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Heski Bar-Isaac and Raphaël Levy

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Centre for Economic Policy Research
33 Great Sutton Street, London EC1V 0DX, UK
Tel: +44 (0)20 7183 8801
www.cepr.org

MOTIVATING EMPLOYEES THROUGH CAREER PATHS

Abstract

Firms have discretion over task allocations, which may dampen employees' career prospects, and, hence, motivation. Task assignments and worker motivation interact through the extent of labor market competition; that is, the possibility of moving to another firm. More competition enhances motivation but decreases firms' incentives to assign workers to informative tasks. One consequence is that competitive firms sometimes choose strategies that lead to intermediate competition. When the employee pool is heterogeneous, firms might choose different human resources practices that attract different kinds of workers, and differentiate themselves through the career opportunities within and beyond the firms that they offer.

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Heski Bar-Isaac - heski.bar-isaac@rotman.utoronto.ca
University of Toronto and CEPR

Raphaël Levy - levyr@hec.fr
HEC Paris

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Motivating employees through career paths*

Heski Bar-Isaac† Raphaël Lévy‡

June 26, 2019

Abstract

Firms have discretion over task allocations, which may dampen employees' career prospects, and, hence, motivation. Task assignments and worker motivation interact through the extent of labor market competition; that is, the possibility of moving to another firm. More competition enhances motivation but decreases firms' incentives to assign workers to informative tasks. One consequence is that competitive firms sometimes choose strategies that lead to intermediate competition. When the employee pool is heterogeneous, firms might choose different human resources practices that attract different kinds of workers, and differentiate themselves through the career opportunities within and beyond the firms that they offer.

1 Introduction

When evaluating different job offers, young graduates consider not only the salaries offered but also the career trajectories that these jobs bring. In fact, surveys suggest that career paths rank among the top five factors when considering a job opportunity.[1] Career

*We thank Matthew Bidwell, Pierre Chaigneau, Arijit Mukherjee, Matthew Mitchell and Hugo Hopenhayn, as well as audiences at CREST, Paris School of Economics, Humboldt University, Geneva School of Economics and Management, Queen's University, Rotman School of Management, at the MaCCI annual conference (Mannheim). Raphaël Lévy gratefully acknowledges the financial support form the Agence Nationale de la Recherche (ANR-11-IDEX-0003/Labex Ecodec/ANR-11-LABX-0047); Heski Bar-Isaac gratefully acknowledges financial support from SSHRC (435-2014-0004).

†University of Toronto. Email: heski.bar-isaac@rotman.utoronto.ca

‡HEC Paris. Email: levyr@hec.fr

[1] See for instance `https://content.linkedin.com/content/dam/business/talent-solutions/global/en_us/blog/2015/07/what-students-want-in-a-job.jpg` or `http://asia.fnst.org/content/top-5-things-graduates-look-their-first-job`

prospects are particularly relevant in professional services such as management consulting, investment banking and accounting, where firms often sell their jobs as springboards to a great career. For instance, Bidwell, Won, Barbulescu, and Mollick (2015) find that "students applying to investment banks consistently rated the extent to which the firm's reputation would help with future employability as the most important factor shaping their decisions." This preference for firms that enhance employability points to an intrinsic conflict between two major goals of human resources management: attracting and motivating talented workers on the one hand, and retaining them on the other hand. In the face of this dilemma, employers will often market themselves to potential recruits not only by describing potential careers within the firm, but also by underlining how they sponsor potential career development beyond the firm.[2]

Workers recognize that career trajectories reflect the evolution of their reputations in the labor market and, accordingly, will depend on the opportunities to develop and showcase their talents. These opportunities, however, are controlled by the employer, who decides on task assignments.[3] An efficient task assignment is critical for workers along two dimensions: first, *productive* efficiency requires that more-challenging tasks be performed by more-talented workers; second, these tasks are often more *informative* about the worker's talent. As a consequence, more-informative tasks are also valuable to the extent that they generate information about the worker, which improves the efficiency of future task allocations. In addition to these well-studied effects, one contribution of the paper is to emphasize how such learning, in turn, fosters career concerns incentives, which ultimately increase productive efficiency. Accordingly, part of the welfare gain arises from the enhanced worker motivation that an efficient task allocation yields.

We assume that workers undertake efforts that are non-contractable and are accordingly governed by career concerns incentives. As noted, we also assume that firms have

[2]As a prominent example, Bain & Company states at the beginning of its careers homepage: "We want our employees to thrive at Bain, regardless of what their future plans are. Our dedicated career teams provide guidance and support at all stages (...). Just two or three years with us will offer you incredible opportunities, both at Bain and beyond – from becoming a Bain partner to starting your own business, stepping into a senior role at a top tech company, joining a private equity firm or making a meaningful social impact at a nonprofit you love." See `https://www.bain.com/careers/`, accessed last on May 22, 2019.

[3]As McKenna and Maister (2010) point out, "Junior staff, by definition, are at the early stages of a career, and need one thing above all: the chance to develop and build their skills. How well skills are built depends upon (...) the work assignment system that decides what projects they get to work on" (page 221).

discretion over the nature of the work. Given this lack of commitment on both sides of the employment relationship, both parties will take costly short-run actions – effort for the worker or an assignment for the purpose of learning for an employer – only if they expect sufficient future rents.[4] In this context, labor market competition has a potentially ambiguous impact: although workers have stronger motivation when they are more likely to receive an outside job offer, they then worry that their employer might (inefficiently) assign tasks that deprive them of the opportunity to prove their value.

If follows that total welfare can be non-monotonic in the extent of labor market competition. In particular, welfare may be larger in a monopsony than in a competitive labor market. This happens when performance is a poor indicator of talent – that is, when effort incentives are relatively weak. In this case, the firm assigns the worker to an informative task only if it can privately appropriate enough of the returns from generating information, which is impossible when the labor market is perfectly competitive. Instead, when performance is a more reliable signal of talent – that is, when career concerns are stronger – welfare increases with labor market competition, as the higher worker efforts resulting from more competition outweigh the loss in the private value of experimentation.

In such an environment, we analyze how firms can set up human resources practices that respond to workers' career aspirations. Specifically, we allow firms to commit to the likelihood with which their employees receive outside offers and, hence, choose how much they expose themselves to labor market competition. For example, consulting firms can choose the extent to which junior associates work directly with clients or, instead, force all contact through the partner; they can also engage in more or less active outplacement policies;[5] technology firms can choose whether or not to allow their workers to spend time on open source projects (Lerner and Tirole, 2005; Blatter and Niedermayer, 2008) or, more generally, on individual research agendas (Stern, 2004); finally, firms can also directly impose non-compete clauses or other contractual limitations that give them some

[4] This is akin to the well-known argument that firms must earn sufficient returns to invest in general human capital training, following Becker (1962) (see Acemoglu and Pischke (1999) for a useful overview). Note that our model includes a career concerns aspect, so that assignment to the risky task (that generates valuable general information), in turn, provides complementary investment (effort) incentives for the workers that are productive in the current period and, therefore, firm-specific.

[5] In professional services that are often organized as partnerships, most labor contracts are *up-or-out*, meaning that juniors denied promotion to partnership must leave the firm. For such contracts to be acceptable, firms have to credibly commit to outplacing denied employees – i.e., to helping them land a high-quality job outside the firm.

monopsony power with respect to their employees. To the extent that it is easier to commit to such policies (indeed, some of these may be explicit contractual terms), they may imperfectly mitigate the lack of commitment on task allocation.

We assume that firms are ex ante competitive (they can affect the extent of outside competition only once employment relationships are formed), so, in equilibrium, firms choose the welfare-maximizing level of competition. When the pool of potential workers is heterogeneous, we show that ex-ante identical firms choose to offer different career trajectories to appeal to different types of workers when performance is a poor indicator of talent. In particular, by committing to allowing workers opportunities to leave, some firms can actually attract, hold on to, and motivate the most talented workers. Further, this equilibrium outcome features a "Matthew effect" (Merton, 1968), in that workers who enter the workforce with a better reputation obtain jobs that not only pay better, but also are more motivating and provide better opportunities for career advancement.

