 *If $\tau > \delta\lambda(\theta_P - 0.5)$, then there exists $\rho = \rho^*$, such that for $\rho \in (0, \rho^*]$, it is optimal for the firm to promote exclusively internally.*

Concerns about compensation can be so severe that the firm completely neglects the maximization of the expected managerial skill, and only focuses on the incentive effect of promotions. Interestingly, the reverse of the corollary is not true. The reason is that we focus on cases where the firm wants to incentivize high effort. Therefore, absent any other incentive mechanisms, there must always be some probability of promoting internally. Furthermore, Corollary 1 relies on the assumption that the distribution of skills has a lower bound. If skills are e.g. normally distributed, then there always exists a sufficiently negative realization of skills such that the firm would not find it optimal to promote internally.

The results of Proposition 1 and Corollary 1 emphasize that there is not a single best practice for firms how to design the promotion strategy. However, if the firm had discretion over the job design of the entry level and managerial job, i.e. the firm chooses the optimal job similarity, it would always choose the higest similar-

ity possible. The reason is that the conditional expected value for the mangerial task increases with more information, which a higher job similarity can provide. Therefore, a higher job similarity always increases expected firm value, $\overline{V}(\overline{y})$. Firms could design jobs more similarly by allocating more responsibilities to entry-level workers. The implications for the frequency of internal promotion would differ depending on the characteristics of firms: If compensation costs are small, internal promotion becomes more likely, if compensation costs are large, external hiring becomes more likely.

Besides job similarity, other firm and worker characteristics also influence the promotion threshold, which we elaborate in the following section. For a specific empirical discussion of the results, see Sect. 6.

3.3 Comparative Statics

Several variables determine the cost and benefits of internal promotion and thus $\overline{y}$.

Corollary 2 *The performance threshold $\overline{y}$ increases if*

(i) the marginal benefit of the managerial position (λ) increases
(ii) the cost of effort (k) decreases,
(iii) the effect of high effort (e^h) on output increases, or
(iv) the discount factor (δ) increases.

Part (i) addresses predominantly the importance of the sorting function. If λ increases, then it is crucial to hire the most competent person for the managerial position. The performance threshold, $\overline{y}$, increases because compensation concerns are pushed back.

Contrary, parts (ii) and (iii) emphasize the compensation concerns. Both a decrease in the cost of effort k and an increase in the impact of high effort e^h relax the moral hazard problem since the firm needs a lower compensation surcharge, τ, on the managerial wage to incentivize high effort. A lower managerial wage reduces the costs of the managerial position for both external candidates and internal workers. However, to ensure participation in the first period for internal workers, the firm has to counteract the decrease of the managerial wage with an increase of the entry-level wage. Although this increase is smaller, since internal workers are only promoted in a fraction of total cases, external hiring becomes relatively cheaper. As a result, the promotion threshold, $\overline{y}$, increases.

Part (iv) combines the previous elements. First, the discount factor δ influences the sorting function. A higher δ increases the importance of future managerial performance and the promotion threshold, $\overline{y}$, increases. Second, a higher δ decreases the compensation surcharge for future managerial performance, τ. As in parts (ii) and (iii), a lower surcharge increases the promotion threshold, $\overline{y}$. Overall, both effects are positive and the promotion threshold increases.

4 Labor Market Competition

So far, we did not specify the source of information for the external hiring option, θ_P. The aim of this section is to provide a rationale how this information can arise endogenously and what effect competition has on a firm's promotion strategy. For this purpose, we consider competition on the labor market between two firms, $n \in \{1,2\}$, where $-n$ describes the competitor firm. The firms can either promote internally, hire from the external pool of self-employed workers, or they can try to hire the entry-level worker from the competitor. Parameter ρ_n (ρ_{-n}) indicates the job similarity between the entry-level job in firm n (firm $-n$) and the vacant managerial job in firm n.[14] We assume in this section that the firms have no prior information about the skill level of the external pool, which means that it equals the unconditional expected skill of the entry-level cohort within the firm, $\theta_P = 0.5$. According to (4), this change implies that the benchmark threshold is $\overline{\theta}_B = 0.5$.[15] All other assumptions remain unchanged. Then, the optimal promotion threshold yields

