Task Discretion, Labor-market Frictions, and Entrepreneurship†

Andrea Canidio
IMT School of Advanced Studies

Patrick Legros*
Université libre de Bruxelles (ECARES), Northeastern University and CEPR

An agent can perform a job in several ways, which we call *tasks*. Choosing agents' tasks is the prerogative of management within firms, and of agents themselves if they are entrepreneurs. While agents' comparative advantage at different tasks is unknown, it can be learned by observing their performance. However, tasks that generate more information could lead to lower short-term profits. Hence, firms will allocate workers to more informative tasks only if agents cannot easily move to other firms. When, instead, workers can easily move to other firms, agents may prefer to become entrepreneurs and acquire task discretion, even if their short-term payoff is lower than employees. Our model generates novel predictions with respect to, for example, how the wage dynamics of agents who switch between entrepreneurship and employment are affected by labor and contracting frictions. (*JEL* D83, J24, J62, J63, L26, M13).

Key words: Task discretion; organizational choice; entrepreneurship; labor-market frictions; entrepreneurial failure; learning.

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*Université libre de Bruxelles, ECARES, 50 Ave FD Roosevelt, CP114-04, 1050 Brussels, Belgium. Email: Patrick.legros@ulb.be. We are grateful to Carlos Casso Dominguez for excellent research assistance. We are also grateful to Chris Avery, Raul Baptista, Werner Bönte, Jing-Yuan Chiou, Roberta Dessi, Robert Gibbons, Denis Gromb, Thomas Hellmann, Andrea Mantovani, Massimo Riccaboni, Marko Terviö, Peter Thompson, John van Reenen, Michael Waldman, Timothy van Zandt, conference participants at the CEPR Workshop in Entrepreneurship Economics, the Annual Searle Center Conference on Innovation Economics, the 2018 ASSA meetings, the Organizational Lunch Workshop at MIT, the ZEW Conference on the Dynamics of Entrepreneurship, as well as seminar participants at the University of Montréal, INSEAD, and HEC Paris. We gratefully acknowledge the financial support of the European Research Council under the European Union's Seventh Framework Programme (FP7/2007-2013/ERC grant agreement n339950).

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1. Introduction

The literature on property rights has long argued that contracting frictions may prevent the efficient allocation of inputs within production units (Grossman and Hart 1986). An overlooked implication is that, if the allocation of residual decision rights differs across occupations, then contractual frictions may lead to misallocation of inputs also across occupations. Motivated by this observation, we study how contractual frictions affect agents' sorting between occupations, and then, within each production unit, between different ways of doing a job, which we call *tasks*. We do so by building a two-period model in which agents first sort between employment in a firm and entrepreneurship, and then between one of two tasks. Agents' productivity at different tasks, that is, their talent, is unknown but can be learned by observing their performance at a task, with some tasks being more informative than others. However, task allocation is not contractible. As in the property rights literature, task allocation is chosen by owners or management within firms, and by agents themselves if they are entrepreneurs.

Examples of noncontractible tasks informative about talent are plentiful. A contract with a scientist defines the objective of the research (e.g., find a cure for Alzheimer's) but not the exact experimental design, even if the experimental design may reveal the scientist's comparative talent at following well-established or unusual research paths. Contracts with new managers rarely specify the identity and behavior of the people under their authority, and of the people who have authority over them. As a consequence, contracts do not specify the extent to which the managers will be able to delegate or centralize decisions. Delegating or centralizing decisions may, however, reveal the managers' comparative advantage at different styles of management.

As an initial result, we characterize a novel motive for entrepreneurship: we show that agents may turn entrepreneurs to gain task discretion and learn their talent. This motive resembles the well-documented "be one's own boss" motive (see e.g., the survey by Stephan et al. 2015). Importantly, though, we do not assume that individuals have an intrinsic benefit from task discretion, or from being their own boss. Becoming an entrepreneur to acquire task discretion is beneficial if, and only if, learning is inefficiently low in firms. This in turns depends on the level of labor-market frictions which, in the model, is inversely related to the probability that an agent will receive an external wage offer. As this probability decreases, firms are more likely to allocate their employees to informative tasks because they capture part of the benefit of learning their workers' comparative advantage. It follows that agents are less likely to become entrepreneurs to gain task discretion when labor-market frictions are high.

The novelty of our model lies, therefore, in connecting contracting and labor-market frictions, with both firms' internal organization and agents' career choice.[1] Doing so generates a number of interesting results.

For example, the level of labor-market frictions determines the productivity of former entrepreneurs relative to former workers, and hence to their respective wage dynamics. When labor-market frictions are low, because of contracting frictions learning will be inefficiently low in firms, and some agents will become entrepreneurs to learn their talents. As a consequence, in the following period, if these agents decide to switch occupation, they will earn a higher wage than former workers; that is, there is a positive wage premium for former entrepreneurs. On the other hand, if labor-market frictions are high, learning will occur within firms despite the presence of contracting frictions. Agents may choose entrepreneurship if they have a very valuable business idea or if they fail to find a job. These agents are less likely than workers to choose an informative task allocation, leading to a negative wage premium for former entrepreneurs.

Also, it is possible that, as the labor market becomes more efficient, fewer agents are hired by firms and more of them become entrepreneurs. The reason is that, as labor-market frictions decrease, firms' organization will change, reducing the probability of learning within firms and making entrepreneurship more appealing. This result is consistent with a rough comparison between the United States and the European Union (EU). By most estimates, labor-market frictions in continental Europe are significantly higher than in the United States.[2] Consistent with our theoretical mechanism, the United States has a higher rate of entrepreneurship than the EU (see, e.g., the Global Entrepreneurship Monitor 2015/16 Global Report).[3] Also, US firms tend to give less task discretion to their workers than EU firms; according to OECD (2013), the United States ranks 14th among 22 nations in terms of task discretion within firms that is below most European countries.[4]

1. The connection between contracting frictions and labor-market frictions with organizational choice has been noted before. For example, in Acemoglu and Pischke (1999), in the presence of contracting frictions, as labor-market frictions increase firms become more likely to invest in generic human capital. Here we point out that these changes in organizational structure have implications for career choice. Note also that there are ways other than task allocation in which firms' organizational choice affects talent discovery. For example, in Meyer (1994) the organizational choice affecting talent discovery is how to form teams.

2. Close to our measure of labor-market frictions, Ridder and Berg (2003) estimate the rate of arrival of job offers to employed workers for the United States, France, UK, Germany, and Holland; they show that, with the exception of the UK, European countries have a rate of job arrival significantly lower than in the United States; Layard et al. (2005) find a similar ranking among countries when looking at the arrival rate of job offers to unemployed workers.

3. Available at http://www.gemconsortium.org/report/49480.

4. In this study, the variable *task discretion* is defined, as in our model, as "Choosing or changing the sequence of job tasks, the speed of work, working hours; choosing how to do

Relative to the existing literature (which we discuss in detail below), our main methodological innovation is to assume that agents sort across occupations, each bundled with different decision rights. This is in sharp contrast with existing papers that study how learning determines wage dynamics and career paths *within* an occupation but across heterogeneous firms (see, e.g., Papageorgiou 2013; Pastorino 2019, both discussed in greater detail below). Instead, we assume that firms are identical and focus on occupational choice and wage dynamics *across* occupations, for example, how former entrepreneurs fare with respect to past workers when they go back to employment.

The rest of this paper proceeds as follows. The next section discusses the relevant literature. In Section 3, we introduce the model. In Section 4, we analyze how task allocations influence learning and future probabilities of success. We derive the equilibrium of the model in Section 5. In Section 6, we present additional results relative to the career path of workers and entrepreneurs. Section 7 is the conclusion. Unless otherwise stated, all mathematical derivations are in Appendix A. In appendixes B and C, we relax some of our assumptions.

2. Relevant Literature

We contribute to the literature on occupational choice, learning in the labor market, entrepreneurial failures, and incentives for experimentation.

2.1 Co-Determination of Organizations and Occupational Choices

Other models in which organization and occupational choice are simultaneously determined are Hellmann (2007) and De Bettignies and Chemla (2008), who study how intellectual protection determines whether innovation occurs within or outside firms. When employees own their inventions, their incentive to innovate increases, and with it the incentive to develop this innovation as an entrepreneur, outside the firm . The firm's optimal response may be to allow the worker to develop the innovation internally as an "intrapreneur." De Bettignies and Chemla (2008) also find that as the returns to entrepreneurship increase, firms become more likely to engage in corporate venturing. We focus instead on contracting and labor-market frictions as determinants of both entrepreneurial activity and firms' organizational structure.

2.2 Occupational Choices

We introduce learning agents' comparative advantages at different tasks as a driver of organizational and occupational choice. We, therefore, complement the literature on occupational choice initiated by Banerjee and Newman (1993) and Galor and Zeira (1993) that has considered financial

the job." The study is available at https://read.oecd-ilibrary.org/education/oecd-skills-outlook-2013_9789264204256-en, see in particular Figure 4.2.

frictions as a key determinant of career choices. Closer to our focus on learning, the literature initiated by Vereshchagina and Hopenhayn (2009) studies the choice between wage work and entrepreneurship, under the assumption that the return on entrepreneurship is uncertain but can be learned. Manso (2016) and Dillon and Stanton (2017) in particular show that the instantaneous payoff for entrepreneurs may be lower than that for comparable workers. This happens because entrepreneurs can always go back to wage work after having learned their entrepreneurial returns, and hence some agents are willing to "try out" entrepreneurship even if their returns are expected to be low. In our model, instead, agents learn their comparative advantage at different tasks, and by doing so increase their productivity at all possible occupations. Hence, by becoming entrepreneurs, agents learn their overall ability rather than their entrepreneurial ability. This has novel empirical implications relative to, for example, the wage paid by firms to former entrepreneurs, which could be above or below that of former workers, depending on the severity of labor-market frictions (see Section 6.1).

In this respect, our work relates to Hincapié (2020), who considers a model in which agents are risk averse and performance as a worker is informative with respect to entrepreneurial ability (and vice versa). The model is then estimated using US data, leading to a number of interesting results. For example, an agent may want to work for a few years before becoming an entrepreneur, which rationalizes the observation that most entrepreneurs start when they are in their mid-thirties (instead of at the beginning of their career). For our purposes, Hincapié (2020) finds a positive wage premium for entrepreneurs returning to wage work (provided that the entrepreneurial spell was long enough and that the agent returns to white collar work). This is in line with our model for the case of low labor-market frictions. We show, however, that the entrepreneurial wage premium may be negative when labor-market fictions are large (again, see Section 6.1).

2.3 Talent Discovery in the Labor Market

Starting from Jovanovic (1979), a large body of literature has studied the implications of learning for career paths and wage dynamics. In two pioneering papers, MacDonald (1982a, 1982b) analyzes a task-assignment problem with symmetric uncertainty about talent, a frictionless labor market, and employment as the unique occupation. Gibbons and Waldman (1999, 2004) develop within-firm task assignment models in which there is learning about an agent's talent via task allocation, and also task-specific human capital accumulation. Terviö (2009) argues that cash constraints and the absence of long-term (LT) contracting prevent optimal talent discovery, in the sense that jobs will not reveal the productivity of the worker. Antonovics and Golan (2012) address experimentation, defined as choosing a job where, relative to other jobs, the expected probability of success is low but where the outcome is strongly correlated with the agent's type. Pastorino (2019) estimates a labor-market model in which firms generate information about their workers via task assignment, and measures the importance of learning relative to human capital accumulation in explaining cumulative wage growth and wage dispersion. In Canidio and Gall (2019) the rate of on-the-job talent discovery depends on the task allocation chosen within firms, which may be inefficient.

