Talent Discovery and Poaching under Asymmetric Information*

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Abstract

We develop a model of the market for knowledge workers in which talent is discovered on the job. In the model, asymmetric information and firm-specific human capital combine to generate several predictions relating firm heterogeneity to talent discovery and poaching. We show that high-quality (i.e., large and high-productivity) firms are more likely to become talent poachers, while lower quality firms are more likely to invest in talent discovery. Job-to-job flows are adversely selected, which implies that internally promoted managers are more productive than those who are externally promoted. The model generates several additional predictions linking firm heterogeneity to the distribution of managerial talent, productivity, compensation, and promotions.

Keywords: Adverse Selection, Poaching, Talent Discovery

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1 Introduction

There is ample evidence that employers engage in talent discovery by observing their employees' performance on the job (see e.g., Gibbons and Katz, 1991; Schönberg, 2007; Pinkston, 2009; Kahn, 2013). A key challenge for such employers is the possibility of talent poaching by competitors. For example, Haltiwanger, Hyatt, and McEntarfer (2018) find that job-to-job transitions account for approximately half of all worker reallocations. Talent discovery and poaching are particularly important concerns in high-skilled occupations (such as management) and knowledge industries (such as finance and technology).

We develop a model of the market for knowledge workers – whom we call managers, for brevity. The model has three main features: managerial talent and firm quality are complements, firm-specific human capital is valuable, and learning about managerial ability is asymmetric.[1] In the model, firm heterogeneity creates a trade-off between exploiting firm-specific human capital and matching talent with firm quality. Firms' desire to match talent and firm quality creates job-to-job flows. Such flows lead to losses of firm-specific human capital. We show that because of asymmetric information, the loss in firm-specific human capital is typically greater than the gain from matching talent and firm quality, implying that equilibrium job-to-job flows are inefficient.

We use the model to address a number of questions: Which firms invest in talent discovery? Which firms become talent poachers? What are the characteristics of retained and poached managers? How do informational frictions affect the allocation of talent across firms?

The model predicts that high-quality (i.e., larger and more productive) firms are more likely to poach managers from other firms, while lower quality firms are more likely to engage in talent discovery. The model implies the existence of job ladders: Job-to-job flows are typically from low-quality firms to high-quality firms. Firms retain their best

[1] Many papers have the first two features, but not the third: Rosen (1982), Baker and Hall (2004), Gabaix and Landier (2008), Terviö (2008), Edmans, Gabaix, and Landier (2009), Eisfeldt and Kuhnen (2013), and DeVaro and Morita (2013).

managers and high-quality firms have higher retention rates (i.e., internal promotions are more common in large firms than in small firms). Only mediocre managers are poached, which implies that job-to-job flows are adversely selected. We show that these adversely selected job-to-job flows are socially inefficient; misallocation of talent occurs both because of inefficient retention of high-talent managers by low-quality firms and because of excessive poaching of mediocre workers by high-quality firms. The model also predicts that some managers become less productive after being poached.

The model's predictions are relevant for markets in which there are significant complementarities between firm quality and managerial talent. Pan (2017) shows evidence of complementarities between firm size and managerial talent for executives of large U.S. companies. Using a proprietary data set of public and private UK firms, Mueller, Ouimet, and Simintzi (2017) show evidence that managerial talent and firm size/performance are complements. Célérier and Vallée (2019) show evidence of strong complementarities between firm scale and talent in the financial sector. Our model applies to occupations for which firm-specific human capital and asymmetric learning are important features. Groysberg, Lee, and Nanda (2008) shows evidence of firm-specific skills in security analysis. Berk, van Binsbergen, and Liu (2017) show evidence of asymmetric employer learning in the mutual fund industry. Cremers and Grinstein (2014) show evidence of firm-specific human capital in CEO markets. Cziraki and Jenter (2021) show that more than 90% of all CEO hires are either insiders or connected outsiders and conclude that "*explaining our findings requires both firm-specific human capital and asymmetric learning*."

The model can rationalize several empirical facts about job transitions: (i) Job-to-job flows are typically from small and low-productivity firms to large and high-productivity firms (Haltiwanger, Hyatt, and McEntarfer, 2018; Haltiwanger, Hyatt, Kahn, and McEntarfer, 2018),[2] (ii) internal promotions are more frequent in large and high-productivity firms than in small and low-productivity firms (Zhang and Rajagopalan, 2003; Naveen,

[2] By contrast, Partow (2020) shows evidence of inverted job ladders in law firms.

2006; Cziraki and Jenter, 2021), (iii) job-to-job flows are adversely selected in some sectors (Bidwell, 2011; Berk, van Binsbergen, and Liu, 2017; Bates, 2020), (iv) internally promoted managers are more productive than externally promoted managers (Bidwell, 2011; Berk, van Binsbergen, and Liu, 2017), (v) some managers become less productive after switching jobs (Groysberg, Lee, and Nanda, 2008; Groysberg, 2010), and (vi) within-job compensation growth increases with firm heterogeneity (Andersson et al., 2009).

Our model has its origins in the asymmetric employer learning literature, which was initiated by Waldman (1984) and Greenwald (1986).[3] In such models, the current employer learns about the talent of incumbent workers, while competing employers remain uninformed. A key difference of our model is that firms are (ex ante) heterogeneous.[4] Because firm quality and managerial talent are complements, high-quality firms have a comparative advantage at poaching managers. Thus, job-to-job flows are typically from low-quality to high-quality firms. However, asymmetric learning and firm-specific human capital allow firms to retain their best managers, implying that poachers can only succeed at poaching mediocre managers. Mediocre managers are adversely selected with respect to the set of employed managers while, at the same time, being positively selected relative to the population as a whole.[5]

[3]The theoretical labor literature on asymmetric employer learning has focused on a number of different applications, such as the signaling effects of promotion and retention decisions (Waldman, 1984; Lazear, 1986; Milgrom and Oster, 1987; Ricart i Costa, 1988; Laing, 1994; Bernhardt and Scoones, 1993; Bernhardt, 1995; Golan, 2005; Li, 2013; Waldman and Zax, 2016), the optimal design of disclosure policies (Mukherjee, 2008; Bar-Isaac, Jewitt, and Leaver, 2021; Bar-Isaac and Leaver, 2022), and training and investment in skills (Waldman, 1990; Chang and Wang, 1996; Acemoglu and Pischke, 1998, 1999; Bar-Isaac and Leaver, 2022). Bar-Isaac, Jewitt, and Leaver (2021) and Bar-Isaac and Leaver (2022) consider asymmetric learning over multiple dimensions of worker productivity.

[4]Bernhardt and Scoones (1993) and Mukherjee and Vasconcelos (2018) develop asymmetric learning models with match-specific productivity gains. In these models, firms become heterogeneous ex post (that is, when they learn about match-specific gains) but are homogeneous ex ante.

[5]More generally, our paper is related to the literature on adverse selection in markets initiated by Akerlof (1970). This literature typically focuses on the impact of private information about the quality of a good on the occurrence of trade. For example, Ellingsen (1997) shows that there exists a separating equilibrium in which some trade of high-quality goods occurs in markets for lemons. Levin (2001) studies how the degree of information asymmetry affects trade. Adriani and Deidda (2009) consider a case in which a seller values a low-quality good more than the buyer does. Daley and Green (2012) and Fuchs and Skrzypacz (2019) develop dynamic models of adverse selection and its impact on trade. In a generalization of Akerlof's market for lemons, Bar-Isaac, Jewitt, and Leaver (2021) study how the structure of information asymmetry impacts outcomes in a setting with both public and private information.

There are few theoretical papers on talent discovery on the job. In Terviö (2009), a worker's talent is revealed on the job, but – unlike in our model – this information is public. Terviö (2009) shows that, in a competitive labor market with homogeneous firms and limited liability, firms invest too little in talent discovery and over-recruit workers with mediocre abilities. In contrast, we show that asymmetric information restores firms' incentives to invest in talent discovery. Strobl and Van Wesep (2013) develop a dynamic asymmetric employer learning model in which some firms commit to reveal the ability of their workers to future potential employers. In their model, as in ours, low-quality firms are more likely to discover talent. In contrast with our model, in their model worker flows are positively selected, leading to very different empirical implications. Bar-Isaac and Levy (2022) develop a model of talent discovery in which task allocation and competition for talent can impact workers' and firms' incentives.

Our analysis also shares certain ideas with those found in models of executive markets. As in firm-CEO assignment models, there are complementarities between firm quality and managerial talent (Rosen, 1982; Baker and Hall, 2004; Gabaix and Landier, 2008; Terviö, 2008; Edmans, Gabaix, and Landier, 2009; Eisfeldt and Kuhnen, 2013; DeVaro and Morita, 2013). As in Frydman (2019), managers are endowed with both firm-specific and general skills. As in Edmans and Gabaix (2011), the process of matching managers with firms is distorted by informational frictions.

DeVaro and Morita (2013) develop a job-assignment model to analyze internal versus external promotions. Similar to our model, their model also features firm heterogeneity, complementarities between firm quality and managerial ability, and firm-specific human capital. Unlike our model, information is symmetric. Their model also predicts that internal promotions are more frequent in large firms and that internally-promoted managers are more productive than externally-promoted ones.

2 Model Setup and Timing

We first present a simple two-period version of the model, which we use to derive our main results. In Section 6, we present an overlapping-generations model, in which the two-period model of this section is repeated infinitely. The infinite-horizon model delivers similar predictions as the simpler two-period model. In addition, the infinite-horizon model rationalizes some of the assumptions that may appear less natural in the two-period version of the model and also allows for a complete discussion of the benefits and costs of talent discovery.

The economy is populated with a continuum of risk-neutral firms and agents, which for simplicity we refer to as *managers*, that live for two periods, $t = 0, 1$. Firms can be of one of two types, L or H, representing both the type and the mass of firms of each type. We denote a firm of each type by $i \in \{l, h\}$. Firm i has *productivity parameter* θ_i. Low-quality firms – L firms – have parameter $\theta_l = 1$, and high-quality firms – H firms – have parameter $\theta_h = \theta$, where $\theta > 1$. Productivity differences are the only source of (exogenous) heterogeneity between firms. For each type $i \in \{l, h\}$, we use subscripts ji to denote a unique firm j of type i.

Managers are endowed with general (i.e., portable) talent τ distributed according to a differentiable cumulative distribution function (c.d.f.) $F(.)$ with support $[0, \overline{\tau}]$ and mean μ. A firm of type i that employs a manager with talent τ produces revenue $\theta_i \varphi \tau$ if the manager has already worked for the firm in a previous period and $\theta_i \tau$ if the manager is newly hired. Parameter $\varphi > 1$ represents the firm-specific skills acquired on the job.

At $t = 0$, a mass $M \gg H + L$ of managers enters the labor market. Each firm (of either type, L or H) hires one manager from the pool of available managers. Firm j of type i offers wage w_{ji}^{y} to a young manager. Because all managers are ex ante identical, the initial pairing of firms and managers is random. Since jobs are in short supply, some managers remain unemployed. We normalize the wage of those managers who remain unemployed to zero.

At $t = 1$, each firm learns the talent τ of its incumbent manager. We assume that managers have no available action that could allow them to signal their types to potential employers. We also assume that a firm's payoff is not directly observable and thus remains private information to the firm. This information cannot be credibly disclosed to outsiders. One interpretation is that performance is observed only with noise, which could occur for a number of reasons, such as insufficient disclosure, imperfect measurement of the performance of complex tasks, difficulties in measuring a manager's individual contribution to the output of a team, or any other similar confounding effects. In all such cases, the firm could have an informational advantage over outsiders when estimating the performance of managers because the firm can directly observe a manager's actions. The assumption that the information cannot be credibly disclosed to outsiders also rules out the possibility for firms to offer performance-based screening contracts to managers. We choose to rule out these possibilities in order to focus on the role of asymmetric information among employers.

At the beginning of $t = 1$, all players face the following timing, summarized in Figure 1:

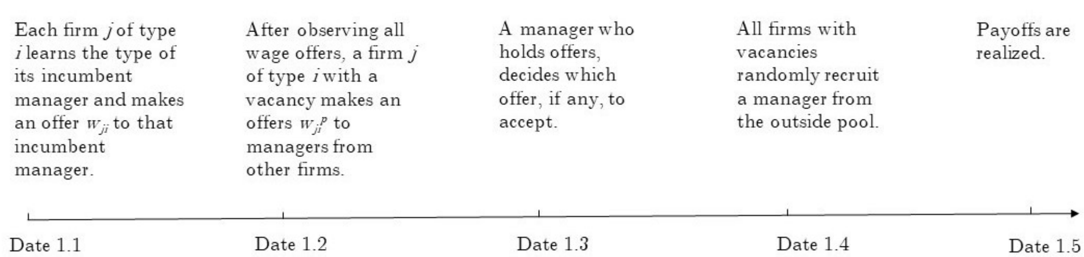

Figure 1. Time line

Date 1.1. Each firm j of type i learns the type $\tau_{ji} \in [0, \overline{\tau}]$ of its incumbent manager and independently commits to a wage offer $w_{ji} \in \mathbb{R}$ to this manager. We permit strictly negative wage offers. Since the outside option of an unemployed manager is normalized to zero, these offers will not be accepted. Therefore, a negative wage offer is equivalent to dismissing the incumbent manager. When firms offer a negative wage, managers quit immediately, thus creating vacancies.

Date 1.2. After observing the wage offers made by all firms in the sector, a firm j of type i with a vacancy makes offers w^p_{ji} to managers from other firms; all firms act simultaneously. Importantly, firms making poaching offers do not observe the incumbent managers' types. Instead, they form beliefs regarding these types after observing the set of all wage offers.

Date 1.3. A manager who holds offers decides which offer, if any, to accept. Managers always agree to work for the maximum non-negative wage offered to them:

Assumption A1 A manager who holds an offer w_{ji} accepts all poaching offers where $w^p_{ji} > w_{ji}$ and rejects all poaching offers where $w^p_{ji} \leq w_{ji}$.

In other words, if indifferent, a manager stays with their current employer, which is a standard assumption in the literature (see, e.g., Waldman, 1984). However, this assumption entails some loss of generality because it eliminates a number of equilibria in mixed strategies. Thus, we consider (A1) as an equilibrium selection criterion with intuitive properties: Managers may have a small bias against changing jobs because of unmodeled moving costs.[6] If a manager accepts multiple poaching offers, the manager is randomly matched with one poaching firm.