Finally, we relate our findings to the human resources practices set up by professional services firms. In particular, we discuss the "under-delegation problem" associated with task assignment, the importance of outplacement activities, and the evolution of career paths offered in this industry. The emergence of information technologies has dramatically changed the nature of tasks performed by junior associates from easy-to-measure tasks (collecting information in libraries or casebooks) to tasks (such as processing information) that may be harder to assess. In this context, our model predicts a switch from a regime where different firms offer similar career prospects to one where they offer differentiated career paths. This is consistent both with the tendency for some firms to abandon (partly or fully) up-or-out contracts, and with the fact that professional services firms have been differentiating and sustaining different human resources management cultures.

Our paper is related to a literature that focuses on learning in employment relationships (Holmström, 1999; Harris and Holmström, 1982) – in particular, studies in which the extent of learning can be manipulated through task assignments (MacDonald, 1982; Gibbons and Waldman, 1999a,b; Waldman, 2012; Pastorino, 2013).[6] As we do, Antonovics and Golan (2012) and Canidio and Legros (2017) stress that different jobs vary in the information they generate about ability, but rather focus on workers' incentives to learn

[6] Waldman (2017) presents an excellent introduction to this literature.

through their occupational choice.[7]

In these papers, the information that various tasks generate about workers is observed to the same extent by everyone on the labor market, so that rents accrue to workers. Another stream of the literature has focused, instead, on situations in which the information created on the job is private to the employer, which generates inefficiencies (Greenwald, 1986). As a response to asymmetric learning, employers may have strategic incentives to distort task assignments. For instance, in Waldman (1984), employers can decide to make their employees *visible* by offering them a promotion, which then acts as a signal. On the contrary, in Milgrom and Oster (1987), firms might deny promotions to some workers to keep them *invisible* so as to lower their rents. In a similar vein, Picariello (2018a,b) show that task allocation or promotion decisions are distorted because some tasks generate human capital that is *portable* to other firms, which hampers worker retention. Similar to these papers, our study allows firms to strategically choose the *visibility* of individual performance. However, we develop an approach whereby firms can choose the visibility of performance independently of the task chosen. Mukherjee (2008) and Bar-Isaac, Jewitt, and Leaver (2018) also endogenize the information observed by the labor market and consider a richer set of information structures. These papers feature match-specific ability, so that too little disclosure may impair efficient turnover. However, ability is not match-specific in our framework, and firms instead strategically design their disclosure policies to remedy their lack of commitment on task assignments.

Finally, our result that homogeneous firms may endogenously choose different human resources practices in equilibrium relates our paper to Bond (2017), who establishes that some firms decide to lock in their employees by choosing a technology that precludes external hiring, while others choose to keep an open access to the outside labor market.

The paper is organized as follows. We describe the model in Section 2, and study the impact of labor market competition on welfare in Section 3. In Section 4, we examine firms' human resources strategies when they can endogenously choose their exposure to labor market competition. Finally, in Section 5, we discuss the application of our model to professional services.

[7] In Canidio and Legros (2017), workers become entrepreneurs precisely to choose the tasks they perform and, in that way, learn efficiently.

2 Model

2.1 Setup

We consider a labor market with a mass 1 of risk-neutral workers and a mass $M >> 1$ of risk-neutral firms. Within firms, workers can be assigned one of two tasks: a routine task that generates a certain output s, and a risky task that yields a random output y_t. We assume that workers can produce the safe output s through self-employment, which implies that firms generate no surplus on the routine task. The output y_t produced by an employee performing the risky task at date t is given by

$$y_t = \theta + a_t + \varepsilon_t,$$

where θ is the (invariant) intrinsic productivity of the worker (his type); a_t is the effort that the worker puts in at date t; and ε_t is a noise term following a Normal distribution with zero mean and variance σ^2, where ε_t are i.i.d. across periods and orthogonal to θ. Effort involves a cost $C(a_t) = \frac{1}{2}a_t^2$ to workers and is non-contractable. Furthermore, we assume symmetric information on θ : both workers and employers believe at the outset that talent θ is Normally distributed with mean μ_1 and variance 1. Finally, we assume that wages in each period can be contingent neither on performance nor on task allocation, and must be paid upfront.

Given these three assumptions, our environment is similar to the career concerns setup pioneered by Holmström (1999), which we augment with a strategic task allocation problem. Importantly, the employer has discretion on task assignments – i.e., cannot commit to a task allocation policy. Therefore, our model features a two-sided commitment problem, on the worker side (effort) and on the firm side (task allocation).

We consider a two-period game where, in each period, firms allocate tasks to their employees. In such a repeated environment, the social value of the risky task features two dynamic components: first, it generates learning about the worker's talent, which improves the efficiency of future task allocations (the value of information is positive);[8]

[8] The risky task could, for example, be understood as granting the worker greater autonomy, which allows firms to learn about his ability. Alternatively, one may interpret the risky task as an exploration of new ideas or processes, and the safe task as an exploitation of well-known actions (see, e.g., Manso (2011)).

second, precisely because it conveys information about talent, the risky task induces career concerns incentives: workers are willing to exert efforts in order to jam the signal observed on performance, which also boosts welfare by increasing output.

2.2 Division of surplus

Given that firms are unable to commit to a task assignment policy and that workers are unable to commit to exerting effort, incentives depend on the *ex post* division of surplus between firms and workers. If the worker captures all the surplus, the firm does not benefit from any information generated, which may lead to inefficiently staffing the worker on the uninformative task; on the contrary, if the worker gets no surplus, his reputation has no value, which shuts down effort incentives.

For simplicity, we assume that either the firm or the worker has all the bargaining power *ex post*, but that there is *ex ante* uncertainty as to which party does. We let the parameter α denote the prior probability that a worker has bargaining power. Therefore, α is a reduced-form parameter that captures the extent of labor market competition. It it is easy to see how one could micro-found α as the likelihood that a worker currently employed at a firm is in the position of receiving an outside job offer in period 2. For instance, suppose that α measures the probability that competitors are able to observe the performance of a given firm's employee. Whenever they do, Bertrand competition on wages delivers all the expected surplus to the employee. However, if competing firms do not observe performance, they will never try to poach an employed worker due to a lemons problem. Indeed, if the current employer, who holds private information on the worker's past performance, does not match the outside offer, then it means that the offered wage must be too high.[9]

Two related remarks are in order. First, α governs the division of surplus in period 2, but not in period 1. That is, it measures the bargaining power of workers already employed. This captures the idea that, even if firms are ex ante competitive, monopsony power (e.g., barriers to exit) may arise within the employment relationship. Second, we

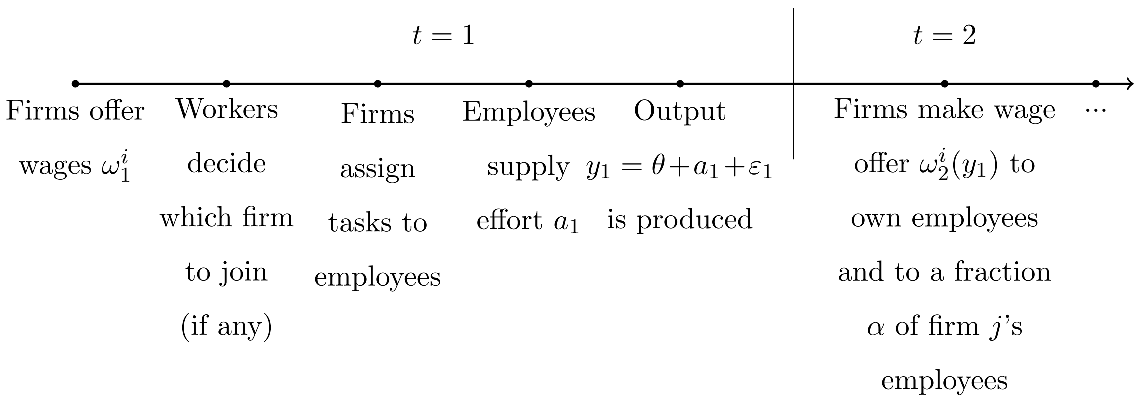
[9]See, for instance, Greenwald (1986). This extreme form of adverse selection is driven by the fact that the worker's talent has the same value in all firms. Thus, for simplicity, we abstract from learning about firm-specific capabilities, which is at the heart of the analysis of, e.g., Jovanovic (1979) and Felli and Harris (1996).

view α as having both an exogenous and an endogenous dimension: workers' performance may be intrinsically more or less observable, but firms can also decide to make it more or less visible. In the same spirit, different labor markets may vary in how competitive they are, but firms can still try to reduce turnover through active retention policies (e.g., non-compete clauses). Alternatively, they may provide training that is more or less firm-specific to impair or boost the market value of their employees.