Within this literature, Papageorgiou (2013) is the most closely related to our work because it considers labor-market frictions, and studies how it affects talent discovery. His model assumes that firms use only one task and cannot choose their internal organization. In his framework, agents must move *between* firms to discover their comparative advantage. Hence, as labor-market frictions increase, mobility decreases and the rate of talent discovery must decrease. This is not always true in our model because agents can learn *within* firms, and more severe labor-market frictions enhance learning in firms. Also related is Bruenner et al. (2019) who study how the incentive to learn one's talent is affected by the structure of the labor market (i.e., whether the labor market is competitive or monopsonistic). They consider a two-period model in which agents first learn (in a stage i.e., interpreted as education) and then work. They show that a competitive market creates more incentives to learn because a larger fraction of the benefit of learning is earned by the agent. Here instead we are interested in learning on the job: how performing a job in different ways (which we interpret as tasks) may generate information relative to the agent's talent.

All the above papers consider a single occupation, and hence study how learning affects wage dynamics within an occupation. The main novelty of our work compared to this literature is that, in our model, agents can switch occupation and become entrepreneurs. Our focus is on how learning affects occupational choices and wage dynamics *across occupations*.[5]

2.4 Value of Failures

It is a common assumption in the economic literature that failures provide bad news about the expected productivity of an agent. Prominent examples in the literature on entrepreneurship are Gromb and Scharfstein (2002) and Landier (2005), who build equilibrium models in which an entrepreneurial failure always produces a stigma, which may be more or less pronounced depending on some features of the economy.[6] On the

5. An important observation is that our paper assumes symmetric uncertainty (as do all those discussed above). Bar-Isaac et al. (2020) instead assume asymmetric information. In that model, the selection of workers into different sectors is driven by adverse (or sometimes advantageous) selection.

6. In Gromb and Scharfstein (2002), failed entrepreneurs are hired by firms. Because of exogenous noise, failing in a start-up is not as bad a signal as being fired as a manager, and firms will replace failed managers with failed entrepreneurs. Landier (2005) shows that when failures are widespread, they reveal little information regarding the entrepreneur's type and hence there is a high level of entrepreneurship. When failures are rare, they carry a

other hand, many business leaders and scholars share Henry Ford's view that a failure "is only the opportunity to begin again more intelligently." For example, the *Harvard Business Review* dedicated an entire issue to failures and how they led to business success ("Failure Chronicles," April 2011). A book by the journalist Tim Harford, *Adapt: Why Success Always Starts with Failure*, summarizes well this positive attitude in the business world toward entrepreneurial failures.

Our model shows that the *nature of talent* affects the value of entrepreneurial failures. Talent can be *horizontal*—different agents have an absolute advantage at different tasks, or *vertical*—the same agents have an absolute advantage at all tasks. We show that failure can be good news or bad news depending on the level of labor-market frictions only if talent is horizontal. If instead talent is vertical, failure is always bad news. As we will see, the available empirical evidence provides support to the horizontal view.

2.5 Experimentation and Incentives

The literature on experimentation and incentives (Jeitschko and Mirman 2002; Manso 2011; Drugov and Macchiavello 2014; Gomes et al. 2016) focuses on how to design a contract that motivates an agent to experiment. In contrast, in our model the contracting friction is that firms cannot commit to allocating a worker to a given task. Hence, our focus is on how to design a contract that motivates a firm to experiment.

Finally, at the core of our model there is a tradeoff between short-run profit maximization and learning. This tradeoff has been extensively studied by the literature on multi-armed bandit problems, and is therefore neither new nor specific to our model. This literature typically assumes that the arms are independent; success or failure at one arm is not informative with respect to the other arm. Hence, failure always reduces the probability of future success. This case is therefore equivalent to the vertical talent case. But there is also a small literature studying negatively correlated arms, which is equivalent to our horizontal talent case (see, for instance, Klein and Rady 2011). This last case better matches the empirical evidence related to the value of entrepreneurial failure (see Section 6.2).

3. The Model

The economy is composed of a finite set of risk-neutral agents and a finite set of at least two identical firms competing for workers. Agents live for two periods $t \in \{1, 2\}$, and can be of type $\theta \in \{l, h\}$, where l stands for low and h for high. Agents' types are *not* observable by agents or firms. The common initial belief about a young agent's type is $\text{pr}\{\theta = h\} = p_1$.

greater stigma and deter entrepreneurship. See also Schumacher et al. (2015) for a related model.

3.1 Production and Returns

At the beginning of each period, each agent gets an idea about a project $k_t \geq 0$, drawn from a distribution $F(k_t)$. The support of the distribution of projects is convex and has a lower bound at 0. It may or may not have an upper bound, but if it has one, the upper bound must be greater than 1.

In each period $t \in \{1,2\}$, an agent can become either an entrepreneur or a worker. In each occupation, an agent can succeed ($s_t = 1$) or fail ($s_t = 0$). An entrepreneur pursues a project that generates a monetary return k_t in case of success and 0 in case of failure.[7] A worker instead works on an "off-the-shelf" project that generates a monetary return equal to 1 in case of success and 0 in case of failure. Hence, in each period, with probability $1 - F(1) \geq 0$ individuals can improve on the "off-the-shelf" project available within firms, while with probability $F(1)$ these individuals will not be able to do so.

In each period t and in both occupations, an agent can work either on an *A*dvanced task ($\tau_t = A$) or a *B*asic task ($\tau_t = B$). The probability of success depends on the agent's type and the task chosen[8]:

τ θ	l	h
B	l_B	h_B
A	l_A	h_A

When individual agents are assigned to the task at which they are most likely to succeed, high types have an advantage over low types:

$$\max(h_A, h_B) \geq \max(l_A, l_B). \tag{1}$$

To avoid trivialities, we assume that individuals have different comparative advantages, high types being better at the advanced task while low types are better at basic tasks:[9]

7. We therefore prevent entrepreneurs from working on "old" ideas. The alternative would be, in each period, to allow entrepreneurs to work on old projects as well, so that the value of an entrepreneurial success in period 2 is $\max\{k_1, k_2\}$. Under this assumption, on average entrepreneurial projects become better over time. This will actually strengthen our results because the benefit of becoming an entrepreneur to learn one's comparative advantage increases. The distribution of entrepreneurial returns is, however, non-stationary, thereby complicating our derivations.

8. Note that the specification allows for a task to be uninformative (for instance $l_B = h_B$). In a previous version of the model we considered the possibility of a third type of agent who is "bad" at all tasks, but this extension complicated the analysis without bringing additional insights (if there is a minimum productivity threshold for an agent to be hired, then some agents may be unemployable, but otherwise the task allocation problem of employable agents is the same as in the current specification).

9. If this is not the case, then there is a task that maximizes the probability of success of both types, and no firm or entrepreneur will pursue the other task since learning has no value for task allocation.

$$h_A - h_B > 0, \; l_B - l_A > 0. \tag{2}$$

For instance, some agents may excel at finding creative solutions to a new problem but will be unproductive at following strict orders; others flourish and can be creative in a team environment but will be low performers in isolation. The environment described in equations (1) and (2) is a discrete version of MacDonald (1982a, 1982b) and is consistent with the following two perspectives of talent.

- (**Vertical talent**) If $h_B \geq l_B$, the probability of success at both tasks is at least as large for type h as for type l. Hence types can be ranked in terms of productivity. High types have an absolute advantage over low types: they have higher "quality," regardless of the task they are working on. This is the usual interpretation of talent as a vertical dimension.
- (**Horizontal talent**) When $h_B < l_B$, high-type agents have a greater probability of success only if assigned to the advanced task A. Otherwise, if assigned to the basic task, a high type agent is in fact less successful than a low type agent. Talent is *horizontal* rather than vertical, and it is not possible to rank types in terms of productivity unless the task assignment is defined.

3.2 Contract Offers

We confine our attention to short-term contracts. In every period, a contract consists of a fixed payment f and a bonus payment b contingent upon success. We make the following assumptions on the contracting environment.

Assumption 1.

(i) *Output is not fully contractible; the bonus is strictly bounded above by the monetary return of the firm, that is* $b \leq \beta < 1$.
(ii) *Task allocation within firms is observable but not contractible.*

We interpret the parameter β in (i) as an index of contract completeness. A familiar micro-foundation for this bound is the possibility for the owners of a firm to "run away" and capture a proportion $1 - \beta$ of the monetary return, which implies that bonus payments with a share of monetary returns greater than β are not incentive compatible. Since $\beta < 1$, a worker and a firm cannot sign a contract that leaves the firm completely indifferent to success or failure.

Part (ii) of the assumption implies that contracts cannot be made contingent upon task allocation. This is consistent with the modern literature on delegation, which emphasizes that ownership restricts the ability not to interfere with other agents' decisions, in particular in the context of the delegation of tasks (Aghion and Tirole 1997; Baker et al. 1999). Of course, in a specification of the model with more than two tasks, it may be possible to contract over sets of tasks (e.g., different sets of task may require different locations, and location may be contractible). Such an extension would not change our results.

Restricting our investigation to short-term contracts and observable task allocations simplifies the analysis but is not essential. In Appendix B, we consider the case of unobserved task allocation, and show that our results hold in this case as well. In Appendix C, we introduce the possibility of using long-term contracts. Not surprisingly, long-term contracts improve the value of entering into an employment relationship. Despite this, if contracting frictions are sufficiently severe (in the sense that β is sufficiently low), then the equilibrium with long-term contracts is identical to that with short-term contracts.

3.3 Labor-Market Frictions

We introduce labor-market frictions in a stark way, assuming that agents receive no offer from firms with probability $1 - \alpha$, and receive some offers with probability α. For technical reasons, we also assume that when agents who were not previously employed receive a wage offer, they receive at least two wage offers.[10] This would be the case, for instance, if there is a central place where all vacancies are posted and an agent has access only to an imperfect search technology.

3.4 Timing

In period $t = 1, 2$, the timing is as follows:

(1) Each agent draws his entrepreneurial project k_t (i.i.d. among agents). For ease of derivation, we assume that k_t is publicly observable.[11]
(2) All firms simultaneously offer contracts to all agents.

10. If the probability of such an agent receiving a single offer is positive, firms can design their contracts knowing that there is a small probability that they might have monopsony power over the agent. This significantly complicates the firm's problem but does not modify our qualitative results. As we will see, this problem does not arise when a firm sends an offer to an agent who was previously employed. The reason is that agents can always continue an employment relationship, which implies that all other firms compete with the agent's former employer.

11. The observability of k_t plays a role only if an agent is hired by a firm in period 1 and does not receive any wage offer in period 2, in which case the worker and the former employer need to share the surplus generated by continuing the employment relationship. This surplus depends on the agent's outside option, which is entrepreneurship. Assuming that the value of entrepreneurship is observable prevents inefficient bargaining failures. Equivalently, we could assume that k_t is private information but can be disclosed, in which case a standard unraveling logic implies that, in equilibrium, workers who wish to continue an employment relationship in the absence of an outside offer will disclose k_t to their former employer. If instead k_t is unobservable and cannot be credibly disclosed, then there is the possibility of a bargaining failure; that is, in period 2, an agent may leave a company to become an entrepreneur even if $k_2 < 1$. This will constitute an additional motive for entrepreneurship.

(3) **If t = 1**: Agents who receive an employment offer choose between accepting the offer and being an entrepreneur. Agents who do not receive an employment offer become entrepreneurs.
(4) **If t = 2**: Agents who receive an employment offer choose between accepting the employment offer, continuing to work for their old employer (if the agents were employed in period 1), and being entrepreneurs. For agents who do not receive an employment offer, their career choice depends on their previous occupation. Former entrepreneurs who do not receive an offer remain entrepreneurs. Former workers who do not receive an offer choose between entrepreneurship and continuing to work for their former employers. In this last case, their wage is determined by a take-it-or-leave-it offer made by their former employer.[12]
(5) After a contract is signed, each firm chooses tasks for its workers. Entrepreneurs choose their own task.
(6) Outcomes (success or failure) are realized and observed by everybody.[13] In case of success, a firm's output is 1, while an entrepreneur's output is k_t.

Hence, the main difference between the two periods is the possibility of continuing an employment relationship.

3.5 Equilibrium

We derive the subgame-perfect equilibrium of the game. We do so by backward induction. In terms of strategies, in the second period, each firm offers contracts to all agents who were not already their employees in period 1. Firms also offer contracts to their former workers who did not receive outside offers. After receiving all offers, each agent chooses the occupations that maximize his period-2 payoffs.