Date 1.4. All firms with vacancies at this date randomly recruit one manager from the *outside pool,* which is defined as the set of unemployed managers available for hire. The outside pool exclusively comprises managers not employed at $t = 0$ (this is without loss

[6] Relaxing this assumption makes mixed-strategy equilibria possible. A complete characterization and discussion of mixed-strategy equilibria can be found in the Internet Appendix.

of generality; in equilibrium, a firm with a vacancy would never hire a manager who was dismissed by another firm).[7]

Date 1.5. Payoffs are realized.

The timing assumes that firms with vacancies move after offers have been made to incumbent managers. Alternatively, there could also be multiple rounds of offers and counter-offers by firms with incumbent managers and firms with vacancies. We assume a single round of offers as a simple way of introducing costs of delayed negotiations. In the Appendix, we show that our main results continue to hold when firms with incumbent managers make the last offer.[8]

We assume away bonding contracts: A manager is free to work for the highest bidder and the current employer receives no compensation if the manager is poached by another firm. There are no other contractual restrictions.[9]

To better understand the role of our assumptions for the implications of the model, in Section 5, we also consider the problem of a social planner who faces no exogenous restrictions on the set of mechanisms that can be chosen. We show that the main properties of the equilibrium do not depend on our assumptions on the contractual environment, timing of actions, structure of competition, and equilibrium selection.

3 Equilibrium

We now solve for the equilibrium. We focus on characterizing the equilibrium only at $t = 1$ because wage determination at $t = 0$ is a trivial problem. If there are no binding constraints on transfers from managers, firms will choose a negative $t = 0$ wage to

[7] The implication of this assumption is that the distribution of talent in the outside pool is characterized by $F(.)$. If fired managers cannot be distinguished from never-employed agents, then the unconditional c.d.f. of the agents in the outside pool is $\tilde{F}(.) \neq F(.)$. Nothing important changes in the model.

[8] For a model in which incumbents and poachers move simultaneously, see Li (2013).

[9] In the Internet Appendix, we present a setting in which a firm commits in $t = 0$ to a deferred compensation contract in which a manager is paid only at the end of the game. We show that such contracts, even when feasible, may not be voluntarily adopted by firms.

extract all future expected surpluses from managers. If, instead, such constraints exist, $t = 0$ wages will be set at the lowest level compatible with these constraints. In Section 6, we solve an infinite-horizon version of the model in which, among other things, we characterize wages at all periods.

At $t = 1$, consider a manager with expected type τ. When firms' outside option is to hire a manager from the outside pool, the maximum wage that a firm of type i with a vacancy would be willing to offer to this type is $\theta_i (\tau - \mu)$. This implies that H firms with vacancies always benefit more from poaching managers than do L firms with vacancies. For simplicity, we make the following assumption:

Assumption A2 *Poachable managers are in short supply relative to vacancies in H firms.*

We present this assumption in this general form to avoid imposing unnecessary restrictions on parameters and functional forms. A sufficient parametric condition for (A2) to hold is $H\left[2F(\frac{\mu}{\varphi}) - 1\right] > L\left[1 - F\left(\frac{\mu}{\varphi}\right)\right]$.[10] Assumption (A2) simplifies the analysis by reducing the number of cases to be considered, but is not necessary for the main results. In Subsection 3.2.3, we show that our main results do not depend on this assumption (with proofs in the Internet Appendix).

3.1 Symmetric Information

In this subsection, we discuss the benchmark case of symmetric information in which, at Date 1.1, all firms learn about managers' talent. We show that the allocation of talent obtained in a market equilibrium with symmetric information is efficient.

We first note that, since we assumed that H firms with vacancies are in excess supply (see (A2)), only H firms will become poachers. Thus, from now on, we call an H firm with a vacancy at Date 1.2 a *poacher*. Notice also that no H firm will dismiss a manager with

[10]The condition is obtained by considering that vacancies in H firms, which are at least $F(\frac{\mu}{\varphi})H$, exceed the poachable managers in L and H firms, who are at most $(H + L)(1 - F(\frac{\mu}{\varphi}))$.

type greater than $\frac{\mu}{\varphi}$ in order to become a poacher; managers in L firms are in short supply, thus poachers cannot do better than their outside option, which is to hire an outside agent with expected type μ.

The next proposition characterizes the equilibrium.

Proposition 1. *A unique equilibrium exists where*

1. *L firms fire all manager types lower than $\frac{\mu}{\varphi}$ and retain all manager types in $\left[\frac{\mu}{\varphi}, \tau^{\#}\right]$, where*

$$\tau^{\#} = \begin{cases} \overline{\tau} & \text{if } \theta \leq \varphi \\ \min\{(\theta-1)\mu/(\theta-\varphi), \overline{\tau}\} & \text{if } \theta > \varphi. \end{cases} \tag{1}$$

2. *H firms fire all types lower than $\frac{\mu}{\varphi}$ and retain all types in $\left[\frac{\mu}{\varphi}, \overline{\tau}\right]$.*

3. *In L firms, incumbent managers with types higher than $\tau^{\#}$ are poached by H firms.*

Proof. See the Appendix. □

The equilibrium is such that there is a *critical type* $\tau^{\#}$ above which all manager types initially assigned to L firms are poached by H firms. All firms fire all managers below threshold $\frac{\mu}{\varphi}$. H firms retain all managers above this threshold, while L firms retain only *mediocre managers*, that is, managers in $\left[\frac{\mu}{\varphi}, \tau^{\#}\right]$.

In equilibrium, managers who move up the job ladder are the most talented ones. If initially allocated to low-quality firms, such managers eventually move to high-quality firms and earn higher wages. That is, poached managers are positively selected.[11]

To verify whether the equilibrium outcome is efficient, we consider what a social planner would choose. Because of firm-specific skills, it is never efficient to reallocate managers from one firm to another when both firms are of the same type. Similarly, under

[11] Bates (2020) provides evidence of positive selection in job-to-job transitions for high-human capital workers (teachers) in a setting where talent discovery is symmetric. He finds that for teachers whose performance scores become available to all employers in the same district, the probability of a teacher moving to another employer in the same district is increasing in teacher quality (see Table 3 in Bates (2020). He also finds that within-district flows are typically from low-quality schools to high-quality schools .

(A2), transferring managers from H firms to L firms is always inefficient. Thus, the planner needs to consider only the possibility of transferring managers from L firms to H firms.

To simplify the exposition, we refer to an L firm with an incumbent manager at the beginning of $t = 1$ as an *incumbent firm*. The net surplus created by a manager of talent τ who is assigned to an incumbent firm is $\varphi\tau - \mu$. Similarly, the net surplus created by a manager of talent τ assigned to a poacher is $\theta\tau - \theta\mu$. A social planner who wants to maximize social surplus should: (i) replace all managers such that $\tau \leq \frac{\mu}{\varphi}$ with a random replacement from the outside pool and (ii) assign managers such that $\tau \geq \frac{\mu}{\varphi}$ to a poacher if and only if

$$\varphi\tau - \mu \geq \theta\left(\tau - \mu\right). \tag{2}$$

In other words, manager τ should be matched with a poacher when the incremental surplus to the poacher is larger than the net loss to the incumbent firm. Condition (2) implies that poaching should occur only if $\tau \geq \tau^{\#}$. We thus conclude that the decentralized equilibrium with symmetric information implements the efficient allocation of talent (i.e., the first-best allocation).

3.2 Asymmetric Information

3.2.1 Equilibrium: Assumptions and Definition

We now define the equilibrium conditions under asymmetric information. We first define the strategies for incumbents (i.e., firms at Date 1.1) and poachers. Under (A2), only H firms with vacancies will become poachers.[12] We denote an incumbent firm's strategy by $w_{ji} \in \mathbb{R}$. For simplicity, we assume that an incumbent would never offer a positive wage if it is weakly dominated by offering a strictly negative wage:

[12] If (A2) does not hold, L firms can also become poachers. In the Internet Appendix, we show that our main predictions hold even when (A2) does not hold and L firms also poach.

Assumption E1 Incumbent ji offers $w_{ji} \geq 0$ only if $\theta_i \varphi \tau_{ji} - w_{ji} \geq \theta_i \mu$.

The only action of poacher jh (i.e., an H firm with a vacancy at Date 1.2) is to offer a poaching wage w^p_{jh}. When a poacher observes an offer w made to a manager, the poacher believes that the manager's talent τ is distributed according to $F^W(\tau \mid w, i)$, where i is the type of the incumbent firm that made the offer, and W is the set of all offers made by all incumbent firms. We represent poachers' strategies by a function, $w^p_{jh}(w, i, W)$. Because poachers compete among themselves in Bertrand fashion, no poacher can have a payoff larger than the outside payoff $\theta\mu$. A poacher thus offers

$$w^p_{jh}(w, i, W) = \theta \left(\int_0^{\overline{\tau}} \tau dF^W(\tau \mid w, i) - \mu \right) \tag{3}$$

to all managers who hold offers w from incumbent firms of type i. If $w^p_{jh}(w, i, W) < 0$, the offer is not accepted, implying that a negative poaching wage offer is equivalent to no offer. Because the right-hand side of (3) does not depend on jh, for simplicity, we now omit this subscript from function w^p.

We use Perfect Bayesian Equilibrium (PBE) as the equilibrium concept, augmented by some additional restrictions on beliefs. As usual in PBE definitions with many players, we assume that all poachers hold identical beliefs $F^W(\tau \mid w, i)$, both on and off the equilibrium path. Beliefs must be consistent with Bayes's rule on the equilibrium path. We also assume that poachers believe that the incumbent firms behave independently of one another, specifically implying that, if $ji \neq j'i$, $F^W\left(\tau_{ji}, \tau_{j'i} \mid w_{ji}, w_{j'i}, i\right) = F^W(\tau_{ji} \mid w_{ji}, i) \cdot F^W\left(\tau_{j'i} \mid w_{j'i}, i\right)$ for all W. We do not need to characterize managers' beliefs because such beliefs do not influence equilibrium outcomes.

Finally, we also assume the following:

Assumption E2 (*Divinity*) After observing an off-the-equilibrium-path wage w', poachers believe that the probability that an incumbent firm with a manager of type $\tau' \geq \frac{w'}{\theta_i \varphi} + \frac{\mu}{\varphi}$ offers wage w' is no less than the probability that a firm with a manager of type $\tau'' > \tau'$ offers w'.

(E2) is a technical assumption that restricts the set of admissible off-the-equilibrium-path beliefs. This assumption is an adaptation to our setup of the divinity criterion of Banks and Sobel (1987).[13]

The role of (E1) and (E2) is to restrict the set of equilibria; thus, they can be interpreted as equilibrium selection criteria. They simplify the analysis significantly, although they do not eliminate equilibrium multiplicity. In Section 5, we show that our main results do not depend on any equilibrium selection assumptions, including (E1) and (E2).

3.2.2 Equilibrium: Characterization

We start by proving some preliminary results:

Lemma 1. *A firm offers the same wage to all manager types retained in equilibrium.*

This important result has a very simple proof. Suppose that there are two types, τ and τ', where $\tau' > \tau$. Suppose that the incumbent firm wishes to retain both types. Suppose also that $w' > w$ (the argument is analogous if $w' < w$). This situation cannot be an equilibrium because there is a profitable deviation for an incumbent firm with manager τ': The incumbent prefers to offer w to a manager of type τ'. Such a manager would nonetheless be retained, although at a lower wage.

Lemma 2. *Any equilibrium must have a threshold property: If an incumbent firm retains a manager of type τ, the firm also retains any manager of type $\tau' > \tau$.*

[13] The intuition for (E2) is as follows. For concreteness, suppose that type τ'' is retained by an L firm in an equilibrium with wage w'', while type $\tau' \in \left[\frac{w'}{\varphi} + \frac{\mu}{\varphi}, \tau''\right)$ is not retained (the intuition for the other cases is analogous to this example). An incumbent with a manager of type τ'' that deviates and offers this type wage w' can benefit from the deviation only if poachers offer $w^p\left(w'\right) \leq w'$. However, for this set of poaching wages, type τ' would also benefit from a deviation. Conversely, type τ'' would be worse off if $w^p\left(w'\right) > w'$, whereas type τ' would not be worse off. Thus, the logic of Banks and Sobel's divinity criterion requires that the probability of τ' deviating should be no less than that of τ'' deviating.

This result is again easily proven: For a given retention wage, w, if it is optimal to retain τ (that is, if $\theta_i \varphi \tau - w \geq \theta_i \mu$), then it is also optimal to retain any τ' such that $\tau' \geq \tau$.

The next proposition shows that, in equilibrium, incumbent managers will find themselves in one of the following three situations: unemployed, employed by their incumbent firm, or employed by a high-quality poacher. Because of Lemma 2, the very best managers will typically be retained by the incumbent firm, which implies that, if managers are retained at all, they must be the best managers. In equilibrium, incumbent firms never retain types $\tau < \frac{\mu}{\varphi}$ because the unemployment replacement value is higher. Some mediocre types not retained by an incumbent will be either fired or poached. The following proposition provides a complete characterization of the equilibrium.[14]

Proposition 2. *An equilibrium exists. All equilibria have the following properties:*

1. *There is a unique $\tilde{\tau}_i \in \left[\frac{\mu}{\varphi}, \overline{\tau}\right]$ such that, for each firm type $i \in \{l, h\}$, all manager types $\tau \geq \tilde{\tau}_i$ are retained. Threshold $\tilde{\tau}_i$ is the same for all equilibria and is either $\overline{\tau}$ or the least element of the set of fixed points of*

$$G_i\left(x\right) \equiv \frac{w^*\left(x\right)}{\theta_i \varphi} + \frac{\mu}{\varphi} \tag{4}$$

   where

$$w^*\left(x\right) = \theta\left(\int_x^{\overline{\tau}} \tau dF(\tau \mid \tau \geq x) - \mu\right) \tag{5}$$

   is the wage offered (by both poachers and incumbents) to retained managers whose types are greater than x.

2. *All types $\tau \in \left[0, \frac{\mu}{\varphi}\right]$ are fired in equilibrium (wages are negative).*

3. *There is a subset of manager types $P_i \subseteq \left[\frac{\mu}{\varphi}, \tilde{\tau}_i\right]$, such that $\theta\left(\int_0^{\overline{\tau}} \tau dF\left(\tau \mid \tau \in P_i\right) - \mu\right) >$*

[14]In what follows, for simplicity, we define all equilibrium sets of types as closed intervals. That is, we refrain from specifying what happens in equilibrium in the knife-edge cases in which an incumbent is indifferent between retaining or not retaining a type. The equilibrium is unaffected by what happens in these cases.

0, who are poached in equilibrium, and a subset of manager types $S_i \subseteq \left[\frac{\mu}{\varphi}, \tilde{\tau}_i\right]$ *who are fired in equilibrium (wages are negative), with* $S_i \cup P_i = \left[\frac{\mu}{\varphi}, \tilde{\tau}_i\right]$.