In the next section, we first analyze the impact of α (treated as an exogenous parameter) on the equilibrium task allocation and welfare. We then explore how firms endogenously set α in Section 4.

3 Exogenous competition

Let us start by solving for the equilibrium effort and task allocation for an exogenous $\alpha \in [0, 1]$. The timing of events for this case is summarized as follows:



We solve the game backwards and first derive the equilibrium behavior in period 2. If the worker has executed the risky task in period 1 and has produced an output y_1, players believe at the outset of period 2 that θ is Normally distributed with mean μ_2 given by

$$\mu_2 = E(\theta|y_1) = \lambda\mu_1 + (1 - \lambda)(y_1 - a_1^*), \tag{1}$$

where $\lambda \equiv \frac{\sigma^2}{1+\sigma^2}$ is the noise-to-signal ratio and a_1^* is the equilibrium (expected) level of effort.

When facing the risky task in period 2, the worker never exerts effort ($a_2^* = 0$) because his wage has been paid upfront, so the surplus-maximizing policy is to allocate the risky task in period 2 if and only if $\mu_2 \geq s$. Therefore, the expected surplus to be split in period 2 is worth $E \max(\mu_2 - s, 0)$.

3.1 Career concerns incentives

We now turn to the effort choice in period 1. The worker obtains a share α of the future surplus, and his continuation expected payoff is, thus, given by:

$$s + \alpha E \max(\mu_2 - s, 0).$$

We derive the following lemma:

Lemma 1. *The equilibrium level of effort is given by*

$$a_1^* = \delta\alpha(1-\lambda)(1 - \Phi(\frac{s-\mu_1}{\sqrt{1-\lambda}})), \quad (2)$$

where Φ denotes the cdf of a Normal distribution with mean 0 and variance 1.

Proof. In the Appendix. □

As in Holmström (1999), effort incentives stem from the desire to influence employer beliefs about θ. Since more talent translates into a higher output, employers believe that employees who perform better are more talented, which, in turn, provides incentives to supply effort to increase the likelihood of higher outputs. In equilibrium, it is impossible to fool the market, but positive effort is still supplied.[10] a_1^* captures the marginal benefit of effort, which depends on the discount factor δ and on the sensitivity of future beliefs to current production $(1-\lambda)$, as in Holmström (1999). In addition, effort incentives here also depend on how likely it is that reputation matters, which is captured by two distinct variables: the probability α of having bargaining power tomorrow; and the probability that future beliefs are large enough to justify adoption of the risky task (reputation does not matter if the routine task is adopted).

Before turning to the task allocation problem in period 1, let

$$u_r(\alpha) \equiv \delta s + \delta\alpha E \max(\mu_2 - s, 0) - C(a_1^*) \quad (3)$$

denote the expected intertemporal utility (gross from his period 1 wage) that a worker derives from being assigned the risky task (the dependence on μ_1 is kept implicit). The next lemma shows that, conditional on being assigned the risky task, workers always benefit from being granted a larger share of future surplus.

[10] That it is impossible to actually influence employers' beliefs in equilibrium implies that the expected period 2 surplus $E\max(\mu_2 - s, 0)$ is independent of a_1^*.

Lemma 2. *$u_r(\alpha)$ is increasing in α*

Proof. In the Appendix. □

3.2 Task allocation in period 1

The firm gets a share $1-\alpha$ of the future expected surplus, so its expected profit (gross of the period 1 wage) from choosing the risky task in period 1 reads

$$\pi_r(\alpha) \equiv \mu_1 + a_1^* + \delta(1-\alpha)E\max(\mu_2 - s, 0), \tag{4}$$

whereas the profit from choosing the safe task is

$$\pi_s(\alpha) \equiv s + \delta(1-\alpha)\max(\mu_1 - s, 0). \tag{5}$$

Since the period 1 wage is sunk at the time when the firm allocates a task to the worker, the firm chooses the risky task if and only if

$$\pi_r(\alpha) \geq \pi_s(\alpha). \tag{6}$$

If $\mu_1 \geq s$, one easily checks that $\mu_1 + a_1^* + \delta(1-\alpha)E\max(\mu_2, s) \geq s + \delta(1-\alpha)\mu_1$. This is because $a_1^* \geq 0$ and $E\max(\mu_2, s) \geq \max(E(\mu_2), s) = \max(\mu_1, s) = \mu_1$, using Jensen's inequality. This implies that the firm chooses the risky task in period 1. Let us concentrate on the more interesting case $\mu_1 < s$, which implies that $\pi_s(\alpha) = s$, and examine the conditions under which a firm is willing to experiment – i.e., choose the risky task even though the routine task yields a higher static profit. We can now derive the equilibrium task allocation.

Proposition 1. *There exists a cutoff $\overline{\mu} < s$ such that a firm assigns the risky task if and only if $\mu_1 > \overline{\mu}$. $\overline{\mu}$ is increasing in λ. Finally, there exists a cutoff value $\lambda^* \in (0,1)$ such that: $\overline{\mu}$ is increasing in α if $\lambda > \lambda^*$; $\overline{\mu}$ is decreasing in α if $\lambda < \lambda^*$; and, $\overline{\mu}$ is independent of α if $\lambda = \lambda^*$.*

Proof. In the Appendix. □

A firm is less willing to experiment by choosing the risky task when λ increases. Indeed, an increase in λ means that performance is more volatile, hence less informative about talent. This *both* reduces incentives to exert effort and lowers the value of information. This unambiguously reduces the motive for learning. The impact of α is more nuanced. On the one hand, a higher

α boosts effort incentives but, on the other hand, reduces how much the firm privately benefits from the information that the risky task generates. The magnitude of these two countervailing effects depends on the value of λ. The former effect dominates (a higher α generates more experimentation) when λ is small (performance better reflects ability) – i.e., when career concerns incentives are strong – and the latter effect dominates when λ is large and career concerns are mild. Put differently, there is a complementarity between α and λ both in workers' and firms' incentives, but the complementarity in workers' incentives is relatively stronger when λ is small, and weaker when λ is large.

3.3 Welfare

The total welfare $W(\alpha)$ depends on the initial task assignment to the safe (s) or risky task (r) and can be written as follows:[11]

$$W(\alpha) = \begin{cases} W_s = (1+\delta)s & \text{if } \mu_1 < \overline{\mu}(\alpha) \\ W_r(\alpha) = \mu_1 + a_1^*(\alpha) + \delta E \max(\mu_2, s) - \frac{1}{2}a_1^*(\alpha)^2 & \text{if } \mu_1 \geq \overline{\mu}(\alpha) \end{cases}$$

Welfare is independent of α if the worker is assigned to the safe task. In addition, as long as $\delta \leq 1$, one has $a_1^*(\alpha) < 1$, which implies that $\frac{\partial W_r}{\partial \alpha} = (1 - a_1^*(\alpha))\frac{\partial a_1^*}{\partial \alpha} > 0$. Therefore, a higher α, by boosting effort, improves welfare as long as the risky task is chosen. Using this result and Proposition 1, it is immediate to derive the following Proposition.

Proposition 2. *α may have an ambiguous impact on welfare:*

1. *if $\mu_1 < \min(\overline{\mu}(0), \overline{\mu}(1))$, then the safe task is chosen for any α and total welfare does not depend on α;*

2. *if $\mu_1 > \max(\overline{\mu}(0), \overline{\mu}(1))$, then the risky task is chosen for any α, and total welfare increases in α;*

3. *otherwise, there exists $\alpha^* \in (0,1)$ such that $\overline{\mu}(\alpha^*) = \mu_1$; there are then two subcases:*

   (a) if $\lambda < \lambda^*$, $\overline{\mu}(\alpha)$ is decreasing: the risky task is chosen if and only if $\alpha > \alpha^*$. Then, welfare weakly increases with α;

[11] Since the main focus of the paper is on the role of α, we henceforth explicitly write the functions W, a_1^* and $\overline{\mu}$ as functions of α. For notational simplicity, however, we keep implicit the dependence of these functions on λ and the dependence of W on μ_1.

(b) if $\lambda > \lambda^*$, $\overline{\mu}(\alpha)$ is increasing: the risky task is chosen if and only if $\alpha < \alpha^*$. Then, welfare is single-peaked in α.