In period 1, firms offer contracts to all agents. Agents then choose the occupation that maximizes their lifetime utility—that is, the sum of period-1 and period-2 payoffs.

3.6 Efficiency benchmark

In what follows, we compare the equilibrium outcome with an efficiency benchmark in which the agent's talent is unknown and there are labor-market frictions, but there are no contracting frictions. In other words,

12. All our results are robust to other assumptions, provided that some of the surplus generated by continuing the employment relationship is captured by the firm. The change in bargaining power of the firm from the *ex ante* to the *ex post* stage is in the spirit of the "fundamental transformation" of Williamson (1979).

13. The fact that entrepreneurial success or failure is observable is undisputed. Observability of output within firms is a common assumption in the career-concerns literature (see, e.g., the seminal work of Holmström, 1999), but it is not universal (e.g., in Waldman, 1984, output is non-observable). In the present work we assume observability of output within firms so as to simplify the comparison with output produced by entrepreneurs.

our efficiency benchmark corresponds to the above model under the assumption that $\beta = 1$: a firm and an agent can, if they wish, agree that the entire output will be paid to the agent as bonus.

4. Learning

As a first step to solving the model, we study how the probability that the agent is a high type evolves depending on period-1 task allocation and outcome. In the next section, we derive the optimal period-1 task allocation for each occupation, and then the choice between entrepreneurship and wage work.

For any belief p_t that the individual is of type h, the probability of success in a given period is:

$$\pi(\tau_t, p_t) \equiv \begin{cases} (1-p_t) \cdot l_A + p_t \cdot h_A & \text{if } \tau_t = A \\ (1-p_t) \cdot l_B + p_t \cdot h_B & \text{if } \tau_t = B. \end{cases}$$

It follows that the probability of success in the current period is maximized by assigning the agent to task B if, and only if, p_t is smaller than the cutoff value

$$p^* \equiv \left(1 + \frac{h_A - h_B}{l_B - l_A}\right)^{-1}, \tag{3}$$

We define the period-1 probability of success as $\sigma_1(\tau_1) \equiv \pi(\tau_1, p_1)$; that is, the probability of instantaneous success at the initial belief p_1. Without loss of generality, we assume that task B is the short-term output maximizing task.

Assumption 2. $p_1 < p^*$*: task B maximizes period-1 probability of success, that is* $\sigma_1(B) > \sigma_1(A)$.

We can also derive the *period-2* probability of success as a function of *period-1* task allocation. Since period 2 is the last period of the game, in that period both entrepreneurs and firms choose the task allocation that maximizes the probability of success. For given belief p_2, the *equilibrium* probability of success in period 2 is therefore the following:

$$\pi^M(p_2) \equiv \max_{\tau_t} \pi(\tau_t, p_2) = \begin{cases} (1-p_2)l_B + p_2 h_B & \text{if } p_2 \leq p^* \\ (1-p_2)l_A + p_2 h_A & \text{if } p_2 \geq p^*. \end{cases} \tag{4}$$

The belief p_2 depends on period-1 task allocation τ_1 and whether there was a success ($s_1 = 1$) or a failure ($s_1 = 0$):

$$p_2(\tau_1, s_1) \equiv \begin{cases} \left(\frac{1-p_1}{p_1}\frac{l_{\tau_1}}{h_{\tau_1}}+1\right)^{-1} & \text{if } s_1 = 1 \\ \left(\frac{1-p_1}{p_1}\frac{1-l_{\tau_1}}{1-h_{\tau_1}}+1\right)^{-1} & \text{if } s_1 = 0. \end{cases}$$

We can therefore define the expected period-2 probability of success as a function of the task chosen in period 1 as follows:

$$\sigma_2(\tau_1) \equiv \mathbb{E}_{s_1\in\{0,1\}}\pi^M(p_2(\tau_1, s_1)),$$

In the following steps, we use the index

$$\Omega \equiv \frac{\sigma_2(A) - \sigma_2(B)}{\sigma_1(B) - \sigma_1(A)}$$

to measure the benefit of learning (given by the increase in period-2 probability of success $\sigma_2(A) - \sigma_2(B)$) relative to its cost (given by the decrease in the period-1 probability of success $\sigma_1(B) - \sigma_1(A)$).

This index is relevant because, as we will show in the next section, a meaningful tradeoff between short-run profit maximization and learning emerges within firms if, and only if, Ω is positive and sufficiently large (see Assumption 3). We present in Appendix A conditions on the primitives p_1, h_A, h_B, l_A, and l_B which ensure that $\sigma_2(A) > \sigma_2(B)$. When these conditions are satisfied and $p_1 \to p^*$, $\sigma_1(B) - \sigma_1(A)$ becomes arbitrarily small. At the same time, $\sigma_2(A) - \sigma_2(B)$ remains bounded away from zero, and hence Ω becomes arbitrarily large.

5. Equilibrium Analysis

In the following subsection, we derive the lifetime utility of becoming an entrepreneur in period 1, whereas in the next subsection we derive the lifetime utility of becoming a worker in period 1. We then solve for the choice of occupation, taking into account that some agents may not receive wage offers. In particular, we explore how the number of entrepreneurs, the projects they work on, as well as their task allocation change with the level of labor-market frictions.

5.1 Lifetime Utility of a Period-1 Entrepreneur

In period 2, a former entrepreneur may receive a wage offer. Since competition among firms guarantees that they earn a zero profit, the former entrepreneur earns the full expected return of the firm's project in the second period.[14] It follows that, if a former entrepreneur receives a wage

14. Since period 2 is the last period of the game, firms and workers have the same preferences over task allocation: they prefer the task allocation that maximizes period-2 output. Hence, the exact structure of a period-2 contract (i.e., what part is paid as bonus b and what part is paid as fixed wage f) is not relevant.

offer in period 2, then the choice of becoming an entrepreneur or employee depends on whether the firm's project or the entrepreneurial project is more valuable. A former entrepreneur, however, may not receive a wage offer in period 2, in which case he will again be an entrepreneur and earn k_2 in case of success. Hence, for a former entrepreneur, the expected value of a period-2 success is

$$K(\alpha) \equiv \alpha \mathbb{E}[\max(k_2, 1)] + (1 - \alpha)\mathbb{E}[k_2],$$

which is strictly increasing in α. The above expression can be rewritten as

$$K(\alpha) = \mathbb{E}[k_2] + \alpha \cdot Q,$$

where Q is the option value of an employment relationship; that is, the extra expected output generated by the possibility of being employed rather than being an entrepreneur:

$$Q \equiv \mathbb{E}[\max(1 - k_2, 0)] = F(1)(1 - \mathbb{E}[k_2 | k_2 < 1]).$$

It follows that a period-1 entrepreneur generates an expected return over the two periods equal to

$$\sigma_1(\tau_1)k_1 + \sigma_2(\tau_1)K(\alpha).$$

Hence, a period-1 entrepreneur chooses $\tau_1 = A$ whenever

$$k_1 \leq K(\alpha)\Omega. \tag{5}$$

That is, the entrepreneur will favor learning over short-run profits whenever the value of a period-1 success relative to a period-2 success is below the value of learning. Note that as labor-market frictions become more severe the value of a period-2 success decreases and the entrepreneur is more likely to choose task B in period 1.

The above discussion directly implies the following lemma:

Lemma 1. The lifetime utility of a period-1 entrepreneur is:

$$W^E(k_1, \alpha) = \begin{cases} \sigma_1(A)k_1 + \sigma_2(A)K(\alpha) & \text{if } k_1 \leq K(\alpha)\Omega \\ \sigma_1(B)k_1 + \sigma_2(B)K(\alpha) & \text{if } k_1 \geq K(\alpha)\Omega, \end{cases} \tag{6}$$

which is continuous and strictly increasing in both arguments.

5.2 Lifetime Utility of a Period-1 Worker

In period 1, a worker generates a return equal to 1 in case of success. In period 2, the same agent will become entrepreneurs if $k_2 > 1$. Otherwise, he will again work for a firm and produce 1 in case of success. Hence, for the given period-1 task allocation, the expected output generated over the two periods by a period-1 worker is:

$$\sigma_1(\tau_1) + \sigma_2(\tau_1)K(1).$$

Because firms compete for workers in the first period, they make zero profits. Hence, the above expression is the total lifetime utility of a period-1 worker for the given τ_1.

For a meaningful tradeoff between learning and short-run profit maximization to emerge in firms, it must be the case that the expected output generated over the two periods is maximized by implementing $\tau_1 = A$, which we assume.[15]

Assumption 3. Total output within the firm is maximized by implementing $\tau_1 = A$, that is

$$K(1)\Omega \geq 1. \tag{7}$$

However, the output maximizing task allocation may not be incentive compatible because of the moral hazard problem of the firm.

5.3 Firms' Incentive Compatibility

When agents receive wage offers in period 2, competition among firms guarantees that period-2 profits are zero. However, when workers do not receive a wage offer in period 2, their former employer will make them a take-it-or-leave-it offer, and therefore earn positive profits in period 2. These period-2 profits are front-loaded in the period-1 contract offered to the workers, so that firms earn zero profits over the two periods. Nonetheless, this front-loading is relevant for the period 1 task allocation. Indeed, after a contract (f, b) is signed in period 1, the fixed component f is sunk and the determinants of the optimal task choice are the bonus b and the expected period-2 profits. Choosing task A generates a period-1 opportunity cost equal to $(\sigma_1(B) - \sigma_1(A))(1 - b)$, a decreasing function of b. On the other hand, the *future* benefit of choosing task A in the first period is equal to the value of continuing the employment relationship, which in expected terms is equal to

$$(1 - \alpha)\sigma_2(\tau_1)\mathbb{E}[\max\{1 - k_2, 0\}] = (1 - \alpha)\sigma_2(\tau_1)Q.$$

These profits are decreasing in α and, crucially, for $\alpha < 1$ are larger when $\tau_1 = A$ than when $\tau_1 = B$; that is, because of labor-market frictions, firms may be able to earn in period 2 part of the benefit of learning their workers' talent.

Since the largest possible bonus is $b = \beta$, the firm can commit to implementing task A in the first period if $(\sigma_1(B) - \sigma_1(A))(1 - \beta) \leq (\sigma_2(A) - \sigma_2(B))(1 - \alpha)Q$; that is, when

15. Indeed, firms can commit to implement task $\tau_1 = B$ in the first period by choosing $b = 0$. Hence, if task B is efficient, competition among firms guarantees that, in equilibrium, all workers will work on task $\tau_1 = B$, which is both the short-run profit maximizing one and the efficient one.

$$\Omega \cdot Q \geq \frac{1-\beta}{1-\alpha}. \tag{8}$$

Quite intuitively, the above condition is more likely to hold whenever the value of learning is sufficiently large, when labor-market frictions are large, and when contracting frictions are low (i.e., high β). It is also more likely to hold when Q is high, because Q is the expected surplus earned by a firm in period 2 in case the worker does not receive an outside wage offer.

There is a threshold

$$\alpha^F(\beta) \equiv 1 - \frac{1-\beta}{\Omega \cdot Q},$$

such that for $\alpha \leq \alpha^F(\beta)$, by offering a sufficiently large bonus b, a firm can commit to implementing the most informative task (task A).[16] If instead $\alpha > \alpha^F(\beta)$, firms can only implement task B, despite the fact that task A is the output-maximizing one. By construction, $\alpha^F(\beta) < 1$ and hence there are always values of α such that firms can only implement task $\tau_1 = B$. It is, however, possible that $\alpha^F(\beta) < 0$, in which case firms can only implement task $\tau_1 = B$ for all values of α.

Competition for workers among firms allows us to reduce the firms' problem to the choice of a task τ_1 that maximizes the two-period total output subject to the incentive compatibility constraints. This leads to the following lemma:

Lemma 2. The lifetime utility of a period-1 worker is

$$W^F(\alpha, \beta) \equiv \begin{cases} \sigma_1(A) + \sigma_2(A)K(1) & \text{if } \alpha \leq \alpha^F(\beta) \\ \sigma_1(B) + \sigma_2(B)K(1) & \text{otherwise,} \end{cases} \tag{9}$$

which is constant in α for $\alpha \neq \alpha^F(\beta)$ and has a downward discontinuity at $\alpha = \alpha^F(\beta)$.