4. *If* $\tau \in P_i$*, then the incumbent firm offers any* $w_i' \in \left[0, w^p\left(w_i', i, W\right)\right)$ *, where*

$$w^p\left(w_i', i, W\right) = \theta\left(\int_0^{\overline{\tau}} \tau dF^W(\tau \mid w_i', i) - \mu\right) \tag{6}$$

and $F^W\left(\tau \mid w_i', i\right) = F\left(\tau \mid \tau \in P_i\right)$.

Proof. See the Appendix. □

To illustrate the intuition behind this proposition, consider a firm that wants to retain a manager. The firm knows the manager's general ability. In contrast, competing firms observe the wage offered by the incumbent employer but not the manager's ability. A high wage is interpreted as a signal of high ability. To prevent the manager from being poached, the incumbent employer must offer a sufficiently high wage to the manager but will do so only if the manager is indeed very talented. Therefore, only the very best managers are retained.

Because incumbent firms cannot retain manager types in $\left[\frac{\mu}{\varphi}, \tilde{\tau}_i\right]$, such managers are either fired or poached. As before, we call these managers mediocre managers, although, in some cases, this interval also includes the very best managers (e.g., if $\tilde{\tau}_i$ is close to or equal to $\overline{\tau}$). An equilibrium with poaching (i.e., P_i is non-empty) exists if $\tilde{\tau}_i > \mu$ for at least one $i \in \{h, l\}$. It is rational for H firms with vacancies to poach managers with types greater than μ because these managers are better than the average unemployed agent. Firms that poach managers are not fooled in equilibrium and have correct beliefs about the abilities of the managers that they hire.

Proposition 2 also reveals that equilibria differ from one another (meaningfully) only because the sets P_i and S_i can differ.[15] In the infinite-horizon version of the model in Sec-

[15]There are multiple combinations of sets P_i and S_i that constitute different equilibria, but the set of P_i

tion 6, sets P_i and S_i are uniquely pinned down. However, in the two-period version, we require some additional equilibrium selection criteria to discuss the efficiency properties of the equilibrium. In this case, it is natural to select the most efficient equilibrium as the focal equilibrium:

Corollary 1. *There is a most efficient equilibrium in which* $P_i = [\mu, \tilde{\tau}_i]$ *and* $S_i = \left[\frac{\mu}{\varphi}, \mu\right]$.

We prove the existence of this equilibrium in the proof of Proposition 2. In this equilibrium, some firms perform the role of talent discoverers: by attempting to retain types in $P_i = [\mu, \tilde{\tau}_i]$, firms reveal that such managers are better than the average agent in the outside pool. In this one-shot version of the model, firms are not compensated for their talent discovery role. However, in the infinite-horizon version of the model, firms benefit from choosing some P_i that is more attractive to poachers than the outside pool. Thus, the infinite-horizon version of the model provides a micro-foundation for the selection of P_i. We note that our focus on the most efficient equilibrium is inconsequential for the empirical predictions that we will discuss in Section 4; these predictions only require P_i to be non-empty.

For a solvable example, suppose that τ is uniformly distributed on support $[0, \overline{\tau}]$. Suppose first that $2\varphi - \theta > 1$. From (4) and (5), we find the unique interior solutions for both $\widetilde{\tau}_l$ and $\widetilde{\tau}_h$:[16]

$$\widetilde{\tau}_l = \frac{\overline{\tau}}{2\varphi - \theta} \text{ and } \widetilde{\tau}_h = \frac{\overline{\tau}}{2\varphi - 1}. \tag{7}$$

We then have $P_l = [\mu, \widetilde{\tau}_l]$ and $P_h = [\mu, \widetilde{\tau}_h]$. If $2\varphi - \theta \leq 1$, we have that $\widetilde{\tau}_l = \overline{\tau}$ and $P_l = [\mu, \overline{\tau}]$.

3.2.3 Equilibrium: Further Results, Comparative Statics, and Efficiency

Proposition 2 implies the following result:

subsets is restricted by condition $\theta(\int_0^{\overline{\tau}} \tau dF(\tau \mid \tau \in P_i) - \mu) > 0$. Two observationally equivalent equilibria with the same P_i and S_i can also differ from one another because they are sustained by different beliefs off the equilibrium path and can display different wages offered by incumbent firms for types in P_i.

[16]We present the calculations in the Appendix.

Corollary 2. *L firms choose higher retention thresholds than H firms, i.e.,* $\tilde{\tau}_l > \tilde{\tau}_h$.

This implies that, if an H firm prefers a new draw to retaining type τ, then an L firm would also prefer a new draw to retaining that type. This corollary follows directly from (4) and (5). This result is crucial for many of the empirical predictions relating firm quality to poaching and talent discovery; we will discuss these predictions in the next section. In the Internet Appendix, we show that Corollary 2 does not depend on (A2).

Define the *net flow* from L firms to H firms as the mass of managers poached by H firms from L firms minus the mass of managers going in the opposite direction. We then have:

Corollary 3. *The net flow of managers from L firms to H firms is positive.*

This result is trivial since only H firms poach in equilibrium, so the net flow from L to H is simply $L\left(F\left(\tilde{\tau}_l\right) - F\left(\mu\right)\right)$. However, under the more general case where (A2) need not hold, it is possible to have positive flows from H to L. In the Internet Appendix, we show that Corollary 3 remains true even when (A2) does not hold.

We define the *rate of talent discovery* as the probability that a firm hires a new manager from the outside pool at $t = 1$. We then have:

Corollary 4. *L firms discover talent at rate* $F\left(\tilde{\tau}_l\right)$ *and H firms discover talent at rate* $F\left(\mu\right) - \frac{L}{H}\left(F\left(\tilde{\tau}_l\right) - F\left(\mu\right)\right)$.

Because $F\left(\tilde{\tau}_l\right) > F\left(\mu\right) - \frac{L}{H}\left(F\left(\tilde{\tau}_l\right) - F\left(\mu\right)\right)$, L firms are more frequent talent discoverers than H firms. This happens for two reasons: H firms are more likely than L firms to retain incumbent managers (from Corollary 2) and, when they choose to dismiss the manager, H firms often poach incumbent managers from other firms. In short, L firms have a higher rate of talent discovery than H firms, while H firms have a higher poaching rate than L firms.

The aggregate rate of talent discovery is $F(\mu)$, which is higher than that of the symmetric information case, $F(\frac{\mu}{\varphi})$. Thus, in a sense, the equilibrium displays too much talent discovery relative to the first-best. However, welfare cannot be increased by selecting an alternative equilibrium with a lower rate of talent discovery because that would create more talent allocational inefficiencies.

The model also has predictions for the productivity of managers that are retained versus those who move across firms:

Corollary 5. *The average productivity of managers retained by their firms is higher than that of managers poached by the same firms.*

Proof. See the Appendix. □

To discuss further implications, here we focus on the more interesting and empirically relevant case where equilibrium is interior (i.e., $\tilde{\tau}_l < \overline{\tau}$). [17]

We now discuss the efficiency properties of the equilibrium. Proposition 2 implies that job-to-job flows are adversely selected. The most-efficient equilibrium implies that managers with type $\tau \in [\tilde{\tau}_l, \overline{\tau}]$ are retained by low-quality firms and managers with type $\tau \in [\mu, \tilde{\tau}_l]$ move up the job ladder to high-quality firms. We then have the following result:

Proposition 3. *In any interior equilibrium, $\widetilde{\tau}_l < \tau^{\#}$.*

Proof. See the Appendix. □

This proposition implies the following corollary:

Corollary 6. *In equilibrium, types $\tau_l \in [\mu, \tilde{\tau}_l]$ are poached but should have been retained.*

This corollary implies that high-quality firms poach managers from low-quality firms, even in the absence of gains from trade. This inefficiency is solely a consequence of information asymmetries and firm heterogeneity, and not of the other assumptions of our model, as we show in Section 5. Inefficient poaching also arises because some high-quality firms poach managers from other high-quality firms: Types $\tau_h \in [\mu, \tilde{\tau}_h]$ are poached but

[17] Assuming $\max_{x \in [0, \overline{\tau})} x - G_l(x) > 0$ is sufficient for guaranteeing an interior solution.

should have been retained. This result is, unlike Corollary 6, sensitive to assumptions on the timing of offers, as we show in the Appendix.

In the most-efficient equilibrium, there are two additional distortions relative to the first-best scenario. The first distortion is excessive firing (or, equivalently, excessive talent discovery): Types $\tau \in \left[\frac{\mu}{\varphi}, \mu\right]$ are fired but should have been retained. Firing these types is inefficient because valuable firm-specific skills are lost. The second distortion is excessive retention of high types: Types $\tau_l \in [\tau^{\#}, \overline{\tau}]$ are retained but should have been poached. Retaining these types is inefficient because they should instead be matched with better firms.[18]

Although poached managers are adversely selected, they can still be more productive in H firms than in L firms. Poached managers are more productive in H firms if and only if $\theta > \varphi$. Thus, we have:

Corollary 7. *If $\theta < \varphi$, poached managers are less productive in H firms than in L firms.*

For comparative statics, we focus on φ and $\Delta \equiv \frac{\theta_h}{\theta_l}$ (θ_l is normalized to 1 in the model, for simplicity), which can be interpreted as a (cross-sectional) measure of firm heterogeneity. Corollary 7 implies that poached managers become less productive after moving to H firms if φ is sufficiently high and/or Δ is sufficiently low.

It is immediate from (4) and (5) that Δ has no effect on $\tilde{\tau}_h$. However, Δ does affect $\tilde{\tau}_l$. By the implicit function theorem, we find the following:[19]

$$\frac{d\tilde{\tau}_l}{d\Delta} = \frac{\int_{\tilde{\tau}_l}^{\overline{\tau}} \tau f(\tau)\, d\tau - [1 - F(\tilde{\tau}_l)]\, \mu}{\varphi\, [1 - F(\tilde{\tau}_l)] \left[1 - G_l'(\tilde{\tau}_l)\right]} > 0. \tag{8}$$

That is, the retention threshold for L firms increases with firm heterogeneity Δ. Intuitively, as L and H firms become more heterogeneous, L firms find it increasingly difficult

[18] Inefficient retention does not occur in the uniform distribution example. For inefficient retention to occur, we need function $G_l(x)$ (defined in (4)) to have at least two fixed points. The shape of $G_l(.)$ is determined by $F(.)$; numerical examples can be constructed in which $G_l(.)$ has multiple fixed points.

[19] In an interior solution, $\tilde{\tau}_l$ is the least fixed point of $G_l(x)$. Because $G_l(0) < 0$, it follows that $1 - G_l'(\tilde{\tau}_l) > 0$.

to retain managers and are thus able to retain only the very best managers.

4 Model Implications and Applications

In this section we discuss some of the empirical implications of the model. The first set of predictions (Predictions 1 to 3) relates firm heterogeneity to talent discovery and poaching. The remaining predictions concern the characteristics of retained and poached managers.

Prediction 1. *Job-to-job flows are typically from small and low-productivity firms to large and high-productivity firms.*

This prediction follows from Corollary 3. Haltiwanger, Hyatt, and McEntarfer (2018) and Haltiwanger, Hyatt, Kahn, and McEntarfer (2018) show evidence that most job-to-job transitions are movements up the wage and firm productivity ladders: workers move from low-wage and low-productivity firms to high-wage and high-productivity firms.[20] Cziraki and Jenter (2021) show evidence of job ladders in the market for CEOs: Firms that raid CEOs are typically large and well performing, while raided firms are much smaller and have worse performance. [21]

The typical explanations for the existence of job ladders emphasize search frictions; see Moscarini and Postel-Vinay (2018) for a review. Unlike models based on search frictions, our model provides a unified explanation for the existence of both external and "internal" job ladders:

Prediction 2. *Internal promotions are more frequent in large and high-productivity firms than in small and low-productivity firms.*

[20] In the Appendix, we show that H firms pay higher average wages than L firms.

[21] Although external job ladders are observed in many sectors and occupations, "inverted ladders" in which workers move from large to small firms can also exist. For a theory and evidence of inverted job ladders in law, see Partow (2020). Our model can also be modified to generate inverted job ladders. For example, if high-quality firms recruited more talented workers on average but were unable to retain all of them, some of these dismissed workers would be picked up by low-quality firms. For a model along these lines (although with homogeneous firms), see Waldman and Yin (2022).

This prediction follows from Corollary 2. Consistent with this prediction, Zhang and Rajagopalan (2003), Naveen (2006), and Cziraki and Jenter (2021) show evidence that large firms are more likely than small firms to promote insiders to the CEO post. Our model thus provides an explanation for why higher-quality firms are more likely to promote insiders and poach outsiders than lower-quality firms.

Our model has predictions linking the rate of talent discovery to firm quality (talent discovery refers to firms hiring managers from the outside pool):

Prediction 3. *Talent discovery is more frequent in small and low-productivity firms than in large and high-productivity firms.*

This prediction follows from Corollary 4. We are unaware of empirical work testing this prediction. This prediction can be tested by measuring the rate of talent discovery by the hiring rate of previously unemployed or unattached workers and then relating it to measures of firm size and productivity.

We are aware of only one model that delivers Prediction 3: Strobl and Van Wesep (2013) develop a dynamic asymmetric employer learning model in which some firms commit to reveal the ability of their workers to future potential employers. In their model, as in ours, low-quality firms specialize in discovering talent. Their model, however, delivers different predictions with respect to the characteristics of retained and poached managers, as for example the next prediction:

Prediction 4. *Job-to-job flows are adversely selected.*

That is, managers who are retained by their firms are more talented than managers who are poached by other firms. Evidence of adversely selected job-to-job flows is found by Bidwell (2011), who finds that externally-hired investment bankers perform worse than internally-promoted ones.

Berk, van Binsbergen, and Liu (2017) study internal and external promotions of mutual fund managers. They find that mutual fund firms are able to identify their best managers, who are then retained. In contrast, managers who move up the job ladder to larger mutual funds (i.e., funds with more assets under management) are not as skilled as those who are promoted internally (i.e., they do not seem to add value; see their Table 6).

Bates (2020) provides evidence of adverse selection in job-to-job transitions for high-human capital workers (teachers) when talent discovery is asymmetric. One can interpret the results in Table 3 of Bates (2020) as showing that the probability of a teacher moving to another employer in a different district (where teacher ratings are unknown) is decreasing in teacher quality, and that some of these flows are from low-quality schools to high-quality schools.