Figure 1 illustrates the result of Proposition 2 (the left panel corresponds to case 3a, the right panel to 3b). The figure depicts welfare and how it is split between employees and firms (abstracting from the wage paid to workers in period 1).[12]

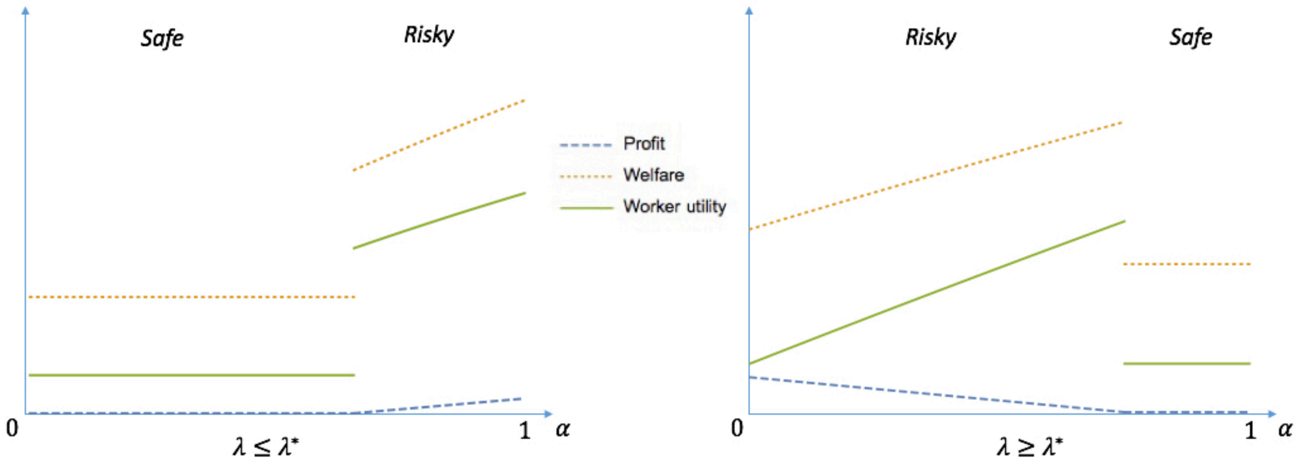


Figure 1: Expected welfare, profit and worker utility as a function of α.
Parameter specification: $s = 0.1, \delta = 0.99$ *(both panels);*
$\mu_1 = -0.15, \lambda = 0.3$ *(left panel);* $\mu_1 = -0.03, \lambda = 0.7$ *(right panel)*

In case 3b of Proposition 2, welfare is single-peaked in α, with a maximum attained at the value where a firm is exactly indifferent between both tasks. Because firms internalize only a fraction of the social value of the risky task, the risky task is thus strictly better from a welfare perspective at this point. This implies that an increase in α, by triggering a switch in the task allocation, generates a downward jump in welfare. In particular, one derives the following corollary:

Corollary 1. *If $\lambda > \lambda^*$ and $\overline{\mu}(0) < \mu_1 < \overline{\mu}(1)$, then $W(0) > W(1)$: Total surplus is larger with a monopsonistic firm than with competitive firms.*

Proof. In the Appendix. □

When performance is a poor indicator of talent, it is therefore better to give all bargaining power to firms than to workers. This shuts down effort incentives, but restores firms' incentives to assign the task that generates more surplus. An important normative implication of Proposition

[12]The profit curve is simply the difference between total welfare and workers' intertemporal utility.

2 and Corollary 1 is that public policies designed to foster competition, promote transparency, or reduce frictions in the labor market may actually backfire in environments in which performance is more volatile or more difficult to observe (high λ). In particular, this implies that no-poaching agreements may actually be warranted from a welfare perspective.[13]

3.4 Commitment benchmarks

Given the two-sided commitment problem, there are two sources of inefficiency: first, for a given task allocation policy of the employer, the employee's effort is inefficiently low; second, for a given effort, the employer assigns the routine task too often, as the firm can appropriate only a fraction of the value of information generated by the risky task. In this context, there are three benchmarks of interest: (a) when there is no commitment problem whatsoever – i.e., workers can commit to effort, and firms can commit to task allocations; (b) when workers can commit to effort, but firms cannot commit to task allocations; (c) when workers cannot commit to effort, but firms can commit to task allocations. In case (a), effort is set to maximize

$$E(\theta) + a - \frac{1}{2}a^2.$$

This implies that the efficient level of effort is

$$a^{FB} = 1.$$

Notice that $a_1^*(\alpha) < a^{FB} = 1$; that is, reputation provides incentives to supply positive effort, but the equilibrium level of effort is always below the first best.

The first best effort level is, thus, set independently of α. In turn, the risky task is optimal if and only if

$$\mu_1 + a^{FB} - \frac{1}{2}(a^{FB})^2 + \delta E \max(\mu_2, s) \geq (1 + \delta)s.$$

As one can see, this condition does not depend on α. Overall, α then simply affects the way that firms and workers share surplus across periods but has no efficiency impact.

[13] In the US in 2016, the FDC and the DoJ jointly published the "Antitrust guidance for human resources professionals," which explicitly stresses that the labor markets will be treated as any other market regarding antitrust matters. The EU has no specific labor market regulation, but anti-competitive practices in the labor market have been used as motivating elements of prosecution in recent cases (see, e.g., PVC floorings cartel case in France, see `http://www.autoritedelaconcurrence.fr/user/standard.php?id_rub=663&id_article=3044&lang=en`).

In case (b), the effort would be set at $a_1 = a_1^{FB}$ and the firm would allocate the risky task if

$$\mu_1 + a_1^{FB} + \delta(1-\alpha)E\max(\mu_2 - s, 0) \geq s;$$

that is, if α is small enough. Since α has no impact on effort, but may generate a switch in task allocation, welfare is non-increasing in α.

In case (c), the firm would commit to assigning the risky task as long as this is efficient – i.e., whenever

$$\mu_1 + a_1^*(\alpha) - \frac{1}{2}a_1^*(\alpha)^2 + \delta E\max(\mu_2, s) \geq (1+\delta)s.$$

The left-hand side is increasing in μ_1 and α, so this condition can be rewritten

$$\mu_1 \geq \mu^*(\alpha),$$

where $\mu^*(\alpha)$ is decreasing in α. This implies that a higher α, by increasing effort, makes experimentation more valuable and, hence, increases welfare.

Figure 2 illustrates the role of the ability to commit on task allocation. The figure depicts the regions in which the risky task is assigned with and without commitment on task allocation when effort is non-contractable, and hence, driven by career concerns.

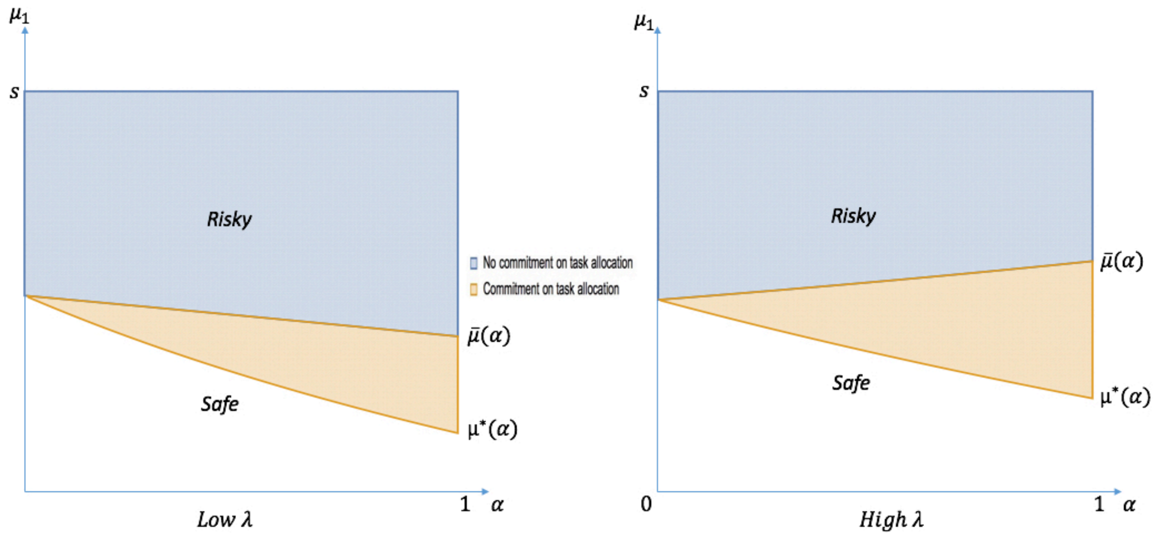


Figure 2: Task assignments with and without commitment on task allocation
Parameter specification: $\lambda = 0.2$ *(left panel);* $\lambda = 0.7$ *(right panel)*

