WORKING PAPER NO. 546

Organizational Design with Portable Skills

Luca Picariello

October 2019

University of Naples Federico II | University of Salerno | Bocconi University, Milan

CSEF - Centre for Studies in Economics and Finance
DEPARTMENT OF ECONOMICS – UNIVERSITY OF NAPLES
80126 NAPLES - ITALY
Tel. and fax +39 081 675372 – e-mail: csef@unina.it
ISSN: 2240-9696

WORKING PAPER NO. 546

Organizational Design with Portable Skills

Luca Picariello*

Abstract

Workers can move across firms and carry along portable human capital. I present a model where workers' talent is observable but task allocation is non-contractible. To reduce mobility firms may inefficiently match workers with tasks that reduce their outside option. I show that by organizing the firm as an equity-partnership, the efficient task allocation can be implemented and profits increase. This result is attained by shifting control rights to workers who become partners, decide over task allocation and earn dividends as compensation. This provides a new rationale for the widespread presence of firms organized as partnerships in human-capital intensive industries.

JEL Classification: D86, J24, J54, M52.

Keywords: Task Allocation, Retention, Control Rights, Partnerships

Acknowledgement: I thank Eirik Gaard Kristiansen for his outstanding supervision and for many motivating discussions. I am grateful to Ricardo Alonso, Charles Angelucci, Malin Arve, Heski Bar-Isaac, Alberto Bennardo, Alessandro Bonatti, Chiara Canta, Antonio Dalla Zuanna, Wouter Dessein, Tore Ellingsen, Robert Gibbons, Maria Guadalupe, Ola Kval_y, Gabriele Lattanzio, Jin Li, Rocco Macchiavello, Trond Olsen, Marco Pagano, Salvatore Piccolo, Andrea Prat, Marko Tervi o as well as the participants to the Midwest Economic Theory Meeting, Young Economists' Meeting, EEA-ESEM Congress, Royal Economic Society Symposium of Junior Researchers, and to seminars at Columbia Business School, Rotman Business School, NHH, CSEF (University of Naples Federico II) for their comments. All errors are mine.

* Università di Napoli Federico II and CSEF. Email: lucapicariello1@gmail.com

Table of contents

1 Introduction

Workers' mobility is a relevant issue for firms operating in human capital-intensive industries such as law companies, hedge funds and medical firms: in these sectors employers do not own the main input of production as they would with physical capital and face some costs to retain their workers. When moving across firms, workers carry along human capital that may be useful even for the new employer. This human capital is referred to as *portable* (Grosyberg et al. 2008; Groysberg, 2010). Human capital portability depends inversely on its firm-specificity. However, not just skills are portable, but any kind of assets impacting on firms' performance. For instance, one could think of a lawyer working for a company, who, when moving to a competitor, or starting up a spin-out firm, can carry along a fraction of clients from the previous employer's pool.

Firms adopt several tools to retain their best workers, such as wage bonuses, noncompete clauses (Mukherjee and Vasconcelos, 2012) and perks. Another common strategy is to allocate talented workers to tasks that make them less attractive for competitors in the industry, as shown in Waldman (1984), Greenwald (1986) and more recently in Mukherjee and Vasconcelos (2018), thus reducing workers' outside options and consequently retention wages.[1]

Anecdotal evidence shows a constant increase in the number of firms organized as profit-sharing partnerships in human capital-intensive industries.[2] This paper analyzes how competition for talented workers affects the organizational design of human capital-intensive firms. More specifically, I address two questions: first, will a profit-maximizing firm efficiently allocate workers across tasks with heterogeneous production technology and providing access to more or less portable human capital? Second, if the firm is organized as a partnership rather than as a corporation, will it match tasks and workers more efficiently? To answer these questions, I propose a model in which firms produce their output by means of two tasks: One featuring a talent-sensitive production technology; the other task producing a talent-insensitive

[1] For further implications of workers' mobility and portability of their human capital, Acharya and Volpin (2010) show how the competition for workers in the labor market affects the quality of corporate governance in a firm. Ellingsen and Kristiansen (2019) describe the impact of portability on experts' competitive compensation.

[2] IRS Data on the amount of professional partnerships in the U.S. highlight a significant increase in the last ten years, with an average growth rate of 5.6% per year.

output. The first task is assumed to give access to more portable human capital than the second one.[3] To better understand this production structure, consider the example of a law firm in which a worker may be assigned either of two tasks: she can be selected as an attorney, going to court, and whose talent affects the outcome of trials, these workers have "access" to the firm's pool of clients with whom they build up relations; alternatively, she could be selected as back office employee executing bureaucratic, routine tasks and who does not interact much with clients, hence, if she were to leave the incumbent employer, she would certainly carry along fewer clients than an attorney would.

I present a model in which a firm hires a pool of workers whose talent is unknown before a training period, and after which it becomes publicly observable yet nonverifiable in courts. Thus, task allocation is noncontractbile, as it depends on workers' productivity. An efficient cutoff value of ability is derived, such that workers who (do not) fulfill it, shall be allocated to the more (less) talent-sensitive task. I then describe two benchmark contracts allowing the attainment of the efficient task allocation. First, I assume firms to be able to commit on task allocation (alternatively, talent to be verifiable). Second, I assume workers to be able to commit not to leave the incumbent employer once task allocation takes place (for instance because they sign a binding non-compete agreement). Specifically, when one source of contract incompleteness is removed, task allocation is efficient.

When instead, neither firms nor workers can commit to agreements, firms assign the more talent-sensitive task to fewer workers than in the efficient benchmark as it implies higher retention costs than the alternative task. Hence, some workers' talent is not efficiently used in the production process. The magnitude of this inefficiency depends on the relative portability of the human capital acquired while executing the two tasks. Workers who are inefficiently allocated on the less talent-sensitive task would create more value when assigned to the more talent-sensitive task, yet, since the firm does not capture enough value from it due to high retention costs, task assignment is inefficient.

I also examine to what extent more elaborate contracts can reduce productive inefficiencies. Specifically, I introduce the possibility for the firm to offer *up-or-out contracts.* These contracts are widely used in human capital intensive industries

[3]This assumption can be alternatively interpreted as the case in which one task makes the worker more "visible" than the other, in the spirit of Milgrom and Oster (1987)

(Waldman, 1990) and may be seen as (extreme) forms of tournaments (Lazear and Rosen, 1981). They state that a worker should either perform so as to satisfy certain standards (ideally, to get a promotion, thus go "up" in the hierarchy), or be dismissed (namely, go"out"). I show that such mechanism can restore the efficient task allocation, yet at a cost in terms of productivity. Indeed, even imposing the efficient cutoff for allocating workers on the more talent-sensitive task as a standard required to keep workers, the firm makes losses on those who are let go, as it should either hire new workers of unknown talent or poach them from competitors, thus earning no profits from the production on the talent-insensitive task.

The model predicts that a change in the firm's organizational form improves efficiency. If the incumbent employer adopts the partnership organizational form by selling shares of the firm to some employees, the efficient task allocation can be attained. I consider the equity-partnership organizational form, which requires prospective partners to buy equity of the firm in advance, and then they will be remunerated with realized dividends later on. By giving control and cash flow rights to some workers, the partnership organizational form eases the retention of both partners and salaried workers. I show that an *"eat-what-you-kill"* sharing rule entitling more productive workers to higher shares of the realized profit (namely, to more equity and control rights) incentivizes the best workers to become partners and not to leave the firm before the production process is completed. This is an interesting result, as both empirical and anecdotal evidence show that more ad more partnerships in human capital-intensive industries have been adopting the eat-what-you-kill remuneration scheme instead of lockstep seniority (Levin and Tadelis, 2005). Partners choose task allocation to maximize the profit to be shared. This shift in control rights allows for efficiency as partners assign to themselves and all other workers the task on which they are more productive. Henceforth, I show that if (at least) all the inefficiently allocated workers are made partners, the efficient outcome is attained.

Finally, to understand why not all firms are organized as partnerships across and within industries, I discuss some possible frictions that impair firms' ability to adopt such organizational form. Four possible frictions may be: costly equity issuance, uncertain output, wealth constraints and heterogeneous productivity across firms. Selling equity of the firm to prospective partners may be costly because of bureaucratic duties or because the firm owner may enjoy private benefits from control which are mitigated upon granting some control rights to partners. Uncertain output is linked with the fact that making highly productive workers partners may not suffice to guarantee the success of the company: partners are not mere workers, but they also manage the firm, and not necessarily a good producer is a good manager, or albeit being good managers, their ideas may conflict with other partners' and this makes room for delays and forgone investments reducing the firm's output. Wealth constraints may be a consequence of credit rationing (so that workers are unable to borrow money) or impatience (so that even if workers could save money from previous periods, they do not wish to do so). Finally, productive heterogeneity across firms may happen for technological reasons, for instance if a firm adopts better accounting softwares than its competitors', or because one firm simply has a wider pool of clients than its competitors'.

The paper is structured as follows. Section 2 reviews the related literature. Section 3 sets up the basic model. Section 4 derives the efficient task allocation. It is shown that the efficient outcome can be implemented if workers' mobility can be limited or contracts are complete. Section 5 introduces the allocative inefficiency due to portability of talent and contractual incompleteness. Section 6 analyzes the impact of up-or-out contracts on task allocation and profits. Section 7 modifies the initial model introducing the possibility for the employer to sell shares of the firm to some workers and run it as a partnership. Section 8 proposes some frictions that may impair the adoption of the partnership organizational form. Section 9 concludes.

2 Related Literature

This paper contributes to two branches of organizational economics: one dealing with optimal allocation of workers within firms, and the other analyzing the design of organizations and the allocation of control rights.

Task allocation across workers has been analyzed in settings characterized by asymmetric information among firms. Waldman (1984) considers a framework with a competitive labor market in which only the incumbent employer observes workers' ability. Future potential employers task assignment as a signal. Henceforth, the current employer may exploit her informational advantage and allocate workers inefficiently in order to send an incorrect signal to the opponents. Greenwald (1986), instead, shows that if the current employer has an informational advantage about workers' ability, task allocation can be exploited to prevent poaching raids by rival firms. The latter, in fact, can be refrained from poaching a worker whose ability is uncertain, to avoid paying too much for a "lemon" (winner's curse). Task allocation may be perceived by the uninformed parties as a signal of workers' talent. [4] Bar-Isaac and Levy (2019) study a model of career concerns in which the firm manipulates workers' *visibility* in the labor market thus changing their outside options, although this process is independent of task allocation. Moreover, I focus on a case in which the access to human capital is conditional on task allocation, in a similar spirit as Rajan and Zingales (1998) and (2001)

In this paper, I show that allocation inefficiencies persist when workers' abilities are observable in the industry, but task allocation is not contractible.[5] I argue that observing workers' talents is not enough to obtain efficient outcomes if the employer cannot commit to a certain task allocation which in turn affects human capital accumulation.

Another branch of the literature on organizational design has focused on the role of asymmetric information between firms and clients. Levin and Tadelis (2005) argue that partnerships abound in human capital-intensive industries because clients cannot perfectly observe the quality of the products supplied (for instance, a patient cannot tell whether a diagnosis is correct, or a plaintiff could not perfectly evaluate a lawyer's technical advice). The authors show that firms use the partnerships organizational form in order to signal the quality of their output. They assume partners to share the profit equally. Such assumption is fundamental for the signaling purpose: partners maximize the average profit instead of the total. This implies that they will hire only the best workers on the market (the more productive ones).

I develop a different framework with respect to the one in Levin and Tadelis (2005) in several respects. First, I assume the quality of the output produced to be observable. Second, I do not consider a monopolistic firm. Third, in my model the firm hires workers who develop all the possible talents. Indeed, at the beginning of the job relationship, abilities are unobservable. Fourth, I depart from the assumption

[4] Bernhardt (1995) features a similar argument to justify the existence of the so-called *"Peter principle"*. This principle describes the empirical evidence that some promoted workers turn out to be less productive than before, when they were working on a simpler task.

[5] This assumption makes the model similar to the matching model presented by Jovanovic (1979) in which workers' abilities are perfectly observable and they need to be allocated between firms depending on complementarities and technologies so as to attain efficient matches.

that partners share profits equally, as I am not concerned with the signaling problem. The results provided in this paper show that for the retention motive, partners should receive a share of profit proportional to their productivity and not the average share.