$$\overline{y}_n = \max\left[\frac{1}{2} + \frac{T_n(\rho_{-n}) - \frac{1}{2}}{\rho_n} + e^h - \frac{\tau}{\delta\lambda\rho_n}, e^h\right] \tag{11}$$

$$\text{with } T_n(\rho_{-n}) = (1-0.5)^2 E\left[\theta_{iM} | \min_i[\theta_{iE}] > 0.5\right] + \left(1-(1-0.5)^2\right) 0.5. \tag{12}$$

What effectively changes compared to the monopoly setting is the value of the outside option, which is $T_n(\rho_{-n})$. Competition offers an additional option to hire external talent from the competitor, summarized in $T_n(\rho_{-n})$. However, the firm can never attract the best worker from the competitor since the competitor can match all wage offers and convince the worker to remain in the firm. The bidding does not impact firm value of either firm since the workers' participation constraint is binding and all wage increases in the managerial wage can be anticipated and deducted accordingly from the entry level wage. As a consequence, only the excess talent from the competitor is available for hiring.

Then, the value of the outside option, $T_n(\rho_{-n})$, is as follows. Firm n hires the second best worker from the competitor and receives the expected skill $E[\theta_{iM} | \min_i[\theta_{iE}] > 0.5]$, if the competitor has two workers, which would be promoted internally, $(1-\overline{\theta}_{-n})^2$, and whose expected managerial skill is better than the benchmark threshold, $(1-0.5)^2$.

If the competitor has at most one worker who is better than the benchmark, $1-(1-0.5)^2$, firm n can still hire from the external pool to receive average skill

[14] In most cases, the entry-level performance in the same firm is a better indicator for managerial performance, ergo $\rho_n > \rho_{-n}$. However, our results are not restricted to this case.

[15] To simplify the structure, we assume that the entry-level workers' output in $t+1$ is observable by the own firm and the competitor to the same extent.

0.5.[16] Comparing both thresholds from competition (11) and monopoly (10) with $\theta_P = 0.5$ leads to the following proposition:

Proposition 2 *Competition of firms decreases the firms' use of the internal labor market compared to a monopoly scenario,* $\overline{y}_n \geq \overline{y}$.

The difference between the thresholds boils down to the difference in value of the outside option in competition and monopoly, $T_n(\rho_{-n}) - 0.5$. The value of the outside option in competition, $T_n(\rho_{-n})$, is ultimately a mix of the option to hire from the competitor, $E[\theta_{iM} | \min_i[\theta_{iE}] > 0.5]$, and from the external pool, $\theta_P = 0.5$, weighted by $(1-0.5)^2$. Thus, it resembles a call option. Since there are no costs to the call option in this model, the outside hiring option in competition is always better than the external pool $T_n(\rho_{-n}) - \theta_P \geq 0$. Therefore, the firms always increase the promotion threshold in competition, which reduces the likelihood of internal promotions. Simultaneously, this effect also causes the firm value to increase in the competition scenario, $V_n \geq \overline{V}(\theta_P = 0.5)$ (Appendix for details).

Corollary 3 *If the job similarity between the entry-level job in the competitor firm* $-n$ *and the vacant managerial job in firm n increases (*ρ_{-n} *increases), the likelihood of internal promotion decreases (*$\overline{y}_n$ *increases).*