It is easy to check that $\mu^*(\alpha) < \overline{\mu}(\alpha)$ for all α : since firms capture only a fraction of the future surplus created by experimentation, there is a set of reputations μ_1 for which the risky task would be efficient, but, nevertheless, firms pick the routine task. In Figure 2, this corresponds to the intermediate region where $\mu_1 \in (\mu^*(\alpha), \overline{\mu}(\alpha))$. This region – and hence, the inefficiency – expands with α.[14] This suggests that being able to commit to task allocations is valuable only when there is enough labor market competition. This result is consistent with the tendency of some professional service firms to specialize – that is, to narrow down the set of tasks that are performed in-house, which reduces discretion in task assignments. For instance, McKinsey typically outsources all of its presentations for business pitching to India.[15] Our model suggests that these policies may be an optimal way for firms to respond to increases in labor market competition.

4 Endogenous competition

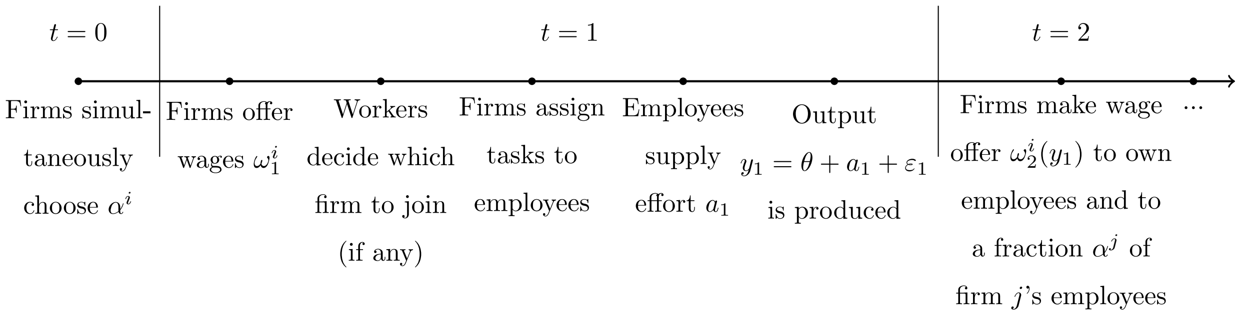
In this section, we examine how firms can strategically choose the extent to which they want to expose themselves to or insulate themselves from labor market competition. In line with our idea that firms can endogenously create monopsony power within the employment relationship, we assume that firms are competitive in period 1, but can, through their choice of α, design how much to lock in their own current employees (for instance, by managing exit opportunities or outplacement, by imposing non-compete clauses, by making employee performance more or less visible, and so on).

We assume that firms can commit at no cost to a given policy α^i, and that firms choose α^i non-cooperatively.[16] The timeline of the game with endogenous α is as follows.

[14]In particular, when $\lambda \geq \lambda^*$, an increase in α reduces the extent of experimentation ($\overline{\mu}(\alpha)$ increases), while more experimentation would be desirable ($\mu^*(\alpha)$ decreases). Notice that when $\alpha = 0$, the firm can appropriate the full social value of information, so that commitment does not matter.

[15]See `https://timesofindia.indiatimes.com/business/india-business/Now-its-offshoring-of-presentations/articleshow/856257.cms`

[16]Commitment power may come from reputational concerns that are not explicitly modeled here and may be more effective for these policies than harder-to-observe task allocation policies. Notice that the cooperative and non-cooperative solutions coincide here, as there are no externalities between firms. If a firm decides to let other firms make job offers to its own employees, it does not generate any value to competitors, since all the rents from competition would then accrue to workers. In this way, the level of competition chosen could also be interpreted as the cooperative outcome determined through, for example, a self-regulatory body.



Notice that, for the sake of concreteness, we assume that firms simultaneously choose their α in a first step, and then offer period 1 wages, but this assumption is actually irrelevant in our two-period model.[17]

Finally, we consider the case in which there exists at least a value of $\alpha \in [0, 1]$ such that $\mu_1 \geq \overline{\mu}(\alpha)$. Otherwise, no worker can ever be assigned to a risky task, so that firms' choices are inconsequential (in any case, firms generate no surplus and, thus, get zero profit). This implies that α^* – i.e., the degree of competition that maximizes welfare – is uniquely defined on $[0, 1]$. We derive the following Proposition:

Proposition 3. *The equilibrium is constrained-efficient: in equilibrium, some firms choose α^* and only firms that choose α^* are active – i.e., attract workers.*

Proof. In the Appendix. □

The intuition is as follows: to be attractive to workers, a firm must be able to credibly assign the risky task, which requires $\mu_1 \geq \overline{\mu}(\alpha)$. Once this is secured, worker utility is maximized when α is as high as possible (because u_r increases in α; see Lemma 2). Therefore, competition pushes firms to set the highest α consistent with $\mu_1 \geq \overline{\mu}(\alpha)$, which is precisely the one that maximizes total welfare $W(\alpha)$ – i.e., α^*.

4.1 Heterogeneous workers

The result that active firms all choose the same level of competition α^* reflects the fact that the welfare-maximizing degree of competition is the same for all workers, given that all workers are *ex ante* identical. In what follows, we relax this last assumption and assume that there are two types of workers who differ in their initial reputation. A fraction β of workers has initial

[17]Which timing assumption is appropriate depends on the interpretation one has in mind: if one views α as an organizational design decision, it makes sense to think of firms first designing the environment of the organization, and then setting wages; another version of the timing, where α and wages are offered simultaneously, better fits the interpretation of α as contractual terms such as non-compete clauses.

reputation μ_1^H, while the remaining $1-\beta$ start with reputation $\mu_1^L < \mu_1^H$. We make the two following assumptions:

Assumption 1: The type of a given worker is observable, and firms can make different wage offers to workers of different types.[18]

Assumption 2: α is determined at the firm level – i.e., firms cannot offer different α to workers of different types.

One interpretation is that μ_1 captures a worker's level of education, which determines his first wage offer.[19] In turn, α captures the career prospects that workers expect by joining the firm. These expectations reflect workers' perceptions regarding the firm's human resources practices – be these perceptions shaped by the observation of contracts already in place (e.g., wage-tenure profiles of existing employees, non-competes, etc.), or by the firm's reputation or managerial culture. In this context, the choice of α is driven not only by the desire to attract workers, but also by the pool of workers that a firm can attract.

As before, we restrict attention the interesting case in which there exists a value of α such that $\mu_1^L \geq \overline{\mu}(\alpha)$. Otherwise, a low type can never be assigned to a risky task, and is then irrelevant to firms, so we are back to the case of homogeneous workers for which equilibrium has been described in Proposition 3.

Proposition 4. *There are two cases:*

Case 1: $\lambda > \lambda^*$ *and* $\overline{\mu}(0) < \mu_1^L < \overline{\mu}(1)$.

In this case, $\alpha_L^* < \alpha_H^* \leq 1$. *In equilibrium, some firms choose* α_L^*, *and attract only L-workers; some firms choose* α_H^*, *and attract only H-workers. Firms that offer* $\alpha \notin \{\alpha_L^*, \alpha_H^*\}$ *are inactive.*

Case 2: $\lambda < \lambda^*$ *or* $\lambda > \lambda^*$ *and* $\mu_1^L > \overline{\mu}(1)$.

In this case, $\alpha_L^* = \alpha_H^* = 1$. *In equilibrium, some firms choose* $\alpha = 1$ *and only firms that choose* $\alpha = 1$ *are active.*

In each of the two cases, the equilibrium is constrained-efficient, in that each type of worker joins a firm that, in equilibrium, offers the level of α that maximizes welfare given his type.

[18] That wage offers can be contingent on the reputation of an individual worker was already implicit in the above analysis, as, in period 2, workers receive offers that depend on their individual performance in period 1.