The existence of adversely selected flows is also an implication of Mukherjee and Vasconcelos's (2018) model, in which the probability that a firm poaches a worker is decreasing in the workers' general ability. Because in their model poaching happens when the worker is a better match with the poacher, their model does not have the following prediction:

Prediction 5. *Internally promoted managers are more productive than externally promoted managers.*

This prediction follows from Corollary 5. Bidwell (2011) shows empirically that, for the same post and rank, internally promoted investment bankers have better performance ratings than those hired from the outside. Similarly, Berk, van Binsbergen, and Liu (2017) find that externally promoted mutual fund managers add less value to their funds than internally promoted managers.

Prediction 6. *Firms poach managers who will become less productive after switching jobs if (i) firm heterogeneity is sufficiently low and/or (ii) the value of firm-specific human capital is sufficiently high.*

This prediction follows from Corollary 7. If adverse selection is very strong (in the sense of the average quality of those who are poached being very low), some managers will become less productive after switching jobs. Consistent with this prediction, Groysberg, Lee, and Nanda (2008) find that the performance of security analysts who are successfully poached by competitors declines after switching employers. The decline in performance is more pronounced for managers who switch to firms with similar capabilities (i.e., when firm heterogeneity is low). Groysberg (2010) presents both formal and anecdotal evidence of this phenomenon across several sectors of the knowledge economy. Groysberg, Lee, and Nanda (2008) emphasize the importance of firm-specific human capital; they show that the fall in performance is lower when analysts move together with their teams. Neither Groysberg, Lee, and Nanda (2008) nor Groysberg (2010) provide a formal model to explain their findings. Commenting on Groysberg, Lee, and Nanda (2008), Oyer and Schaefer (2011, p. 1804) describe their findings as a puzzle: "There may be substantial firm-specificity in analyst skills that is lost upon job mobility. It is also possible that this is evidence of a winner's curse stemming from asymmetric learning. *It is not clear how this set of facts is consistent with equilibrium behavior by market participants*." Our model shows that these facts are compatible with equilibrium behavior by rational agents.

Our model has several additional predictions for which empirical evidence is still scant or inexistent:

Prediction 7. *The average quality of poached managers (i) improves with firm heterogeneity and (ii) worsens with the importance of firm-specific human capital.*

We note that this prediction is in sharp contrast with models with symmetric information, where more heterogeneity and more valuable firm-specific human capital are associated with lower quality of poached managers.

Prediction 8. *Managers who stay (leave) with low-quality firms are on average better than managers who stay (leave) with high-quality firms.*

This prediction follows from Corollary 2. Intuitively, low-quality firms are more concerned about the threat of poaching because they are competing with firms that value manager talent more and offer higher wages. Thus, low-quality firms are willing to compete only for the very best managers; consequently, more of their managers leave. This prediction also implies that low-quality firms exhibit greater dispersion in managerial ability than high-quality firms do.

When firms are more heterogeneous, matching is more important and thus there is more competition for talent. It then becomes more difficult for L firms to retain their managers, which forces them to pay higher wages (this next result is proven in the Appendix):

Prediction 9. *Compensation for retained managers increases with firm heterogeneity.*

If a manager is first hired with a zero wage (as it would happen if, for example, they could not be paid negative wages), then the retention wage measures the increase in earnings for those managers who are retained by their firms. Thus, we obtain the following result:

Prediction 10. *Within-job wage growth in low-quality firms increases with firm heterogeneity.*

In the context of knowledge workers, Andersson et al. (2009) study compensation patterns in a number of sectors of the software industry. They find that sectors in which there is greater dispersion in potential payoffs (e.g., differences in productivity) offer higher earnings growth for employees who are retained by their firms.

5 The Planner's Problem

From a social welfare perspective, the equilibrium of the game has potentially three inefficiencies: (i) excessive retention of high-ability types by L firms, (ii) inefficient poaching of mediocre types by H firms, and (iii) and excessive firing of some mediocre types by both types of firms. In this section, we ask whether these inefficiencies are theoretically robust. To do so, here we consider the problem of a social planner who faces no exogenous restrictions on the set of mechanisms that can be chosen. We show that the social planner generally cannot achieve the first best allocation and that, in any allocation, either excessive retention or excessive poaching must occur.

As in the decentralized case, at $t = 0$ there is no meaningful decision problem; each firm should hire one manager from the outside pool. At $t = 1$, because of firm-specific skills, it is never efficient to reallocate managers from one firm to another when both firms are of the same type. Similarly, transferring managers from H firms to L firms is always inefficient. Thus, the planner needs to consider only the possibility of transferring managers from L firms to H firms.

The timing of decisions in $t = 1$ is significantly simplified. First, the planner offers (and commits to) a mechanism (i.e., a contract) to each incumbent firm. Second, each incumbent firm sends a message $\tau^m \in [0, \overline{\tau}]$.[22] Third, the allocation is implemented.

The planner's problem is to assign incumbent managers to one of three possible sets: P denotes the set of managers who are assigned to a poacher, R denotes the set of managers who remain with the incumbent firm, and S denotes the set of managers who are unassigned (i.e., they are "sacked").

For expositional simplicity, we restrict the analysis to the case in which, for a given $\widehat{\tau} \in [0, \overline{\tau}]$, all managers with type $\tau < \widehat{\tau}$ are fired (i.e., they are assigned to S) and all managers with type $\tau \geq \widehat{\tau}$ are either retained (i.e., assigned to R) or poached (i.e., assigned to P). Although such a constraint substantially simplifies the presentation, it has no implications for the analysis, because this constraint is not binding in the optimal solution.

Definition 1. *An **allocation** is a function $p(\tau \mid \widehat{\tau}) : [\widehat{\tau}, \overline{\tau}] \to [0, 1]$ where, for a given $\widehat{\tau}$, $p(\tau \mid \widehat{\tau})$ is the probability that a manager with type τ is assigned to set P.*

In other words, we define an allocation as a stochastic assignment rule. The allocation function determines which types of incumbent managers are allocated to L firms, to H firms, or to no firm.[23]

[22] Note that by appealing to the revelation principle, we can restrict the set of messages to the set of types.

[23] For the sake of brevity, our definition of allocation does not consider feasibility. An allocation $p(\tau \mid \widehat{\tau})$ must meet some market clearing conditions in order for it to be feasible.

From Proposition 1, we know that the first-best allocation is

$$p^{FB}\left(\tau \mid \widehat{\tau} = \frac{\mu}{\varphi}\right) = \begin{cases} 1 & \text{if } \tau \in \left[\tau^{\#}, \overline{\tau}\right] \\ 0 & \text{if } \tau \in \left[\frac{\mu}{\varphi}, \tau^{\#}\right] \end{cases} . \tag{9}$$

To make information asymmetries relevant, we maintain the assumption that outsiders (including the planner) cannot observe performance outcomes. We assume that the planner can force firms and managers to participate in any mechanism, and also that the planner can assign managers to firms in any way she chooses.[24] Similarly, we assume that the planner faces no constraints on the transfers she can impose on players, e.g., there are no liquidity or budget-balance constraints. Our planner is thus completely unconstrained in her choices and actions; the only friction the planner faces is incomplete information about the types of incumbent managers.

Because of (A2), the planner wants to make sure that no H firm with $\tau \geq \frac{\mu}{\varphi}$ dismisses its manager, which can be easily accomplished by setting the maximum payoff for H firms who dismiss managers at $\frac{\theta\mu}{\varphi}$. Thus, the planner needs to consider as potential poachers only the set of H firms with managers with talent below $\frac{\mu}{\varphi}$.

A *mechanism* $\langle p, t \rangle$ is an allocation rule $p\left(\tau^m \mid \widehat{\tau}\right)$ and a *transfer function* $t\left(\tau^m\right)$, where τ^m is a message sent by an L firm. We consider only symmetric mechanisms where the planner offers the same contract to all L firms. Thus, to simplify notation, we omit firm subscripts.

Let $U\left(\tau, \tau^m \mid p, t\right)$ denote the payoff of an incumbent firm with type τ from reporting τ^m under mechanism $\langle p, t \rangle$. An allocation p is *implementable* if there exists at least one transfer function t such that

$$\tau \in \arg\max_{\tau^m \in [0, \overline{\tau}]} U\left(\tau, \tau^m \mid p, t\right). \tag{10}$$

[24]In other words, we do not require the mechanisms to satisfy individual rationality constraints. Our goal in this section is to show that incentive compatibility constraints are the main reason for our results.

In other words, p is implementable if there exists at least one transfer function such that truth-telling is incentive compatible.

Proposition 4. *For any implementable allocation p, if $p(\tau') > p(\tau'')$ for some $\tau', \tau'' \in [\widehat{\tau}, \overline{\tau}]$, then it must be that $\tau' < \tau''$.*

Proposition 4 shows that incentive compatibility implies that any implementable allocation in which there are job-to-job flows, these flows are adversely selected. Proposition 4 has a straightforward corollary:

Corollary 8. *There is no mechanism that implements the first-best allocation.*

Intuitively, Corollary 8 holds because, under the first-best allocation, the planner has to compensate a firm that risks losing a high-ability manager with a high monetary transfer to induce this firm to truthfully reveal the manager's type. However, if the planner takes this approach, then a firm with a low-ability manager would prefer to pretend to have a high-ability manager in order to receive a higher transfer.[25]

Because manager flows between two firms of the same type are always inefficient, the social planner, being unconstrained, can easily prevent such inefficiency. Thus, for an equilibrium with inefficient job-to-job flows to exist, we need firms to be heterogeneous. Proposition 4 implies that the social planner faces a trade-off: the planner can mitigate the problem of inefficient retention only by exacerbating the problem of inefficient poaching. How the planner will resolve this tension depends on her objective function. In the Internet Appendix, we show that a planner who maximizes social surplus will always choose a mechanism with a threshold property (as in Lemma 2). Thus, for any $\tau^{\#} < \overline{\tau}$, an allocation must display inefficient retention, inefficient poaching, or both. We show that the social planer always chooses a threshold that implies only one of these inefficiencies: the solution displays either excessive poaching or excessive retention. We also show that if

[25]Formally, Corollary 8 holds because the first-best allocation violates the typical monotonicity requirement for implementable decisions (here, for simplicity, we call a decision an allocation) under incomplete information (see, e.g., Fudenberg and Tirole, 1991, p. 260).

the social planner chooses excessive retention, the allocation will also display inefficient firing.

Proposition 4, and its Corollary 8, imply that the inefficiency of job-to-job flows is a robust property of our setup. That is, we cannot restore efficiency by changing assumptions regarding the structure of competition or equilibrium refinements. In particular, the timing of actions as described in Section 2 is not necessary for our results. As an example of this point, in the Appendix, we show a complete analysis of the case in which incumbents move last.

6 Talent Discovery: An Infinite-Horizon Model

We now develop an infinite-horizon version of the model. This version allows us to present a more complete analysis of the costs and benefits of talent discovery. In this version, firms explicitly benefit from their role as talent discoverers: Firms hire young managers hoping to retain them once their talent is revealed. In addition, firms may be able to extract ex ante some of the surplus that accrues to managers who are poached. This version thus clarifies that the opportunity cost of poaching is the lost benefit from talent discovery. Similarly, the opportunity cost of discovering talent (i.e., hiring a young manager) is the lost benefit from poaching an old worker with known talent.

The economy is populated with many infinitely-lived firms. Again, firms can be of one of two types, L or H, representing both the type and the mass of firms of each type. Managers live for two periods: young age and old age. Firms and managers are risk-neutral with common discount factor $\delta \in [0, 1)$. At each period t ($t = 0, 1, 2, ...$), a mass M of young managers enter the labor market. For brevity, we do not present the benchmark case of symmetric information; a full analysis of this case can be found in the Internet Appendix.

At the beginning of a period, a firm can be in one of the following states:

(i) The firm has a vacant position because its manager retired at the end of the previous period (i.e., the manager was old).

(ii) The firm does not have a vacant position because its manager was young in the previous period.

Both types of firms can have incumbent managers and can also become poachers. In each period t, the timing of actions for a firm with an incumbent manager is exactly as described in Section 2. At Date 2 in period t, a type-h firm can attempt to poach a manager from a type-l firm or from another type-h firm. In general, we also allow type-l firms to make poaching offers. However, for simplicity, we (implicitly) restrict our analysis to a set of parameters for which, in equilibrium, managers would strictly prefer poaching offers from type-h firms. Thus, without loss of generality, we assume that type-l firms cannot poach managers.

As above, there could be a subset P_i of types poached in equilibrium and a subset S_i of types fired in equilibrium. For simplicity, we focus only on cases in which both P_i and S_i are convex sets; that is, they are intervals, which means that, if type τ is poached, then type $\tau' > \tau$ is also poached. Similarly, if type τ is fired, then type $\tau' < \tau$ is also fired. We call an equilibrium with this property a *monotonic equilibrium*.

In a monotonic equilibrium, in each period we need to find two types of thresholds. As discussed above, $\tilde{\tau}_i$, $i \in \{l, h\}$, denotes the threshold such that all types $\tau \geq \tilde{\tau}_i$ are retained. We define $\hat{\tau}_i$ as the threshold for which all types $\tau \leq \hat{\tau}_i$ are fired. Each monotonic equilibrium has a unique sequence of thresholds $\{\tilde{\tau}_l, \tilde{\tau}_h, \hat{\tau}_l, \hat{\tau}_h\}_t$, $t = 0, 1, .., \infty$. For simplicity, we focus only on equilibria in which these thresholds are time-invariant. Thus, we can omit the time subscript from the analysis that follows.

Now, at Date 4 in each period t, firms with vacancies offer wage w_i^y, $i \in \{l, h\}$, to unemployed young managers. Thus, we also need to determine such wages in equilibrium. We assume that firms can offer any wage that they want, including negative wages. Managers may accept negative wages when young if, by working for the firm, they can earn higher wages when old. Later, we briefly discuss the effects of relaxing this assumption. To select among possible equilibria, we assume that, at Date 4, firms publicly announce a threshold $\hat{\tau}_i$. We assume that all players (i.e., firms and managers) share the same beliefs on and off the equilibrium path, and beliefs are such that players expect incumbent firms to use threshold $\hat{\tau}_i$ if this threshold is announced (that is, we select truth-telling as an equilibrium refinement). This belief is rational because incumbent firms are indifferent with respect to which threshold $\hat{\tau}_i$ they use after the announcement.