Another relevant branch of literature is the one on human-capital and its firm-specificity. Key contributions on this topic are Becker (1964), Rosen (1972), Acemoglu and Pischke (1998), Moen and Rosen (2004) for analyses on the mobility of human capital. Differently from all these papers, I study a model in which human capital specificity depends on the task a worker is assigned and therefore its accumulation can be manipulated by the employer who then changes the firm structure and its composition (specifically, by allocating too few workers on more talent-sensitive tasks).

This paper is also related to Rebitzer and Taylor (2006). It focuses on the role of *"up-or-out contracts"* in law partnerships. In their model there is a continuous turnover of associates, in an overlapping generation framework. Dismissed workers, however, should be replaced by newly hired ones who are either of unknown talent or that need to be poached from a competitive labor market, thus generating a loss of profits for the firm. This loss is not featured in Rebitzer and Taylor (2006), whereas the present paper emphasizes that also low-skilled workers' departures cause losses for the incumbent employer. Indeed, the employer bears the cost to train freshly hired workers to substitute the dismissed ones. If these are poached from a competing firm, they cannot produce as well as the dismissed workers because of imperfect portability of human capital across firms.

Other theoretical contributions on the economics of partnerships focusing on different issues with respect to the impact of workers' mobility on the design of organizations include: Alchian and Demsetz (1972), emphasizing the incentive to monitor peers in such organization; Farrell and Scotchmer (1988) showing that many law firms have few partners because the best workers do not want to equally share their earnings with weaker ones; Kochan and Rubinstein (2000); Garicano and Santos (2004) showed how a firm organized as a partnership can favor the transmission of human capital between partners and associates and senior and junior partners; Morrison and Whilelm Jr (2004) who study the reasons why some companies turn from partnerships to corporation and argue that technological progress has made less relevant the benefits of knowledge trasmission across cohorts of partners.

Finally, this paper is linked to the classical literature on incomplete contracts and control rights in organizations, dating back to Grossman and Hart (1986), Hart and Moore (1988), Hart and Moore (1990), Aghion and Tirole (1997). In this paper, contracts feature bilateral incompleteness: firms cannot commit to task allocation and workers cannot commit to stay with their incumbent employer. These frictions generate inefficient talent allocation and the solution I suggest echoes, but does not coincide with *vertical integration* as proposed in the above mentioned literature.

3 The Model

A firm takes prices as given and hires a continuum of measure 1 of workers from a perfectly competitive labor market. Let the output price be normalized to 1 and the output be produced only by means of workers' talent and no effort.[6] Employer and employees are risk-neutral. The latter get utility from consumption, namely from the wage they earn. Workers' heterogeneous productivities are denoted as $y \in [\underline{y}\,,\,\bar{y}]$, with $\underline{y} > 0$. Productivity is continuously distributed according to a cumulative distribution function $F(y)$ with $\frac{\partial F(y)}{\partial y} = f(y)$. Each worker's productivity is unknown at the beginning of the job relationship.[7]

Initially, employees execute a nonproductive task (which can be considered as a training period).[8] After this stage, their talent becomes publicly observable in the industry, but not verifiable in courts. This last assumption makes contracts contingent on workers' ability, not enforceable. Since the employer chooses task allocation depending on abilities, this is noncontractible. Once abilities are observed, the employer allocates workers to either of two tasks. This allocation is determined by a new spot contract defining a task and a new wage. Tasks differ in productivity and portability (or specificity) rate of the human capital workers acquire by executing

[6]Picariello (2019) removes this assumption to study the interaction between promotions (or task allocation) and workers' incentives to acquire more or less firm-specific human capital with competitive labor markets. In such framework, talent allocation has a dual role: on the one hand it can reduce mobility, on the other hand, it serves as an incentive for workers to acquire human capital.

[7]This is a common assumption, see for instance Waldman (1984) and Greenwald (1986).

[8]The output of this task is normalized to zero for simplicity, but it could be whatever constant value independent of workers' ability without changing the qualitative results provided throughout the paper.

them. After task allocation, workers may be poached by competing firms in the industry. Let there be no discounting across the two periods and no financial markets.

3.1 Contracts and Tasks

The employer offers spot wage contracts.[9] Let w_1 be the wage offered to hire workers. Let w_2^i, with $i = \{A, B\}$, denote the wage offered to the worker after her talent becomes observable and she is allocated to task i, thus acquiring portable human capital.

Let θ_i define the *portability rate,* of the human capital acquired while executing task *"i"* (namely, the share of task i output a leaving worker can reproduce outside the initial firm). The two tasks are characterized as follows:

Assumption 1. Task A *produces* βy *with* $\beta \in \mathbb{R}_+$ *and gives access to human capital with portability rate* $\theta_A \in (0; 1]$.
Task B *produces* $x \in [\beta \underline{y}\,,\, \beta \bar{y}]$ *and gives access to human capital with portability rate* $\theta_B \in (0\,;\, \theta_A)$.

To sum up, task A is the more talent-sensitive of the two and the human capital it delivers is more portable, whilst task B can be thought of as a routine task whose output is talent-insensitive. The assumption that the human capital acquired when working on task A is more portable than that deriving from working on task B is motivated by the fact that the first yields an output positively correlated with innate talent, hence a larger fraction of it can be reproduced. Alternatively, one could think of task A as making workers more "visible" (hence, attractive) on the labor market.[10]

I assume workers' talent to be unknown to everyone at the beginning of the game. For this reason, workers receive an homogeneous initial wage offer. After talents become observable and task allocation takes place, every worker will have an heterogeneous outside option depending on the human capital acquired on the assigned job. Specifically, a worker assigned to task A can produce outside the initial

[9]This assumption can be relaxed without qualitatively altering results: allowing the employer to offer long-term contracts would not change the predictions of the model as long as contracts are incomplete.

[10]The ranking of portability rates could be changed and all the main results of the paper would hold true, although the inefficiencies shown later are reversed.

firm

$$\theta_A \beta y,$$

while a worker assigned to task B, can produce

$$\theta_B x.$$

Importantly, I assume that a worker assigned to task i acquires the necessary human capital to execute only that task after being poached. Namely, a workers allocated to task B (respectively, A), cannot be poached to execute task A (respectively B) immediately, as she needs training for the new task (following the example from the introduction, an attorney carries along clients who do not need to be served by a back-office employee and vice versa).

3.2 Time Line

The time line of the model includes five stages:

- $t = 1$ *(hiring stage),* firms bid competitively for workers offering w_1. Workers who accept will work on a training task.
- $t = 2$ *(training stage),* workers' productivities become observable to them and to all the firms in the industry. Wages for the training task are paid.
- $t = 3$ *(task allocation),* firms offer a new spot contract specifying task i and wage w_2^i.
- $t = 4$ *(interim poaching stage),* workers can leave the initial firm for a new one.
- $t = 5$, the production process is completed and wage w_2^i is paid.

3.3 Equilibrium Concept

The model features perfect information about workers' talent in a sequential game. The equilibrium concept is *subgame perfect Nash equilibrium* (SPNE). In the simple initial model, workers only decide whether to work for a firm at the beginning of the game, whereas firms choose wage contracts and task allocation. Hence, a subgame perfect Nash equilibrium for this game consists of a vector of wages and a noncontractible task allocation $\{w_1 \, , \, w_2^i \, , \, i\}$.

4 Efficient Task Allocation

Since productivity on task A is increasing with workers' ability y whereas productivity on task B is constant, yet may be larger than the former, and since y is a continuous variable, the optimal allocation rule will be a threshold rule of the kind

$$\mathcal{A}(y^*) = \begin{cases} \textit{Task A} & \forall \; y \in [y^* \, , \, \bar{y}], \\ \textit{Task B} & \forall \; y \in [\underline{y} \, , \, y^*). \end{cases}$$

I now derive the efficient threshold value for workers' talent $y^* \in [\underline{y} \, , \, \bar{y}]$. It is chosen so that all workers with ability larger or equal (respectively, smaller) than y^* are assigned to task A (respectively, task B). The employer and the employees sign two spot contracts. At the beginning of the job relationship (stage 1), the firm pays a wage w_1 to convince workers to join the firm. As described later, this wage is an outcome of Bertrand competition for workers.

After the execution of the training task, workers' abilities are revealed and they are allocated one of the two tasks. At this stage, workers are offered a wage depending on task allocation w_2^i. Let us define the social welfare as

$$W = \underbrace{\int_y^{\bar{y}} \beta y f(y) dy + F(y)x - w_1 - \int_{\underline{y}}^{\bar{y}} w_2^i(y) f(y) dy}_{\pi} + w_1 + \int_{\underline{y}}^{\bar{y}} w_2^i(y) f(y) dy. \quad (1)$$

Let π denote the profit of the firm, whereas the other terms define the sum of wages earned by the employees.

The efficient cutoff value for workers' productivity is defined as:

$$y^* \in \underset{\{y\}}{argmax} \; W.$$

The first-order condition delivers the optimal threshold value

$$y^* = \frac{x}{\beta}. \tag{2}$$

This cutoff value maximizes the total surplus. Notice that, ceteris paribus, the higher the production enhancer β, the lower y^*. Hence more workers should be allocated to task A. Instead, when x increases, the threshold value increases. Namely, only very productive workers should work on task A.

4.1 Implementing the Efficient Allocation

The model presented in this paper features bilateral contract incompleteness. On the one hand, firms cannot commit to task allocation; on the other hand, workers cannot commit to stay with their employer after task allocation takes place. I will now relax one incompleteness at a time in order to show that when either of the parties can commit to an agreement, efficient task allocation is implemented.

4.1.1 Workers' Commitment

Assume that workers can commit to stay with the incumbent employer after task allocation (for instance, because labor contracts feature strict noncompete clauses). In this framework, workers' ex-post retention is not an issue for the employer.

If the parties can sign unconstrained contracts limiting workers' mobility, the following proposition holds:

Proposition 1. *If the employer and the employees can sign unconstrained contracts, through which the worker can commit not to leave the firm after task allocation, task allocation is efficient.*

The proof of this and all other propositions and lemmas is relegated to the Appendix. Intuitively, if retention is not an issue at the interim stage, the employer pays workers a fixed wage after task allocation, independent of the task they are assigned. Specifically, they just need to obtain their reservation wage to stay with the incumbent employer. Thus, the firm allocates tasks only considering employees' marginal productivity on either task: this leads to an efficient outcome. The ability cutoff for a worker to be allocated to task A will be $y^{**} = y^*$, which maximizes productivity.

Workers extract all the surplus generated at $t = 1$, as the labor market is perfectly competitive ex-ante.

4.1.2 Firms' Commitment

Suppose workers' talent is verifiable, so that firms can credibly commit to task allocations ex-ante. In this framework, at the hiring stage, the firm can offer contracts of the type

$$\{w(y)\,,\, i(y)\}.$$

By means of this contract, the firm can commit to the efficient task allocation.

Proposition 2. *If workers' ability is verifiable, the employer can commit to match workers to tasks efficiently, according to the cutoff value* $y^* = \frac{x}{\beta}$.

In this case, the firm can attract as many workers as possible in the competitive labor market and offer the highest total expected surplus possible. Since the contract including task allocation is enforceable, the firm cannot holdup at the allocation stage.

5 Portability and Inefficiency

Consider now the case in which workers can leave the firm after being assigned a task and having acquired the relative human capital. If they are successfully poached by a competing firm, workers produce a fraction of what they did in the source firm, depending on the task they executed. Therefore workers' outside option depends on task allocation and on their talent. As after task allocation firms compete á la Bertrand for workers, the incumbent employer's wage offer does not exceed the opponent's which equals the worker's marginal productivity. Hence, the optimal wage offers will be $w_2^A = \theta_A \beta y$ for workers assigned to task A, and $w_2^B = \theta_B x$ for those assigned to task B. Since talent is nonverifiable, task allocation is non-contractible. The following proposition states the incumbent employer's allocation rule.