Remember that the efficient task allocation within the firm is $\tau_1 = A$. This implies that the task allocation within the firm is inefficient whenever $\alpha > \alpha^F(\beta)$. The definition of $\alpha^F(\beta)$ implies the following corollary.

Corollary 1. When $\alpha > \alpha^F(\beta)$ firms are short-termists; they inefficiently choose the short-run output maximizing task allocation. Short-termism is more likely to happen when contracting frictions are high (i.e., low β), and

16. The observation here that larger bonuses can generate more learning is contrary to that of Manso (2011), who argues that a principal may motivate a worker to experiment by offering to pay a fixed wage initially and a large bonus for success in the future. The reason for this contrast is that in Manso (2011) the worker has a moral hazard problem, while in our model the firm has a moral hazard problem. Hence in our world, if a large bonus is paid to the worker, the firm's payoff is less sensitive to the realization of failure and success and therefore the firm is more likely to choose the learning-maximizing task allocation.

the value of learning is small (i.e., Ω small), and the surplus expected to be generated by continuing an employment relationship is low (i.e., Q small).

5.4 Equilibrium Occupational Choices

Having derived the value of being a period-1 worker or a period-1 entrepreneur, we now close the model by solving for the optimal period-1 occupational choice. In period 1, a fraction $1-\alpha$ of agents do not receive a wage offer and therefore become entrepreneurs. Those who receive a wage offer will become entrepreneurs if, and only if, their entrepreneurial projects are of sufficiently high value.

To derive the project value that would leave agents indifferent as to whether they choose entrepreneurship or employment, it is useful to introduce two thresholds. The first is the project value that would render agents indifferent to whether they become entrepreneurs or workers *in case firms implement the efficient task* $\tau_1 = A$. We call such a threshold $k^A(\alpha)$, implicitly defined as

$$W^E(k^A(\alpha),\alpha) = \sigma_1(A) + \sigma_2(A)K(1),$$

or, in explicit form:

$$k^A(\alpha)=\begin{cases} 1+\dfrac{\sigma_2(A)}{\sigma_1(A)}\big(K(1)-K(\alpha)\big) & \text{if } 1+\dfrac{\sigma_2(A)}{\sigma_1(A)}\big(K(1)-K(\alpha)\big)\leq K(\alpha)\Omega \\ \dfrac{\sigma_1(A)}{\sigma_1(B)}+\dfrac{\sigma_2(A)}{\sigma_1(B)}K(1)-\dfrac{\sigma_2(B)}{\sigma_1(B)}K(\alpha) & \text{otherwise.} \end{cases}$$

The second threshold is the project value that leaves agents indifferent to whether they become entrepreneurs or workers *in case firms implement the inefficient task* $\tau_1 = B$. We call such a threshold $k^B(\alpha)$, implicitly defined as:

$$W^E(k^B(\alpha),\alpha) = \sigma_1(B) + \sigma_2(B)K(1),$$

or, in explicit form:

$$k^B(\alpha)=\begin{cases} 1+\dfrac{\sigma_2(B)}{\sigma_1(B)}\big(K(1)-K(\alpha)\big) & \text{if } 1+\dfrac{\sigma_2(B)}{\sigma_1(B)}\big(K(1)-K(\alpha)\big)\geq K(\alpha)\Omega \\ \dfrac{\sigma_1(B)}{\sigma_1(A)}+\dfrac{\sigma_2(B)}{\sigma_1(A)}K(1)-\dfrac{\sigma_2(A)}{\sigma_1(A)}K(\alpha) & \text{otherwise.} \end{cases}$$

Because the level of labor-market frictions determines the task allocation within firms, the project value that leaves agents indifferent to whether they become workers or entrepreneurs is

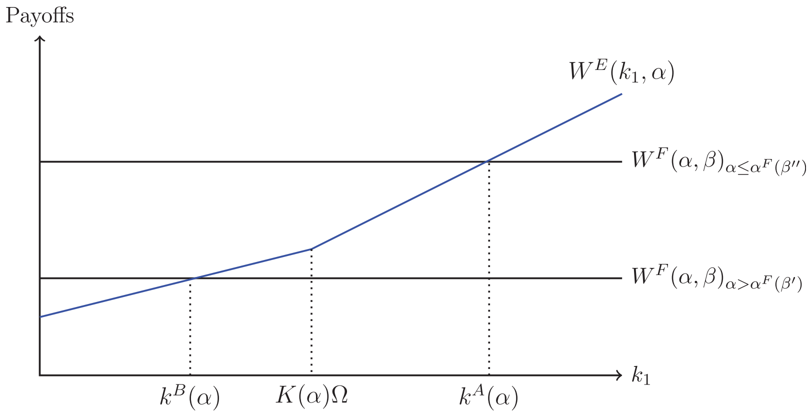

Figure 1. Lifetime Utility of Being an Entrepreneur in Period 1 ($W^E(k_1,\alpha)$) and Lifetime Utility of Working for a Firm in Period 1 ($W^F(\alpha,\beta)$) as a Function of k_1. The graph considers a given value of $\alpha < 1$ and two values of β, one (β') sufficiently low so that firms implement task B and the other (β'') sufficiently high so that firms implement task A.

$$k^E(\alpha,\beta) \equiv \begin{cases} k^A(\alpha) & \text{if } \alpha \leq \alpha^F(\beta) \\ k^B(\alpha) & \text{if } \alpha > \alpha^F(\beta). \end{cases}$$

Figure 1 derives $k^A(\alpha)$ and $k^B(\alpha)$ for a given value of $\alpha < 1$. Note that, for a given α, the firm will implement task A when β is sufficiently large, and task B when β is sufficiently low. Using this, in the graph $k^A(\alpha)$ and $k^B(\alpha)$ are given by the intercept of $W^E(k_1,\alpha)$ and $W^F(\alpha,\beta)$ for β' such that $\alpha > \alpha^F(\beta')$ and for β'' such that $\alpha \leq \alpha^F(\beta'')$. Figure 2 instead plots $k^A(\alpha)$ (dashed), $k^B(\alpha)$ (dashed), and $k^E(\alpha,\beta)$ (solid blue) as a function of α. Note a few things. First, the value of working for a firm is higher when firms implement task A, which implies that $k^A(\alpha) > k^B(\alpha)$. It must also be the case that $k^A(1) = 1$: by Assumption 3, entrepreneurs with project value $k_1 = 1$ choose to work on task A; these entrepreneurs are therefore indifferent to whether they work on task A in a firm or as entrepreneurs. Also, both $k^A(\alpha)$ and $k^B(\alpha)$ are continuous and decreasing in α. That is because $K(\alpha)$ increases in α, and hence the future payoff of a period-1 entrepreneur increases in α.

Furthermore, both $k^A(\alpha)$ and $k^B(\alpha)$ are parallel when they are both above or below $K(\alpha)\Omega$, and both functions decrease at a faster rate when they are below than when they are above $K(\alpha)\Omega$. Intuitively, this is because an increase in the period-2 value of success (given by an increase in α) has a larger impact on the entrepreneur's lifetime utility if this entrepreneur chooses $\tau_1 = A$ and hence favors learning in his period-1 task allocation.[17] With respect to $k^E(\alpha,\beta)$, note that it has a downward discontinuity at $\alpha = \alpha^F(\beta)$. Furthermore, at $\alpha = \alpha^F(\beta)$, $k^E(\alpha,\beta)$ will either

17. Mathematically, this is because assumptions 2 and 3 imply that $\frac{\sigma_2(A)}{\sigma_1(A)} > \frac{\sigma_2(B)}{\sigma_1(B)}$.

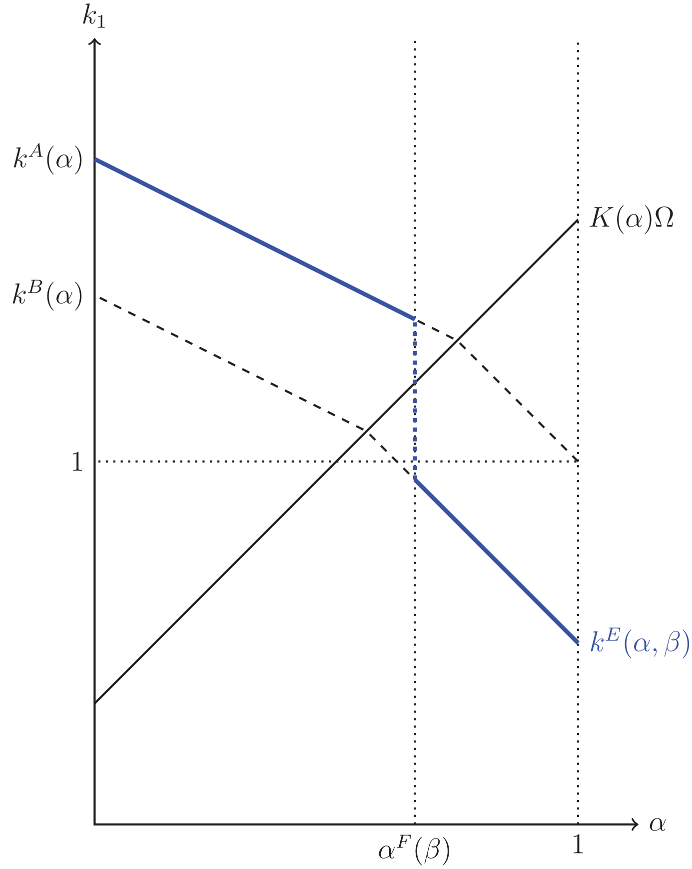

Figure 2. $k^A(\alpha)$ (Dashed), $k^B(\alpha)$ (Dashed), and $k^E(\alpha,\beta)$ (Solid Blue) as a Function of α (Note: the Axes are Not to Scale).

maintain its slope (when $\alpha^F(\beta)$ is sufficiently large or sufficiently small) or may increase its slope (when $\alpha^F(\beta)$ is in an intermediate range, as drawn in the figure).

The probability of becoming an entrepreneur in period 1 is therefore

$$P_1^E(\alpha,\beta) = (1-\alpha) + \alpha(1 - F(k^E(\alpha,\beta))).$$

Note that the first part of the above expression is continuously decreasing in α, while the second one is increasing in α, discontinuously so at $\alpha = \alpha^F(\beta)$. It follows that, whenever $\alpha^F(\beta) > 0$, at $\alpha = \alpha^F(\beta)$ there is a first-order jump in the number of entrepreneurs.[18] This is due to the fact

18. The presence of this jump is an artifact of the fact that firms' success has a constant value equal to 1. In a previous version of this paper, the value of firms' success was drawn randomly at the beginning of each period. In that version of the model, the probability of becoming an entrepreneur is continuous. Also, in that version of the model, as α increases

that firms change their task allocations, switching from the efficient one (for $\alpha \leq \alpha^F(\beta)$) to the inefficient one (for $\alpha > \alpha^F(\beta)$). Hence, it is possible that as the labor market becomes more efficient, fewer people become workers, preferring entrepreneurship instead.

Because $\alpha^F(\beta)$ is increasing in β, the above reasoning implies that if α is sufficiently above or below $\alpha^F(\beta)$, then changes in β do not affect the probability of becoming an entrepreneur. However, if α is sufficiently close to the threshold $\alpha^F(\beta)$, changes in β may affect the probability of becoming an entrepreneur. More precisely, if $\alpha > \alpha^F(\beta)$ but sufficiently close to $\alpha^F(\beta)$, as β increases firms will be able to switch to task A, leading to a drop in the probability of becoming an entrepreneur. Hence, as contracting inefficiencies become less severe, fewer people choose entrepreneurship. The following lemma summarizes these observations (its proof is omitted).