Proposition 5. *A unique monotonic equilibrium with time-invariant thresholds* $\{\tilde{\tau}_l, \tilde{\tau}_h, \hat{\tau}_l, \hat{\tau}_h\}$ *and wages* $\left\{w_l^y, w_h^y, w_l^{**}, w_h^{**}, w^*(\tilde{\tau}_l), w^*(\tilde{\tau}_h)\right\}$ *exists and has the following properties:*[26]

1. *For any given pair* $(\hat{\tau}_l, \hat{\tau}_h)$*, there is a unique* $\tilde{\tau}_i$ *such that, for each firm type* $i \in \{l, h\}$*, all manager types* $\tau \geq \tilde{\tau}_i$ *are retained. Threshold* $\tilde{\tau}_i$ *is either* $\overline{\tau}$ *or the least element of the set of fixed points of*

$$G_i(x) \equiv \frac{w^*(x) - w_i^y - \delta\theta_i \int_x^{\overline{\tau}} (\varphi\tau - \mu) dF(\tau)}{\theta_i \varphi \left[1 + \delta(1 - F(x))\right]} + \frac{\mu}{\varphi}. \tag{11}$$

2. *For any given pair* $(\hat{\tau}_l, \hat{\tau}_h)$*, equilibrium wages are such that all retained managers are offered*

$$w^*(x) = \max\left\{\theta\left(\int_x^{\overline{\tau}} \tau dF(\tau \mid \tau \geq x) - \mu\right) + w_h^y - \frac{\delta \int_{\tilde{\tau}_h}^{\overline{\tau}} (\theta\varphi\tau - w^*(\tilde{\tau}_h) - \theta\mu + w_h^y) f(\tau) d\tau}{\left[1 + \delta(1 - F(\tilde{\tau}_h))\right]}, 0\right\}, \tag{12}$$

all managers who are poached (if any) are paid

$$w_i^{**} = \theta\left(\int_{\hat{\tau}_i}^{\tilde{\tau}_i} \frac{\tau f(\tau) d\tau}{F(\tilde{\tau}_i) - F(\hat{\tau}_i)} - \mu\right) + w_h^y - \frac{\delta \int_{\tilde{\tau}_h}^{\overline{\tau}} (\theta\varphi\tau - w^*(\tilde{\tau}_h) - \theta\mu + w_h^y) f(\tau) d\tau}{1 + \delta(1 - F(\tilde{\tau}_h))}, \tag{13}$$

[26]We consider uniqueness in the generic sense: Multiple equilibrium values could still arise for a set of parameters with measure zero.

and all young managers who agree to work for a type-i firm are offered wage

$$w_i^y = -\delta(1 - F(\tilde{\tau}_i))w^*(\tilde{\tau}_i) - \delta(F(\tilde{\tau}_i) - F(\hat{\tau}_i)) \max\{w_i^{**}, 0\}. \tag{14}$$

3. *At Date 4, type-i firms with vacancies announce the threshold $\hat{\tau}_i$ that maximizes the present value of their expected profits given (11), (12), (13) and (14).*
4. *All types $\tau_i \in [0, \hat{\tau}_i]$ are fired in equilibrium (wages are negative).*

Proof. See the Appendix. □

From this proposition we conclude that the equilibrium displays the same type of talent misallocation as in the two-period model: The best types $[\tilde{\tau}_i, \overline{\tau}]$ are retained and the mediocre types $P_i = [\hat{\tau}_i, \tilde{\tau}_i]$ are poached. Thus, our main conclusions continue to hold in the infinite-horizon model.

The equilibrium poaching wage illustrates the trade-off between discovering talent and poaching known talent:

$$w_i^{**} = \underbrace{\theta\left(\int_{\hat{\tau}_i}^{\tilde{\tau}_i} \frac{\tau f(\tau) d\tau}{F(\tilde{\tau}_i) - F(\hat{\tau}_i)} - \mu\right)}_{\text{net benefit from poaching}} + \underbrace{w_h^y - \frac{\delta \int_{\tilde{\tau}_h}^{\overline{\tau}} (\theta\varphi\tau - w^*(\tilde{\tau}_h) - \theta\mu + w_h^y) f(\tau) d\tau}{1 + \delta(1 - F(\tilde{\tau}_h))}}_{\text{(minus) net benefit from talent discovery}}. \tag{15}$$

The first term on the right-hand side of (15) is the net benefit from poaching an old worker from a firm of type i. If a firm poaches such a worker it loses the option of hiring a young worker and discovering their talent in the next period. The latter part constitutes the option value associated with talent discovery and is represented by the second term on the right-hand side of (15).

Terviö (2009) develops a dynamic model of symmetric employer learning with homogeneous firms and limited liability. He shows that the equilibrium rate of talent discovery is inefficiently low from a social welfare perspective. If we introduce a non-negative wage constraint (i.e., limited liability), then we have $w_h^y = 0$, and the net benefit from talent discovery is reduced. As in Terviö (2009), such a constraint would thus reduce the rate of talent discovery in the economy. Differently from Terviö (2009), in our model the combination of asymmetric learning and firm-specific human capital creates incentives for talent discovery even under limited liability.

7 Final Remarks

We develop a model of the trade-off between talent discovery and poaching. In a model with heterogeneous firms, we show that asymmetric information and firm-specific human capital combine to generate several allocational inefficiencies. Some of the best managers are retained by low-productivity firms even when they would be better matched with high-productivity firms. Some mediocre managers are either inefficiently fired or inefficiently matched with high-productivity firms.

The model underscores the important role that firms play as talent discoverers. Competition for talent implies that firms may not capture most of the value that they help create. In our model, firms asymmetrically learn about the abilities of their managers. This knowledge gives firms informational rents, helping to explain firms' incentives to invest in talent discovery. Because of their informational advantage, firms that invest in talent discovery are able to retain their best managers. In equilibrium, some firms – typically large and highly productive – have a comparative advantage at poaching talent, while others – typically small and with low productivity – have a comparative advantage at discovering talent.

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A Appendix: Proofs

Proposition 1.

Proof. Note first that all firms with a manager of type $\tau < \frac{\mu}{\varphi}$ will not retain the manager because hiring an unemployed agent would give them a higher profit. Thus, all such firms will have vacancies. Because of (A2), H firms with vacancies are in excess supply. Because H firms are willing to pay up to $\theta(\tau - \mu)$ for a manager of type $\tau > \mu$, while L firms will pay only up to $\tau - \mu$, only H firms with vacancies will become poachers. Poachers compete à la Bertrand and the poaching wage offered to type τ is given by $w^{pS}(\tau) = \theta(\tau - \mu)$, where the superscript S denotes symmetric information.

We now show that H firms with an incumbent manager of type $\tau \geq \frac{\mu}{\varphi}$ will not become a poacher. Consider first the case in which $\tau > \mu$. If this firm fires this manager to hire a manager with known type $\tau' > \tau$, its net payoff is $\theta\tau' - \theta(\tau' - \mu) - \theta\varphi\tau + \theta(\tau - \mu) = -\theta\tau(\varphi - 1) < 0$. Thus, this firm is always better off retaining τ. Suppose now that $\tau \leq \mu$. Then, the net payoff from firing τ to hire τ' is $\theta(\mu - \varphi\tau)$, which is only strictly positive for $\tau < \frac{\mu}{\varphi}$. We conclude that, in equilibrium, all H firms with incumbent managers of type $\tau \geq \frac{\mu}{\varphi}$ retain their managers.

Suppose that $\tau_{ji} \leq \mu$. In this case, the firm does not have to worry about poaching and will pay $w_{ji} = 0$ if $\tau_{ji} \in \left[\frac{\mu}{\varphi}, \mu\right]$, and some $w_{ji} < 0$ if $\tau_{ji} < \frac{\mu}{\varphi}$ (in other words, it dismisses the manager).

If instead $\tau_{ji} > \mu$ and the firm wants to retain the manager, then it must offer at least as much as a poacher, that is, w_{ji} must be equal to or greater than $\theta\left(\tau_{ji} - \mu\right) > 0$. Then, ji's payoff is $\theta_i \varphi \tau_{ji} - \theta\left(\tau_{ji} - \mu\right)$, which implies that retaining the manager is an optimal choice if and only if $\theta_i \varphi \tau_{ji} - \theta\left(\tau_{ji} - \mu\right) \geq \theta_i \mu$. If $i = h$, this condition holds always, thus implying that, in equilibrium, no manager is poached from an H firm. An H firm's optimal strategy regarding its incumbent manager is summarized by:[27]

$$w^S_{jh} = \begin{cases} \text{any } w < 0 & \text{if } \tau_{jh} \leq \frac{\mu}{\varphi} \\ 0 & \text{if } \tau_{jh} \in \left[\frac{\mu}{\varphi}, \mu\right] \\ \theta\left(\tau_{jh} - \mu\right) & \text{if } \tau_{jh} \in [\mu, \overline{\tau}] \end{cases} . \tag{16}$$

Now the analysis that follows refers to L firms only. If $\frac{\theta}{\varphi} \leq 1$, the retention condition $\varphi \tau_{jl} - \theta\left(\tau_{jl} - \mu\right) \geq \mu$ is true for any τ_{ji}. If $\frac{\theta}{\varphi} > 1$, the retention condition holds for any $\tau_{jl} \leq (\theta - 1)\mu / (\theta - \varphi)$. This reasoning implies that an L firm's optimal strategy is to offer

$$w^S_{jl} = \begin{cases} \text{any } w < 0 & \text{if } \tau_{jl} \leq \frac{\mu}{\varphi} \\ 0 & \text{if } \tau_{jl} \in \left[\frac{\mu}{\varphi}, \mu\right] \\ \theta\left(\tau_{jl} - \mu\right) & \text{if } \tau_{jl} \in \left[\mu, \tau^{\#}\right] \\ \text{any } w < w^{pS}\left(\tau_{jl}\right) & \text{if } \tau_{jl} \geq \tau^{\#} \end{cases} , \tag{17}$$

where

$$\tau^{\#} = \begin{cases} \overline{\tau} & \text{if } \theta \leq \varphi \\ \min\{(\theta - 1)\mu / (\theta - \varphi), \overline{\tau}\} & \text{if } \theta > \varphi. \end{cases} \tag{18}$$

□

Proposition 2.

Proof. Part 1: From Lemma 2, we know that an equilibrium must have a threshold $\tilde{\tau}_i$ above which all manager types are retained by incumbent firms of type i. Here we want to find $\tilde{\tau}_i$.

From Lemma 1 we know that all types τ_i in $[\tilde{\tau}_i, \overline{\tau}]$ are paid the same wage; let w^* denote

[27] Recall that, for simplicity, we always use closed intervals to denote the equilibrium sets of types.

such a wage. To retain such managers, an incumbent firm must offer $w^* \geq w^p(w^*, i, W)$, where function w^p denotes the wage offered by poachers when they observe an incumbent firm of type i that offers a wage w^* when the set of all equilibrium wage offers is W. Upon observing w^*, beliefs must be $F(\tau \mid \tau \geq \tilde{\tau}_i)$, which implies that the poaching wage is given by (here we use (A2) and Bertrand competition among poachers):

$$w^p(w^*, i, W) = \theta \left(\int_{\tilde{\tau}_i}^{\overline{\tau}} \tau dF(\tau \mid \tau \geq \tilde{\tau}_i) - \mu \right). \tag{19}$$

Consider an incumbent firm of type i with a manager of type $\tau_i \in [\tilde{\tau}_i, \overline{\tau}]$. For w^* to be an equilibrium wage offer, the incumbent firm must be better off by retaining the manager at this wage rather than hiring a new manager from the outside pool:

$$\theta_i \varphi \tau_i - w^* \geq \theta_i \mu, \tag{20}$$

which implies

$$\tilde{\tau}_i \geq \frac{w^*}{\theta_i \varphi} + \frac{\mu}{\varphi}. \tag{21}$$

If the inequality above is strict, then there exists $\tau' < \tilde{\tau}_i$ such that $\tau' > \frac{w^*}{\theta_i \varphi} + \frac{\mu}{\varphi}$, which implies that the incumbent firm would like to retain manager τ' at wage w^*, which contradicts the assumption that $\tilde{\tau}_i$ is an equilibrium threshold. Thus, it must be that

$$\tilde{\tau}_i = \frac{w^*}{\theta_i \varphi} + \frac{\mu}{\varphi}. \tag{22}$$

We now show that $w^* = w^p(w^*, i, W)$. Suppose first that $w^* > w^p(w^*, i, W)$ and consider a deviation from an incumbent with a manager of type $\tau_i > \tilde{\tau}_i$ who chooses to offer $w^p(w^*, i, W)$ instead of w^*. For this not to constitute a profitable deviation, it must be that the manager rejects the incumbent firm's offer, that is the following condition needs to hold:

$$w^p(w^p(w^*, i, W), i, W) > w^p(w^*, i, W), \tag{23}$$

that is,

$$\theta\left(\int_0^{\overline{\tau}} \tau dF^W(\tau \mid w^p\left(w^*, i, W\right)) - \mu\right) > \theta\left(\int_{\tilde{\tau}_i}^{\overline{\tau}} \tau dF(\tau \mid \tau \geq \tilde{\tau}_i) - \mu\right). \tag{24}$$

This can only happen if distribution F^W puts more more weight on higher manager types than distribution $F(\tau \mid \tau \geq \tilde{\tau}_i)$. Formally, this requires that there exists at least one manager type $\tau'' > \tilde{\tau}_i \geq \frac{w^p(w^*,i,W)}{\theta_i \varphi} + \frac{\mu}{\varphi}$ for which the probability of deviation of an incumbent firm is strictly greater than the probability of a deviation of an incumbent firm with a manager of type $\tau' \in (\tilde{\tau}_i, \tau'')$. However, this is ruled out by (E2). Thus, it must be that $w^* = w^p\left(w^*, i, W\right)$ and the equilibrium threshold (if interior) must satisfy the following condition:

$$\tilde{\tau}_i = \frac{\theta}{\theta_i \varphi}\left(\int_{\tilde{\tau}_i}^{\overline{\tau}} \tau dF(\tau \mid \tau \geq \tilde{\tau}_i) - \mu\right) + \frac{\mu}{\varphi}. \tag{25}$$

This condition is necessary, but not sufficient, and there may be multiple values of $\tilde{\tau}_i$ that solve this equation. Another necessary condition for an equilibrium is that

$$\tilde{\tau}_i + \varepsilon \geq \frac{\theta}{\theta_i \varphi}\left(\int_{\tilde{\tau}_i+\varepsilon}^{\overline{\tau}} \tau dF(\tau \mid \tau \geq \tilde{\tau}_i + \varepsilon) - \mu\right) + \frac{\mu}{\varphi} \tag{26}$$

for $\varepsilon > 0$ arbitrarily small. To see this, suppose that

$$\tilde{\tau}_i + \varepsilon < \frac{\theta}{\theta_i \varphi}\left(\int_{\tilde{\tau}_i+\varepsilon}^{\overline{\tau}} \tau dF(\tau \mid \tau \geq \tilde{\tau}_i + \varepsilon) - \mu\right) + \frac{\mu}{\varphi} \tag{27}$$

then the incumbent would be better off by not retaining types in the interval $[\tilde{\tau}_i, \tilde{\tau}_i + \varepsilon]$, which contradicts the assumption that $\tilde{\tau}_i$ is an equilibrium threshold.