Proposition 3. *If workers cannot commit to stay with their initial employer and firms cannot commit to task allocation, it is profit maximizing to assign task A to fewer workers with respect to the efficient benchmark. In a competitive equilibrium the threshold value is*

$$\hat{y} = \frac{(1-\theta_B)x}{(1-\theta_A)\beta} > y^*.$$

This result shows that if workers can leave the source-firm, the incumbent employer sets a more stringent allocation rule than the efficient one. Workers with ability $y \in y^*, \hat{y}$ could potentially be assigned to task A (since $\beta y > x$ for them), but they are not (see Figure 2). Their productivity is not large enough to compensate the spread between $\theta_A \beta y$ and $\theta_B x$. Namely, the wage necessary to retain them at the interim stage if working on task A, is relatively too high. To reduce retention costs, firms strategically match them with the less portable task. Specifically, due to high retention costs, the employer does not manage to capture much of the value created by these workers when allocated to task A.[11]

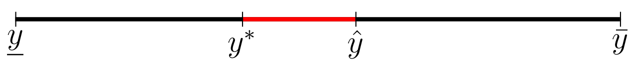

Figure 1: Inefficiency

This is not a surplus maximizing outcome: some workers' talent is inefficiently used and developed. If a worker is matched with task B, she will not be able to work on task A in another firm, although her talent would potentially allow her to do so.

If θ_A increases, ceteris paribus, the threshold value $\hat{y}$ increases. As in Waldman (1984), the degree of allocative inefficiency is decreasing in the firm-specificity of workers' human capital. However, in this paper, the result is driven by a different mechanism. I do not consider informational asymmetries across firms, about workers' talent. I study an informational setting similar to those used in matching models, with symmetric information (Jovanovic, 1979). Suppose workers can send a signal about their ability to the market in the setting presented by Waldman (1984). Such action may reduce the relevance of the signal delivered by task allocation. Workers could do *signal jamming* (as in Holmström, 1982/1999 and Gibbons, 2005) to convey more precise information about their ability, out of task allocation. The more informative the signal (the more important the signal jamming activity), the less effective is task allocation for firms to retain the best workers. Indeed, if a very talented worker is allocated to a simple routine task, she can signal her actual skills. This would increase her probability of being hired by a competing firm seeking highly productive employees. In this model, task allocation is an effective retention tool. A key role,

[11] Allowing firms to poach workers before task allocation would not change the result as all firms are identical and solve the same profit maximization problem. Namely, in equilibrium, no firm would bid to poach and allocate to task A a worker with ability $y \in [y^*, \hat{y}]$.

for this result to exist, is played by contract incompleteness and by firm and task-specificity of the skills acquired by the employees.

5.1 Complete vs Incomplete Contracts

It is now interesting to compare the cases studied so far. It has been shown that bilaterally incomplete contracts yield inefficient production, as a consequence of opportunistic task allocation within firms. However, removing one source of incompleteness makes room for the implementation of the efficient task allocation. Namely, if either firms or workers are able to commit to agreements, production is efficient. Consider the case where firms can credibly commit to task allocation In this scenario, a larger surplus is generated. Consider the case in which workers' interim participation constraints bind in equilibrium. At $t = 1$ they earn

$$w_1(y^*) = (1 - \theta_A) \int_{y^*}^{\bar{y}} \beta y f(y) dy + F(y^*)(1 - \theta_B)x$$

and they expect

$$\mathbb{E}[w_2(y^*)] = \theta_A \int_{y^*}^{\bar{y}} \beta y f(y) dy + F(y^*)\theta_B x.$$

If task allocation is noncontractible, workers earn

$$w_1(\hat{y}) = (1 - \theta_A) \int_{\hat{y}}^{\bar{y}} \beta y f(y) dy + F(\hat{y})(1 - \theta_B)x$$

and

$$\mathbb{E}[w_2(\hat{y})] = \theta_A \int_{\hat{y}}^{\bar{y}} \beta y f(y) dy + F(\hat{y})\theta_B x.$$

In this case, the following inequalities hold:

$$w_1(y^*) < w_1(\hat{y}) \tag{3}$$

$$\mathbb{E}[w_2(y^*)] > \mathbb{E}[w_2(\hat{y})]. \tag{4}$$

Let

$$w_1(y) + \mathbb{E}[w_2(y)] \equiv W(y) \tag{5}$$

thus, in this scenario, one can see that

$$W(y^*) \geq W(\hat{y}) \tag{6}$$

These inequalities provide a clear picture of the issues generated by the inability to commit to task allocation. Suppose the firm promises a worker that at $t = 3$, task allocation will be efficient. In this case, should the firm be credible, the worker could accept $w_1(y^*)$ smaller than $w_1(\hat{y})$ to be hired. However, if firms cannot actually commit to task allocation, they will have an incentive to allocate tasks inefficiently later on, so as to obtain a positive rent

$$w_1(\hat{y}) - w_1(y^*) = [F(\hat{y}) - F(y^*)](1 - \theta_B)x - (1 - \theta_A)\int_{y^*}^{\hat{y}} \beta y f(y)dy. \tag{7}$$

If firms can holdup, they will do it, thus generating less surplus and earning a positive rent with respect to the efficient benchmark case. For this reason, if workers anticipate this, they will not accept a lower wage ex-ante. They will require higher wages to be hired and have a “flatter” wage schedule.

6 Up-or-out Contracts

Thus far, I have considered firms and workers agreeing to simple wage contracts. Now I suppose that firms can offer *“up-or-out”* contracts, which are widespread in human capital-intensive industries. In this case, employers set a certain performance standard and only workers fulfilling it will be kept (promoted, “go up”) in the firm, whereas the others will be dismissed (“go out”). There are two possible ways to define an up-or-out contract: either as a minimum productivity standard denoted as $y_{uo} \in [\underline{y}\,,\,\bar{y}]$, or as a minimum wage commitment. In the first case, at $t = 2$, when workers’ productivities become observable, the firm will lay off all those producing $y < y_{uo}$ and allocate all the others to task A. In the second case, the firm sets a minimum wage and workers whose productivity is too low to earn that wage are laid off, otherwise the firm would make losses. In this model, workers’ productivity is nonverifiable, therefore the firm cannot commit to contracts contingent on it. However, firms can commit to wages, thus I study to what extent the second type of up-or-out contracts can improve allocative efficiency.[12]

Rebitzer and Taylor (2006) show that, under certain conditions, up-or-out contracts can solve retention issues with no loss of welfare. I show that the limited portability of the human capital workers acquire generates a cost of using these contracts.

Lemma 1. *Suppose an up-or-out contract is in place and after talent revelation, the firm keeps only workers worth earning $w_2 \geq \theta_A \beta y^*$. In this case:*

1. *Task allocation is efficient*
2. *The firm faces a loss $F(y^*)(1-\theta_B)x$.*

Intuitively, if a firm commits to keep workers who should be paid as much as they earn if efficiently allocated to task A, efficient task allocation is implemented. [13]

Workers who do not fulfill the requirement and therefore are dismissed, do not acquire firm-specific human capital. Specifically, a share $1-\theta_B$ of the human capital they could acquire if staying with the firm would be specific. Replacing laid off workers with poached ones with similar abilities (or with newly hired workers) yields the firms at most zero profit from task B, given labor market competitiveness. For this reason, up-or-out contracts generate a tradeoff between efficient production and losses in terms of human capital.

Proposition 4. *It is not profitable for firms to use up-or-out contracts instead of simple wage contracts.*

The intuition for this result hinges on two factors. First, if all workers who would execute task B are dismissed, the employer will substitute them with workers poached from competing firms. These workers will not be able to produce the same amount as those who would have been trained inside the firm. Second, when using these contracts, the firm does not maximize its profit. Profit maximization requires

[12] All the results hold even using the first type of up-or-out contracts.

[13] I analyze the scenario in which these contracts deliver the most efficient task allocation, and show that it may not suffice to cover replacement costs. Note that the firm would optimally choose a different promotion threshold. See the proofs of Lemma 1 and Proposition 4 in the Appendix for a more detailed analysis.

workers with productivity smaller than $\hat{y}$ to be allocated task B. With up-or-out contracts, these workers will work on task A.

To sum up, even choosing the efficient threshold as up-or-out cutoff (thus attaining the highest productivity), the firm prefers implementing simple wage contracts. The extant literature has shown the efficacy of up-or-out clauses in providing incentives for workers to exert effort. This is one of the benefits supporting the widespread use of these contracts in talent-sensitive industries. However, this model shows that these contracts impose a loss on firms using technologies requiring the acquisition of specific skills to be operated. Moreover, these contracts may generate efficient, but not optimal talent allocation within organizations.

7 Partnership

In this section I allow the firm owner to choose the organizational form of her firm. The firm can be ran either as a corporation or as a partnership. A partnership is an organizational form in which some workers (referred to as "partners") have both cash flow and control rights. Suppose that before task allocation, the employer can decide whether to keep all the control rights and run the firm as sole owner of a corporation, or to make it a partnership, by offering shares of it to some workers. In the latter case, those workers who buy equity of the firm will run it as the owner's partners. Many firms operating in professional services industries are organized as partnerships (Teece, 2003).

To maximize the sale price of the firm's equity, the employer will select a bounded segment of abilities for prospective partners. The sale price depends on the profit of the partnerships, which in turn depends on who is made partner.

7.1 Equity and Shares

In order to analyze task allocation in an equity partnership, I now introduce some notation. Let ϕ denote the price of equity every prospective partner purchases from the current firm owner to buy her stake in the firm.[14] Let π^p denote the profit of the firm organized as a partnership. The firm owner defines a segment $y^p \in [\bar{y}\,,\, \underline{y}]$ in which a prospective partner's ability should lie. Let y_1 and y_2 be respectively the lower and the upper bound of y^p chosen by the employer. Every partner is entitled to a share of the firm's profit $s \in [0\,,\,1]$. I impose a feasibility constraint on the shares sold to partners, so that the firm owner cannot offer more than the firm's profit: $\int_{y_1}^{y_2} sf(y)dy \leq 1$; the firm owner retains the remaining shares, so that her payoff in a partnership is

$$\int_{y_1}^{y_2} \phi f(y)dy + \left(1 - \int_{y_1}^{y_2} sf(y)dy\right)\pi^p. \tag{8}$$

The owner designs *partnership contracts* $\{\phi\,,\, s\}$ for prospective partners.[15] These contracts specify the shares of the firm for a prospective partner, s and the cost of such equity, ϕ. When offering partnership contracts, the firm owner makes take-it-or-leave-it offers.

7.2 New Timing

The baseline timeline is slightly modified. The new timing of the game is the following:

- At $t = 1$, firms bid competitively for workers offering w_1. Workers who accept will work on a training task.
- At $t = 2$, workers' productivity becomes observable to them and to all the firms in the industry. Wages for the training task are paid.
- At $t = 3$, the firm owner selects the length of the segment y^p and offers a partnership contract $\{\phi\,,\, s\}$.
- At $t = 4$, potential partners accept or reject.

[14] This fee may also be considered as a reduction in the ex-ante wage that a prospective partner pays in order to gain a higher wage ex-post. Importantly, this fee entitles the worker with control rights.

[15] As the firm hires a continuum of measure 1 of workers, the employer does not offer a contract to each individual, but since she can perfectly tell each worker's productivity, she can design a partnership contract for each ability y.

- At $t = 5$, partners choose task allocation for themselves and salaried workers.
- At $t = 6$, partners and salaried workers can leave the firm.
- At $t = 7$, the production process is completed and wages are paid.

7.3 Partnership Contracts

Prospective partners decide whether to buy some equity of the firm by accepting the offered partnership contract. A worker of ability y accepts the offer if the cost of equity is not too high, so that it satisfies a *"willingness-to-pay"constraint* (WTP). Depending on the task she would be assigned to in a corporation, either of two conditions needs to be satisfied for the worker to buy equity:

$$\phi \leq s\pi^p - \theta_B x \;\; \forall y \in [\underline{y}\,,\, \hat{y}) \qquad (WTP_B)$$

or

$$\phi \leq s\pi^p - \theta_A \beta y \;\; \forall y \in [\hat{y}\,,\, \bar{y}]. \qquad (WTP_A)$$

Partners acquire cash flow and control rights: they earn a share of the realized profit of the firm rather than a fixed wage and decide over task allocation for themselves and all other employees. This affects the employer's choice on whether to sell the firm, since it changes the profit generated and whereby the surplus to be extracted through the sale of equity ϕ.