[19] In a related analysis, DeVaro and Waldman (2012) allow for ex-ante observably heterogeneous workers. They argue and show empirically that promotion decisions (which firms cannot commit to in advance) depend on a worker's type.

However, Proposition 4 yields the additional prediction that firms differentiate when performance is a poor indicator of talent. The intuition is as follows: a firm always creates more surplus to workers when α increases, *as long as the worker is assigned the risky task.* In the case in which $\lambda \leq \lambda^*$, increasing α increases the extent of experimentation (i.e., the range of worker reputations to whom the risky task is assigned), so a higher α unambiguously raises a firm's attractiveness to all types of workers. The choice of α here is akin to a choice of quality: all firms should make the same choice of maximizing quality, which results in a Bertrand-like equilibrium.

However, in the case $\lambda > \lambda^*$, increasing α decreases the extent of experimentation, so increasing α has an ambiguous effect: a higher α creates more surplus for workers but may result in the exclusion of low-quality workers, as the firm cannot commit not to assigning them the routine task were they to accept a job offer. In particular, when the choice of α determines whether or not low-quality workers can be attracted – that is, when $\overline{\mu}(0) < \mu_1^L < \overline{\mu}(1)$ – the choice of α is akin to a location choice, and the equilibrium is such that firms differentiate by focusing on different segments of the market.

Notice that our differentiation result rests on the assumption that α is chosen at the firm level and cannot be made contingent on the worker's education level (Assumption 2). It would be possible to assume that firms can offer different α to different workers (e.g., contractual clauses), in which case Proposition 3 would immediately extend: the market would consist of a collection of distinct homogeneous markets, with each firm offering each type of worker his efficient α. Thus, an interpretation of the result of Proposition 4 is that, whenever there are constraints that make it costly for firms to offer different career prospects to different kinds of workers, we should expect firms to endogenously differentiate. Thinking of α as corporate culture, different firms would then develop and sustain different cultures with different career paths offered to employees.

Proposition 4 yields important empirical predictions regarding differences across industries: in industries in which performance is highly informative about talent ($\lambda < \lambda^*$), firms are undifferentiated, in that the pool of employees hired by different firms looks similar. Accordingly, firms should have similar levels of output per worker. On the contrary, in industries in which performance is a relatively poor indicator of talent ($\lambda > \lambda^*$), firms are differentiated in their pool of workers: some only attract good workers, and others only bad workers. In this case, we should expect important variations in wage-experience profiles *across* firms, but relatively less across workers in the same firm. In such markets, firms are also expected to differ in terms of output per worker. Note that firms that attract the best talents produce more not only because of their employees' higher innate ability, but also because it is easier to provide better workers with career concerns incentives, which lead to more effort and, hence, higher production. Specifically, low-ability workers are punished three times: first, because they are endowed with lower expected ability; second, because this lower ability generates lower incentives to supply effort ($\frac{\partial a_1^*}{\partial \mu_1} > 0$) – hence a lower surplus;[20] and third, because low-ability workers are facing reduced opportunities to prove themselves, as firms' lack of commitment on task allocation limits the possibilities for steep career paths, which, again, lowers effort and surplus. This "triple jeopardy" is reminiscent of the Matthew effect (Merton, 1968).

5 Discussion: professional service firms

As we suggest in the introduction, a natural application of our model is to professional service firms. Human capital is the main asset of such firms, and talent management is key: in one of the leading practitioner books on professional services firms, Maister (2012) suggests that "the ability to attract, develop, retain and deploy staff will be the single biggest determinant of a professional service firm's success" (p.189). Moreover, in their recruitment activities, such firms stress that jobs are stepping stones to broader careers. That is, such jobs provide opportunities for workers to prove their capabilities, particularly since performance can be hard to measure explicitly and to contract on. Thus, career concerns play an important role in providing incentives and, hence, in attracting workers. At the same time, these firms rely on development opportunities that arise through staffing decisions. One relevant interpretation of staffing in the context of professional services is the extent of autonomy granted to junior associates.[21] Autonomy is costly since juniors may be underqualified, but it also creates an upside risk, in that it allows workers to prove themselves, which potentially benefits both workers and firms. In practice, Maister (2012) points to massive inefficiencies in staffing. In particular, he estimates that partners spend up to 50% of their time on tasks that could be performed by juniors, and views this "underdelegation problem" as the key management challenge for professional service firms.[22] This suggests that discretion on task allocation is a major issue for those firms, and that they should thus strive

[20]In our model, returns to effort are increasing with reputation because the talent-intensive task is assigned to workers with higher reputations only. This property is general in such a two-period model with task assignments, as Martinez (2009) shows.

[21]Von Nordenflycht (2010), for instance, stresses that professionals have a strong preference for autonomy, which notably makes retention ("cat herding") particularly difficult.

[22]Relatedly, Maister (2012) writes elsewhere: "There is a reluctance to invest in the coaching and supervision time necessary to achieve successful delegation. ... This is the old Catch-22. Using the junior person on "this one" is more costly because we haven't previously trained him or her, so we end up not training the person on this one either. Thus firms tend to underinvest in good coaching." (p.44)

to design strategies that deal with this commitment problem.

In this respect, the results of Sections 3 and 4 are consistent with labor market strategies set by professional service firms. On the one hand, most professions are self-regulated through professional organizations, which have a tendency to tame competition (often in the name of preserving the trustworthiness of the profession). This can take the form of barriers to entry (formal or not), implicit agreement not to solicit clients, or poach from competitors, or compete on prices, etc. (Von Nordenflycht, 2010). Corollary 1 suggests that such entry barriers or limits to competition set by professional organizations may actually be warranted from a social welfare perspective.

On other dimensions, professional service firms seem to promote some competition – through outplacement activities for example.[23] As Maister (2012) points out, management of exit opportunities is a key strategic lever to attract and to motivate workers: "A firm that is truly committed to (and actively works at) placing its 'alumni' (not passed-over partnership candidates) in good positions can respond to the career progress needs of all of its juniors, and thereby create a highly motivational atmosphere" (p.173). Overall, firms seem to promote an intermediate level of competition, and notably concede some bargaining power to workers in order to boost their motivation, consistent with our analysis.

Independently of the level of competition that firms choose, the result of Proposition 4 provides an additional prediction on the degree of differentiation between firms. Specifically, the model predicts that firms offer differentiated (resp. undifferentiated) career paths in environments in which performance is a poor (resp. good) indicator of talent. In line with this prediction, there has been a noteworthy evolution in the prevalence of up-or-out contracts. While this contract form used to be almost universal in professional services, there is now evidence that many firms have partly or fully abandoned this system.[24] For instance, Morris and Pinnington (1998) show that two thirds of U.K. law firms no longer use up-or-out contracts. In line with our result that better workers are offered "steeper" career paths, they also show evidence that firms that still resort to up-or-out contracts are typically larger and more successful.

In the management consulting industry, there is also anecdotal evidence that the extent of differentiation has increased over time. In a history of consulting, McKenna (2006) writes about the 1960s: "Paralleling economist Harold Hotelling's famous description of ice cream vendors

[23]In an *up-or-out* system where a tiny fraction of associates will end up promoted as partners, firms must somehow find ways to commit to enhancing the market value of all their junior associates.

[24]For instance, non-partner permanent positions, which were inconceivable a few decades ago, have been expanding a great deal (Malos and Campion, 1995; Galanter and Henderson, 2008; Malhotra, Morris, and Smets, 2010).

crowding each other on the beach, the elite consulting firms not only closely imitated each other in their range of services but also clustered together in their choice of office location" (pp. 152-3). By contrast, there is evidence of some differentiation today. As Hansen, Nohria, and Tierney (1999) document, some firms (e.g., Ernst&Young, Andersen Consulting) have specialized in addressing routine problems by reusing codified knowledge in a more standardized way, while others (e.g., McKinsey, Bain) have specialized in "out-of-the-box" problem solving. Specializing in high-level strategic problems can, in effect, provide a firm with some commitment power to staff consultants on non-routine tasks that allow them to showcase their skills, thus allowing them to attract the most talented employees. In addition, firms with different human resources cultures coexist on the market, as underlined by Broderick (2010): "The career development process varies significantly across firms and (...) is driven by values and culture. At one end of the spectrum are the "sink or swim" firms (...) that see little or no need to spend dollars on development. (...) At the other end of the spectrum are the firms that take the nurturing and development of their people very seriously. These are the firms that consistently recruit the top students in the class or the best industry and service experts in their fields. These are also the businesses with the highest retention rate of top performers and the highest scores on all the "Best Places to Work" charts" (p.47). Thus, in line with our results, firms seem to strategically sustain different cultures in terms of the career profiles they offer their employees: firm that provide workers with opportunities to move on are able to consistently attract and motivate the best talent.