In the competition setting, the role of the firm's own job similarity between entry-level and managerial task, ρ_n, is similar to the monopoly case. In contrast, ρ_{-n} takes over the role of an above average pool of external workers, $\theta_P > 0.5$, since it increases the quality of the outside option. This effect explains Corollary 3. If the informativeness of the outside option is high (ρ_{-n} is high, similar to $\theta_P > 0.5$), then job similarity within the firm (ρ_n is high) enables internal workers to compete with external hires. This benefit can outweigh the costs of promoting a below-average worker when compensation costs are low $\tau < \delta\lambda\frac{\rho_{-n}}{24}$, which leads to a lower promotion threshold [resembles Proposition 1 (ii)]. In the case of high compensation costs, $\tau > \delta\lambda\frac{\rho_{-n}}{24}$, the cost of promoting internally prevail, which leads to a higher promotion threshold [resembles Proposition 1 (i)]. In this sense, the results from the monopolistic setting with an exogenous source of information, $\theta_P \neq 0.5$, can be replicated in a competition setting with an endogenous source of information.[17]

5 Empirical Implications

In prior literature, the firm's promotion strategy is often connected to the agent's acquisition of firm specific knowledge (e.g. Prendergast 1993). Contrary to this view, our paper shows the importance of the firm learning about the possible fit of its internal candidates. This perspective can be useful for empirical studies. Job similarity

[16] Since $\overline{\theta}_{-n}$ describes the threshold including the moral hazard problem (compare (10) and Corollary 2), it is true that $\overline{\theta}_B = 0.5 > \overline{\theta}_{-n}$; thus, beating $\overline{\theta}_{-n}$ is implied if workers exceed 0.5.

[17] Other information sources about the quality of the external hiring option render similar results, such as education certificates or managerial experience.

between the entry level and the managerial level as the firm's source of learning divides careers into different categories. For example, the tasks of an assistant in an audit firm, who mostly performs structured auditing tasks, highly differ from a manager, who is responsible for managing younger staff and dealing with more complex matters. In contrast, an investment banker, who advances to handle more important clients, continues to perform very similar tasks as before. At the same time, both jobs from this example stem from a labor-intensive industry, where the focus lies on the human capital and compensation is a top priority [compare Proposition 1 (i)]. Our model shows that these two scenarios lead to different promotion strategies for the deciding firm.

Prediction 1 *Job similarity increases the frequency of internal promotions in labor-intensive industries.*

The design of the career for a certain job within a firm is not the only determinant of the promotion strategy. Firms can differ with respect to a variety of characteristics, one of those are agency costs. Our model provides two possible sources of an increase in agency costs: a higher disutility for high effort, k, or a lower impact of high effort on the output, e^h. Both aggravate the principal-agent conflict and increase compensation costs via the compensation surcharge, τ, which decreases the promotion threshold (compare Corollary 2). Therefore, we can state the following prediction:

Prediction 2 (a) *A firm with high agency costs is more likely to promote internal candidates than a firm with low agency costs.*

An additional effect of high agency costs is that the incentive function of promotion becomes more important relative to the sorting function (compare Proposition 1). Therefore, we can also state:

Prediction 2 (b) *Job similarity decreases the frequency of internal promotions in a firm with high agency costs and increases it in a firm with low agency costs.*

Further, our insights relate to the extant empirical literature. For example, Bidwell (2011) analyzes the effect of promotion within the department in comparison to a promotion for a worker from a different department in one investment bank (vertical and horizontal move at the same time). Firm workers, who are promoted in the same department, show a higher subsequent performance than workers, who are transferred and promoted. The author attributes the finding to the benefit of internal learning. Alternatively, it is also consistent with our prediction. Suppose that (1) promotions within the department offer more job similarity than a promotion with transfer, and (2) compensation is a top priority in investment banking firms, then job similarity increases the performance threshold to be promoted. Therefore, workers that are promoted within the department have higher average skills than transfers.

