The Value of Entrepreneurial Failures: Task Allocation and Career Concerns*

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Abstract

The task assignment that maximizes present expected output is not necessarily the most informative about an agent's comparative advantage at different tasks. Entrepreneurs are free to choose their task assignment—workers in firms are not. When labor market frictions are low, any surplus generated by a more informative task assignment is captured by the worker, and firms maximize present expected output in their task assignment. Hence, agents may choose entrepreneurship to learn their comparative advantage. The opposite holds when labor market frictions are large. The model establishes a causal relation between the degree of labor market frictions, the value of entrepreneurial failures, the level of entrepreneurial activity, the degree of firms' short-termism, and the rate of within-firm talent discovery. The theoretical correlations between these variables are consistent with the evidence available for the US and continental Europe.

JEL classification: D83, J24, J62, L26, M13.

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1 Introduction

Highly publicized stories of entrepreneurial success hide a much longer list of entrepreneurial failures. Failures can be bad news, leading to more entrepreneurial failures or lower wages than comparable workers. In this case, agents become entrepreneurs only if their business idea has the potential to generate a sufficiently large return to compensate for the decrease in their future opportunities. But failures can also be good news, leading to a higher probability of success in a new enterprise or to higher wages than comparable workers. In this scenario, agents may become entrepreneurs even if their ideas are unlikely to generate a high return. Understanding when and why failures lead to penalties or rewards is therefore integral to understanding the scope and performance of entrepreneurial activity. We provide here a unified framework that explains why failures are sometimes perceived as good news and sometimes as bad news, and how the level of entrepreneurial activity changes with the value of entrepreneurial failures.

Our theory is partly motivated by the contrasting empirical findings about the value of entrepreneurial failures. In the US, entrepreneurial failures seem to lead to positive outcomes. For example, Gompers, Kovner, Lerner, and Scharfstein (2010) show that entrepreneurs who previously failed are marginally more likely to succeed than first time entrepreneurs.[1] Hamilton (2000) shows that entrepreneurs who leave entrepreneurship and re-enter 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.[2]

The evidence available for Europe tells a very different story. Using German data, Gottshalk, Greene, Höwer, and Müller (2014) show that entrepreneurs

[1] See also Lafontaine and Shaw (2014), who find similar results among entrepreneurs in the retail sector in Texas.

[2] However, excluding the few superstar entrepreneurs, entrepreneurs earn less than workers on average. For example, the median entrepreneur after 10 years in business earns 35% less than a similar individual who never left employment.

who have previously failed are subsequently more likely to fail than first time entrepreneurs. Using Portuguese data, Baptista, Lima, and Preto (2012) find that the wage of former entrepreneurs is lower than the wage of workers who have never left employment.[3]

Hence, the US evidence suggests that failures may be good news but the EU evidence suggests that failures may be bad news. Therefore, theories that stress the negative value of failures are counterfactual. But theories that stress the positive value of failures may also be counterfactual. We provide a framework that links the degree of labor market frictions to firms' organization, entrepreneurial activity, and the positive or negative value of entrepreneurial failures.

We build an equilibrium model of career choice in which agents repeatedly choose between entrepreneurship and employment. Following MacDonald (1982a,b) and Gibbons and Waldman (2004), we model talent in a horizontal fashion: each agent has a comparative advantage at one task. For instance, two agents with the same human capital may have different abilities to interact with others: one agent may like precise guidelines while another may prefer flexibility or fuzzy missions; some managers may be good at improving an existing project but may be uncomfortable at supervising a totally new project. The business literature is replete with such examples.

But talent is rarely perfectly known and often requires hands-on learning, something that may be enhanced by working on some tasks but not others.[4] Any task assignment therefore generates costs and benefits, both privately and socially. From a static perspective, one would like to assign an agent to the task that maximizes the static expected return. From a dynamic perspective, one would like to learn as quickly as possible the agent's talent, which may require assigning this agent to a task that does not maximize the static expected return.