Moreover, the partnership is *stable* if workers and partners are retained at the interim stage and remunerations should be designed to guarantee such stability. The *interim participation constraints* for salaried workers are the same as in the maximization program for a corporation in section 4. For partners instead, interim participation constraints depend on the task they are matched with. A partner working on task A will not leave the firm if

$$s\pi^p(y_1\,,\, y_2) \geq \theta_A \beta y. \qquad (IPC_A)$$

A partner working on task B, instead, will not leave the firm if

$$s\pi^p(y_1\,,\, y_2) \geq \theta_B x. \qquad (IPC_B)$$

These constraints are designed based on the assumption that there is a *partnership buyout agreement* forbidding partners to sell their equity on the financial market, so that when a partner leaves the company, all of her equity is recollected by the firm owner and she only obtains the portable human capital acquired as outside option.[16]

Finally, the employer selects the workers who shall receive partnership contract offers, namely, the boundaries of the segment y^p, in order to maximize $\int_{y_1}^{y_2} \phi f(y)dy$. The owner is willing to sell the firm if

$$\int_{y_1}^{y_2} \phi f(y)dy + \left(1 - \int_{y_1}^{y_2} sf(y)dy\right)\pi^p \geq \pi. \tag{9}$$

Given the interim participation constraints, the following result holds:

Corollary 1. *If partners' interim participation constraints bind in equilibrium, the firm owner offers each prospective partner a non-decreasing share of the firm with respect to her ability.*

As it is shown in the proof of this corollary, partners' interim-participation constraints may bind in equilibrium. If this is the case (and not necessarily only in this case), the firm owner offers partnership contracts featuring an *"eat-what-you-kill"* sharing rule. Most results in the existing literature are based on equal-sharing mechanisms (see, for instance, Levin and Tadelis, 2005). In this paper, workers' abilities are continuously distributed and this requires the best partners to obtain different rents with respect to the less productive ones in order to break even. Hence, partners are entitled to a share of the firm proportional to their productivity in order to be retained. Interestingly, the resulting sharing rule is linked to the competition in the labor market (via the portability of the human capital acquired on task A). Thus, an empirical prediction of this model is that eat-what-you-kill sharing rules should be more frequent in industries where labor market competition is fierce (or human capital acquired is more portable). Alternatively, as one core feature of the model is the fact that workers' ability is observed in the whole industry, this kind of mechanism should prevail in settings where workers' productivity is easily observable in

[16]This is an empirically relevant assumption, as already stated in Morrison and Whilelm jr. (2008) who provide also some anecdotal evidence corroborating their assumption that partnership shares are highly illiquid.

the labor market, or if not directly observable, more certifiable when applying for job openings at outside employers.

As a remark, notice that interim-participation constraints may not bind because for the firm owner it is costless to issue equity and the equity price (i.e., ϕ) she gets when selling shares of the firm is increasing in these shares. As I will discuss later in greater detail, if issuing each unit of equity has even an infinitesimally small cost, then the interim-participation constraints binding.

7.4 Partners' Selection

I will now analyze the employer's optimal selection of partners and check whether the efficient task allocation is implemented in this framework. Notice that whether the interim-participation constraints bind or not does not affect the results presented next, so I will consider the case where they bind without loss of generality.

When focusing on the efficiency of task allocation as related to the selection of partners, one observes the following result:

Lemma 2. *Efficiency in task allocation cannot be improved by selling the firm to workers who are efficiently allocated in a corporation. The firm owner is indifferent between running the firm as a corporation or as a partnership with partners of any ability* $y \notin [y^*, \hat{y})$

The selection of partners is crucial for the implementation of the efficient task allocation. If none of the workers who would be inefficiently matched to a task in a corporation is made partner, running the firm as a corporation or as a partnership makes no difference in terms of surplus generated. Profit maximizing partners match tasks and workers in the same way as the sole owner would in a corporation. Thus, there is no improvement with respect to the corporation case: the firm generates the same surplus which is differently distributed. As a consequence, there is no surplus for the firm owner to extract via the equity fees, which therefore equal zero.[17] In this case, the owner herself is indifferent between selling shares of the firm and running it as a corporation.

[17] This result is a consequence of the simple model at work, yet in real life situations, there are other kind of costs embedded in the value of the equity sold to workers for them to become partners. Importantly, though, this equity is seldom sold for its market value.

Consider the cases in which workers with ability $y \in [y^*, \hat{y})$ are offered a partnership contract. It is important to verify that they accept it, and that the dividend they earn will suffice to retain them after task allocation. The following proposition states the results obtained.

Proposition 5. *If at least all workers with ability $y \in [y^*, \hat{y})$ are made partners, the optimal partnership contract is $\{\phi^*, s^*\} = \{\theta_A \beta y - \theta_B x, \frac{\theta_A \beta y}{\pi^p}\}$ and the efficient task allocation is implemented. The partnership generates a higher profit with respect to the corporation.*

A necessary condition for the implementation of efficiency is that workers with ability $y \in [y^*, \hat{y})$ are made partners. When this is the case, they will have an incentive to accept the partnership contract and not to leave the firm at the interim stage. Since partners' remuneration is given by a share of the profit realized, they have an incentive to allocate themselves and the other partners to tasks that maximize their productivity, increasing the profit generated. In this scenario, partners are committed to choices made. This allows to circumvent the holdup issue generated by contract incompleteness when only the firm owner has control rights.[18]

Efficient task allocation generates more surplus to be split between partners and the incumbent firm owner (through the equity price paid to buy the firm). Moreover, the firm owner is indifferent to how many workers should be made partners on top of those with ability on the $[y^*, \hat{y})$ segment.

In equilibrium, the firm owner is able to extract all the surplus generated by the partnership by charging fees $\phi = \theta_A \beta y - \theta_B x$ for workers who would be inefficiently allocated in a corporation environment. As a consequence, the firm owner strictly prefers making all workers with ability $y \in [y^*, \hat{y})$ partners, as this allows her to extract the maximum amount of surplus possible.

Furthermore, partnerships can offer higher wages than corporations at $t = 1$. As they allocate talent efficiently, partnerships generate the highest expected surplus possible, which accrues to workers through w_1. Hence, one more prediction is that firms organized as partnerships should be able to offer higher wages at the hiring stage than corporations, because, by allocating talent more efficiently, they produce more.

[18]Given linearity of the problem at hand and perfect information, such result is attainable with both majoritarian and proportional voting rule.

The model also predicts that the firm owner is indifferent about how many workers with productivity larger or equal to $\hat{y}$ should be made partners, but strictly prefers all workers with ability $y \in [y^* , \hat{y})$ to become partners. This is because the latter are efficiently allocated to task A when they are partners, whilst all other workers execute the same task as in a corporation. Thus, not only the best workers should be made partners, but also those who are more productive in task A than in task B and whose talent would not be used efficiently in a corporation. This provides a rationale for a "lower bound" on the ability of workers that should become partners for an organization to produce efficiently.

As a remark, it is worth noting that I study the choice of a single owner who decides whether to offer some shares of the firm to some employees; if they accept the partnership contract, they become partners and the firm is organized as a partnership. The results provided are still valid if the initial firm owner is considered to be an individual partner, looking for new partners. Namely, at the beginning of the game, the firm can be assumed to be a partnership with a unique partner who wants to enlarge the pool of partners, thus avoiding the idea of a corporation evolving into a partnership.

8 Discussion: Some Frictions

I've shown that organizing the firm as an equity-partnership allows for efficient task allocation, which generates more surplus with respect to the corporation case. In this setting, the employer extracts all the extra surplus generated by means of equity fees, so that she also has an incentive to support the efficient task allocation. However, empirical and anecdotal evidence suggest that not every firm in human capital intensive industries is a partnership. This is true not only across, but also within industries. I now discuss slight extensions of the baseline model by introducing some frictions that may impair the feasibility of partnerships and their efficiency. For the sake of simplicity and in order to deliver clear predictions on how frictions may affect the feasibility of partnerships, I make some assumptions. First, I assume the worker to be only one, instead of having a continuum of them. Furthermore, from now on I let $\theta_B = 0$ and simplify the notation so that $\theta_A = \theta$. Finally, I will consider only talents $y \in [y^*, \hat{y})$, as this is the set of abilities for which in the baseline model, the firm owner is strictly willing to make partners As it shall be clear later, these assumptions are without loss of generality, as the key mechanisms would be at work even relaxing them.

I will first discuss the case in which selling shares of the firm has a cost for the firm owner, in order to show that in that scenario, the partner's interim participation constraint binds in equilibrium and therefore the firm owner offers just one possible partnership contract. Then I will consider other empirically relevant frictions, considering the equilibrium in which the interim participation constraint is binding in order to provide a clear intuition of the impact of the other frictions on the feasibility of partnerships and on the efficiency of task allocation therein.

8.1 Costly Equity Issuance

First, I discuss an extension of the baseline model in which the firm owner faces a cost $\psi > 0$ for each unit of equity she sells. [19] In this scenario, the owner's maximization program when designing partnership contracts becomes:

$$\underset{\{\phi,s\}}{Max} \;\; \phi + (1-s)\pi^p - s\psi$$

subject to the WTP-constraint

$$\phi \leq s\pi^p$$

and the interim participation constraint

$$s\pi^p \geq \theta\beta y$$

Since I assume the worker to have ability $y \in [y^*, \hat{y})$, it is immediate, from the previous analyses, that upon becoming partner, she would be assigned task A, hence the profit of the partnership would be $\pi^p = \beta y$. By solving the maximization program, one can immediately see that both constraints binds in equilibrium, as now the shadow cost of issuing equity (i.e., s) is positive and therefore, the firm owner does not totally recoup each unit of s via the equity price ϕ. In this case, the unique optimal partnership contract offered to the worker is $\{\phi^*, s^*\} = \{\theta\beta y, \theta\}$. Finally, the firm owner is willing to organize the firm as a partnership rather than as a corporation

[19] This cost may reflect bureaucratic or fiscal costs, but also costs she faces for losing control of the firm.

if

$$\phi^* + (1 - s^*)\pi^p - s\psi \geq \pi = x \iff y \geq \frac{x + \theta\psi}{\beta} > y^*.$$

Hence, if issuing equity for partners is costly, on the one hand, the interim participation constraints bind in equilibrium, therefore there exists a unique optimal partnership contract; on the other hand, when organizing the firm as a partnership, the owner does not manage to capture all the extra surplus generated by efficient task allocation via the price of equity ϕ as it costs ψ to issue each unit of such equity. This implies that the owner is willing to make a partnership only with sufficiently productive workers and not with all those who wold be inefficiently assigned task B in a corporation. In fact, if $\psi \geq x$, the firm owner does not wish to make partner any worker with ability $y \in [y^*, \hat{y})$ so that corporation is the only viable organizational form.

From now on, I will relax the assumption of costly equity issuance and will focus on the case in which the interim participation constraint binds in order to provide clear intuition of the individual effect of other frictions that may impair the viability and the efficiency of partnerships.

8.2 Risky Output

The basic model features deterministic output, however, making a partnership may generate some risk as compared to corporation. To understand the possible sources of such risk, recall that so far workers are selected to become partners based on their productive ability, yet this does not need to be correlated with managerial talent. The latter is crucial for partners as they are not just producers, but they also take managerial decisions. If we assume that the firm owner is an experienced manager whereas the partner is not, then the partnership organization form implies more risk with respect to corporation. Such risk does not need to be generated just by the fact that new partners are unable to take managerial decisions, but it could also be due to some form of heterogeneity in management preferences: some partners may have different opinions on investments to be made in the firm and there could be some conflict among all partners so that the firm stays idle forgoing profitable opportunities. On the one hand, given the risk of earning lower profits, the firm owner may not be willing to choose the partnership organizational form; on the other hand, when becoming partners, workers give up limited liability, namely, they share both in earnings and in losses, so they may end up earning less than the wage they would earn as workers in a corporation. As it will be more clear below, both the firm owner and the worker may be unwilling to start a partnership.