Outside of these firm specific factors, the general economic conditions also influence the promotion strategy, i.e., interest rates and labor market competition. In our model, a higher interest rate is reflected in a lower discount factor since the importance of the current period increases relative to future periods. Consequently, higher interest rates relax the firm's need to find the best talent for the future job

and external hiring becomes relatively more expensive [compare Corollary 2 (iv)]. Therefore, we can state the following prediction:

Prediction 3 (a) *Higher market-wide interest rates increase the frequency of internal promotions.*

Similar to Prediction 2b, we can also draw on Proposition 1 to predict the following effect of a change in job similarity:

Prediction 3 (b) *Job similarity decreases the frequency of internal promotions when interest rates are sufficiently high.*

Higher interest rates reduce the importance of the sorting function because the benefits of a more skilled manager get discounted more.

With respect to the labor market, companies compete with each other for the best talents. From Proposition 2, we know that competition boosts the outside option and raises the attractiveness of external hiring. Therefore, we can state

Prediction 4 (a) *A stronger labor market competition decreases the frequency of internal promotions.*

Labor market competition could be shaped by regulation or industries. Sect. 4 further shows that the job similarity of performance observed in the competing firm influences the promotion decision. Job similarity with other firms could be high due to standard jobs in a high competition industry or the knowledge transfer from a different profession into the higher-level position, for example, when a manager of an audit firm is hired by the engagement client of the audit firm. This outside fit reduce the relative importance of compensation concerns and increase the focus on the sorting function, as in Proposition 1 (i). Therefore, we can state the following Prediction:

Prediction 4 (b) *Job similarity increases the frequency of internal promotions when a competing firm has high job similarity with the managerial job*

6 Discussion

We make a number of simplifying assumptions to keep our model traceable. We assume that the firm already knows the expected managerial skills of the available external candidates in period one. A more realistic scenario could be that the firm learns about the skills in period one. Then, the firm would implement a promotion strategy that takes the ex-post observed quality of the external candidate into account. When the ex-post observed quality of the external candidate is high, the ex-post threshold for internal promotion will be higher and vice versa. However, this additional feature does not affect our key results. The reason is that the internal worker only considers the ex-ante promotion probability when deciding whether to accept the offer and to provide high effort.

In reality, signals are often imperfect. For example, cash flows are a noisy signal for the skills of a worker since they often have random components not related

to skill. With uniformly distributed skills, the worker's promotion probability is unchanged. The worker will sometimes outperform a higher-skilled colleague due to good luck and sometimes underperform a less-skilled worker due to bad luck. The two effects even out. For the firm, noise is equivalent to lower job similarity. The firm will learn less about the managerial skills of the entry-level workers. Similarly, noise could be introduced when workers need to report their performance due to measurement error or potential manipulation. As long as all workers are affected in the same way, noise has the same effect as lower values of ρ.

The workers could have skills correlated to each other, such as education or background. Correlation in skills among the lower-level employees would be a disadvantage to the firm but has no other consequences. The chance that one of the workers is exceptional (and therefore potentially good at the higher-level job, too) increases when the correlation between two workers is lower.

When considering labor market competition, we model two identical firms. One could think of firms with uneven bargaining power on the labor market. In this scenario, both firms would hire external candidates more frequently than without a competing firm on the market, but the stronger firm would do so even more. The reason is that the stronger firm could also poach the best talent from the weaker firm, while the weaker firm can only attract talent from the stronger firm that is not internally promoted.

We assume same wages for the external and the internal hire for the managerial position. Often, external hires receive a premium for joining a new company (Bidwell 2011; Murphy and Zabojnik 2007; Palomino and Peyrache 2013). We fix the wage for an external hire to the managerial wage, W_M, that the firm would have paid an internally promoted worker, if it had promoted internally. The results remain qualitatively unchanged as long as this wage is higher than the reservation utility. Further, our results do not depend on whether the firm is contractually committed to paying W_M. If the firm reneges on its promise, future workers would no longer believe that they will receive the higher wage after a promotion, and choose not to work for the company. This logic is identical to the trigger strategy for the promotion decision described in the main results section.

The participation constraint for workers is binding in our model. The results would change if we assume a limited liability constraint, rather than a binding participation constraint. Then, the entry-level wage, W_E, is independent of the firm's promotion strategy. Our model reflects an environment, where the entry-level wage is above the legally required minimum wage.