In the model, the value of failures, that is the lifetime expected utility

[3] Neither Hamilton (2000) nor Baptista, Lima, and Preto (2012) discuss the reason for re-entry.

[4] Hence, talent discovery is different from the usual "experimentation" motive for entrepreneurship where agents learn about the returns of a project.

of an agent following a failure, is higher when the initial task assignment favors the dynamic benefit over the static expected return. Task assignment within firms depends on the severity of labor market frictions, modeled as the probability that an agent receives a wage offer. When the labor market is frictionless, firms choose allocate tasks to maximize the static expected profits, because any learning benefit would be captured by the workers. If instead labor market frictions are sufficiently severe, firms capture part of the benefits of learning and therefore may choose a task assignment that favors discovering their workers' talents. It follows that, depending on the severity of labor market frictions, two equilibrium regimes may possibly emerge in the model.[5]

In the first regime, labor market frictions are low and firms only value short-run output: firms are "short-termists." Because entrepreneurs can choose their task allocation while workers cannot, some agents choose entrepreneurship even when the instantaneous payoff to an entrepreneur is lower than the instantaneous payoff to a worker. Besides entrepreneurs who favor learning, there are agents who choose entrepreneurship because they have valuable projects that they want to pursue. Overall, entrepreneurs learn more and have greater future productivity than workers: former entrepreneurs receive a higher wage than former workers when re-entering the labor market.

In the second regime, labor market frictions are high and firms capture part of the benefit of learning their workers' talents; firms are willing to trade off short term losses for long term profits: they are "long-termists." Hence, agents can discover their comparative advantage by working for firms. They become entrepreneurs only to pursue projects that have a higher return than that of firms. But then, entrepreneurs are more likely than workers to favor short-run profits in their choice of task allocation. On average, former workers are more valuable than former entrepreneurs, and entrepreneurs who go back to the labor market will have a lower wage than comparable workers.

[5] While we focus on labor market frictions as a proxy for agents' ability to switch occupations, other frictions, like borrowing constraints, are also relevant. However, in our model, financial frictions play a role only if there are labor market frictions. See our discussion in the Conclusion.

The model therefore establishes a causal relation between the degree of labor market frictions and four quantities:

- The value of entrepreneurial failures.
- The level of entrepreneurial activity.
- Whether firms maximize short-term or long-term output.
- The rate of within-firm talent discovery via task allocation.

According to most estimates, labor market frictions in Europe are significantly higher than in the US. For instance, Ridder and Berg (2003) define search frictions in the labor market as the rate of arrival of job offers to employed workers for the US, France, UK, Germany and Holland; they show that all EU countries (with the exception of the UK) have a rate of job arrival that is significantly lower than in the US. Layard, Nickell, and Jackman (2005) find a similar ranking among countries when looking at the arrival rate of job offers to unemployed workers.

As a consequence, our results are consistent with the evidence about entrepreneurial failures discussed above. Entrepreneurial failures in high frictions countries (EU) are less valuable than entrepreneurial failures in low frictions countries (US), both when starting a new venture and when re-entering the labor market.

Furthermore, in the model, the level of entrepreneurial activity and the proportion of serial entrepreneurs is higher in the US regime than in the EU regime because of the additional learning motive for entrepreneurs, which is consistent with the available empirical evidence.[6]

The model also predicts that European firms are less short-termist than their US counterparts, which is something that is well documented (e.g., Becht, Bolton, and Roëll, 2003). The usual explanations in the corporate finance literature are regulation or the dilution of ownership. Our labor-market effect complements these explanations, because the ability of firms to engage in long-term planning, e.g., investing in projects that require highly specific human

[6] See, for instance, the Global Entrepreneurship Monitor 2013 global report, available at http://www.gemconsortium.org/docs/3106/gem-2013-global-report.

capital or talent discovery, is not only a function of corporate governance rules but also of the ability of firms to identify and retain talent in an incentive compatible way.