Define the function

$$G_i\left(x\right) = \frac{\theta}{\theta_i \varphi}\left(\int_x^{\overline{\tau}} \tau dF(\tau \mid \tau \geq x) - \mu\right) + \frac{\mu}{\varphi}. \tag{28}$$

Because $G_i\left(x\right)$ is continuous and $G_i\left(0\right) = \frac{\mu}{\varphi} > 0$, at least one fixed point of G_i exists if and only if

$$\max_{x\in[0,\overline{\tau})} x - G_i\left(x\right) \geq 0. \tag{29}$$

This condition always holds if the incumbent is an H firm (i.e., $\theta_i = \theta$), but it may or may not hold if the incumbent is an L firm (i.e., $\theta_i = 1$). If (29) does not hold, the unique equilibrium displays no retention by L firms, that is, $\tilde{\tau}_l = \overline{\tau}$.

Assuming that (29) holds, we define the least element of the set of fixed points of $G_i\left(x\right)$:

$$\underline{x}_i = \min_{\{x:G_i(x)=x\}} x. \tag{30}$$

Since $G_i\left(x\right) \geq \frac{\mu}{\varphi}$ for all $x \geq 0$, we have that $\underline{x}_i \geq \frac{\mu}{\varphi}$.

We now show that $\underline{x}_i$ is an equilibrium threshold. First, notice that setting $\tilde{\tau}_i = \underline{x}_i$ satisfies (25) because $\underline{x}_i$ is a fixed point of $G_i\left(.\right)$. Second, because $G_i\left(0\right) > 0$, $x - G_i\left(x\right)$ crosses zero from below at $\underline{x}_i$, which satisfies condition (26).

Now we show that no other fixed point of $G_i\left(x\right)$ that also satisfies (26) and such that $x > \underline{x}_i$ can be an equilibrium. Suppose that there is a candidate equilibrium threshold $x' > \underline{x}_i$ such that only types $\tau \geq x'$ are retained at wage

$$w' = \theta\left(\int_{x'}^{\overline{\tau}} \tau dF(\tau \mid \tau \geq x') - \mu\right). \tag{31}$$

Then, an incumbent firm with a manager of type $\underline{x}_i + \varepsilon$, with $\varepsilon > 0$ arbitrarily small, could deviate and offer $w_i^* < w'$, with

$$w_i^* = \theta\left(\int_{\underline{x}}^{\overline{\tau}} \tau dF(\tau \mid \tau \geq \underline{x}) - \mu\right). \tag{32}$$

If a manager of type $\underline{x}_i + \varepsilon$ is successfully retained at wage w_i^*, then the incumbent firm is strictly better off. For such a deviation not to be profitable, poachers' beliefs must be such that $w^p\left(w_i^*, i, W\right) > w_i^*$. This would occur if poachers believe that firms with managers with better types are more likely to deviate than those with worse types. Formally, this requires that there exists at least one manager type $\tau'' > \underline{x} \geq \frac{w_i^*}{\theta_i \varphi} + \frac{\mu}{\varphi}$ for which the probability of deviation of an incumbent firm is strictly greater than the probability of a deviation of an incumbent firm with a manager of type $\tau' \in (\underline{x}_i, \tau'')$. However, this is ruled out by (E2). Thus, $\underline{x}_i$ is the unique equilibrium threshold; i.e. $\tilde{\tau}_i = \underline{x}_i$. The unique retention wage is given by w_i^* as in (32).

*Part 2***.** It follows trivially from (E1).

*Part 3***.** Suppose that there is some type τ_i' in $\left[\frac{\mu}{\varphi}, \tilde{\tau}_i\right]$ that is retained in equilibrium. Lemma 2 implies that all types in $\left[\tau_i', \tilde{\tau}_i\right]$ are also retained, and Lemma 1 implies that all types in $\left[\tau_i', \overline{\tau}\right]$ must be paid the same wage. However, because $\tau_i' \leq \tilde{\tau}_i$, then by the definition of $\tilde{\tau}_i$ in (30), we have $\tau_i' - G_i\left(\tau_i'\right) \leq 0$. Thus, type τ_i' cannot be profitably retained. Thus, all types in $\left[\frac{\mu}{\varphi}, \tilde{\tau}_i\right]$ must be either poached (and thus included in set P_i) or fired (and thus included in set S_i). Since a manager only accepts an offer from a poacher if that offer is positive, for any set P_i it must be that $\theta\left(\int_0^{\overline{\tau}} x dF\left(\tau \mid \tau_i \in P_i\right) - \mu\right) > 0$ (at least one equilibrium with $P_i \neq$ exists if $\tilde{\tau}_i > \mu$). Thus, if an equilibrium exists, Part 3 must hold.

Part 4. If $\tau_i \in P_i$, then the incumbent must offer the managers in this set some wage w_i' that is lower than the poaching wage $w^p\left(w_i', i, W\right)$. Because poachers' beliefs must be Bayesian on the equilibrium path, then

$$w^p\left(w_i', i, W\right) = \theta\left(\int_0^{\overline{\tau}} \tau dF^W(\tau \mid w_i', i) - \mu\right), \tag{33}$$

and poachers' beliefs are given by $F^W\left(\tau \mid w_i', i\right) = F\left(\tau \mid \tau_i \in P_i\right).$

To complete the proof, we only need to show that at least one equilibrium exists. Suppose first that $\max_{\tau_l \in [0, \overline{\tau})} \tau_l - G_l\left(\tau_l\right) > 0$. In this case, we know that there exists a unique pair $\{\tilde{\tau}_l, \tilde{\tau}_h\} < \{\overline{\tau}, \overline{\tau}\}$. The following fully characterizes one possible equilibrium:

Consider the retention wages

$$w_i(\tau_i) = \begin{cases} w_i^* & \text{if } \tau_i \in [\tilde{\tau}_i, \overline{\tau}] \\ 0 & \text{if } \tau_i \in [\mu, \tilde{\tau}_i] \\ -1 & \text{if } \tau_i \in [0, \mu] \end{cases}, \tag{34}$$

the poaching wages on the equilibrium path

$$w^p(w_i) = \begin{cases} w_i^* & \text{if } w_i = w_i^* \\ \theta(\int_{\mu}^{\tilde{\tau}_i} \tau dF(\tau \mid \tau \in [\mu, \tilde{\tau}_i]) - \mu) & \text{if } w_i = 0 \\ -1 & \text{if } w_i = -1 \end{cases}, \tag{35}$$

and beliefs such that $F(\tau \mid \tau \geq \frac{w_i}{\theta_i \varphi} + \frac{\mu}{\varphi})$ for any w_i that is off the equilibrium path. In this equilibrium, $P_i = [\mu, \tilde{\tau}_i]$ and $S_i = \left[\frac{\mu}{\varphi}, \mu\right]$.

If we have $\max_{\tau_l \in [0,\overline{\tau})} \tau_l - G_l(\tau_l) \leq 0$, nothing is changed for H firms. For L firms, no type τ_l is retained, and an equilibrium in which all types $\tau_l \geq \mu$ are offered $w_l = 0$, and types below μ are fired, exists and is sustained by beliefs such that $F(\tau \mid \tau \geq \frac{w_l}{\varphi} + \frac{\mu}{\varphi})$ for any w_l that is off the equilibrium path. This equilibrium implies $P_l = [\mu, \overline{\tau}]$ and $S_l = \left[\frac{\mu}{\varphi}, \mu\right]$. □

Example: Uniform distribution of talent

Proof. We assume for this example that talent is uniformly distributed on the support $[0, \overline{\tau}]$. In this case

$$w(x) = \theta(E[\tau \mid \tau \geq x] - \mu) = \theta\left(\tfrac{x+\overline{\tau}}{2} - \tfrac{\overline{\tau}}{2}\right) = \tfrac{\theta x}{2} \tag{36}$$

and therefore

$$G_i(x) = \frac{\theta x}{2\theta_i \varphi} + \frac{\overline{\tau}}{2\varphi}. \tag{37}$$

For $i = h$, a fixed point always exists and

$$\widetilde{\tau}_h = \frac{\overline{\tau}}{2\varphi - 1}. \tag{38}$$

For $i = l$, we consider two cases:

Case 1: $2\varphi - \theta > 1$. A fixed point of $G_l(x)$ exists and therefore

$$\widetilde{\tau}_l = \frac{\theta \widetilde{\tau}_l}{2\varphi} + \frac{\overline{\tau}}{2\varphi} \Rightarrow \widetilde{\tau}_l = \frac{\overline{\tau}}{2\varphi - \theta}. \tag{39}$$

In this case also $\tau^{\#} = \overline{\tau}$, so all types $\tau \in [\mu, \widetilde{\tau}]$ are inefficiently poached.

Case 2: $2\varphi - \theta \leq 1$, in that case the L firm cannot retain any of its employees:

$$x \leq \frac{\overline{\tau}}{2\varphi} + \theta \frac{x}{2\varphi} \text{ for any } x \in [0, \overline{\tau}] \tag{40}$$

and therefore $\widetilde{\tau}_l = \overline{\tau}$ and $\tau^{\#} = \frac{\mu(\theta-1)}{\theta-\varphi} = \frac{\overline{\tau}(\theta-1)}{2(\theta-\varphi)}$. In this case, all types $\tau \in \left[\frac{\overline{\tau}}{2}, \frac{\overline{\tau}(\theta-1)}{2(\theta-\varphi)}\right]$ are inefficiently poached. □

Corollary 5.

Proof. Consider first the case of H firms. Since the managers poached from H firms lie in the interval $[\mu, \widetilde{\tau}_h]$, they are trivially less productive than those retained by H firms, as their types are greater than $\widetilde{\tau}_h$. Thus, we need to consider only those poached from L firms, who lie in the interval $[\mu, \widetilde{\tau}_l]$.

Note first that threshold $\widetilde{\tau}_h$ is given by

$$\varphi \widetilde{\tau}_h = E\left[\tau \mid \tau \geq \widetilde{\tau}_h\right]. \tag{41}$$

Define φ^* such that

$$\varphi^* \mu = E\left[\tau \mid \tau \geq \mu\right]. \tag{42}$$

That is, if $\varphi = \varphi^*$, the optimal threshold is $\widetilde{\tau}_h = \mu$. Suppose now that $\widetilde{\tau}_h < \mu$. Because $\widetilde{\tau}_h$ is decreasing in φ, we have $\varphi > \varphi^*$.

Now, note that $E\left[\tau \mid \tau \geq \widetilde{\tau}_h\right] > \mu$ because $\widetilde{\tau}_h > 0$ for any finite φ. Thus we have $\varphi E\left[\tau \mid \tau \geq \widetilde{\tau}_h\right] > \varphi\mu > \varphi^*\mu = E\left[\tau \mid \tau \geq \mu\right]$. This implies that the average productivity of all managers retained by H firms, $\varphi\theta E\left[\tau \mid \tau \geq \widetilde{\tau}_h\right]$, is greater than $\theta E\left[\tau \mid \tau \geq \mu\right] \geq \theta E\left[\tau \mid \tau \in [\mu, \widetilde{\tau}_l]\right]$, which is the average productivity of the managers poached from L firms. We conclude that, for H firms, the average productivity of retained managers is greater than the average productivity of poached managers.

For L firms, the result is trivial, because L firms hire from the outside pool (i.e., they do not poach in equilibrium). If (A2) does not hold, L firms can also become poachers. In the Internet Appendix, we show that Corollary 5 continues to hold. □

Proposition 3.

Proof. Threshold $\widetilde{\tau}_l$ is given by:

$$\widetilde{\tau}_l = \frac{\mu}{\varphi} + \frac{\theta}{\varphi}\left(E\left[\tau \mid \tau \geq \widetilde{\tau}_l\right] - \mu\right). \tag{43}$$

In order to have an interior solution (i.e., $\widetilde{\tau}_l < \overline{\tau}$), the expression on the right-hand side must cross the 45 degree line from above. $\tau^{\#}$ is given by:

$$\tau^{\#} = \frac{\mu}{\varphi} + \frac{\theta\left(\tau^{\#} - \mu\right)}{\varphi}. \tag{44}$$

The expression on the right-hand side must cross the 45 degree line from below.

At $\tau = x$, we have $\frac{\mu}{\varphi} + \frac{\theta}{\varphi}\left(E\left[\tau \mid \tau \geq \widetilde{\tau}_l\right] - \mu\right) > \frac{\mu}{\varphi} + \frac{\theta\left(\tau^{\#} - \mu\right)}{\varphi}$ for any $x < \overline{\tau}$. This implies that $\frac{\mu}{\varphi} + \frac{\theta(\tau-\mu)}{\varphi}$would cross the 45 degree line from below at a point such that $\tau^{\#} > \widetilde{\tau}_l$. □

Result: H firms pay higher wages on average than L firms.

Proof. Equilibrium average wages in L firms are given by

$$w_l^a = [1 - F(\tilde{\tau}_l)]\theta \left(\int_{\tilde{\tau}_l}^{\overline{\tau}} \frac{\tau f(\tau)}{1 - F(\tilde{\tau}_l)} d\tau - \mu \right), \tag{45}$$

and equilibrium average wages in those H firms that do not poach any manager are

$$w_h^a = [1 - F(\tilde{\tau}_h)]\theta \left(\int_{\tilde{\tau}_h}^{\overline{\tau}} \frac{\tau f(\tau)}{1 - F(\tilde{\tau}_h)} d\tau - \mu \right). \tag{46}$$

Since

$$\frac{\partial w_i^a}{\partial \tilde{\tau}_i} = (\mu - \tilde{\tau}_i) f(\tilde{\tau}_i) < 0, \tag{47}$$

and because $\tilde{\tau}_l > \tilde{\tau}_h$ (this is implied by (8)), $w_h^a > w_l^a$ for those H firms that do not poach managers. H firms that poach managers offer positive wages to those managers, which implies that their average wage is higher than w_h^a. □

Prediction 9.