To embed such friction I assume the partnership's output (hence, its revenues) to be risky, in the sense that only the worker's productive ability is observable, yet her managerial talent is random and uncorrelated with productivity. As we only have one worker, the partnership profit is

$$\pi^p = \begin{cases} max\{\beta y, x\} & \text{with probability } p \in (0,1), \\ 0 & \text{otherwise .} \end{cases}$$

The probability of producing a strictly positive output is uncorrelated with the worker's talent, and does not necessarily be thought of as the probability of "success". In fact, one could also imagine that the worker produces always the same output, but with probability $1-p$, the partner takes a decision which costs something to the firm and such cost equals the produced output, so that the partnership ends up with zero profits (alternatively, disagreement between partner and initial owner implies that relevant investments to increase profits are forgone).

Since we focus on ability $y \in [y^*, \hat{y})$, it is immediate that if she becomes a partner, the worker is allocated to task A, otherwise to task B. Henceforth, the expected profit of the partnership is

$$\mathbb{E}(\pi^p) = p\beta y.$$

I say a partnership to be *feasible* if the worker accepts a partnership contract with $s^* < 1$: if this is not the case, then either the firm is totally sold to the worker (who would be the only partner running it, hence it would be a corporation with a different owner), or the firm owner should pay extra money out of her pocket to retain the partner (as she commands more than the profits generated to be retained). Namely, a partner is stable (i.e. partners are retained at the interim stage) if it is feasible. Moreover, the partnership organizational form is optimal if the firm owner prefers it to the corporation form.

When offering partnership contracts, the firm owner maximizes her objective function

$$\phi + (1-s)\mathbb{E}(\pi^p)$$

subject to the willingness-to-pay constraint

$$\phi \leq s\mathbb{E}(\pi^p) \tag{WTP}$$

and the interim participation constraint

$$s\mathbb{E}(\pi^p) \geq \theta\beta y. \tag{IPC}$$

Note that the partner has always a safe outside option, as she may leave for a competing firm organized as a corporation and earn the wage $\theta\beta y$; as a result, the optimal partnership contract offered is $\{\phi^*, s^*\} = \left\{\theta\beta y,\, \frac{\theta}{p}\right\}$. The following proposition states the conditions under which the partnership organizational form is feasible and optimal:

Proposition 6. *When the firm's profit is risky, the partnership organizational form is feasible, so that* $s^* < 1$ *and optimal for the firm owner if the prospective partner has talent* $y \geq y' \equiv \frac{x}{p\beta}$ *and* $p > max\{\theta, 1-\theta\}$.

This proposition states that if the probability of the firm being highly profitable, p is sufficiently high, the partner is retained with a feasible share of the firm (i.e., $s^* < 1$). However, despite being feasible, the partnership organizational form may not be optimal for the firm owner if the partner's ability does not exceed the threshold y'. This is because the surplus generated by efficient task allocation in partnership as compared with the one delivered by a corporation, is not sufficiently large if workers are less productive than the threshold, and since the partner is compensated with a larger stake than the one she obtains in the frictionless case, the firm owner may not be willing to organize the firm as a partnership and run the firm as a relatively more inefficient corporation.

8.3 Wealth Constraints

So far I assumed that workers always have some wealth to pay for their stake in the firm. However, this is not always the case. Even when allowing for the possibility to save or borrow money, workers' wealth may be constrained by their own time preferences, or by some institutional factors in the economy generating credit constraints. Let $\omega > 0$ denote each worker's observable wealth when the firm owner offers partnership contracts. In order to focus on the most interesting case, I assume that $\omega < \theta\beta y^* = \theta x$.

In this scenario, when designing partnership contracts, the entrepreneur faces the following willingness-to-pay constraints:

$$\phi \leq min\{\omega,\, s\pi^p\} \tag{WTP}$$

and since from interim participation constraints the partner gets $s\pi^p = \theta\beta y$, for workers to be able to pay for their equity stake in the firm before becoming partners, the firm owner should offer the partnership contract $\{\phi^*, s^*\} = \{\omega,\, \theta\}$, thus leaving some rents to the workers who become partners, whose payoff is not the same as the one obtained when the firm is organized as a corporation. The following proposition states the conditions under which the entrepreneur finds it optimal to organize the firm as a partnership:

Proposition 7. *If the worker has disposable wealth $\omega \in (0,\, \theta x)$, the entrepreneur optimally organizes the firm as a partnership if the worker's ability is $y \geq y' \equiv \frac{x-\omega}{(1-\theta)\beta}$, with $y' \in (y^*, \hat{y})$. If instead $y < y'$, she organizes the firm as a corporation.*

Intuitively, when selling shares of the firm for the price $\phi^* = \omega$, the entrepreneur forgoes some of the rents form value creation in partnerships, as a consequence of efficient task allocation. As a consequence, the firm owner finds it less profitable to sell a share of the firm to workers with ability lower than the cutoff $y^{'}$ as the extra value their efficient task allocation generates is not sufficiently large to compensate for the discounted equity price she earns. Hence, in the presence of wealth constraints, the inefficiency in task allocation is solved only for the more productive workers, whilst it persists for the least productive ones.

This problem is even more severe when considering economies featuring sharp wealth inequality among workers. Potentially, the poorer ones, may not become partners because of this issue and thus waste their talent in inefficiently assigned tasks. This finding advocates for reducing credit constraints so as to allow young workers with little wealth to pursue their career paths and increase productive efficiency (a similar argument is made in Becker, 1964 when discussing the possibility for workers to pay for their on-the-job training).

In the presence of wealth constraints, the possibility for young workers to become partners may imply strong incentives for them to work hard in order to accumulate enough wealth to buy their stake in the company.

8.4 Heterogeneous firms

In the baseline model, all the firms competing in the labor market produce their output by means of an homogeneous technology. I now relax this assumption, by considering a case of duopoly in the labor market with two firms indexed $f = \{1, 2\}$. I assume that one of the two firms uses talent in a more productive way than the other, for instance because one firm uses a technology that fits better workers' talent than its opponent's. Namely, let $\beta_1 \leq \beta_2$, so that firm 2 is more productive than firm 1 when allocating any worker to task A.[20] This impacts workers' reservation wages at the interim stage, and the incumbent employer may need to pay too much to retain workers.

Proposition 8. *If firms feature heterogeneous production technologies so that $\beta_1 \leq \beta_2$ then:*

- *firm* 1 *assigns tasks less efficiently than firm* 2*;*
- *if $\theta \geq \frac{\beta_1}{\beta_2}$, the partnership organizational form is not feasible for firm* 1.

The intuition for this result is the following: since firm 2 is more productive than firm 1 for any level of workers' talent, the former needs to pay high retention wages, hence it optimally set the ability threshold for allocating workers on task A higher than the one with homogeneous firms. Moreover, if portability θ is sufficiently large, the partnership is not feasible, since prospective partners command excessively large shares of profit to stay within the company (i.e. $s^* > 1$). This because not only the competing firm is more productive than the incumbent employer, but also the share of human capital the worker can carry along upon departure is so large that it is impossible retaining her with a share of the realized profit.

[20]Heterogeneous productivity may be though of as firms' scale, or, for instance, as the size of their pools of client, so that for any given talent, firm 2 has more clients than firm 1 and therefore manages to expand more each worker's productivity.

To sum up, this result shows that only the most productive firms on the market (within and across industries) may be organized as partnerships, as they can provide reasonable shares of a large profit to retain partners. The least productive firms, instead, are organized as corporation and allocate tasks inefficiently across workers if the competitive pressure is too fierce due to high asset portability across firms. This increases the performance differential between firms organized as partnerships and those organized as corporations, as the least productive ones are steadily less efficient than the more productive ones and such difference becomes sharper if the most productive firms are organized as equity-partnerships and therefore implement the efficient task allocation.

9 Conclusions

This paper analyzes the impact of access to human capital and its portability on task allocation and on the design of organizations in competitive labor markets. First, I study a setting in which the representative firm is organized as a corporation, where one owner has control rights on task allocation. The acquisition of partially portable human capital in a firm may push the employer to behave opportunistically: in order to reduce retention costs, a profit maximizing firm will inefficiently allocate tasks across its employees. This result echoes those of a vast branch of the literature predicting inefficient allocation (or promotion) of valuable workers to reduce retention costs (Waldman, 1984; Greenwald, 1986; Bernhardt, 1995). This model's result differs from the ones in the existing literature as it is not driven by asymmetric information about employees' talent across firms, but by contract incompleteness and heterogeneous access to more or less portable human capital across tasks.

Organizing the firm as an equity-partnership can help implementing the efficient task allocation and allow the firm to generate higher profits with respect to when it is organized as a corporation. This prediction is driven by the fact that the commitment problem is solved by giving control and cash flow rights to some workers. This solution to the employer's holdup issue resembles the one of "vertical integration", described by Grossman and Hart (1986) and Hart and Moore (1990). These results provide a novel rationale for the widespread existence of partnerships in human capital-intensive industries, which by definition are more exposed to externalities from labor market competition since they do not own the key input for production. Furthermore, the model predicts that for a partnership to be stable (i.e. to retain partners at the interim stage), the profit may be shared via an "eat-what-you-kill" sharing rule, according to which partners are entitled to an increasing share of profits with respect to their productivity. This result is empirically relevant, as in the last few decades there's been a transition from lockstep-seniority compensation schemes to eat-what-you-kill.

However, the baseline model does not feature frictions that may impair firms' ability to organize as partnerships, thus I analyze some possible frictions making the partnership unstable (and therefore unfeasible) or not profitable for the firm owner, such as costly equity issuance probabilistic revenues, wealth constraints and productive heterogeneity. These are only some among many possible frictions that may make the partnership not desirable or inefficient.

I have assumed the human capital acquired on the task producing an outcome dependent on workers' ability to be the more portable ones. This assumption rests on the idea that a worker can carry along more of the output correlated with her talent from one firm to another. Alternative, if one thinks of clients as assets, they may obtain more information about the worker's talent when allocated to task A and therefore be eager to follow her would she change employer. However, the ordering of the portability rates of human capital acquired dealing with the two tasks could be reversed, and inefficiency would still hold but in the opposite direction: there would be too many workers dealing with the more talent-sensitive task, so that again efficient production is forgone in favor of profit maximization.

In the model analyzed, workers are risk-neutral and production is deterministic. Relaxing these assumptions will change equilibrium wages and incentives for workers to accept partnership contracts. In fact, salaried workers have limited liability, whereas partners do not (depending on the type of partnership one considers). Such a framework could be analyzed to deepen our understanding of the role of hybrid organizational structures such as *limited-liability partnerships*, in which some (or all) partners have limited-liability.

Finally, the model provides a partial equilibrium perspective of the partnership equilibrium, in order to focus on the shift of control rights within one organization. However, a general equilibrium analysis could provide broader predictions about the structure of entire industries and the demand for goods would also impact labor market competitiveness.

References

[1] Acemoglu, Daron, and Jorn-Steffen Pischke (1998) "Why Do Firms Train? Theory and Evidence", *Quarterly Journal of Economics*, 113 (February), 79-119.

[2] Acharya, Viral, And Paolo Volpin (2010) "Corporate Governance Externalities", *Review of Finance*, 14, 1-33.

[3] Aghion, Philippe and Jean Tirole (1997) "Formal and Real Authority in Organizations", *Journal of Political Economy*, 105, 1-29.

[4] Alchian, Armen A., and Harold Demsetz (1972) "Production, Information Costs and Organization", *American Economic Review*, 62, 777-795.

[5] Bar-Isaac, Heski, and Raphael Levy (2019) "Motivating Employees Through Career Paths", *Working Paper*.

[6] Becker, Gary (1964) "Human Capital. A Theoretical and Empirical Analysis with Special Reference to Education", Chicago and London, The University of Chicago Press.

[7] Bernhardt, Dan (1995) "Strategic Promotion and Compensation", *Review of Economic Studies*, 62, 315-339.

[8] Coff, Russel W. (1997) "Human Assets and Management Dilemmsa: Coping with Hazards on the Road to Resource-Based Theory", *Academy of Management Review*, 22 (2), 374-402.

[9] Ellingsen, Tore, and Eirik Gaard Kristiansen (2019) "Fair and Square: A Theory of Managerial Compensation", *working paper* .

[10] Farrell, Joseph, and Suzanne Scotchmer (1988) "Partnerships", *Quarterly Journal of Economics*, 103, 279-297.

[11] Garicano, Luis, and Tano Santos (2004) "Referrals", *American Economic Review*, 94 (3), 499-525.