Finally, on-the-job talent discovery via task allocation should be higher in the EU regime than in the US regime. In our model, choosing a task allocation that privileges learning is equivalent to letting workers choose their tasks; on the other hand, choosing a task allocation that privileges short-run output may require imposing a task on the worker. Hence learning via task allocation in our model is similar to the "task discretion" variable collected by the OECD.[7] The data shows that the US has lower "task discretion" than several European countries, and is below the OECD average, consistent with our model's results (the US ranks 14th out of 22, below most European countries).

Literature

We survey the literature in relation with two key features of our model. First, firms' organizational choices and workers' career paths are simultaneously and endogenously determined, and depend on the severity of labor market frictions. The crucial role that the labor market plays in determining the willingness of firms to increase their workers' productivity, either by experimenting or by providing training, is clearly not novel but the application to the joint determination of entrepreneurial activity and firms' organization is. Second, we propose a horizontal view of talent, which implies that failures may be good news.

The optimistic view of failures is prevalent in the management literature and among business practitioners. Many business leaders share Henry Ford's view that a failure "is only the opportunity to begin again more intelligently." A recent issue of *Harvard Business Review* (April 2011) collects several papers under the heading 'Failure Chronicles," each describing an example of failure,

[7] The variable "task discretion" is defined as "Choosing or changing the sequence of job tasks, the speed of work, working hours; choosing how to do the job." See OECD (2013), especially, chapter 4, Figures 4.2 and 4.3; available at https://skills.oecd.org/documents/SkillsOutlook_2013_Chapter4.pdf.

and how it ultimately led to business success. A recent book by the journalist Tim Harford, *Adapt: Why Success Always Starts with Failure* well summarizes this positive attitude in the business world toward entrepreneurial failures.

In contrast, it is a common assumption in the economic literature that talent is a vertical characteristic and therefore that a failure provides 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 entrepreneurial failures always produce a stigma, which may be more or less pronounced depending on some features of the economy. 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, little information regarding the entrepreneur's type is revealed by a failure and hence there is a high level of entrepreneurship. On the other hand, when failures are rare, they carry a larger stigma and entrepreneurship is deterred.

Hellmann (2007) also studies career paths in and out of entrepreneurship and focuses on the change from employment to entrepreneurship. In his model, firms are are reluctant to develop ideas that are too far from their core business and therefore workers may decide to develop ideas outside the employment relationship. We are more interested in the reverse trajectory: agents switching from entrepreneurship to employment, and also in the informational content of failures.

Our assumption that talent is a horizontal dimension and that agents and firms may experiment in order to learn this talent is well represented in the literature. In pioneering papers, MacDonald (1982a,b) analyze a task-assignment problem with symmetric information about talent, in the context of a frictionless labor market and employment as the unique occupation. In contrast, we introduce entrepreneurship and labor market frictions, and show that the equilibrium task allocation depends both on the agent's occupational choice and on the severity of those frictions.

Quite germane to our work is the task allocation model of Gibbons and Waldman (2004), who build on Gibbons and Waldman (1999) by introducing task-specific human capital. In their framework, human capital is accumulated by working on a specific task, and does not affect the worker's expected productivity at other tasks. Here, we explicitly model human capital accumulation as a learning process, which can be informative about the worker's productivity at several tasks. In addition, we are concerned with the implication for career paths between different professions. Papageorgiou (2013) assumes that firms are identified with one task and that agents move between them to discover their comparative advantage.[8] He, therefore, does not allow firms to choose their internal organization, which is a key element in our model for talent discovery. While in our model labor market frictions increase the rate of on-the-job talent discovery, the opposite is true in his model.

Transversal to our work are models of Bayesian learning in the workplace where learning is worker specific and can be transferred between firms (for example Harris and Holmström, 1982, Farber and Gibbons, 1996). Recently, Antonovics and Golan (2010) address the issue of experimentation, defined as choosing a job where the expected probability of success is low, but where outcomes are strongly correlated with the agent's type. Similarly, Terviö (2009) argues that cash constraints or the absence of long term contracting prevent optimal talent discovery, in the sense that too few workers will be employed in jobs where their productivity can be revealed. In contrast, in our model, the rate of on-the-job talent discovery depends on the task allocation chosen within firms. Hence, even if all agents are employed, the optimal rate of talent discovery may not be achieved because workers are allocated to tasks that are not informative.