Lemma 3. Suppose $\beta > 1 - \Omega Q$, so that $\alpha^F(\beta) > 0$. For a given β, there are values α', α'' such that $\alpha' < \alpha^F(\beta) < \alpha''$ and $P_1^E(\alpha', \beta) < P_1^E(\alpha'', \beta)$. For a given α, $P_1^E(\alpha, \beta)$ is weakly decreasing in β.

As a side remark, it is possible to derive conditions on the distribution of entrepreneurial projects $F(k)$ such that the probability of becoming an entrepreneur is increasing locally for α far from the threshold $\alpha^F(\beta)$. We focus here on the threshold because the task allocation of workers and entrepreneurs changes around the threshold (and not far from it). As we will see, this has additional implications regarding the wage of former entrepreneurs relative to that of former workers, and also regarding the value of entrepreneurial failure.

We note an interesting interaction between the two frictions, labor (α) and contracting (β). As β increases, $\alpha^F(\beta)$ increases, and the slope of $k^E(\alpha, \beta)$ decreases weakly, strictly so over some intermediate range of α. In this sense, as contracting inefficiencies become less severe, the marginal project determining the choice of entrepreneurship reacts less strongly to a decrease in labor-market frictions. Of course, how changes in the slope of the threshold $k^E(\alpha, \beta)$ affect the slope of $P_1^E(\alpha, \beta)$ depends on the hazard rate of the distribution, and how it changes from $k^A(\alpha)$ to $k^B(\alpha)$.[19]

In period 2, all individuals who draw projects $k_2 > 1$ become entrepreneurs. Those with $k_2 < 1$ will be workers if they receive a wage offer, or if they were previously employed (in which case they can continue working for their former employer). Former entrepreneurs with $k_2 < 1$ who do not receive a wage offer will remain entrepreneurs. The probability of becoming an entrepreneur in period 2 is therefore:

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the probability of an efficient allocation within firms decreases. Hence, all results are identical to those presented here, but their derivation is significantly lengthier.

19. Indeed, at a point of differentiability $\alpha \neq \alpha^F(\beta)$, the variation of $P_1^E(\alpha, \beta)$ with respect to α is equal to $-f\big(k^E(\alpha, \beta)\big)\left(\frac{F(k^E(\alpha,\beta))}{f(k^E(\alpha,\beta))} + \alpha\frac{dk^E(\alpha,\beta)}{d\alpha}\right)$, where $f(k_t)$ is the p.d.f. of the projects' distribution.

$$P_2^E(\alpha,\beta) \equiv (1-F(1)) + F(1)(1-\alpha)P_1^E(\alpha,\beta).$$

We can now compute two commonly used measures of aggregate entrepreneurial activity: the probability of being a serial entrepreneur and the average probability of becoming an entrepreneur across periods.[20] The probability of being a serial entrepreneur (i.e., an entrepreneur in both periods) is

$$P_{\text{serial}}^E(\alpha,\beta) \equiv P_1^E(\alpha,\beta)\cdot(1-\alpha+\alpha\cdot(1-F(1))) = P_1^E(\alpha,\beta)\cdot\Big(1-\alpha F(1)\Big), \tag{10}$$

and the average probability of becoming an entrepreneur across periods:

$$P_{(1/2)}^E(\alpha,\beta) \equiv \frac{1}{2}\Big(P_1^E(\alpha,\beta)+P_2^E(\alpha,\beta)\Big)$$
$$= \frac{1}{2}\Big(P_1^E\Big(\alpha,\beta)\Big(1+(1-\alpha)F(1)\Big)+1-F(1)\Big)\Big).$$

Note that $P_{(1/2)}^E(\alpha,\beta)$ and $P_{\text{serial}}^E(\alpha,\beta)$ are strictly increasing in $P_1^E(\alpha,\beta)$. Hence, they both inherit the upward jump of $P_1^E(\alpha,\beta)$ at $\alpha^F(\beta)$. These two observations imply the following corollary.

Corollary 2. Suppose $\beta > 1-\Omega Q$, so that $\alpha^F(\beta) > 0$. For given β, there are $\alpha' < \alpha^F(\beta) < \alpha''$ such that $P_{(1/2)}^E(\alpha',\beta) < P_{(1/2)}^E(\alpha'',\beta)$ and $P_{\text{serial}}^E(\alpha',\beta) < P_{\text{serial}}^E(\alpha'',\beta)$. For given α, both $P_{(1/2)}^E(\alpha,\beta)$ and $P_{\text{serial}}^E(\alpha,\beta)$ are weakly decreasing in β.

5.5 Types of Entrepreneurs

Labor-market frictions and contracting frictions affect not only the number of entrepreneurs in the economy, but also the type of projects pursued by entrepreneurs and their task allocation. Based on the different motives for becoming an entrepreneur, our framework allows us to distinguish between three types of entrepreneurship:

- *Necessity entrepreneurs* are those who would prefer to work for a firm, but become entrepreneurs because they do not receive any wage offer. In period 1, they are a fraction $1-\alpha$ of the entrepreneurs with $k_1 < k^E(\alpha,\beta)$; in period 2, they are a fraction $1-\alpha$ of the entrepreneurs with $k_1 < 1$.
- *Opportunity entrepreneurs* are those who prefer entrepreneurship to working for a firm, even when firms implement the efficient task allocation. In period 1, they are the agents with $k_1 > k^A(\alpha)$; in period 2, they are the agents with $k_1 > 1$.

20. In an overlapping generation extension of the model, the average probability of becoming an entrepreneur across periods is the probability that at any given moment in time an agent is an entrepreneur.

- *Learning entrepreneurs* are those who choose entrepreneurship because firms choose an inefficient task allocation, leading to less-than-efficient learning within firms. Because the task allocation within firms is always efficient in period 2, learning entrepreneurs can exist only in period 1. They are the ones with project value $k_1 \in [k^E(\alpha, \beta), k^A(\alpha)]$.

Learning entrepreneurs do not exist whenever $\beta = 1$ (which is our efficiency benchmark). They, however, always exist when $\beta < 1$ and $\alpha > \alpha(\beta)$. Learning entrepreneurs are therefore a second-best response to the presence of contracting frictions and the resulting lack of learning within firms. Furthermore, if $F(1) = 1$ (i.e., agents never have ideas that are better than those of firms), when $\beta = 1$ there can only be necessity entrepreneurs, while if $\beta < 1$ there can also be learning entrepreneurs. In particular, when $\alpha = 1$ there is no entrepreneurship in the efficiency benchmark, but there is a positive mass of learning entrepreneurs when $\beta < 1$.

Figure 3 illustrates how, in period 1, the proportion of different types of entrepreneurs changes with α (for a fixed value of β). Note that, by definition, learning entrepreneurs do not exist when the task allocation within firms is efficient, that is when $\alpha < \alpha^F(\beta)$. However, they always exist when $\alpha > \alpha^F(\beta)$, and their measure increases as contracting frictions become more severe (i.e., as β decreases).

Figure 3 also illustrates how the task allocation of entrepreneurs changes with α. Note how learning entrepreneurs mostly work on task A, but may also work on task B. These entrepreneurs would work for a firm if the task allocation within firms were efficient, but instead choose entrepreneurship. Their project value is, however, sufficiently high so that they prefer task B.[21] It is also possible that opportunity entrepreneurs choose task A. This will happen for α close to 1 and $k_1 \in (1, K(\alpha)\Omega)$: the agent has a project that is better than that of firms, hence if labor-market frictions are negligible this agent will become an entrepreneur; at the same time, the value of this project is relatively low, so this agent will favor learning over short-run profit maximization. While both learning and opportunity entrepreneurs may work on either task, it is clear that learning entrepreneurs are more likely to choose task A than opportunity entrepreneurs. This is due to the fact that, by definition, learning entrepreneurs work on projects of lower value than opportunity entrepreneurs. Another observation is that, because $k^E(\alpha, \beta)$ decreases in α and $K(\alpha)$ increases in α, then as α increases entrepreneurs are, on average, more likely to choose task A. The task choice of entrepreneurs reacts most strongly to changes in α when we compare values below and above the threshold $\alpha^F(\beta)$,

21. Remember that the value of a future success for an entrepreneur $K(\alpha)$ is always below the value of a future success for a worker $K(1)$. Hence, for given $\alpha < 1$ and $k_1 > 1$, it may be efficient to choose task A in firms but task B as an entrepreneur.

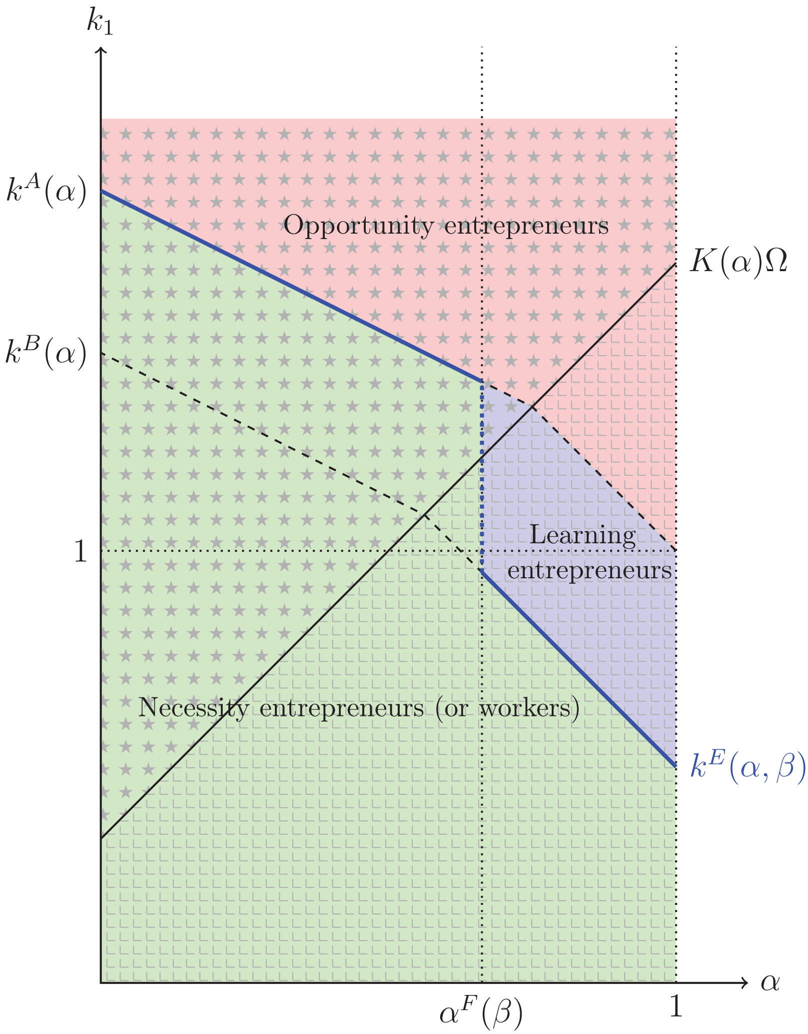

Figure 3. Types of Entrepreneurship and Task Allocation of Entrepreneurs as a Function of α. The colors represent the types of entrepreneurship: red for opportunity, blue for learning, and green for necessity. The patterns represent the task choice of entrepreneurs: the stars are task *B*, and the grid is task *A* (note: the axes are not to scale).

because learning entrepreneurs do not exist below the threshold, but do exist above the threshold.

5.6 Output

In period 1 a fraction $1 - \alpha$ of the population will not receive a wage offer and is forced into entrepreneurship, while a fraction α of the population chooses entrepreneurship or wage work depending on the two-period output generated by these two options. Hence, the two-period total expected output in the economy is

$$(1-\alpha)\cdot E[W^E(k_1,\alpha)] + \alpha\cdot E[\max\{W^E(k_1,\alpha), W^F(\alpha,\beta)\}].$$

Therefore, for a fixed $W^F(\alpha,\beta)$, total expected output increases with α both because fewer agents become necessity entrepreneurs, and because $E[W^E(k_1,\alpha)]$ increases with α. At the same time, $W^F(\alpha,\beta)$ has a downward discontinuity at $\alpha=\alpha^F(\beta)$, and is constant otherwise. Total output is therefore non-monotonic in α: it is increasing for $\alpha\neq\alpha^F(\beta)$ but has downward discontinuity at $\alpha=\alpha^F(\beta)$.