Proof. Consider w_l^*, which is the wage paid to managers retained by l firms. From (5) and (8) we have

$$\frac{dw_l^*}{d\theta_l} = -\frac{\Delta\theta_h}{\theta_l^2} \frac{dE\left(\tau \mid \tau \geq \tilde{\tau}_l\right)}{d\tilde{\tau}_l} \frac{d\tilde{\tau}_l}{d\Delta} < 0. \tag{48}$$

$$\frac{dw_l^*}{d\theta_h} = \left(E\left(\tau \mid \tau \geq \tilde{\tau}_l\right) - \mu\right) + \frac{\Delta}{\theta_l} \frac{dE\left(\tau \mid \tau \geq \tilde{\tau}_l\right)}{d\tilde{\tau}_l} \frac{d\tilde{\tau}_l}{d\Delta} > 0. \tag{49}$$

□

Proposition 4.

Proof. The revelation principle implies that there is no loss of generality from focusing on truth-telling direct mechanisms. Define an incumbent firm's payoff function under mechanism $\langle p, t\rangle$ as

$$U(\tau,\tau^m \mid p,t)=\begin{cases}(1-p(\tau^m))\varphi\tau+p(\tau^m)\mu+t(\tau^m) & \text{if } \tau^m\in[\widehat{\tau},\overline{\tau}]\\ \mu+t(\tau^m) & \text{if } \tau^m\in[0,\widehat{\tau})\end{cases}. \tag{50}$$

Suppose that an allocation p with $p(\tau')>p(\tau'')$ for some pair (τ',τ'') is implementable (i.e., it is incentive compatible for the firm to report $\tau^m=\tau$). Incentive compatibility requires

$$\begin{aligned}(1-p(\tau'))\varphi\tau'+p(\tau')\mu+t(\tau') &\geq (1-p(\tau''))\varphi\tau'+p(\tau'')\mu+t(\tau'')\\ t(\tau')-t(\tau'') &\geq [p(\tau')-p(\tau'')](\varphi\tau'-\mu) \end{aligned}\tag{51}$$

and

$$\begin{aligned}(1-p(\tau''))\varphi\tau''+p(\tau'')\mu+t(\tau'') &\geq (1-p(\tau'))\varphi\tau''+p(\tau')\mu+t(\tau')\\ t(\tau'')-t(\tau') &\geq [p(\tau'')-p(\tau')](\varphi\tau''-\mu). \end{aligned}\tag{52}$$

Adding both sides of (51) and (52) yields

$$0\geq[p(\tau')-p(\tau'')]\varphi(\tau'-\tau'') \tag{53}$$

which implies $\tau'<\tau''$.[28] □

Changing the timing of the offers.

In our baseline model, the timing of the game is such that the uninformed party (the poacher) moves last. We now introduce the case in which the informed party (the incumbent) moves last. We modify the original timing slightly by adding a date between Dates 1.2 and 1.3:

[28]We cannot have $p(\tau')>p(\tau'')$ for $\tau''=\tau'$ because p must be a function.

Date $1.2\frac{1}{2}$. Each firm i independently makes a counter offer w_i^c.

At Date 1.3, a manager who holds an initial offer w_i, a poaching offer $w^p(w_i)$, and a counter offer w_i^c, accepts the poaching offer if and only if $w^p(w_i) > \max\{w_i, w_i^c\}$.

We now characterize the equilibrium under this modified timing. For the sake of brevity, we focus only on the equilibrium that displays the maximum amount of retention by the incumbent firm.[29] First, define the set $Y_i \equiv \{y \in Y_i : H_i(y) = 0\}$ where

$$H_i(y) \equiv y - \frac{\theta}{\theta_i \varphi}\left(\frac{\int_{\frac{\mu}{\varphi}}^{y} \tau dF(\tau)}{F(y) - F\left(\frac{\mu}{\varphi}\right)} - \mu\right) - \frac{\mu}{\varphi}. \tag{54}$$

We then have the following result:

1. *The (maximum-retention) equilibrium has the following properties:*

1. *There is a unique $\tilde{\tau}_i' \in \left[\frac{\mu}{\varphi}, \overline{\tau}\right]$ such that all types $\tau_i \geq \tilde{\tau}_i'$ are retained. Threshold $\tilde{\tau}_i'$ is given by*

$$\tilde{\tau}_i' = \begin{cases} \text{the largest element in } \left\{\frac{\mu}{\varphi}\right\} \cup Y_i & \text{if } H_i(\overline{\tau}) \geq 0 \\ \overline{\tau} & \text{if } H_i(\overline{\tau}) \leq 0 \end{cases}. \tag{55}$$

All retained managers are offered wage

$$w_i^{*\prime} = \max\left\{\theta\left(\frac{\int_{\frac{\mu}{\varphi}}^{\tilde{\tau}_i'} \tau dF(\tau)}{F(\tilde{\tau}_i') - F\left(\frac{\mu}{\varphi}\right)} - \mu\right), 0\right\}. \tag{56}$$

2. *All types $\tau_i \in \left[0, \frac{\mu}{\varphi}\right]$ are fired in equilibrium.*

3. *All types $\tau_i \in \left[\frac{\mu}{\varphi}, \tilde{\tau}_i'\right]$ are poached in equilibrium.*

[29] In the original game, the most-efficient equilibrium is also the equilibrium that maximizes retention. By contrast, in the modified game, these two properties ("most-efficient" and "maximum-retention") may not lead to the same equilibrium. For comparing the two games, we choose the maximum retention criterion as the most natural. However, our conclusions are not sensitive to using alternative equilibrium-selection criteria.

Proof. As before, we assume that E1 and E2 hold. To find the equilibrium, we work backwards. At Date $1.2\frac{1}{2}$, the incumbent observes a poaching wage w_i^p. The incumbent pays the poaching wage and retains type τ if and only if $\tau - \frac{w_i^p}{\theta_i \varphi} \geq \mu$.

At Date 1.2, a manager with a wage offer w_i receives a poaching offer equal to

$$\theta \left(\int_0^{\overline{\tau}} \tau dF \left(\tau \mid w_i, i \right) - \mu \right). \tag{57}$$

The beliefs represented by $F\left(\tau \mid w_i, i\right)$ must be Bayesian on the equilibrium path and consistent with E2.

At Date 1.1, the incumbent chooses w_i. We argue that an incumbent offers a unique wage $w_i = 0$ to any retained employee, i.e., an employee with talent $\tau_i \geq \frac{\mu}{\varphi}$. The argument is similar to the one used to prove Lemma 1. Suppose that there are two types $\tau' > \tau''$ and that an incumbent i wants to retain both of them. Suppose the incumbent offers two different wages $w_i' > w_i''$ and suppose the poacher's offers are $w^p(w_i') > w^p(w_i'')$. Then, there is a profitable deviation for the incumbent, which is to offer w_i'' to both types. Now, suppose that $w_i > 0$. Then, the incumbent could deviate and offer $w_i' = 0$; Assumption E2 implies that $w^p(0) < w^p(w_i)$. Thus, $w_i = 0$. E1 implies that all $\tau < \frac{\mu}{\varphi}$ receive negative offers. Maximum retention implies that the incumbent offers $w_i = 0$ to all $\tau_i \geq \frac{\mu}{\varphi}$. This proves Part 2 of the result and that there is a unique $\tilde{\tau}_i' \in \left[\frac{\mu}{\varphi}, \overline{\tau}\right]$ such that all types $\tau_i > \tilde{\tau}_i'$ are retained. Then, it follows that the equilibrium poaching wage is given by

$$w_i^p = \theta \left(\frac{\int_{\frac{\mu}{\varphi}}^{\tilde{\tau}_i'} \tau dF(\tau)}{F\left(\tilde{\tau}_i'\right) - F\left(\frac{\mu}{\varphi}\right)} - \mu \right), \tag{58}$$

and thus all retained managers are offered wage

$$w_i^{*\prime} = \max \left\{ \theta \left(\frac{\int_{\frac{\mu}{\varphi}}^{\tilde{\tau}_i'} \tau dF(\tau)}{F\left(\tilde{\tau}_i'\right) - F\left(\frac{\mu}{\varphi}\right)} - \mu \right), 0 \right\}, \tag{59}$$

because the incumbent only needs to offer $w_i^c = \max\left\{w_i^p, 0\right\}$. If w_i^p is strictly positive, then clearly all types $\tau_i \in \left(\frac{\mu}{\varphi}, \tilde{\tau}_i'\right)$ are poached in equilibrium. If $w_i^p \leq 0$, then no one is poached and thus $\tilde{\tau}_i' = \frac{\mu}{\varphi}$. This proves Part 3.

To prove Part 1, suppose first that $H_i(\overline{\tau}) < 0$. Then, the incumbent does not wish to retain any type, implying that $\tilde{\tau}_i' = \overline{\tau}$.

Suppose now that $H_i(\overline{\tau}) \geq 0$. If $H_i(\tau_i) \geq 0$ for all τ_i, then the incumbent can retain any type for a given equilibrium w_i^p and still make a net profit. Thus, all types higher than $\frac{\mu}{\varphi}$ are retained. Finally, if $H_i(\tau_i) < 0$ for some τ_i, then the set Y_i is non-empty and the equilibrium threshold must be in Y_i (which has at least two elements because $H_i(0) > 0$). Consider a candidate equilibrium threshold $\tau_i^* \in Y_i$, with respective equilibrium poaching wage w_i^{p*}, and assume that τ_i^* is not the largest element of Y_i. Then, a single poacher may deviate and offer an alternative poaching wage equal to

$$w_i^{p\prime} = \tilde{\tau}_i' - \alpha - \frac{\mu}{\varphi}, \tag{60}$$

where $\tilde{\tau}_i'$ is the largest element in Y_i and $\alpha > 0$ is sufficiently small so that $w_i^{p*} < w_i^{p\prime}$. This poacher would be successful at poaching all types $\left[\frac{\mu}{\varphi}, \tilde{\tau}_i' - \alpha\right)$ at a wage that is strictly lower than the one implied by the zero net profit condition. Thus, this deviation is profitable. Thus, the equilibrium threshold must be $\tilde{\tau}_i'$, i.e., the largest element of Y_i. □

The equilibrium outcome is qualitatively similar to the outcome in Proposition 2: All types above a threshold are retained and only mediocre types are poached. Thus, our result that some mediocre types are inefficiently poached does not depend on whether the informed party moves last or not. In particular, we note that inefficient poaching will often occur because at least a subset of types in $\left[\frac{\mu}{\varphi}, \tilde{\tau}_i'\right]$ should be retained in the first-best allocation. Note that $\frac{\mu}{\varphi}$ is the only fixed point of $H_h(y)$, which implies that H firms do not poach managers from other H firms.

The change in the timing of offers (i.e., letting the initial employer make the final offer) does not change any of the key implications of the model. The change in the timing however affect the implications regarding the wage distribution for the managers who are retained and those who are poached. For L firms, if there is poaching in equilibrium (i.e., if $\tilde{\tau}_l' > \frac{\mu}{\varphi}$) both the stayers and the movers have the same wage

$$w_l^{*\prime} = \theta \left(\frac{\int_{\frac{\mu}{\varphi}}^{\tilde{\tau}_l'} \tau dF(\tau)}{F(\tilde{\tau}_l') - F\left(\frac{\mu}{\varphi}\right)} - \mu \right). \tag{61}$$

For H firms, all managers with talent $\tau > \frac{\mu}{\varphi}$ are retained and the retention wage is $w_h^{*\prime} = 0$. Two key differences now are: (i) H firms do not necessarily pay higher average wages than L firms and (ii) for firm H, internally promoted managers are paid less than those who are externally promoted.

Proposition 5.

Proof. To prove Part 1, we need to find the unique pair $\{\tilde{\tau}_l, \tilde{\tau}_h\}$ conditional on a given pair of equilibrium thresholds $\{\hat{\tau}_l, \hat{\tau}_h\}$, which for now we take as givens. Because many of the steps are similar to those in the proof of Proposition 2, we refer the reader to that proof in some instances.

Lemma 2 implies that an equilibrium with retention must have a threshold $\tilde{\tau}_i$. Lemma 1 implies that all types in $[\tilde{\tau}_i, \overline{\tau}]$ are paid the same wage. To prevent poaching, this wage must be such that $w^*(\tilde{\tau}_i) \geq w^p(w^*(\tilde{\tau}_i))$, where $w^p(w^*(\tilde{\tau}_i))$ is the wage offered by poachers who observe $w^*(\tilde{\tau}_i)$ ($w^p(.)$ will be derived below). Because poachers know that all types in $[\tilde{\tau}_i, \overline{\tau}]$ are offered $w^*(\tilde{\tau}_i)$, their beliefs must be given by $F(\tau \mid \tau \geq \tilde{\tau}_i)$ upon observing $w^*(\tilde{\tau}_i)$. The poaching wage offered by a type-h firm with a vacant position is implicitly determined by the following condition:

$$V_h^p(\tilde{\tau}_i) - V_h^y = 0, \tag{62}$$

where

$$V_h^p(\tilde{\tau}_i) = \theta \int_{\tilde{\tau}_i}^{\overline{\tau}} \frac{\tau f(\tau) d\tau}{1 - F(\tilde{\tau}_i)} - w^p(w^*(\tilde{\tau}_i)) + \delta V_h^y, \tag{63}$$

$$V_h^y = \theta\mu - w_h^y + \delta V_h^o, \tag{64}$$

and

$$V_h^o = F(\tilde{\tau}_h) V_h^y + (1 - F(\tilde{\tau}_h)) \left(\int_{\tilde{\tau}_h}^{\overline{\tau}} \frac{\theta\varphi\tau f(\tau)}{(1 - F(\tilde{\tau}_h))} d\tau - w^*(\tilde{\tau}_h) + \delta V_h^y \right). \tag{65}$$

From equations (64) and (65), we obtain:

$$V_h^o - V_h^y = \frac{\int_{\tilde{\tau}_h}^{\overline{\tau}} (\theta\varphi\tau - w^*(\tilde{\tau}_h) - \theta\mu + w_h^y) f(\tau) d\tau}{[1 + \delta(1 - F(\tilde{\tau}_h))]}. \tag{66}$$

The poaching wage offered by a type-h firm upon observing $w^*(\tilde{\tau}_i)$ is

$$w^p(w^*(\tilde{\tau}_i)) = \theta \left(\int_{\tilde{\tau}_i}^{\overline{\tau}} \frac{\tau f(\tau) d\tau}{1 - F(\tilde{\tau}_i)} - \mu \right) + w_h^y - \frac{\delta \int_{\tilde{\tau}_h}^{\overline{\tau}} (\theta\varphi\tau - w^*(\tilde{\tau}_h) - \theta\mu + w_h^y) f(\tau) d\tau}{[1 + \delta(1 - F(\tilde{\tau}_h))]}. \tag{67}$$

Using this poaching wage, we can now proceed exactly as in the proof of Proposition 2 to show that $w^*(\tilde{\tau}_i) = \max\{w^p(w^*(\tilde{\tau}_i)), 0\}$ if the equilibrium threshold is $\tilde{\tau}_i$ for $i \in \{l, h\}$.[30] Solving it for $w^*(\tilde{\tau}_h)$, we obtain (after some algebra)

$$w^*(\tilde{\tau}_h) = \max\left\{ \theta \left(\int_{\tilde{\tau}_h}^{\overline{\tau}} \frac{\tau f(\tau) d\tau}{1 - F(\tilde{\tau}_h)} - \mu \right) + w_h^y - \delta\theta \int_{\tilde{\tau}_h}^{\overline{\tau}} (\varphi - 1) \tau f(\tau) d\tau, 0 \right\}, \tag{68}$$

which can be plugged into (67) to find $w^*(\tilde{\tau}_l)$:

$$w^*(\tilde{\tau}_l) = \max\left\{ \theta \left(\int_{\tilde{\tau}_l}^{\overline{\tau}} \frac{\tau f(\tau) d\tau}{1 - F(\tilde{\tau}_l)} - \mu \right) + w_h^y - \delta\theta \int_{\tilde{\tau}_h}^{\overline{\tau}} (\varphi - 1) \tau f(\tau) d\tau, 0 \right\}. \tag{69}$$

[30] Formally, we need to modify Assumption E2 slightly to fit the dynamic setup: After observing an off-the-equilibrium-path wage w_i', poachers believe that the probability that type $\tau' \geq w_i' + \frac{\theta_i \mu}{\varphi} - w_i^y + \delta\left(V_i^o - V_i^y\right)$ deviates is no less than the probability that type $\tau'' > \tau'$ deviates. The application of this equilibrium refinement thus depends on some other equilibrium values (w_i^y, V_i^o, and V_i^y); this creates no difficulties as the condition can always be checked for each candidate equilibrium.