7 Conclusion

This paper analyzes the effect of job similarity along the career path on the firm's promotion choice. The firm is concerned about optimally assigning workers to tasks and motivating high effort. When choosing a candidate for the managerial job, it can choose between an internal worker or an external hire. If it picks external candidates more likely, then this reduces incentives for its employees to provide high effort in the first period due to the increased competition and thus lowered probability of

receiving a promotion. The firm anticipates this problem and, as a solution, could institute a lenient promotion strategy.

As jobs become more similar, the required skills will be more correlated. If compensation concerns are low, then this will help internal workers, because their above average performance will translate well into a better expected managerial skill, incentivizing the firm to offer them a promotion. If compensation concerns are high, then the performance threshold will be below average, and increased job similarity works against internal employees, whose below-average entry-level performance foreshadows below-average managerial performance, disincentivizing the firm from offering them a promotion, and rather going with an external candidate.

Furthermore, when there is labor market competition, then there will be less internal promotion. The reason is that the outside hiring option becomes more attractive because firms have the additional option to hire personnel outside of the firm, whose performance they can observe. This also translates into higher firm value.

Overall, our results show the various possible effects of job similarity on the hiring and promotion decisions, which might be of interest to organizations and other researchers. Future research can empirically test the predictions made in this paper.

8 Appendix

Proof of Proposition 1 and Corollary 1:

The firm needs to structure wages such that agents find it optimal to participate in the game, PC, and that they find it optimal to work hard, IC.

$$\begin{aligned}\text{IC}: W_E + \delta(1-\overline{\theta})\frac{(1+\overline{\theta})}{2}W_M + \delta\frac{1+\overline{\theta}^2}{2}\overline{U} - k \\ \geq W_E + \delta\left(\left(1-e^h\right)^2 - \overline{\theta}^2\right)\frac{1}{2}W_M + \delta\left(1-\left(\left(1-e^h\right)^2 - \overline{\theta}^2\right)\frac{1}{2}\right)\overline{U}\end{aligned}$$

On the left-hand side of the inequality, $(1-\overline{\theta})$ is the probability of beating the performance threshold. $\frac{(1+\overline{\theta})}{2}$ is the conditional probability of outperforming the other entry-level worker, which multiplies to the probability of being promoted $\Pr(\text{Prom}|e^h, \overline{y}) = \frac{1-\overline{\theta}^2}{2}$. Then, the counter probability of not receiving the promotion is $\frac{1+\overline{\theta}^2}{2}$. On the right-hand side of the inequality, the firm mistakenly subtracts high effort from output, thus making it harder for the worker to receive the promotion. It should be noted that the right-hand side is only valid, as long as probabilities are non-negative, i.e. $\overline{\theta} < 1 - e^h$.

This IC simplifies to

$$W_M = \overline{U} + \underbrace{\frac{k}{\delta e^h \left(1 - \frac{e^h}{2}\right)}}_{=\tau}. \tag{13}$$

The participation constraint is as follows:

$$PC : W_E + \delta \frac{1 - \overline{\theta}^2}{2} W_M + \delta \frac{1 + \overline{\theta}^2}{2} \overline{U} - k \geq (1 + \delta)\overline{U}. \tag{14}$$

The left-hand side is the same as in the incentive constraint. The right-hand side represents the worker's outside option at the beginning, which would be receiving $\overline{U}$ in both periods.

Plugging (13) into this formula, and simplifying gives

$$W_E = \overline{U} - (1 - \overline{\theta}^2) \frac{k}{\delta e^h \left(1 - \frac{e^h}{2}\right)} + k. \tag{15}$$

Note that $\frac{1-\overline{\theta}^2}{2}$ is the probability that an internal worker, ex-ante, will receive the promotion, which explains the expression in the main text of the paper.