[12] Gibbons, Robert (2005) "Four Formal(izable) Theories of the Firm", *Journal of Economic Behavior and Organization*, 58, 200-245.

[13] Greenwald, Bruce C. (1986) “Adverse Selection in the Labour Market”, *Review of Economic Studies*, 53, 325-347.

[14] Grossman, Sandford, and Oliver Hart (1986) “The Costs and Benefits of Ownership: A Theory of Lateral and Vertical Integration”, *Journal of Political Economy*, 94, 691-719.

[15] Groysberg, Boris, Linda-Eling Lee, and Ashish Nanda (2008) “Can They Take It With Them? The Portability Of Star Knowledge Workers' Performance”, *Management Science*, 54(7), 1213-1230.

[16] Groysberg, Boris (2010) “Chasing Stars. The Myth of Talent and The Portability of Performance”, *Princeton University Press* .

[17] Hansmann, Henry (2013) “Ownership and Organizational Form”, in *The Handbook of Organizational Economics*, edited by Robert Gibbons and John Roberts, Princeton University Press, 891-917.

[18] Hart, Oliver, and John H. Moore (1988): “Incomplete Contracts and Renegotiation,” *Econometrica*, 56, 755-786.

[19] Hart, Oliver, and John H. Moore (1990) “Property Rights and the Nature of the Firm”, *Journal of Political Economy*, 98, 1119-1158.

[20] Holmström, Bengt (1999) “Managerial Incentive Problems: A Dynamic Perspective”, in *Essays in Economics and Management in Honor of Lars Wahlbeck*, edited by Björn Walroos, Bo-Göran Ekholm, Alf-Erik Lerviks and Hendrik Meyer, Helsinki: Swedish School of Economics and Business Administration (1982) : 209-230. Republished in *Review of Economic Studies* 66, 169-182.

[21] Jovanovic, Bojan (1979) “Job Matching and The Theory of Turnover” , *Journal of Political Economy,* 87, 972-990.

[22] Kochan, Thomas, and Saul Rubinstein (2000) “Toward a Stakeholder Theory of the Firm: The Saturn Partnership”, *Organization Science*, 11 (4), 367-386.

[23] Lazear, Edward P., and Paul Oyer (2013) “Personnel Economics”, in *The Handbook of Organizational Economics*, edited by Robert Gibbons and John Roberts, Princeton University Press, 479-519.

[24] Lazear, Edward P., and Sherwin Rosen (1981) "Rank-Order Tournaments as Optimal Labor Contracts", *Journal of Political Economy*, 89 (5), 841-864.

[25] Levin, Jonathan, and Steven Tadelis (2005) "Profit Sharing and The Role of Professional Partnerships",*Quarterly Journal of Economics*, 120(1), 131-171.

[26] Milgrom, Paul and Sharon Oster (1987) "Job Discrimination, Market Forces and the Invisibility Hypothesis", *Quarterly Journal of Economics*, 102(3), 453-476.

[27] Moen, Espen R., and Åsa Rosen (2004) "Does Poaching Distort Training?", *Review of Economic Studies*, 71, 1143-1162.

[28] Morrison, Alan, and William Wilhelm Jr. (2004) "Partnership Firms, Reputation and Human Capital", *American Economic Review* 94 (5), 1682-1692.

[29] Morrison, Alan, and William Wilhelm Jr. (2008) "The Demise of Investment Banking Partnerships: Theory and Evidence", *The Journal of Finance* 63 (1), 311-350.

[30] Mukherjee, Arijit and Luis Vasconcelos (2012) "Star Wars: Exclusive Talent and Collusive Outcomes", *Journal of Law, Economics, and Organizations* 28 (4), 754–782.

[31] Mukherjee, Arijit and Luis Vasconcelos (2018) "On the Trade-off between Job Assignment and Efficiency in Turnover: The Role of Breakup Fees", *Journal of Law, Economics, and Organizations*, *forthcoming*

[32] Picariello, Luca (2019) "Promotions and Training: Do Competitive Firms set the Bar too High?", *Working Paper.*

[33] Rajan, Raghuram, ad Luigi Zingales (1998) "Power in a Theory of the Firm", *The Quarterly Journal of Economics* 113(2), 387-432.

[34] Rajan, Raghuram, ad Luigi Zingales (2001) "The Firm as a Dedicated Hierarchy: A Theory of the Origins and Growth of Firms", *The Quarterly Journal of Economics* 116(3), 805-851.

[35] Rebitzer, James B. , and Lowell J. Taylor (2006) "When Knowledge Is an Asset: Explaining the Organizational Structure of Large Law Firms", *IZA Discussion Paper*, No. 2353.

[36] Rosen, Sherwin (1972) "Learning and Experience in the Labor Market", *The Journal of Human Resources* 7(3), 326-342.

[37] Teece, David J. (2003) "Expert Talent and the Design of (Professional Services) Firms", *Industrial and Corporate Change*, 12(4), 895-916.

[38] Waldman, Michael (1984) "Job Assignments, Signaling and Efficiency ", *RAND Journal of Economics*, 15, 255-267.

[39] Waldman, Michael (1990) "Up-or-Out Contracts: A Signaling Perspective", *Journal of Labour Economics* , 8(2), 230-250.

[40] Williamson, Oliver (1975) "Markets and Hierarchies, Analysis and Antitrust Implications: A Study in the Economics of Internal Organization", *Free Press, NY.*

Appendix

Proof of Proposition 1

Proof. Consider the possibility for employer and employee to sign a contract in which the latter can commit not to leave the firm after task allocation. In this framework, at $t = 3$, workers are locked in and the firm can offer a fixed wage $w_2 = \bar{w}$. Namely, the firm pays workers' reservation wage regardless of task allocation. Now, by backward induction, consider task allocation. The employer matches workers to tasks to maximize her profit. To do so, she defines an ability threshold y^{**} for a worker to be allocated to task A. Namely, the allocative mechanism $\mathcal{A}(y)$ is such that tasks will be assigned as follows:

$$\mathcal{A}(y) = \begin{cases} \textit{Task A} & \forall\ y \in [y^{**}\ , \ \bar{y}], \\ \textit{Task B} & \forall\ y \in [\underline{y}\ , \ y^{**}). \end{cases}$$

The firm's expected profit is given by

$$\pi = \int_{y}^{\bar{y}} \beta y f(y) dy + F(y)x - \bar{w}. \tag{10}$$

The firm chooses the threshold as:

$$y^{**} \in \underset{\{y\}}{argmax}\ \pi \tag{11}$$

The first-order condition for the profit maximization problem is

$$f(y^{**})x - \beta y^{**} f(y^{**}) = 0$$

delivering the optimal threshold value

$$y^{**} = \frac{x}{\beta} = y^{*}. \tag{12}$$

Therefore the employer allocates all workers with ability $y \geq \frac{x}{\beta}$ to task A, and all the others to task B in a competitive equilibrium without labor market competition after task allocation.

Since the labor market is perfectly competitive at $t = 1$, the worker extracts all the expected surplus through w_1. ■

Proof of Proposition 2

Proof. Suppose the employer offers contracts $\{w_1\,,\, w_2(y)\,,\, i(y)\}$. These contracts will be:

$$\{w_1\,,\, \theta_A \beta y\,,\, A\}\ \ \forall y \in [y^*\,,\, \bar{y}] \tag{13}$$

and

$$\{w_1\,,\, \theta_B x\,,\, B\}\ \ \forall y \in [\underline{y}\,,\, y^*) \tag{14}$$

with $y^* = \frac{x}{\beta}$. Namely, the firm commits to allocate tasks efficiently.

In this case, at $t = 1$, the worker expects

$$\mathbb{E}[w_2(y^*)] = \theta_A \int_{y^*}^{\bar{y}} \beta y f(y) dy + F(y^*)\theta_B x \tag{15}$$

if the interim participation constraints bind in equilibrium. The ex-ante individually rational wage is instead

$$w_1(y^*) = (1 - \theta_A) \int_{y^*}^{\bar{y}} \beta y f(y) dy + F(y^*)(1 - \theta_B)x. \tag{16}$$

Notice that this allocation generates the highest surplus possible, so that, given labor market perfect competitiveness and the possibility for the firm to commit to task allocation upfront, only firms implementing the efficient task allocation will attract workers and be active. ■

Proof of Proposition 3

Proof. As in the proof for Proposition 1, the employer allocates workers across tasks so as to maximize her profit. To do so, she defines an ability threshold $\hat{y}$ for a worker to be allocated to task A. Specifically, the allocative mechanism $\mathcal{A}(y)$ is such that tasks will be assigned as follows:

$$\mathcal{A}(y) = \begin{cases} \textit{Task A} & \forall\ y \in [\hat{y}\ ,\ \bar{y}], \\ \textit{Task B} & \forall\ y \in [\underline{y}\ ,\ \hat{y}). \end{cases}$$

Solving the model by backward induction, first consider task allocation at $t = 3$. The firm maximizes its expected profit the threshold $\hat{y}$. It does so by taking into account both the "ex-ante" and the "interim" participation constraints. Therefore the maximization program is:

$$\underset{\{\hat{y} \in [\underline{y}\ ;\ \bar{y}]\}}{Max} \quad \pi = \int_{\hat{y}}^{\bar{y}} \beta y f(y) dy + F(\hat{y}) x - w_1 - \int_{\hat{y}}^{\bar{y}} w_2^A(y) f(y) dy - F(\hat{y}) w_2^B \tag{17}$$

subject to the *"ex-ante" participation constraint*

$$w_1 \geq \mathbb{E}(\pi) \tag{EAPC}$$

through which workers extract all the expected surplus generated and the *"interim" participation constraints* depending on task allocation:

$$w_2^A \geq \theta_A \beta y \tag{IPC_A}$$

$$w_2^B \geq \theta_B x \tag{IPC_B}$$

The interim participation constraints bind in equilibrium. By plugging these constraints in the objective function and maximizing with respect to $\hat{y}$, one gets the first-order condition:

$$(1 - \theta_A)\beta \hat{y} f(\hat{y}) - f(\hat{y})(1 - \theta_B)x = 0$$

yielding the equilibrium threshold:

$$\hat{y} = \frac{(1 - \theta_B)x}{(1 - \theta_A)\beta} \tag{18}$$

Comparing the profit maximizing threshold (18) with the efficient one (12) , since $\theta_B < \theta_A$, it is immediate to see that $\hat{y} > y^*$. This result is robust as it persists in the limit values of θ_A and θ_B.

At $t = 1$, workers earn the firm's expected profit, as

$$w_1 = (1 - \theta_A) \int_{\hat{y}}^{\bar{y}} \beta y f(y) dy + (1 - \theta_B) F(\hat{y}) x.$$

■

Proof of Lemma 1

Proof. Suppose the employer offers *up-or-out contracts* and sets the minimum wage to $w_2 = \theta_A \beta y^*$. Namely, when abilities become observable in the industry, workers whose productivity is lower than y^* will be laid off. All workers with talent $y \in [y^*, \bar{y}]$ are kept in the firm. All the employees that are kept in the firm are allocated to task A. Workers who would have been inefficiently allocated in the presence of a simple wage contract, are now paid the amount they produce outside the source-firm if allocated to task A. Furthermore, since the labor market is perfectly competitive, all workers will be paid their marginal productivity outside the source-firm when allocated to task A for the retention motive.

Note that I assume $w_2 = \theta_A \beta y^*$ as a performance requirement for a worker to be kept in the firm. This is because I study the "best" possible scenario, in which the threshold for the allocation of task A is efficient.

All workers with productivity $y \in [\underline{y}, y^*)$ are laid off. Hence, the firm needs to replace dismissed workers to also produce by means of task B. Two options are available: either hiring workers with unknown talent from the labor market or poaching workers working on task B in competing firms. Since the first would need a training period before being productive, it is more convenient for the firm to hire workers already trained by competing firms.

However, workers who were assigned to task B in a competing firm produce $\theta_B x$ outside of it. In order to poach them, the representative firm needs to pay their marginal productivity, so that the profit on task B will be zero. Hence, the firm is indifferent between producing or not by means of task B.