6. Implications for Career Paths

6.1 Wages of Past Workers and Past Entrepreneurs

As already discussed in the literature review, our model generates novel predictions with respect to the wage of former workers relative to the wage of former entrepreneurs who change occupation. As we established in Section 5, as α changes, in period 1, the task allocations of workers and of entrepreneurs change in opposite directions.

This difference in task allocation translates into differences in period-2 wage. This is immediate for the case $\alpha>\alpha^F(\beta)$, because in the first period all workers worked on the least informative task, while some entrepreneurs worked on the most informative task. Hence, if hired by firms in period 2, former entrepreneurs will receive a higher wage than former workers. If $\alpha<\alpha^F(\beta)$, in period 1 all workers worked on the most informative task allocation, while some entrepreneurs worked on the least informative task allocation. Hence, in period 2, former workers are more productive than former entrepreneurs. In this case, the period-2 wage of former workers *who receive a wage offer* is higher than that of former entrepreneurs who are hired by firms. However, in period 2, workers who do not receive a wage offer are paid less than their productivity, so it is unclear whether former workers as a whole are paid more or less than former entrepreneurs.[22] Note, however, that if β is large (i.e., the degree of contract incompleteness is low), $\alpha^F(\beta)$ is also large. In this case, there exists an $\alpha<\alpha^F(\beta)$ sufficiently large so that the number of workers not receiving a wage offer is low and, on average, former entrepreneurs receive *lower* wages compared to former workers of equivalent characteristics.

There are unfortunately few empirical analyses relative to the compensation of former entrepreneurs who change occupation, and how it changes with labor-market frictions. Nevertheless, our results are consistent with the existing empirical evidence. Hamilton (2000) shows that US

22. In general, this will depend on the distribution of the entrepreneurial project values: if $\mathbb{E}[k_2|k_2<1]$ is close to 1, then workers who do not receive a wage offer are nonetheless paid almost their productivity; while if $\mathbb{E}[k_2|k_2<1]$ is close to zero, these workers do not receive anything.

entrepreneurs who leave entrepreneurship and reenter the labor market after some years earn higher wages than comparable workers: the median entrepreneur returning to paid employment after 10 years as an entrepreneur earns a wage that is 15% higher than a comparable worker who never left employment.[23] See also Luzzi and Sasson (2016), who show that in Norway former entrepreneurs earn a positive wage premium. Our model suggests an opposite result for high labor-market frictions economies, which is consistent with the finding in Baptista et al. (2012), who show that in Portugal the wage of former entrepreneurs is lower than the wage of workers who have never left employment.[24]

6.2 The Value of Entrepreneurial Failure

A failure can be beneficial to an agent if it allows for a better allocation of talent in the next period. As we show shortly, failures have this property only if the agent has worked on the advanced task *and if* talent is horizontal.

Figure 4 illustrates how the maximum probability of success $\pi^M(p_t)$ varies as a function of the belief that the agent is a high type.[25] As is apparent, when talent is vertical, the success probability is monotonically increasing, but if talent is horizontal, the success probability is nonmonotonic. That is, if talent is horizontal, an agent is least productive when there is a probability p^* that he is a high type, and productivity increases as the agent becomes more likely to be either an h type or an l type. We established in Section 4 that when talent is vertical, failures reduce the probability of being an h type (more so when the failure is at task A), since h types are more likely to succeed than l types at any task. Hence, when talent is vertical failures are always *bad news* because they decrease the probability of success in period 2 relative to the initial probability of success; that is,

$$\pi^M(p_2(\tau_1, 0)) < \pi^M(p_1) \text{ for all } \tau_1 \in \{A, B\}.$$

In the horizontal talent case, instead, failures at task A increase the probability that the agent is a low type. By Assumption 2, such failures are *good news* because they lead to an increase in the future probability of success (relative to no history). Instead, failures at task B increase the probability that the agent is of type h, and may be good or bad news

23. See Table 6 and the discussion on pages 625–626 of Hamilton (2000). Hamilton notes that this result is consistent with the findings of Evans and Leighton (1990). Both Daly (2015) and Hincapié (2020) find similar results, again using US data.

24. Neither Hamilton (2000) nor Baptista, Lima, and Preto (2012) discuss why an agent will leave entrepreneurship.

25. This probability is obtained by allocating an agent to the task with the highest probability of success, see Equation 4 for the formal definition.

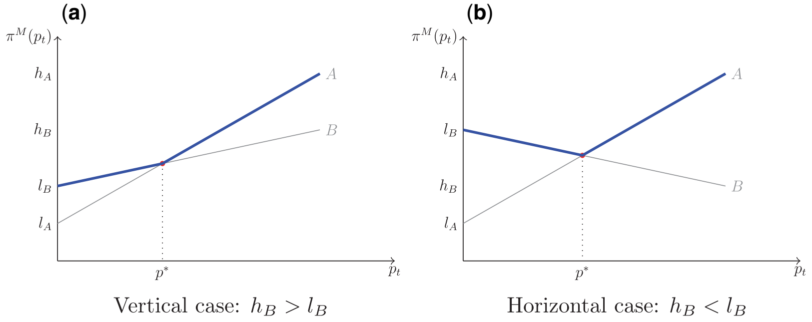

Figure 4. Maximum Probability of Success as a Function of Belief p_t. (a) Vertical case: $h_B > l_B$. (b) Horizontal case: $h_B < l_B$.

depending on the prior belief p_1: failures at task B are good news if p_1 is sufficiently close to p^*; but they are bad news if p_1 is sufficiently low (e.g., p_1 such that the posterior belief $p_2(B,0)$ is also below p^*). The following Lemma formalizes these observations.

Lemma 4.

(i) *In the vertical-talent case failures are always bad news; that is,* $\pi^M(p_2(\tau_1,0)) < \pi^M(p_1)$ *for all* $\tau_1 \in \{A,B\}$.

(ii) *In the horizontal-talent case, failures at task A are always good news; that is,* $\pi^M(p_2(A,0)) > \pi^M(p_1)$. *There is a threshold* p_B *such that failures at task B are bad news for* $p_1 < p_B$ *and good news for* $p_1 > p_B$.

Hence, the vertical view of talent implies that failures should reduce the probability of a future success. Instead, when talent is horizontal, failures can be "good news" depending on the task allocation and the prior p_1. In this case, if labor-market frictions are low (i.e., high α) and the majority of entrepreneurs are learning entrepreneurs,[26] most entrepreneurs will choose $\tau_1 = A$ and a failure at this task leads to an increase in the future probability of success. This motivates the following proposition that relates the degree of labor-market frictions to the value of failure.

Proposition 1. For a serial entrepreneur, the probability of succeeding as an entrepreneur in period 2 is increasing in α. *Furthermore,*

(i) *If talent is vertical, failures are always "bad news"; that is, the probability of succeeding in period 2 as an entrepreneur following*

26. Whether at α close to 1 the majority of entrepreneurs are learning or opportunity types depends on the shape of the distribution of entrepreneurial project values. If it decreases sufficiently quickly (or has a low enough upper bound), then there are more learning entrepreneurs than opportunity entrepreneurs.

an entrepreneurial failure in period 1 is below the initial probability of success $\sigma_1(B)$ for all α.

(ii) *If talent is horizontal, there exist parameter values such that failure is good news for sufficiently high α, and bad news for sufficiently low α.*

The proposition is based on the fact that the degree of labor-market frictions determines the task allocation chosen in period 1 by failed entrepreneurs: if α is large, failures are more likely to be generated by working on task A, while if α is low, they are more likely to be generated on task B. If talent is horizontal, a failure at task A is a strong indication that the agent should instead work on task B in the following period, while a failure at task B increases the uncertainty relative to the optimal period-2 task allocation. It is possible that, in this case, failure is good news for large α but bad news when α is low. If talent is vertical, instead, failure is always bad news, regardless of the task. That is because low types are more likely to fail than high types at any task, meaning that a failure increases the probability that an agent is a low type and will fail in the future.

Based on the existing evidence, in the US entrepreneurial failure seems to lead to entrepreneurial success. For example, Gompers et al. (2010) show that entrepreneurs who have previously failed are marginally more likely to succeed than first time entrepreneurs.[27] Again, the evidence available for Europe tells a very different story. Using German data, Gottschalk et al. (2014) show that entrepreneurs who have previously failed are subsequently more likely to fail than first time entrepreneurs. Our model explains these different values of failure if talent is *horizontal*: different agents have an absolute advantage at different tasks. Instead, when talent is *vertical* (i.e., the same agent has an absolute advantage at all tasks) failure is always bad news, regardless of the level of labor-market frictions, a finding which seems to contradict the evidence we just discussed.

6.3 Age Profile of Entrepreneurs

At $\alpha = 1$, there are no necessity entrepreneurs and in period-2 agents with project value equal to that of firms are indifferent between joining a firm or becoming entrepreneurs. However, in period 1 such agents strictly prefer to become entrepreneurs, because this allows them to learn: to implement task A instead of B. By continuity, therefore, for sufficiently large α young agents are more likely than old agents to become entrepreneurs.

27. See also Lafontaine and Shaw (2016), who use data from Texas to show that the past experience as an entrepreneur predicts entrepreneurial success. This is consistent with our model for the case of “low labor-market frictions” in which, in period-1, entrepreneurs are more likely to choose an informative task allocation than workers. It follows that, in period 2, an entrepreneur who was formerly an entrepreneur is more likely to succeed than an entrepreneur who was formerly a worker.

For lower values of α, however, other effects come into play. For example, in period-1 agents anticipate that, if they become entrepreneurs, they may not be able to find a job in the future. This concern is absent in period 2. It is therefore possible that, for some intermediate α, there are more entrepreneurs in period 2 than in period 1.

We are not aware of any evidence linking the probability of becoming an entrepreneur at different ages with the degree of labor-market frictions. Using US data, Hincapié (2020) shows that people are most likely to become entrepreneurs when in their mid-thirties. This is consistent with our model for the "low labor-market frictions" case, provided that we interpret "mid-thirties" as part of period 1 of the model (which is the only period of our model in which learning is valuable). A recent paper by Azoulay et al. (2020) shows that older entrepreneurs are more likely *to succeed* than young entrepreneurs. This is consistent with the model, because the information acquired by an agent at the end of the first period generates an increase in the expected probability of success in the second period.[28]

7. Concluding Remarks

We have shown that, when contracts are incomplete, the choice of occupation can be partially explained by the difference in decision rights across occupations and the level of labor-market frictions. This approach allows us to highlight a novel motive for entrepreneurship (learning one's comparative advantage) that is especially important when firms compete fiercely for workers. This learning motive has important consequences for career and wage dynamics.

In our model, we have intentionally ignored some important determinants of entrepreneurial activity, such as financial constraints, learning by doing, or the possibility of working on multiple tasks.

Financial constraints are a barrier for entry into entrepreneurship. In our model, when entrepreneurs face financial constraints, the effect of labor-market frictions on entrepreneurial activity will in fact be stronger. Indeed, if the labor market is frictionless, firms' competition ensures that workers are able to appropriate the full benefit of learning. Hence firms adopt a less informative task allocation regardless of the importance of financial constraints, and some agents may become learning entrepreneurs. On the other hand, when labor-market frictions are severe, financial constraints limit the exit of workers into entrepreneurship and therefore increase the ability of firms to appropriate the benefit of learning.[29]

28. Formally, for any τ_1, $\sigma_2(\tau_1) > \sigma_1(\tau_1)$.

29. On the role of financial constraints, see Hellmann (2007), who shows that cash constraints shape the way ideas are financed, within or outside the firm, and Terviö (2009), who argues that, in the absence of long-term contracts, financial constrains may prevent optimal talent discovery in firms.

Financial constraints, therefore, increase the effect of a change in α on whether learning occurs within or outside firms.