We now have the necessary foundation to describe the firm's expected short-term profit using the equilibrium strategy.

$$\overline{V} = 2\left(\frac{1}{2} + e^h\right) + \delta\lambda \left(\overline{\theta}^2 \theta_P + \left(1 - \overline{\theta}^2\right) E\left[\theta_{iM} | \max_i[\theta_{iE}] > \overline{\theta}\right]\right) - 2W_E - \delta W_M \tag{16}$$

The part of this equation that has not received detailed discussion in the main text above, is the expected managerial skill, if an internal worker receives the promotion. First, the expected entry-level skill in case of internal promotion has to be found. The pdf of the higher value of two uniformly distributed variables is 2θ (from 0 to 1). Thus, the conditional expected value, if the higher value exceeds $\overline{\theta}$, is

$$E[\max_i[\theta_{iE}] | \max_i[\theta_{iE}] > \overline{\theta}] = \int_{\overline{\theta}}^{1} \frac{2\theta^2}{1 - \overline{\theta}^2} d\theta = \frac{2(1 + \overline{\theta} + \overline{\theta}^2)}{3(1 + \overline{\theta})}. \tag{17}$$

Knowing this value, the final step is calculating the expected managerial skill using the following formula:[18]

$$E[\theta_{iM} | \theta_{iE}] = \frac{1}{2} + \rho\left(\theta_{iE} - \frac{1}{2}\right). \tag{18}$$

[18] E.g. Arya and Mittendorf (2011, p. 1434).

The remainder of the proof is solving the first-order condition, resulting in (10), and Proposition 1.

Lastly, it remains to be shown that a sufficiently patient firm will not deviate. Let the present-value of the whole infinite-horizon game, if the firm sticks with its strategy, be

$$\Pi(\overline{y}) = \overline{V}(\overline{y}) + \delta\Pi(\overline{y}) \Leftrightarrow \Pi(\overline{y}) = \frac{\overline{V}(\overline{y})}{1-\delta}. \tag{19}$$

If the firm deviates, then it will gain a higher expected short-term profit, denoted by V_D, but has to play the one-shot optimal strategy $\overline{\theta}_B$ thereafter.

$$\Pi(D) = V_D + \frac{\delta}{1-\delta}\widetilde{V}(\overline{\theta}_B). \tag{20}$$

The firm will not deviate, if $\Pi(\overline{y}) \geq \Pi(D)$, which can be rearranged to

$$\delta \geq \delta^* = \frac{V_D - \overline{V}(\overline{y})}{V_D - \overline{V}(\overline{\theta}_B)}. \tag{21}$$

Proof of Proposition 2:

The firm value in competition is

$$\begin{aligned} V_n =& 2(0.5 + e^h) + \delta\lambda\left(\left(1-\overline{\theta}_n^2\right) E\left[\theta_{iM} | \max_{\mathrm{i}}[\theta_{iE}] > \overline{\theta}_n\right]\right) + \overline{\theta}_n^2 T_n(\rho_{-n}) \\ & - 2W_E - \delta W_M + \tau\overline{\theta}_{-n}^2(1-0.5)^2. \end{aligned} \tag{22}$$

$$\text{with } T_n(\rho_{-n}) = (1-\overline{\theta}_B)^2 E\left[\theta_{iM} | \min_{\mathrm{i}}[\theta_{iE}] > 0.5\right] + \left(1-(1-0.5)^2\right)0.5 \tag{23}$$

What effectively changes compared to the monopoly setting is the value of the outside option. Competition offers an additional option to hire external talent from the competitor, summarized in $T_n(\rho_{-n})$. However, the firm can never attract the best worker from the competitor since the competitor can match all wage offers and convince the worker to remain in the firm. The bidding does not impact firm value of either firm since the workers' participation constraint is binding and all wage increases in the managerial wage can be anticipated and deducted accordingly from the entry level wage. As a consequence, only the excess talent from the competitor is available for hiring.