In light of our results, one interpretation of this evolution is that the emergence of information and communication technologies has changed the nature of the tasks performed by juniors. Juniors at law firms typically used to spend significant amounts of time collecting information from casebooks or libraries, a task for which performance is relatively easy to measure. With the Internet and online databases, juniors are now mostly processing this information. In the context of our model, the Internet revolution could be understood as making it more difficult to assess workers abilities—an increase in λ. In line with this evolution, our model predicts that such an increase in λ may trigger a switch from a regime in which firms offer similar career paths to one in which they differentiate. Looking forward, there has been considerable discussion of the future impact of artificial intelligence and automation (Agrawal, Gans, and Goldfarb, 2018; Autor, 2015; Frey and Osborne, 2017; Susskind and Susskind, 2015).[25]As Autor (2015) suggests, computers might "substitute for workers in performing routine, codifiable tasks while amplifying

[25]See also "What the Future of Work Will Mean for Jobs, Skills and Wages," McKinsey Global Institute, 2017.

the comparative advantage of workers in supplying problem-solving skills, adaptability, and creativity." According to the discussion in Section 4, this suggests that the ongoing differentiation in the professional services industry is likely be a structural and long-lasting phenomenon.

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6 Appendix

6.1 Proof of Lemma 1

Denoting $z_1 \equiv \theta + \varepsilon_1$, and noting that z_1 is Normal with mean μ_1 and variance $1 + \sigma^2 = \frac{1}{1-\lambda}$, the worker, if engaged in the risky task, faces the following problem in period 1:

$$a_1^* \in \arg\max_{a_1}$$

$$\delta\left(s + \alpha\int_{\frac{s-\lambda\mu_1}{1-\lambda}-(a_1-a_1^*)}^{+\infty}(\lambda\mu_1 + (1-\lambda)(z_1 + a_1 - a_1^*) - s)\sqrt{\frac{1-\lambda}{2\pi}}e^{-\frac{1-\lambda}{2}(z_1-\mu_1)^2}\,dz_1\right) - \frac{1}{2}a_1^2. \quad (7)$$

Differentiating with respect to a_1 and taking $a_1 = a_1^*$ yields

$$a_1^* = \delta\alpha(1-\lambda)\int_{\frac{s-\lambda\mu_1}{1-\lambda}}^{+\infty}\sqrt{\frac{1-\lambda}{2\pi}}e^{-\frac{1-\lambda}{2}(z_1-\mu_1)^2}\,dz_1.$$

Finally, changing variables in the integral, we can rewrite

$$a_1^* = \delta\alpha(1-\lambda)(1 - \Phi(\frac{s-\mu_1}{\sqrt{1-\lambda}})),$$

where Φ denotes the cdf of a Normal distribution with mean 0 and variance 1.

One should check the second-order condition. Differentiating (7) twice yields

$$\delta\alpha(1-\lambda)\sqrt{\frac{1-\lambda}{2\pi}}e^{-\frac{1-\lambda}{2}(\frac{s-\lambda\mu_1}{1-\lambda}-(a_1-a_1^*)-\mu_1)^2} - 1$$

$$< \delta\alpha(1-\lambda)\sqrt{\frac{1-\lambda}{2\pi}} - 1$$

$$< 0 \text{ for all } (\delta, \lambda, \alpha) \in (0,1)^3.$$

6.2 Proof of Lemma 2

Denoting $X \equiv \frac{s-\mu_1}{\sqrt{1-\lambda}}$, one can rewrite

$$a_1^* = \delta\alpha(1-\lambda)\left(1-\Phi(X)\right). \tag{8}$$

Since in equilibrium $\mu_2 = \lambda\mu_1 + (1-\lambda)(\theta+\varepsilon_1)$, we derive that $\mu_2 \sim \mathcal{N}(\mu_1, \sqrt{1-\lambda})$. This implies that the continuation surplus when the risky task is undertaken can be rewritten, changing variables in the integral,

$$\begin{aligned} E\max\left(\mu_2 - s, 0\right) &= \int_s^{+\infty} \frac{1}{\sqrt{2\pi(1-\lambda)}}(\mu_2 - s)e^{-\frac{(\mu_2-\mu_1)^2}{2(1-\lambda)}}\, d\mu_2 \\ &= \int_{\frac{s-\mu_1}{\sqrt{1-\lambda}}}^{+\infty} \frac{1}{\sqrt{2\pi}}(\sqrt{1-\lambda}\mu + \mu_1 - s)e^{-\frac{\mu^2}{2}}\, d\mu \\ &= \sqrt{1-\lambda}\left(\varphi(X) - X(1-\Phi(X))\right), \end{aligned} \tag{9}$$

where $\varphi(.)$ denote the density of a Normal distribution with mean 0 and standard deviation 1.

Recalling that $u_r(\alpha) = \delta s + \delta\alpha E\max\left(\mu_2 - s, 0\right) - \frac{1}{2}a_1^{*2}$, and using (9) and (8), we derive

$$\frac{\partial u_r}{\partial \alpha} = \delta\sqrt{1-\lambda}\left(\varphi(X) - X(1-\Phi(X))\right) - \delta^2\alpha(1-\lambda)^2(1-\Phi(X))^2.$$

This has the sign of

$$\varphi(X) - X(1-\Phi(X)) - \delta\alpha(1-\lambda)\sqrt{1-\lambda}(1-\Phi(X))^2$$

$$> \varphi(X) - X(1-\Phi(X)) - (1-\Phi(X))^2 \text{ for all } (\delta, \alpha, \lambda) \in (0,1)^3.$$

To prove the Lemma, let us now show that

$$\varphi(X) - X(1-\Phi(X)) - (1-\Phi(X))^2 > 0 \text{ for all } X.$$

The derivative of this function is $(1-\Phi(X))(2\varphi(X)-1) < 0$, using the fact that $\varphi(X) < \frac{1}{\sqrt{2\pi}} < \frac{1}{2}$ for all X.

One can rewrite the function as follows:

$$-(1-\Phi(X))\left(1-\Phi(X)+X-\frac{\varphi(X)}{1-\Phi(X)}\right).$$

The hazard rate $\frac{\varphi(X)}{1-\Phi(X)}$ behaves like X when $X \to \infty$ (using L'Hopital's rule), so the function tends to 0 when $X \to \infty$. This implies that it is always positive.

We conclude that

$$\frac{\partial u_r}{\partial \alpha} > 0.$$

6.3 Proof of Proposition 1

When $\mu_1 < s$, $\pi_r(\alpha) \geq \pi_s(\alpha)$ reads

$$\mu_1 + \delta\alpha(1-\lambda)(1-\Phi(X)) + \delta(1-\alpha)\sqrt{1-\lambda}\,(\varphi(X) - X(1-\Phi(X))) \geq s$$

$$\Leftrightarrow -X + \delta\left((\alpha\sqrt{1-\lambda} - (1-\alpha)X)(1-\Phi(X)) + (1-\alpha)\varphi(X)\right) \geq 0. \tag{10}$$

Let

$$H(X,\alpha,\lambda) \equiv -X + \delta\left((\alpha\sqrt{1-\lambda} - (1-\alpha)X)(1-\Phi(X)) + (1-\alpha)\varphi(X)\right). \tag{11}$$

It is easy to check that:[26]

$$H_1(X,\alpha,\lambda) = -1 - \delta\left((1-\alpha)((1-\Phi(X)) + \alpha\sqrt{1-\lambda}\varphi(X)\right) < 0$$

and that

$$H_3(X,\alpha,\lambda) = -\frac{\delta\alpha}{2\sqrt{1-\lambda}} < 0.$$

In addition, one checks that $H(0,\alpha,\lambda) > 0$ for all α and λ, and one derives $H(1,\alpha,\lambda) < H(1,\alpha,0) = \delta\left((2\alpha-1)(1-\Phi(1)) + (1-\alpha)\varphi(1)\right) - 1 \approx \delta(0.06\alpha + 0.09) - 1 < 0$ for all $(\delta,\alpha) \in (0,1)^2$.