Because $w^*(\tilde{\tau}_i) = \max\{w^p(w^*(\tilde{\tau}_i)), 0\}$, a necessary condition for an incumbent type-i firm with a manager with type $\tau \in [\tilde{\tau}_i, \overline{\tau}]$ not to deviate and fire the manager is:

$$V_i^o(\tilde{\tau}_i) \geq V_i^y, \tag{70}$$

where

$$V_i^o(\tilde{\tau}_i) = \theta_i \varphi \tilde{\tau}_i - w^*(\tilde{\tau}_i) + \delta V_i^y, \tag{71}$$

with

$$V_i^y = \theta_i \mu - w_i^y + \delta V_i^o, \tag{72}$$

and

$$V_i^o = F(\tilde{\tau}_i) V_i^y + (1 - F(\tilde{\tau}_i)) \left(\int_{\tilde{\tau}_i}^{\overline{\tau}} \frac{\theta_i \varphi \tau f(\tau)}{1 - F(\tilde{\tau}_i)} d\tau - w^*(\tilde{\tau}_i) + \delta V_i^y \right). \tag{73}$$

Hence, after some rearranging, condition (70) becomes:

$$\varphi \tilde{\tau}_i - \mu - \frac{w^*(\tilde{\tau}_i) - w_i^y + \delta \theta_i \int_{\tilde{\tau}_i}^{\overline{\tau}} (\varphi \tau - \mu) f(\tau) d\tau}{\theta_i [1 + \delta(1 - F(\tilde{\tau}_i))]} \geq 0. \tag{74}$$

The wage w_i^{**} offered by poachers (i.e. type-h firms) to managers from type-i firm with talent $\tau \in [\hat{\tau}_i, \tilde{\tau}_i]$ is determined by the following condition (from Bertrand competition):

$$\theta \int_{\hat{\tau}_i}^{\tilde{\tau}_i} \frac{\tau f(\tau) d\tau}{F(\tilde{\tau}_i) - F(\hat{\tau}_i)} - w_i^{**} + \delta V_h^y = V_h^y, \tag{75}$$

We use equations (64) and (65) to derive the wage for those managers who are poached (by h firms) in equilibrium:

$$w_i^{**} = \theta \left(\int_{\hat{\tau}_i}^{\tilde{\tau}_i} \frac{\tau f(\tau) d\tau}{F(\tilde{\tau}_i) - F(\hat{\tau}_i)} - \mu \right) + w_h^y - \delta \theta \int_{\tilde{\tau}_h}^{\overline{\tau}} (\varphi - 1) \tau f(\tau) d\tau. \tag{76}$$

From young managers' participation constraint, we obtain:

$$w_i^y = -\delta(1 - F(\tilde{\tau}_i))w^*(\tilde{\tau}_i) - \delta(F(\tilde{\tau}_i) - F(\hat{\tau}_i)) \max\{w_i^{**}, 0\}. \tag{77}$$

We now characterize the thresholds and wages offered by type-h firms only. From (74) and (68), the condition for a type-h firm becomes:

$$\varphi\tilde{\tau}_h - \frac{\int_{\tilde{\tau}_h}^{\overline{\tau}} \tau f(\tau)d\tau}{(1 - F(\tilde{\tau}_h))} \geq 0. \tag{78}$$

At $\widetilde{\tau}_h = 0$, this condition does not hold. If $\widetilde{\tau}_h = \overline{\tau}$, then we have $\varphi\overline{\tau} - \overline{\tau} > 0$ because $\varphi > 1$. Thus, by continuity, there is at least one threshold such this condition holds with equality. By the same arguments as in Proposition 2, the lowest of such thresholds is the unique equilibrium value for $\tilde{\tau}_h$. Note that $\tilde{\tau}_h$ is exactly the same as in the static case and depends only on φ and $F(.)$. In particular, $\tilde{\tau}_h$ is indepedent of $\{\hat{\tau}_l, \hat{\tau}_h\}$.

We now characterize the wages offered by h-firms when there is strictly positive poaching $\left(w_h^y, w_h^{**}, w^*(\tilde{\tau}_h)\right)$:

$$w_h^{**} = \theta\left(\int_{\widehat{\tau}_h}^{\widetilde{\tau}_h} \frac{\tau f(\tau)d\tau}{F(\tilde{\tau}_h) - F(\hat{\tau}_h)} - \mu\right) + w_h^y - \delta\theta\int_{\widetilde{\tau}_h}^{\overline{\tau}}(\varphi - 1)\tau f(\tau)d\tau \tag{79}$$

$$w^*(\tilde{\tau}_h) = \theta\left(\int_{\widetilde{\tau}_h}^{\overline{\tau}} \frac{\tau f(\tau)d\tau}{1 - F(\tilde{\tau}_h)} - \mu\right) + w_h^y - \delta\theta\int_{\widetilde{\tau}_h}^{\overline{\tau}}(\varphi - 1)\tau f(\tau)d\tau \tag{80}$$

$$w_h^y = -\delta(1 - F(\tilde{\tau}_h))w^*(\tilde{\tau}_h) - \delta(F(\tilde{\tau}_h) - F(\hat{\tau}_h))w_h^{**}. \tag{81}$$

We can express w_h^y as a function of thresholds $\{\tilde{\tau}_h, \hat{\tau}_h\}$

$$w_h^y = \frac{-\delta\theta\left(1 - F\left(\widehat{\tau}_h\right)\right)}{1 + \delta\left(1 - F\left(\widehat{\tau}_h\right)\right)}\left(\int_{\widehat{\tau}_h}^{\overline{\tau}} \frac{(\tau - \mu)f(\tau)}{\left(1 - F\left(\widehat{\tau}_h\right)\right)}d\tau - \delta\int_{\widetilde{\tau}_h}^{\overline{\tau}}(\varphi - 1)\tau f(\tau)d\tau\right), \tag{82}$$

which can be plugged into (79) and (80) to obtain w_h^{**} and $w^*(\tilde{\tau}_h)$ as a functions of $\tilde{\tau}_h$ and

$\widehat{\tau}_h$ only. At Date 4, a type-h firm with a vacancy has expected profit

$$V_h^y = \theta\mu - w_h^y + \delta V_h^o, \tag{83}$$

where V_h^o is given by (65). Solving for V_h^y, (after some algebra) we get

$$V_h^y = \frac{\theta\mu - w_h^y}{1-\delta} + \frac{\delta}{1-\delta}\int_{\widetilde{\tau}_h}^{\overline{\tau}} \theta(\varphi - 1)\tau f(\tau) d\tau. \tag{84}$$

A type-h firm with a vacancy announces threshold $\widehat{\tau}_h$; we assume that all players (i.e., firms and managers) share the same beliefs, on and off the equilibrium path, and beliefs are such that players expect incumbent firms to use threshold $\hat{\tau}_h$ if this threshold is announced. Given such beliefs, the announcement of $\widehat{\tau}_h$ pins down w_h^y as given by (82) (recall that $\widetilde{\tau}_h$ is uniquely determined by (78)). Note that a firm that announces $\hat{\tau}_h$ at period t has no incentives to deviate and play a different threshold $\hat{\tau}_h' \neq \hat{\tau}_h$ at period $t+1$, because at $t+1$ the firm is unable to retain any type below $\widetilde{\tau}_h$ and thus the firm is indifferent between any two thresholds $\hat{\tau}_h'$ and $\hat{\tau}_h$.

A type-h firm chooses $\hat{\tau}_h \in [0, \widetilde{\tau}_h]$ to maximize its expected profit (84). A solution exists because of continuity and the fact that $[0, \widetilde{\tau}_h]$ is a closed interval. The solution $\hat{\tau}_h$ is (generically) unique because the expected profit is differentiable with respect to $\hat{\tau}_h$ in the interior of $[0, \widetilde{\tau}_h]$.

Now that we have determined a (generically) unique set of equilibrium thresholds for h firms $\{\widehat{\tau}_h, \widetilde{\tau}_h\}$, we can find the equilibrium thresholds for l firms. For each $\widehat{\tau}_l$, define the function:

$$G_l(\tau; \widehat{\tau}_l) = \frac{\mu}{\varphi} + \frac{w^*(\tau) - w_l^y + \delta \int_\tau^{\overline{\tau}} (\varphi x - \mu) f(x)\, dx}{\varphi\left(1 + \delta(1 - F(\tau))\right)}, \tag{85}$$

with domain over $\tau \in [\widehat{\tau}_l, \overline{\tau}]$, where

$$w^*(\tau) = \max\left\{\theta\left(\int_{\tau}^{\overline{\tau}} \frac{xf(x)dx}{1-F(\tau)} - \mu\right) - \delta\theta \frac{\int_{\widehat{\tau}_h}^{\overline{\tau}}(x-\mu)f(x)dx + \int_{\widetilde{\tau}_h}^{\overline{\tau}}(\varphi-1)xf(x)dx}{1+\delta\left(1-F\left(\widehat{\tau}_h\right)\right)}, 0\right\} \tag{86}$$

$$w_l^{**} = \theta\left(\int_{\widehat{\tau}_l}^{\tau} \frac{xf(x)dx}{F(\tau)-F(\hat{\tau}_l)} - \mu\right) - \delta\theta \frac{\int_{\widehat{\tau}_h}^{\overline{\tau}}(x-\mu)f(x)dx + \int_{\widetilde{\tau}_h}^{\overline{\tau}}(\varphi-1)xf(x)dx}{1+\delta\left(1-F\left(\widehat{\tau}_h\right)\right)} \tag{87}$$

$$w_l^y = -\delta(1-F(\tau))w^*(\tau) - \delta(F(\tau)-F(\hat{\tau}_l))\max\{w_l^{**}, 0\}. \tag{88}$$

The existence of an equilibrium with retention for a given $\widehat{\tau}_l$ requires $\tau - G_l(\tau;\widehat{\tau}_l)$ to be non-negative for some τ. Because, $G_l(\tau;\widehat{\tau}_l)$ is continuous and $G_l(0;0) = \frac{\mu}{\varphi} + \frac{\delta_l\mu(\varphi-1)}{\varphi(1+\delta)} > 0$, at least one fixed point exists if and only if $\max_{\tau\in[0,\overline{\tau})} \tau - G_l(\tau;\widehat{\tau}_l) \geq 0$. As before, if this latter condition does not hold, then no type is retained by firm l in equilibrium, i.e., $\tilde{\tau}_l = \overline{\tau}$. If $\max_{\tau\in[0,\overline{\tau})} \tau - G_l(\tau) \geq 0$, this proves the existence of at least one threshold τ' such that $\tau' = G_l(\tau';\widehat{\tau}_l)$. Among all such τ', we define $\tilde{\tau}_l(\widehat{\tau}_l)$ as the lowest one. To show that this threshold is part of an equilibrium, notice that because $G_l(0;0) > 0$, unless $\tilde{\tau}_l = \overline{\tau}$, $\tau - G_l(\tau;\widehat{\tau}_l)$ crosses zero from below at $\tilde{\tau}_l$, which is also a necessary condition for an equilibrium. To show that no other $\tau' > \tilde{\tau}_l$ can be an equilibrium, we use the same argument as in the the proof of Proposition 2. Thus, $\tilde{\tau}_l(\widehat{\tau}_l)$ is uniquely determined given $\hat{\tau}_l$.

The final step is to determine $\hat{\tau}_l$. By announcing $\hat{\tau}_l$, under the assumption that players believe the announcement, a type-l firm determines a unique equilibrium retention threshold $\tilde{\tau}_l(\widehat{\tau}_l)$. Firm l thus chooses $\widehat{\tau}_l$ to maximize its expected profit and then the optimal $\widehat{\tau}_l$ is given by

$$\widehat{\tau}_l \in \arg\max_{x\in[0,\overline{\tau}]} V_l^y(x) = \frac{\mu - w_l^y + \delta\int_{\widetilde{\tau}_l}^{\overline{\tau}}(\varphi\tau - w^*(\widetilde{\tau}_l))f(\tau)d\tau}{(1-\delta_l)\left[1+\delta\left(1-F\left(\widetilde{\tau}_l\right)\right)\right]}, \tag{89}$$

subject to $\tilde{\tau}_l\left(x\right)$ and

$$w_l^y = -\delta\theta \int_x^{\overline{\tau}} \left(\tau-\mu\right) f(\tau) d\tau + \delta^2\theta(1-F(x)) \frac{\int_{\widehat{\tau}_h}^{\overline{\tau}} \left(\tau-\mu\right) f(\tau) d\tau + \int_{\widetilde{\tau}_h}^{\overline{\tau}} (\varphi-1)\tau f(\tau) d\tau}{1+\delta\left(1-F\left(\widehat{\tau}_h\right)\right)}. \tag{90}$$

From continuity, the solution to this problem is (generically) unique. This completes the characterization of the equilibrium. □