Then, the value of the outside option, $T_n(\rho_{-n})$, is as follows. Firm n hires the second best worker from the competitor and receives the expected skill $E[\theta_{iM} | \min_{\mathrm{i}}[\theta_{iE}] > 0.5]$, if the competitor has two workers, which it would promote internally, $(1-\overline{\theta}_{-n})^2$, and whose expected managerial skill is better than the benchmark threshold, $(1-0.5)^2$.

If the competitor has at most one worker who is better than the benchmark, $1-(1-0.5)^2$, firm n can still hire from the external pool to receive average skill 0.5.

The difference $T_n(\rho) - 0.5$ represents the difference in the outside option between the competition setting and the monopoly setting.[19]

The last summand of (22) shows what competition adds in terms of compensation compared to the monopoly case. In addition to being promoted at the current place of work, a worker can also be hired for the managerial position from the competitor. Thus, the competitor's demand offers a new career path for excess talent, which means that the competitor essentially takes over the role of providing career incentives to the worker. If the competitor hires externally, $\overline{\theta}_{-n}^2$, and firm n has two workers above the benchmark, $(1-0.5)^2$, which saves firm n the compensation surcharge τ in expectation. In sum, the total wage bill is then $2W_E + \delta W_M - \overline{\theta}_{-n}^2(1-0.5)^2\tau$.

In (23), the expected value of the best worker above the threshold is calculated as before in (17) with

$$E\left[\theta_{iM} | \max_{\mathrm{i}}[\theta_{iE}] > \overline{\theta}_n\right] = \frac{1}{2} + \rho_n\left(\frac{2(1+\overline{\theta}_n+\overline{\theta}_n^2)}{3(1+\overline{\theta}_n)} - \frac{1}{2}\right).$$

The expected skill of the second best worker from the competitor is

$$E\left[\theta_{iM} | \min_{\mathrm{i}}[\theta_{iE}] > \frac{1}{2}\right] = \frac{1}{2} + \rho_{-n}\left(\int_{\overline{\theta}_B}^{1} \frac{(2-\theta)\theta}{\left(1-\frac{1}{2}\right)^2} d\theta - \frac{1}{2}\right) = \frac{1}{2} + \frac{\rho_{-n}}{6}.$$

Thus,

$$T_n(\rho_{-n}) = \left(1-\frac{1}{2}\right)^2\left(\frac{1}{2}+\frac{\rho_{-n}}{6}\right) + \left(1-\left(1-\frac{1}{2}\right)^2\right)\frac{1}{2} = \frac{1}{2} + \frac{\rho_{-n}}{24}$$

Additionally, we insert (2), (8), and (7) into (22) and take the derivative of (22) with respect to y_n, which yields

$$\overline{y}_n = \max\left[\frac{1}{2} - \frac{\tau}{\delta\lambda\rho_n} + \frac{\rho_{-n}}{24\rho_n} + e^h, e^h\right]. \tag{24}$$

Next, we compare the thresholds from competition and monopoly, which comes down to comparing $T_n(\rho_{-n})$ and θ_P.

$$\begin{aligned} \overline{y}_n &\geq \overline{y}(\theta_P = 0.5) \\ T_n(\rho_{-n}) &\geq 0.5 \\ (1-0.5)^2\left(0.5 + \rho_{-n}\tfrac{1}{6}\right) + \left(1-(1-0.5)^2\right)0.5 &\geq 0.5 \end{aligned} \tag{25}$$

[19] Since $\overline{\theta}_{-n}$ describes the threshold including the moral hazard problem and moral hazard always causes a lower threshold (compare (10) and Corollary 2), it is true that $\overline{\theta}_B = 0.5 > \overline{\theta}_{-n}$; thus, beating $\overline{\theta}_{-n}$ is implied if workers exceed 0.5.

The left-hand side is always at least as big as the right hand side if

$$0.5 + \rho_{-n}\frac{1}{6} \geq 0.5,$$

Proving that this is a stable equilibrium for a sufficiently large δ proceeds in the same fashion as in the proof for Proposition 1.

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