We conclude that there exists a unique $X^* \in (0,1)$ such that $H(X^*,\alpha,\lambda) = 0$. Accordingly, the firm allocates the risky task if and only if $\mu_1 > \overline{\mu}$, where $\overline{\mu} = s - \sqrt{1-\lambda}X^* < s$.

[26] Subscript i refers to the partial derivative with respect to the i^{th} variable.

By the implicit function theorem, one has

$$\frac{\partial X^*}{\partial \lambda} = -\frac{H_3(X^*, \alpha, \lambda)}{H_1(X^*, \alpha, \lambda)} < 0.$$

This implies that

$$\frac{\partial \overline{\mu}}{\partial \lambda} = \frac{1}{2\sqrt{1-\lambda}} X^* - \sqrt{1-\lambda}\frac{\partial X^*}{\partial \lambda} > 0.$$

Using, again, the implicit function theorem, one has

$$\frac{\partial X^*}{\partial \alpha} = -\frac{H_2(X^*, \alpha, \lambda)}{H_1(X^*, \alpha, \lambda)},$$

which has the sign of

$$H_2(X^*, \alpha, \lambda) = \delta \left((\sqrt{1-\lambda} + X^*)(1 - \Phi(X^*)) - \varphi(X^*) \right),$$

which itself has the same sign as

$$h(\alpha, \lambda) \equiv \sqrt{1-\lambda} + g(X^*),$$

where $g(X) \equiv X - \frac{\varphi(X)}{1-\Phi(X)}$.

We will make use of the following lemma:

Lemma 3. *For all* $X \in [0, 1]$, $g'(X) > 0$ *and* $g(X) \in (-1, 0)$.

Lemma 3 can be proven easily by remarking that g is concave (the hazard rate of the Normal distribution $\frac{\varphi}{1-\Phi}$ is convex), and by using the property (already used) that $\frac{\varphi(X)}{1-\Phi(X)}$ behaves like X when $X \to \infty$ (using L'Hopital's rule).

Given $X^* \in (0, 1)$ and $\frac{\partial X^*}{\partial \lambda} < 0$, the lemma implies that, for any value of α, $\sqrt{1-\lambda} + g(X^*)$ is decreasing in λ, positive at $\lambda = 0$ and negative at $\lambda = 1$.

Therefore, for any α, there exists a $\lambda^*(\alpha)$ such that $h(\alpha, \lambda^*(\alpha)) = 0$.

We now show that $\lambda^*(\alpha)$ does not depend on α. Differentiating $h(\alpha, \lambda^*(\alpha)) = 0$ with respect to α, one gets

$$h_2(\alpha, \lambda^*)\frac{\partial \lambda^*}{\partial \alpha}(\alpha) + h_1(\alpha, \lambda^*) = 0.$$

One has $h_1(\alpha, \lambda^*) = g'(X^*(\alpha, \lambda^*))\frac{\partial X^*}{\partial \alpha}(\alpha, \lambda^*)$. But by definition of λ^*, we have $\frac{\partial X^*}{\partial \alpha}(\alpha, \lambda^*) = 0$. Since $h_2 < 0$, we conclude that $\frac{\partial \lambda^*}{\partial \alpha}(\alpha) = 0$. Therefore, λ^* is independent of α.

Finally, we conclude that, for any α, $\frac{\partial X^*}{\partial \alpha} > 0$ if and only if $\lambda < \lambda^*$.

Given that $X^* = \frac{s-\overline{\mu}}{\sqrt{1-\lambda}}$, for any α, $\frac{\partial \overline{\mu}}{\partial \alpha} > 0$ if and only if $\lambda > \lambda^*$.

□

6.4 Proof of Corollary 1

$\overline{\mu}(0) < \mu_1$ implies that $W(0) = W_r(0) = \mu_1 + \delta E \max(\mu_2, s)$, using $a_1^* = 0$ at $\alpha = 0$. In turn, $\mu_1 < \overline{\mu}(1)$ implies that $W(1) = W_s = (1+\delta)s$.

By definition, $\overline{\mu}(0)$ is such that $\overline{\mu}(0) + \delta E \max(\mu_2 - s, 0) = s$. We derive:

$$\begin{aligned} W(0) - W(1) &= \mu_1 + \delta E \max(\mu_2, s) - (1+\delta)s \\ &> \overline{\mu}(0) + \delta E \max(\mu_2 - s, 0) - s \\ &= 0. \end{aligned}$$

6.5 Proof of Proposition 3

The proof is a direct consequence of Lemma 2, which states that workers have a higher surplus in firms with higher α as long as the risky task is assigned to them.

Suppose that no firm offers $\alpha = \alpha^*$. If all firms choose $\alpha > \alpha^*$, then it must be the case that $\alpha^* < 1$; that is, we are in the case $\lambda > \lambda^*$. In that case, a firm that offers $\alpha > \alpha^*$ attracts no workers, as workers anticipate that they would be assigned the routine task if they were to join the firm. Therefore, a firm could profitably deviate to some $\alpha \leq \alpha^*$ that gives positive profits.

Thus, there must be some firms choosing $\alpha < \alpha^*$. Let $\alpha_0 = \sup\{\alpha, \alpha < \alpha^*\}$. In addition, there must be some firms that make zero profit. Indeed, either $\alpha = \alpha_0$ for all firms, and, therefore, firms must concede all rents to workers, or some firms choose $\alpha < \alpha_0$ (or $\alpha > \alpha^*$) and thus cannot attract any worker. A firm that makes zero profit could deviate and secure a positive profit by choosing $\alpha = \alpha^*$. Indeed, it can then offer a wage $\omega = W(\alpha_0) - u_r(\alpha^*)$. First, this allows to attract all workers, as workers can obtain at most $W(\alpha_0)$ – i.e., the entire surplus – by going to a α_0 firm. In addition, the profit that firm 1 derives reads $\pi_r(\alpha^*) - \omega = W(\alpha^*) - u_r(\alpha^*) - \omega = W(\alpha^*) - W(\alpha_0) > 0$.

Therefore, in equilibrium, at least one firm chooses $\alpha = \alpha^*$. Some firms may choose $\alpha \neq \alpha^*$ in equilibrium, but then will attract no workers.

6.6 Proof of Proposition 4

Let us first remark that, if $\lambda < \lambda^*$, we have $\alpha_L^* = \alpha_H^* = 1$. If $\lambda \geq \lambda^*$, it is easy to see, using that $\overline{\mu}(\alpha)$ is increasing, that we either have $\alpha_L^* = \alpha_H^* = 1$ or $\alpha_L^* < \alpha_H^* \leq 1$.

To accommodate worker heterogeneity, let us twist the notation and denote welfare and utility as $W(\mu_1, \alpha)$ and $u_r(\mu_1, \alpha)$, where $\mu_1 \in \left\{\mu_1^L, \mu_1^H\right\}$.

Suppose first that $\alpha_L^* = \alpha_H^* = 1$. In that case, at least one firm must choose $\alpha = 1$, exactly as in the proof of Proposition 3.

Suppose that $\alpha_L^* < \alpha_H^*$. For the same reasons as above, it is impossible that neither α_L^* nor α_H^* are offered in equilibrium.

Suppose now that α_L^* is offered by some firms in equilibrium, but not α_H^*. Let $\alpha_1 = \sup\left\{\alpha, \alpha < \alpha_H^*\right\}$. There must be firms making zero profits (either those that offer an α different from α_L^* and α_1 if there are some, or firms that pool on α_L^* or α_1). For those firms, it would be profitable to set α_H^*. By offering $\omega^H = W(\mu_1^H, \alpha_1) - u_r(\mu_1^H, \alpha_H^*)$ to H-workers, they would attract all of them, and make positive profits.

Suppose finally that α_H^* is offered by some firms in equilibrium, but not α_L^*. Let $\alpha_2 = \sup\left\{\alpha, \alpha < \alpha_H^*\right\}$. Firms that make no profits in equilibrium (as before, there must be some) could benefit from deviating to α_L^*. By offering $\omega^L = W(\mu_1^L, \alpha_2) - u_r(\mu_1^L, \alpha_L^*)$ to L-workers, they would attract all of them, and make positive profits.