Hence, the expected profit at $t = 3$ in the presence of an up-or-out contract is

$$\pi_{UO} = \int_{y^*}^{\bar{y}} (1 - \theta_A)\beta y f(y) dy. \tag{19}$$

With this mechanism, the firm is substituting workers who would have produced x with others that will produce $\theta_B x$. Hence the loss in human-capital due to the up-or-out contract is

$$F(y^*)(1 - \theta_B)x > 0. \tag{20}$$

Since I assume $0 < \theta_B < \theta_A \leq 1$, implementing the efficient task allocation through an up-or-out policy, has a positive cost in terms of human capital.

Moreover, note that I assume $w_2 = \theta_A \beta y^*$, but this is not the optimal wage the firm would set in equilibrium. In fact, in order to maximize π_{UO}, the firm should set $w_2 = \theta_A \beta \underline{y}$ so that no worker would be laid off at $t = 2$, and all of them would be allocated task A. This is true if

$$\int_{y^*}^{\bar{y}} (1 - \theta_A)\beta y f(y) dy \leq \int_{\underline{y}}^{\bar{y}} (1 - \theta_A)\beta y f(y) dy. \tag{21}$$

This condition is satisfied since in the model $\beta y \geq 0$ for any $y \in [\underline{y}\,,\, y^*]$.

■

Proof of Proposition 4

Proof. The benefit from including an up-or-out clause in the labor contracts is denoted as Δ_{UO} and is given by

$$\Delta_{UO} = \pi_{UO} - \pi = \int_{y^*}^{\hat{y}} (1 - \theta_A)\beta y f(y) dy - F(\hat{y})(1 - \theta_B)x \tag{22}$$

where, π_{UO} is defined in equation (19) and π is the profit of the firm when simple wage contracts are in place.

From inequality (21) it is immediate to see that

$$\int_{y^*}^{\hat{y}} (1 - \theta_A)\beta y f(y) dy \leq \int_{\underline{y}}^{\hat{y}} (1 - \theta_A)\beta y f(y) dy. \tag{23}$$

and the result of the firm's profit maximization problem delivers the inequality

$$\int_{\underline{y}}^{\hat{y}} (1-\theta_A)\beta y f(y)dy \leq (1-\theta_B)F(\hat{y})x. \tag{24}$$

These two inequalities imply that $\Delta_{UO} < 0$. Hence, firms prefer offering simple wage contracts instead of up-or-out ones. This is true for any cutoff value chosen for up-or-out contracts.

■

Proof of Corollary 1

Proof. First, I will derive the optimal partnership contracts. To do so, I will solve the employer's problem in a general framework, namely by denoting w_c the wage prospective partners would get as employees in a corporation, and w_p the outside opportunity they get after becoming partners, so that the generic constraints are

$$\phi \leq s\pi^p - w_c \tag{WTP}$$

and

$$s\pi^p \geq w_p. \tag{IPC}$$

Thus, when contracting vis-a-vis with a prospective parnter, the firm owner's program when

$$\underset{\{\phi,s\}}{Max} \quad \phi + (1-s)\pi^p$$

subject to the WTP and the interim-participation constraints. Let λ_1 be the Lagrange multiplier associated to the WTP-constraints and λ_2 that associated to the IPC. The Lagrangean function for this problem is thus

$$\mathcal{L} = \phi + (1-s)\pi^p - \lambda_1(\phi - s\pi^p + w_c) + \lambda_2(s\pi^p - w_p).$$

The Kuhn-Tucker conditions for this maximization program yield:

$$\lambda_1 = 1 \Rightarrow \phi = s\pi^p - w_c$$

and

$$\lambda_2 \pi^p = 0 \Rightarrow \lambda_2 = 0 \Rightarrow s\pi^p \geq w_p.$$

On the one and, the WTP-constraint will bind in equilibrium, on the other hand, the interim-participation constraint may not bind. Let us now consider the case in which they do actually bind, then for partners working on task B, the share to be offered is

$$s = \frac{\theta_B x}{\pi^p} \tag{25}$$

which is constant, so that $\frac{\partial s(y)}{\partial y} = 0$.

On the other, hand for partners that will be allocated to task A, the owner needs to offer a share

$$s = \frac{\theta_A \beta y}{\pi^p} \tag{26}$$

which is increasing in y, namely, $\frac{\partial s(y)}{\partial y} > 0$.

∎

Proof of Lemma 2

Proof. I consider two cases:

1. <u>*Let $y_1 \in [\underline{y}\,,\, y_2]$ and $y_2 \in [y_1\,,\, y^*)$*</u>
   Proceeding by backward induction, at stage 4 of the game, partners and workers may leave. However the interim participation constraint for partners depends on task allocation which is given for granted at stage 4. Recall that we consider the case in which the interim-participation constraints bind in equilibrium, although all the results shown in this proof hold even if they do not. Given the segment of abilities considered, when choosing task allocation, partners will keep the same choice for salaried workers as in the case in which the firm is organized as a corporation.

   When choosing their own task assignment though, in order to maximize the firm's profit, partners choose:

$$max \left\{ \big[F(y_2) - F(y_1)\big]x\ ,\ \int_{y_1}^{y_2} \beta y f(y) dy \right\}.$$

Since y_1 and y_2 are smaller than y^*, all partners are more productive on task B. Moreover, given the linearity of the problem at hand, there is no profitable deviation from allocating all partners to the same task. Thus, the profit of the partnership will be

$$\pi^p = \left[F(y_1)+F(\hat{y})-F(y_2)\right](1-\theta_B)x+\int_{\hat{y}}^{\bar{y}}(1-\theta_A)\beta y f(y)dy+\left[F(y_2)-F(y_1)\right]x, \tag{27}$$

and the firm owner's problem when choosing whom to make partners is:

$$\underset{\{y_1\,,\,y_2\}}{Max} \quad \int_{y_1}^{y_2}\phi f(y)dy+\left(1-\int_{y_1}^{y_2}sf(y)dy\right)\pi^p$$

subject to:

$$\phi \leq s\pi^p(y_1\,,\,y_2)-\theta_B x \tag{WTP_B}$$

which binds in equilibiurm, and

$$s \geq \frac{\theta_B x}{\pi^p(y_1\,,\,y_2)} \quad \forall y \in [y_1\,,\,y_2] \tag{28}$$

also considered to be binding in equilibrium without loss of generality.

This implies that the owner offers the same partnership contract to each prospective partner: $\{\phi^*, s^*\} = \{0, \frac{\theta_B x}{\pi^p}\}$.

By substituting the optimal values ϕ^* and s^* in the owner's program, one can see that it becomes just

$$\underset{\{y_1\,,\,y_2\}}{Max} \quad \int_{\hat{y}}^{\bar{y}}(1-\theta_A)\beta y f(y)dy+F(\hat{y})(1-\theta_B)x=\pi.$$

Namely, the firm owner ends up maximizing the profit of the firm as a corporation, which is independent of the bounds of the y_P segment. She is indifferent on whom should be offered the partnership contract for all y_1 and y_2 smaller than y^*, as the surplus is unchanged.

2. *Let $y_1 \in [\hat{y}\,,\,y_2]$ and $y_2 \in [y_1\,,\,\bar{y})$*

In this case, all prospective partners would be assigned task A in a corporation as well as in a partnership. As in the previous case, all the salaried employees are allocated across tasks according to the same rule as in a corporation. The firm organized as a partnership generates a profit

$$\pi^p = F(\hat{y})(1-\theta_B)x + \int_{\hat{y}}^{y_1} (1-\theta_A)\beta y f(y)dy + \int_{y_2}^{\bar{y}} (1-\theta_A)\beta y f(y)dy + \int_{y_1}^{y_2} \beta y f(y)dy. \tag{29}$$

The employer's maximization problem is the same as in the previous case, except for the constraints which are

$$\phi \leq s\pi^p - \theta_A \beta y \ \forall\, y \in [y_1\,,\, y_2] \tag{WTP_A}$$

and

$$s \geq \frac{\theta_A \beta y}{\pi^p(y_1\,,\, y_2)} \ \forall\, y \in [y_1\,,\, y_2]. \tag{30}$$

I consider the case in which all the constraints bind in equilibrium, so that the optimal partnership contract offered to each prospective partner is $\{\phi^*, s^*\} = \{0, \frac{\theta_A \beta y}{\pi^p}\}$.

By substituting the optimal values into the owner's maximization program, one gets that again, the firm owner chooses prospective partners by solving :

$$\underset{\{y_1\,,\, y_2\}}{Max} \quad \int_{\hat{y}}^{\bar{y}} (1-\theta_A)\beta y f(y)dy + F(\hat{y})(1-\theta_B)x = \pi.$$

Similar to the previous case, making partners among the workers with ability $y \geq \hat{y}$ does not generate more surplus than the one generated in a corporation. Henceforth, the employer is indifferent about who shall be made partner in such pool of workers. Thus, the firm owner is indifferent between selling shares of the firm and running it as a partnership or adopting the corporation organizational form.

∎

Proof of Proposition 5

Proof. To prove this proposition, I consider three cases: first the case in which the firm owner selects the partners among those workers who would be inefficiently paired with tasks in a corporation. Then, I consider two alternative cases: one in which the lower bound of y^p is below y^* and one in which the upper bound of y^p is greater or equal to $\hat{y}$. These two last cases show that the firm owner makes at least all the workers with ability $y \in [y^*, \hat{y}]$ partners but then she is indifferent on whom to make partner among the other workers.

1. *Let $y_1 \in [y^*\,,\, y_2]$ and $y_2 \in [y_1\,,\, \hat{y})$*

   When task allocation is chosen, all salaried employees will be allocated to the same task as in a corporation. Hence, partners with ability $y \in [y^*, \hat{y})$ are allocated to tasks by choosing

   $$max\left\{\int_{y_1}^{y_2} \beta y f(y)dy,\ \big[F(y_2) - F(y_1)\big]x\right\}.$$

   For such segment of abilities, it will always be the case that

   $$\int_{y_1}^{y_2} \beta y f(y)dy > \Big[F(y_2) - F(y_1)\Big]x$$

   therefore, the profit of the partnership after task allocation will be

   $$\pi^p = \Big[F(y_1) + F(\hat{y}) - F(y_2)\Big](1-\theta_B)x + \int_{y_1}^{y_2} \beta y f(y)dy + \int_{\hat{y}}^{\bar{y}} (1-\theta_A)\beta y f(y)dy. \tag{31}$$

   And the employer chooses the bounds of y^p by solving the maximization program

   $$\underset{\{y_1\,,\,y_2\}}{Max} \quad \int_{y_1}^{y_2} \phi f(y)dy + \left(1 - \int_{y_1}^{y_2} s f(y)dy\right)\pi^p$$

   subject to:

   $$\phi \leq s\pi^p(y_1\,,\, y_2) - \theta_B x \ \ \forall\, y \in [y_1\,,\, y_2] \tag{WTP_B}$$

   and

   $$s \geq \frac{\theta_A \beta y}{\pi^p}\ \forall y \in [y_1\,,\, y_2]. \tag{32}$$

   Without loss of generality, I consider the case where all the constraints bind in equilibrium, so that the optimal partnership contract offered is

   $$\{\phi^*, s^*\} = \left\{\theta_A\beta y - \theta_B x,\ \frac{\theta_A\beta y}{\pi^p}\right\}.$$

Thus, the employer's maximization program boils down to

$$\underset{\{y_1\,,\,y_2\}}{Max} \quad \pi^p - [F(y_2) - F(y_1)]\theta_B x.$$

The first-order condition with respect to y_1 is

$$f(y_1)x - \beta y_1 f(y_1) = 0 \tag{33}$$

which is concave with respect to y_1, so that $y_1 = \frac{x}{\beta} = y^*$ is a maximum. The first-order condition with respect to y_2 is instead

$$\beta y_2 f(y_2) - f(y_2)x = 0. \tag{34}$$

The second derivative with respect to y_2 is positive, hence $y_2 = \frac{x}{\beta} = y^* = y_1$ is a minimum. Linearity of the problem, implies that the owner will pick the maximum value achievable $\hat{y}$ for y_2 in order to maximize the objective function: the firm owner strictly prefers making partners all the workers with ability $y \in [y^*\,,\,\hat{y})$.