There is an element of learning-by-doing in our model because when agents acquire information about their comparative advantage, they are then better able to match their talent to a task, and therefore increase their productivity over time. We do not, however, allow agents to increase their productivity on a given task by simply working on that task; that is, there is no task-specific human capital accumulation (see Gibbons and Waldman 1999, 2004). The effect of introducing task-specific human capital accumulation in the model is quantitatively ambiguous. To illustrate this ambiguity, consider the case of $\alpha = 1$. Unlike individuals, firms do not internalize human capital accumulation or learning about the comparative advantage of their workers and therefore choose task B. If human capital accumulation is present only on task B, there will be fewer entrepreneurs and fewer learning entrepreneurs (in our definition) than in our baseline model. The opposite is true, however, if human capital accumulation is only present on task A, because the opportunity cost of experimenting is lower than in our baseline model. There are therefore more entrepreneurs and more learning entrepreneurs. Nevertheless, our qualitative results stand; in particular, there exists a cutoff value of α above which firms are short-termists and where individuals become learning entrepreneurs and below which firms are long-termists and there are no learning entrepreneurs.

We have assumed that the production process involves only one task. In contrast, Lazear (2004) assumes that workers are engaged in a single task, whereas entrepreneurs work at multiple tasks. He shows, both theoretically and empirically, that people with a more balanced skill set enter entrepreneurship. Åstebro et al. (2011), building on Lazear (2004), propose a model in which agents choose between self-employment (in which case they work on multiple tasks) and wage work (in which case they are allocated to a specific task). Exogenous frictions prevent both the efficient assignment of agents to firms and also the efficient assignment of workers to tasks. These frictions are the reason why some agents may become self-employed. Both in Lazear (2004) and Åstebro et al. (2011) agents' productivity at different tasks is perfectly known, and hence there is no learning. This implies, for example, that these models do not make predictions with respect to the wages of former entrepreneurs. It would be interesting to add uncertainty about talent to Lazear's framework, and study whether learning affects agents' occupational choices. This extension is left for future work.

Finally, one may be tempted to interpret the case of high labor-market frictions as illustrative of developing countries, and there is indeed ample evidence that many people living in developing countries are "reluctant" entrepreneurs (Banerjee and Duflo 2011). However, our comparative statics on (α, β) implicitly keep constant legal enforcement, the quality of the financial markets, the level of human capital, and other institutions.

Developing countries differ significantly from the United States or European countries along these dimensions, which are likely to affect the type, frequency, and market rewards of entrepreneurial ventures.

Appendixes

A. Mathematical Appendix

Conditions for $\sigma_2(A) > \sigma_2(B)$.

Proposition 2. In the vertical talent case $\sigma_2(A) > \sigma_2(B)$ *if, and only if,*

$$p_1 > \left(1 + \frac{h_A}{l_A}\frac{h_A - h_B}{l_B - l_A}\right)^{-1}. \tag{A1}$$

In the horizontal talent case $\sigma_2(A) > \sigma_2(B)$ *if condition equation (A1) holds and*

$$h_A - l_A > l_B \cdot h_A - l_A \cdot h_B > l_B - h_B.$$

Proof.

Independently of the task assignment in the first period, Bayesian updating implies that

$$\mathbb{E}_{s_1 \in \{0,1\}} \pi(\tau_1, p_2(\tau_1, s_1)) p_2(\tau_1, s_1) = p_1. \tag{A2}$$

Because of Assumption 2, there is a realization of s_1 such that the posterior $p_2(\tau_1, s_1)$ is inferior to p^*, leading to task B being adopted in period 2. Since the expected probability of success $\pi^M(p_t)$ is linear when $p \leq p^*$, a necessary condition for A to be more informative than B is that $\max_{s_1} p_2(A, s_1) > p^*$. Since in both the vertical and horizontal cases $\frac{h_A}{l_A} > \frac{1-h_A}{1-l_A}$, the maximum posterior following task A is achieved following a success. More informativeness of A therefore requires that $p_2(A,1) > p^*$, that is

$$p_1 > q_A \equiv \left(1 + \frac{h_A}{l_A}\frac{h_A - h_B}{l_B - l_A}\right)^{-1} \tag{A3}$$

Sufficient condition for (weak) informativeness. Since the maximum probability of success is a convex function of the posterior, whenever the distribution of posteriors following $\tau_1 = A$ is a mean-preserving spread of the distribution following $\tau_1 = B$, we will have $\sigma_2(A) \geq \sigma_2(B)$. Using our previous remark that $\max_{s_1} p_2(A, s_1) = p_2(A, 1)$, the distribution of posteriors following A is a mean-preserving spread of the distribution following B whenever:

$$p_2(A,0) < \min_{s_1} p_2(B, s_1) < p_1 < \max_{s_1} p_2(B, s_1) < p_2(A,1). \tag{A4}$$

Under the above condition, $\sigma_2(A) = \sigma_2(B)$ if, and only if $p_1 \leq q_A$; that is if, and only if, regardless of the task allocation and the realization of success and failure in period 1 the agent is always allocated to task B in period 2. Hence, equation (A4) and $p_1 > q_A$ are sufficient for $\sigma_2(A) > \sigma_2(B)$.

When talent is vertical, $h_A > h_B > l_B > l_A$, and the posteriors are ordered as

$$p_2(A,0) < p_2(B,0) < p_1 < p_2(B,1) < p_2(A,1).$$

and equation (A4) is automatically satisfied.

When talent is horizontal, $l_B > h_B$ implies that

$$p_2(B,1) < p_1 < p_2(B,0) \text{ and } p_2(A,0) < p_1 < p_2(A,1),$$

but not necessarily equation (A4). The distribution of posteriors following A is a mean-preserving spread of the distribution of posterior following B whenever $p_2(A,1) > p_2(B,0)$ and $p_2(A,0) < p_2(B,1)$. Simple algebra shows that these conditions are equivalent to $h_A - l_A > l_B h_A - l_A h_B > l_B - h_B$, which is therefore sufficient for $\sigma_1(A) < \sigma_1(B)$ and $\sigma_2(A) > \sigma_2(B)$ in the horizontal case. □

Proof of Lemma 4. When talent is vertical, we showed in the proof of Proposition 2 that $p_2(A,0) < p_2(B,0) < p_1$, which implies that failure always reduces the probability of being an h type (more so when the failure is at task A). Because the function $\pi^M(p_t)$ is monotonically increasing, we have the inequalities $\pi^M(p_2(A,0)) < \pi^M(p_2(B,0)) < \pi^M(p_1)$, and hence failures decrease the probability of success in period 2 relative to the initial probability of success. Instead, in the horizontal case low types are more likely to succeed at task B than high types and therefore $p_2(A,0) < p_1 < p_2(B,0)$. Furthermore, the function $\pi^M(p_2)$ is decreasing for $p_2 < p^*$ and then increasing, implying that $\pi^M(p_2(A,0)) > \pi^M(p_1)$. Note also that there is a threshold value of p_1 below which $\pi^M(p_2(B,0)) < \pi^M(p_1)$ (failures at B are bad news) and above which $\pi^M(p_2(B,0)) > \pi^M(p_1)$ (failure at B is good news). If p_1 is so low that $p_1 < p_2(B,0) < p^*$, then quite immediately failure is bad news. Instead, whenever $p_1 < p^* < p_2(B,0)$ we have that $\pi^M(p_1)$ is monotonically decreasing in $p_1 < p^*$, but $\pi^M(p_2(B,0))$ is monotonically increasing in p_1. The statement, therefore, follows by continuity.

Proof of Proposition 1. For given project value k_1 the probability that an entrepreneur sets $\tau_1 = A$ increases with α. At the same time α determines the set of k_1 that will be pursued by agents who receive a wage offer and become entrepreneurs. For these agents, as α increases, the set of projects that are pursued enlarges: smaller k_1 are pursued by entrepreneurs. These projects are the ones for which the entrepreneurs are more likely to choose $\tau_1 = A$. Overall, the probability of setting $\tau_1 = A$ increases with α, which implies that the probability of succeeding in period 2 also increases with α.

Parts (i) and (ii) of the Proposition follow by Lemma 4. For part (i), note that in the vertical-talent case the probability of period-2 success following a failure is always below the initial probability of success $\pi^M(p_1) \equiv \sigma_1(B)$. For part (ii), in the horizontal-talent case failures at task A are always good news, while if $p_1 < p_B$ failures at task B are bad news. Furthermore, suppose the distribution of project values has an upper bound sufficiently close to 1. If talent is horizontal, for $\alpha = 1$ and any $p_1 < p_B$ the majority of entrepreneurs are motivated by learning and set $\tau_1 = A$. In this case, failure is good news. When $\alpha \leq \alpha^F(\beta)$, entrepreneurs are either opportunity entrepreneurs or necessity entrepreneurs. They set $\tau_1 = A$ whenever $k_1 \leq K(\alpha)\Omega$, and B otherwise. In the limit case $p_1 \to 0$, we have $\Omega \to 0$ and all entrepreneurs choose task B and entrepreneurial failures are bad news. By continuity, there exists a p_1 and $\alpha < 1$ such that entrepreneurial failures are bad news.

B. Unobservable Task Allocation

We continue to assume that output is observable but we now assume that task allocation is not observable outside of the firm. Therefore, at the beginning of period 2 there is an asymmetry of information between a firm and agents who did not work in this firm.

We restrict our analysis of this problem to the case $\alpha = 1$. Our goal is to show that the basic finding of the model in the text persists: when α is high, firms choose $\tau_1 = B$ and the learning motive for entrepreneurship emerges (As α decreases, a firm can capture part of the benefit of learning and the learning motive for entrepreneurship is less likely.).

There could be a screening equilibrium. In such equilibrium, after observing success or failures, each firm offers agents who were not their workers two contracts (f_A, b_A) and (f_B, b_B). The agents who worked on task A in period 1 choose f_A, b_A, while agents who worked on task B choose f_B, b_B. Again, competition among firms guarantees that they make zero profits on *each* contract offered. But this immediately implies that, from period-1 viewpoint, firms will always choose task B because, again, the cost of choosing instead task A is bore by the firm while the future benefit is competed away by other firms. Hence, in a screening equilibrium, $\tau_1 = B$ in firms.

If instead there is no screening equilibrium, then after observing success or failures, each firm offers a single contract to each agent. This contract depends on the market belief over the workers' previous task allocation. For technical reasons, we also assume that there is an arbitrarily small probability that a worker who receives an outside wage offer changes employer.[30] In this case, the only possible equilibrium is that

30. Without this assumption, it is possible to build equilibria in which the market beliefs about past task allocation differs from the equilibrium task allocation. For example, the market may believe that workers who are willing to switch employer worked on task B. This

firms always set $\tau_1 = B$. Suppose not: the market expects $\tau_1 = A$ with some positive probability. A period-1 employer is better off by maximizing period-1 output and setting $\tau_1 = B$, while workers can then leave the firm and receive a wage which is greater than their expected productivity. Again, the equilibrium is identical to the one derived in the body of the text.

C. Long-Term (LT) Contracts

In the text, we assume that LT contracts are not available. Here we relax this assumption by introducing the possibility that, in period 1, firms and workers can sign a contract specifying a bonus and a fixed payment for period 1, and also a bonus and fixed payment for period 2 (contingent on success or failure in period 1). A contract here is therefore a triplet $\{(b_1, f_1), (f_{2,s_1}, b_{2,s_1}); s_1 \in \{0, 1\}\}$.

To simplify, we restrict our analysis to the case $\alpha = 1$. We show that, if contracting frictions are sufficiently severe (in the sense that $\beta < 1 - (\sigma_1(A)/\sigma_1(B))$) then in equilibrium firms choose $\tau_1 = B$.