In equilibrium the profit of the partnership is

$$\pi^p = F(y^*)(1-\theta_B)x + \int_{y^*}^{\hat{y}} \beta y f(y)dy + \int_{\hat{y}}^{\bar{y}} (1-\theta_A)\beta y f(y)dy. \tag{35}$$

Organizing the firm as a partnership instead of as a corporation increases the surplus at stake as the profit of the firm is increased by

$$\Delta\pi = \pi^p - \pi = \int_{y^*}^{\hat{y}} \beta y f(y)dy - \big[F(\hat{y}) - F(y^*)\big](1-\theta_B)x > 0. \tag{36}$$

2. *Let $y_1 \in [y^*\,,\,\hat{y})$ and $y_2 \in [\hat{y}\,,\,\bar{y}]$*

In this case, during the task allocation process, partners take into account the following:

$$max\left\{\int_{y_1}^{\hat{y}} \beta y f(y)dy\;,\;\big[F(\hat{y}) - F(y_1)\big]x\right\}+$$

and

$$max \left\{ \int_{\hat{y}}^{y_2} \beta y f(y) dy \ , \ \big[F(y_2) - F(\hat{y})\big] x \right\}. \tag{37}$$

Given the segment of abilities that are considered, it is better if all partners are allocated to task A. The profit thereby generated is

$$\pi^p = F(y_1)(1-\theta_B)x + \int_{y_1}^{y_2} \beta y f(y) dy + \int_{y_2}^{\bar{y}} (1-\theta_A)\beta y f(y) dy. \tag{38}$$

The employer's maximization program is the same as in the previous case and the willingness-to-pay constraints for prospective partners differ depending on their abilities:

$$\phi(y) \leq s\pi^p - \theta_B x \ \ \forall\, y \in [y^* \, , \, \hat{y}) \tag{WTP_B}$$

and

$$\phi(y) \leq s\pi^p - \theta_A \beta y \ \ \forall\, y \in [\hat{y} \, , \, \bar{y}]. \tag{WTP_A}$$

The interim participation constraints are instead equal for all prospective partners and deliver

$$s \geq \frac{\theta_A \beta y}{\pi^p} \ \forall y \in [y_1 \, , \, y_2]. \tag{39}$$

When all the constraints bind, the firm owner solves

$$\underset{\{y_1 \, , \, y_2\}}{Max} \quad \pi^p + \big[F(\hat{y}) - F(y_1)\big]\theta_B x.$$

The first-order condition with respect to y_1 for this problem is

$$f(y_1)x - \beta y_1 f(y_1) = 0 \tag{40}$$

yielding the maximizer $y_1 = \frac{x}{\beta} = y^*$. The first-order condition with respect to y_2 is instead

$$\beta y_2 f(y_2) - (1-\theta_A)\beta y_2 f(y_2) - \theta_A \beta y_2 f(y_2) = 0 \tag{41}$$

which implies indifference for the employer on which workers with ability $y \geq \hat{y}$ should be made partners.

If the firm owner chooses $y_2 = \hat{y}$, the increase in the realized profit with respect to the case in which the firm is organized as a corporation is

$$\Delta\pi = \int_{y^*}^{\hat{y}} \beta y f(y)dy + \int_{\hat{y}}^{\bar{y}} \theta_A \beta y f(y)dy - \big[F(\hat{y}) - F(y^*)\big](1-\theta_B)x > 0. \quad (42)$$

3. <u>*Let* $y_1 \in [\underline{y}\,,\,y^*)$ *and* $y_2 \in [y^*\,,\,\hat{y})$</u>

In this case, when choosing upon task allocation, partners select:

$$max\left\{\int_{y^*}^{y_2} \beta y f(y)dy\ ,\ \big[F(y_2) - F(y^*)\big]x\right\}$$

and

$$max\left\{\int_{y_1}^{y^*} \beta y f(y)dy\ ,\ \big[F(y^*) - F(y_1)\big]x\right\}.$$

Given the segment of abilities considered, the resulting profit for the partnership is

$$\pi^p = \big[F(y_1) + F(\hat{y}) - F(y_2)\big](1-\theta_B)x + \int_{y^*}^{y_2} \beta y f(y)dy +$$
$$+ [F(y^*) - F(y_1)\big]x + \int_{\hat{y}}^{\bar{y}} (1-\theta_A)\beta y f(y)dy. \quad (43)$$

The employer's maximizes her payoff in a partnership subject to the willingness-to-pay constraints for all partners

$$\phi \leq s\pi^p - \theta_B x \ \ \forall\, y \in [y_1\,,\,y_2] \quad (WTP_B)$$

and the interim participation constraints

$$s \geq \frac{\theta_B x}{\pi^p}\ \forall\, y \in [y_1\,,\,y^*) \quad (44)$$

and

$$s \geq \frac{\theta_A \beta y}{\pi^p}\ \forall\, y \in [y^*\,,\,y_2]. \quad (45)$$

If all the constraints bind in equilibrium, One gets the following maximization program:

$$\underset{\{y_1\,,\,y_2\}}{Max} \quad \pi^p - \big[F(y_2) - F(y_1)\big]\theta_B x.$$

This yields the first-order condition with respect to y_1

$$f(y_1)(1-\theta_B)x - f(y_1)x + f(y_1)\theta_B x = 0 \tag{46}$$

so that the owner is indifferent about where to set the lower bound for the segment y_P in the segment of ability where $y < y^*$. The first-order condition with respect to y_2 is instead

$$\beta y_2 f(y_2) - f(y_2)(1-\theta_B)x - f(y_2)\theta_B x = 0 \tag{47}$$

so the stationary value $y_2 = \frac{x}{\beta} = y^*$ is a minimum, given that the second derivative with respect to y_2 is positive. For the linearity of the problem, the owner selects $y_2 = \hat{y}$ as a maximizer.

Summing up, the owner is indifferent on how many workers should be made partners in the segment of abilities below y^*, but she wants to make all workers with ability between y^* and $\hat{y}$ partners.This result is in line with the one derived in the previous case.

If the firm owner chooses $y_1 = \underline{y}$, the increase in the profit realized in a partnership relative to the corporation is

$$\Delta\pi_3 = \int_{y^*}^{\hat{y}} \beta y f(y)dy + F(\hat{y})\theta_B x - \big[F(\hat{y}) - F(y^*)\big]x > 0 \tag{48}$$

■

Proof of Proposition 6

Proof. In order to prove this proposition, consider the optimal partnership contract $\{\phi^*, s^*\} = \left\{\theta\beta y,\, \frac{\theta}{p}\right\}$. Such contract is feasible and the partnership is stable if $s^* \leq 1$, which entails $\theta \leq p$. From the owner's perspective, instead, the partnership organizational form is preferred to corporation if

$$\phi^* + (1-s^*)\mathbb{E}(\pi^p) \geq \pi$$

given the set of abilities we take into account, the above inequality translates into the condition

$$p \geq \frac{x}{\beta y}. \tag{49}$$

Hence, the general requirement for partnership to be optimal and feasible is that

$$p \geq max\left\{\theta, \frac{x}{\beta y}\right\}. \tag{50}$$

Now, note that for $y \in [y^*, \hat{y})$, $\frac{x}{\beta y}$ ranges from 1 (when $y = y^*$), to $1 - \theta$ (when $y = \hat{y}$). I now consider two possible scenarios.

- Let $\theta \leq \frac{1}{2}$, then $\theta < 1 - \theta$, hence $\frac{x}{\beta y} > \theta \, \forall y \in [y^*, \hat{y})$. In this case, the relevant condition for partnership to be both feasible and optimal is that $p \geq \frac{x}{\beta y}$, which depends on the prospective partner's talent, namely the condition is met if $y \geq \frac{x}{p\beta} \equiv y'$. Since $p \in (0, 1)$, then $y' > y^*$; moreover, we need $p > 1 - \theta$, to obtain $y' < \hat{y}$, otherwise the firm owner will never prefer partnership to corporation. Now, since $\theta \leq \frac{1}{2}$, then $\theta < 1 - \theta$, hence, the conditions for partnership to be optimal and feasible are that $p > 1 - \theta$ and that $y \geq y'$.

- Let $\theta > \frac{1}{2}$, then there exists a threshold y^θ such that

  $$\theta \geq \frac{x}{\beta y} \; \forall \; y \geq y^\theta \equiv \frac{x}{\theta \beta}.$$

  Notice that since $\theta \in (1/2, 1)$, the threshold is such that $y^\theta \in (y^*, \hat{y})$. Henceforth, for any $y \geq y^\theta$, the condition for partnership to be feasible and optimal is that $p > \theta$. Differently, for any $y < y^\theta$, the partnership organizational form is feasible and optimal if the worker has talent $y \geq y'$, however, it needs to be checked that $y' < y^\theta$ and this is true only if $p > \theta$. Therefore, the conditions for partnership to be feasible and optimal in this scenario are that $p > \theta$ and that $y \geq y'$.

  To sum up the results obtained in the two scenarios, the talent cutoff is the same irrespective of θ, whereas, p needs to exceed the greater amount between θ and $1 - \theta$.

■

Proof of Proposition 7

Proof. To prove the proposition, first recall that the firm owner's maximization program when designing partnership contracts is

$$max_{\{\phi,\, s\}} \phi + (1-s)\pi^p$$

subject to:

$$\phi \leq \omega,$$

$$s\pi^p \geq \theta \beta y.$$

Since I consider the case in which both constraints binds in equilibrium and the worker has talent $y \in [y^*, \hat{y})$, she will be optimally assigned task A, and therefore $\pi^p = \beta y$, the optimal contract is $\{\phi^*, s^*\} = \{\omega, \theta\}$. The worker definitely accepts such contract as it yields him a strictly larger payoff than zero (the wage she gets from being allocated task B in a corporation). The firm owner instead gets an equilibrium payoff

$$\omega + (1-\theta)\beta y, \tag{51}$$

whereas, by organizing the firm as a corporation, she earns x. Hence, the firm owner prefers the partnership organizational form over the corporation one, if

$$\omega + (1-\theta)\beta y \geq x \iff y \geq \frac{x-\omega}{(1-\theta)\beta} \equiv y'.$$

Finally, since we assume that $\omega < \theta x$, it is immediate that $y' > y^*$, and since $\omega > 0$, $y' < \hat{y}$.

■

Proof of Proposition 8

Proof. First, I show that the two firms have different promotion threshold. The efficient thresholds for firm 1 and firm 2 are respectively $y_1^* = \frac{x}{\beta_1}$ and $y_2^* = \frac{x}{\beta_2}$. The profit maximizing thresholds, instead, are $\widehat{y_1} = \frac{x}{(\beta_1 - \theta\beta_2)}$ and $\widehat{y_2} = \frac{x}{(\beta_2 - \theta\beta_1)}$.

It is immediate to see that $y_1^* > y_2^*$ and that $\widehat{y_1} > \widehat{y_2}$, but in order to prove the claim that firm 2 allocates tasks more efficiently than firm 1, we need to show that

$$\widehat{y_1} - y_1^* > \widehat{y_2} - y_2^*.$$

By substituting for the values of the thresholds, the above condition becomes

$$\left(\frac{\beta_2}{\beta_1}\right)^2 > \frac{\beta_1 - \theta\beta_2}{\beta_2 - \theta\beta_1}. \tag{52}$$

Since $\beta_2 > \beta_1$, the left-hand side of (52) is larger than 1, whereas the right-hand side is smaller than 1, so the inequality is certainly met. This proves the claim that firm 2 allocates tasks relatively more efficiently than firm 1.

I now check whether the partnership organizational form is feasible for firm 1: the firm owner maximizes her payoff

$$\phi + (1 - s)\pi^p$$

subject to the WTP-constraint

$$\phi \leq s\pi^p$$

and the interim participation constraint

$$s\pi^p \geq \theta\beta_2 y.$$

Since $\pi^p = \beta_1 y$ and the two constraints bind in equilibrium, the optimal partnership contract is $\{\phi^*, s^*\} = \left\{\theta\beta_2 y,\ \frac{\theta\beta_2}{\beta_1}\right\}$.

The optimal share s^* to insure the partnership's stability, is feasible (i.e., $s^* < 1$) if $\theta < \frac{\beta_2}{\beta_1}$ and is not otherwise. Hence, when firms are heterogeneous, the less productive ones can afford being organized as partnerships, only if the portability rate of the human capital acquired on task A is not too large, otherwise, they should pledge more than the whole profit generated to retain the partner at the interim stage.

■