We maintain the assumption that workers are free to leave their period-1 employer, either to become an entrepreneur or to join another firm. Hence, at the beginning of period 2, competition between firms implies that a firm will be able to retain a worker only if

$$f_{2,s_1} \geq \pi^M(\tau_1, s_1)(1 - b_{2,s_1}).$$

We also maintain the existence of contracting frictions: after output is produced, the firm owners can "run away" and capture a proportion $1 - \beta$ of the monetary return. Suppose that in period 1 there was a success. If the firms' owners run away they earn $1 - \beta$, while if they do not run away they earn:

$$1 - b_1 + S_{\tau_1,1} \min\left\{0, \left(\pi^M(\tau_1, 1)(1 - b_{2,1}) - f_{2,1}\right)\right\},$$

where S_{τ_1,s_1} is the probability that the worker will not leave the firm to become an entrepreneur.[31] Also, the minimum in the above expression accounts for the possibility that the worker may leave the firm for another firm. It follows that, for given task τ_1, only payments such that

$$S_{\tau_1,1} \max\{0, f_{2,1} - \pi^M(\tau_1, 1)(1 - b_{2,1})\} \leq \beta - b_1 \qquad \text{(A5)}$$

are incentive compatible. Similarly, following failures, the firms' owners profits from running away are zero, and only payments such that

belief may sustain an equilibrium in which all workers work on task A, and then never switch employer. This equilibrium is, however, not robust to perturbations such as the one we assume.

31. This probability is, in principle, a function of $b_{2,1}$ and $f_{2,1}$. This dependency, however, will not play any role.

$$f_{2,0} \leq \pi^M(\tau_1, 0)(1 - b_{2,0})$$

are incentive compatible. Since outside firms can give a surplus of $\pi^M(\tau_1, 0)$ to the worker, it must be the case that $\pi^M(\tau_1, 0)b_{2,0} + f_{2,0} = \pi^M(\tau_1, 0)$. Therefore, the firm gets zero surplus in period 2 in case of a failure in period 1.

Suppose now that there is an equilibrium in which firms choose $\tau_1 = A$ and then the firms' owners do not run away. Firms' profits in this case are

$$\sigma_1(A)(1 - b_1) - f_1 - \sigma_1(A)S_{A,1}\max\{0, f_{2,1} - \pi^M(\tau_1, 1)(1 - b_{2,1})\}$$

If instead a firm deviates to $\tau_1 = B$, their profits are

$$\sigma_1(B)(1 - b_1) - f_1 - \sigma_1(B)Y,$$

where

$$Y \equiv \begin{cases} S_{B,1}\left(f_{2,1} - \pi^M(B,1)(1 - b_{2,1})\right) & \text{if } \left(f_{2,1} - \pi^M(B,1)(1 - b_{2,1})\right) \in \left[0, \dfrac{\beta - b_1}{S_{B,1}}\right] \\ 0 & \text{otherwise} \end{cases}$$

is the firm's period-2 net cost, taking into consideration that the firms' owners may run away and that the worker may leave for another firm.

Hence, $\tau_1 = A$ and not running away is incentive compatible if and only if

$$(\sigma_1(B) - \sigma_1(A))(1 - b_1) \leq \sigma_1(B)Y$$
$$- \sigma_1(A)S_{A,1}\max\left\{0, \left(f_{2,1} - \pi^M(A, 1)(1 - b_{2,1})\right)\right\}.$$

For given b_1, the RHS of the above constraint is maximized when $Y = \beta - b_1$ and $f_{2,1} = \pi^M(A, 1)(1 - b_{2,1})$. Intuitively, these two conditions imply that, on the equilibrium path (i.e., when $\tau_1 = A$) the period-2 net cost is minimized (in fact, it is zero). However, the off-equilibrium period-2 net cost is maximized. Importantly, the fact that there should be no "running away" in equilibrium puts a bound to the largest possible off-equilibrium period-2 cost.

Assuming both conditions hold, the above IC constraint becomes:

$$\sigma_1(B)(1 - \beta) \leq \sigma_1(A)(1 - b_1)$$

which never holds if $\beta < 1 - \frac{\sigma_1(A)}{\sigma_1(B)}$. Hence, if contracting imperfections are sufficiently severe (in the sense that β is sufficiently low), then the equilibrium with long term contracts is the same as with short term contracts: firms allocate workers to $\tau_1 = B$, and agents may become entrepreneurs to learn their types.

References

Acemoglu, D. and J. S. Pischke. 1999. “The Structure of Wages and Investment in General Training,” 107 *Journal of Political Economy* 539–72.

Aghion, P. and J. Tirole. 1997. “Formal and Real Authority in Organizations,” 105 *Journal of Political Economy* 1–29.

Antonovics, K. and L. Golan. 2012. “Experimentation and Job Choice,” 30 *Journal of Labor Economics* 333–66.

Åstebro, T., J. Chen, and P. Thompson. 2011. “Stars and Misfits: Self-Employment and Labor Market Frictions,” 57 *Management Science* 1999–2017.

Azoulay, P., B. F. Jones, J. D. Kim, and J. Miranda. 2020. “Age and High-Growth Entrepreneurship,” 2 *American Economic Review: Insights* 65–82.

Baker, G., R. Gibbons, and K. Murphy. 1999. “Informal Authority in Organizations,” 15 *Journal of Law, Economics, and Organization* 56–73.

Banerjee, A. and E. Duflo. 2011. *Poor Economics: A Radical Rethinking of the Way to Fight Global Poverty*. New York, NY: Public Affairs.

Banerjee, A. V. and A. Newman. 1993. “Occupational Choice and the Process of Development,” 101 *The Journal of Political Economy* 274–98.

Baptista, R., F. Lima, and M. T. Preto. 2012. “How Former Business Owners Fare in the Labor Market? Job Assignment and Earnings,” 56 *European Economic Review* 263–76.

Bar-Isaac, H., I. Jewitt, and C. Leaver. 2020. “Adverse Selection, Efficiency and the Structure of Information,” 72 *Economic Theory* 579–614.

Bruenner, T., G. Friebel, R. Holden, and S. Prasad. 2019. “Incentives to Discover Talent.” CEPR Discussion Papers 13979, C.E.P.R. Discussion Papers.

Canidio, A. and T. Gall. 2019. “Rewarding Idleness,” 21 *Journal of Public Economic Theory* 433–59.

Canidio, A. and P. Legros. 2016. The Value of Entrepreneurial Failures: Task Allocation and Career Concerns. C.E.P.R. DP 11295, Centre for Economic Policy Research.

Daly, M. 2015. “The Long Term Returns of Attempting Self-Employment with Regular Employment as a Fall Back Option,” 35 *Labour Economics* 26–52.

De Bettignies, J. E. and G. Chemla. 2008. “Corporate Venturing, Allocation of Talent, and Competition for Star Managers,” 54 *Management science* 505–21.

Dillon, E. W. and C. T. Stanton. 2017. “Self-employment Dynamics and the Returns to Entrepreneurship.” Working Paper 23168, National Bureau of Economic Research.

Drugov, M. and R. Macchiavello. 2014. “Financing Experimentation,” 6 *American Economic Journal: Microeconomics* 315–49.

Evans, D. S. and L. S. Leighton. 1990. *Some Empirical Aspects of Entrepreneurship*, 79–99. Dordrecht, the Netherlands: Springer Netherlands.

Galor, O. and J. Zeira. 1993. “Income Distribution and Macroeconomics,” 60 *The Review of Economic Studies* 35–52.

Gibbons, R. and M. Waldman. 1999. “A Theory of Wage and Promotion Dynamics Inside Firms,” 114 *The Quarterly Journal of Economics* 1321–58.

———. 2004. “Task-Specific Human Capital,” 94 *The American Economic Review* 203–07.

Gomes, R., D. Gottlieb, and L. Maestri. 2016. “Experimentation and Project Selection: Screening and Learning,” 96 *Games and Economic Behavior* 145–69.

Gompers, P., A. Kovner, J. Lerner, and D. Scharfstein. 2010. “Performance Persistence in Entrepreneurship,” 96 *Journal of Financial Economics* 18–32.

Gottschalk, S., F. J. Greene, D. Höwer, and B. Müller. 2014. “If You Don’t Succeed, Should You Try Again? The Role of Entrepreneurial Experience in Venture Survival. ZEW-Centre for European Economic Research Discussion Paper (14-009). ZEW-Centre for European Economic Research.

Gromb, D. and D. S. Scharfstein. 2002. Entrepreneurship in Equilibrium. *Mimeo*. Working Paper 9001, National Bureau of Economic Research Wo.

Grossman, S. and O. Hart. 1986. “The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration,” 94 *The Journal of Political Economy* 691–719.

Hamilton, B. H. 2000. "Does Entrepreneurship Pay? An Empirical Analysis of the Returns to Self-Employment," 108 *Journal of Political Economy* 604–31.

Hellmann, T. 2007. "When Do Employees Become Entrepreneurs," 53 *Management Science* 919–33.

Hincapié, A. 2020. "Entrepreneurship Over the Life Cycle: Where Are the Young Entrepreneurs," 61 *International Economic Review* 617–81.

Holmström, B. 1999. "Managerial Incentive Problems: A Dynamic Perspective," 66 *The Review of Economic Studies* 169–82.

Jeitschko, T. D. and L. J. Mirman. 2002. "Information and Experimentation in Short-Term Contracting," 19 *Economic Theory* 311–31.

Jovanovic, B. 1979. "Job Matching and the Theory of Turnover," 87 (5, Part 1) *Journal of Political Economy* 972–90.

Klein, N. and S. Rady. 2011. "Negatively Correlated Bandits," 78 *The Review of Economic Studies* 693–732.

Lafontaine, F. and K. Shaw. 2016. "Serial Entrepreneurship: Learning by Doing," 34 *Journal of Labor Economics* S217–54.

Landier, A. 2005. Entrepreneurship and the Stigma of Failure. *Mimeo, Available at SSRN 850446*.

Layard, P. R. G., S. J. Nickell, and R. Jackman. 2005. *Unemployment: Macroeconomic Performance and the Labour Market*. Oxford: Oxford University Press.

Lazear, E. P. 2004. "Balanced Skills and Entrepreneurship," 94 *American Economic Review* 208–11.

Luzzi, A. and A. Sasson. 2016. "Individual Entrepreneurial Exit and Earnings in Subsequent Paid Employment," 40 *Entrepreneurship Theory and Practice* 401–20.

MacDonald, G. M. 1982a. "Information in Production," 50 *Econometrica* 1143–62.

——— 1982b. "A Market Equilibrium Theory of Job Assignment and Sequential Accumulation of Information," 72 *The American Economic Review* 1038–55.

Manso, G. 2011. "Motivating Innovation," 66 *The Journal of Finance* 1823–60.

——— 2016. "Experimentation and the Returns to Entrepreneurship," 29 *Review of Financial Studies* 2319–40.

Meyer, M. A. 1994. "The Dynamics of Learning with Team Production: Implications for Task Assignment," 109 *The Quarterly Journal of Economics* 1157–84.

OECD. 2013. *OECD Skills Outlook 2013: First Results from the Survey of Adult Skills*. Paris, France: OECD Publishing.

Papageorgiou, T. 2013. "Learning Your Comparative Advantages," 81 *The Review of Economic Studies* 1263–95.

Pastorino, E. 2019. "Careers in Firms: The Role of Learning and Human Capital." Working Paper 19118.

Ridder, G. and G. J. Berg. 2003. "Measuring Labor Market Frictions: A Cross-Country Comparison," 1 *Journal of the European Economic Association* 224–44.

Schumacher, H., K. Gerling, and M. Kowalik. 2015. "Entrepreneurial Risk Choice and Credit Market Equilibria," 15 *The BE Journal of Economic Analysis & Policy* 1455–80.

Stephan, U., M. Hart, T. Mickiewicz, C. C. Drews, and IFF Research. 2015. *Understanding Motivations for Entrepreneurship*. BIS Research Paper. Department for Business, Innovation and Skills.

Terviö, M. 2009. "Superstars and Mediocrities: Market Failure in the Discovery of Talent," 76 *The Review of Economic Studies* 829.

Vereshchagina, G. and H. A. Hopenhayn. 2009. "Risk Taking by Entrepreneurs," 99 *The American Economic Review* 1808–30.

Waldman, M. 1984. "Job Assignments, Signalling, and Efficiency," 15 *The RAND Journal of Economics* 255–67.

Williamson, O. E. 1979. "Transaction-Cost Economics: The Governance of Contractual Relations," 22 *Journal of Law and Economics* 233–61.