Also related is the literature on experimentation and incentives. Jeitschko and Mirman (2002), Manso (2011), Gomes, Gottlieb, and Maestri (2013) and Drugov and Macchiavello (2014) derive the optimal incentive contract of a principal who would like agents to experiment. In contrast, we focus on the

[8] Papageorgiou (2013) considers labor market frictions, Eeckhout and Weng (2009) analyze a similar model but without labor market frictions.

market incentives for experimentation faced by firms and entrepreneurs.

The rest of this paper proceeds as follows. In Section 2 we introduce the model. In Section 3 we consider a simplified version of the model where entrepreneurial activity is driven exclusively by the desire to learn about one's talent. In Section 4 we consider the general model and the possibility that entrepreneurial activity could also be motivated by short term profit maximization. We conclude in Section 5. All proofs missing from the text are in the Appendix.

2 The model

The economy is composed of a continuum of identical agents and a continuum of identical firms. The measure of agents is smaller than that of firms, implying that some firms are always inactive in equilibrium. Each agent lives for two periods and can be of type $\theta \in \{0, 1\}$. Agents' types are observable neither to agents nor firms. The common initial belief about a young agent's type is $p_0 = E[\theta]$; without loss of generality we assume that $p_0 > 1/2$.

Production The production process involves one of two tasks, denoted by $\tau \in \{0, 1\}$, and leads to an outcome $s \in \{0, 1\}$ that can be success ($s = 1$) or failure ($s = 0$). There is a good match between the individual's type and the task when $\theta = \tau$, in which case the output is produced with probability $q \in (0, 1)$. There is no output if there is a mismatch, that is, if $\theta \neq \tau$.[9] Without loss of generality, we assume that choosing one task over the other has no cost to the agent.

Therefore, talent has here exclusively a horizontal dimension, because both types can be equally productive provided that they are allocated to the right task. For example, agents may excel either at finding creative solutions or at implementing existing solutions; they may excel either at working in teams or

[9] Assuming that there is failure with probability one when $\tau \neq \theta$ implies that success on a task is fully informative. This is for technical convenience but is not crucial for the analysis. Our qualitative results are the same whenever the probability of success in the case of mismatch is positive but lower than q.

at performing independent work; they may excel either at implementing radical changes or at implementing incremental changes. Furthermore, here, each agent has a comparative advantage in one task, but no absolute advantage. This is obviously an extreme assumption, and implies that when individuals learn that they are productive at one task, they also learn that they are not productive at the other task. As we show in Appendices B and C, our results are not dependent on this definition of talent. In Appendix B, we consider a variant of the model in which the probability of succeeding at a given task is independent of the probability of succeeding at the other task. Hence, observing a success or a failure in a specific task is informative about the probability of future successes only in that specific task. In Appendix C, we adopt the most common view, that talent provides an absolute advantage in all tasks, but that there is a comparative advantage in only one task. Both these variations preserve the key insights of our baseline model: different types should be allocated to different tasks, and talent discovery occurs via task allocation. Therefore, all our results continue to hold. However, these variations complicate the problem of inferring an agent's type from the sequence of successes/failures, in ways that are not essential to our argument, and for clarity, we choose to focus, in the text, on talent as a purely horizontal dimension.

It follows that a failure can happen for two reasons: either there is a mismatch between the talent and the task, or there is a good match but the process fails with probability $1-q$ for exogenous reasons. The probability that there is a success is therefore dependent on the task allocation and the belief p that the individual is of type $\theta = 1$:

$$\Pr\{s = 1|\tau, p\} = q\left[p \cdot \tau + (1-p) \cdot (1-\tau)\right].$$

Timing There are two periods, indexed by $t = 1, 2$. In each period t, firms offer contracts to agents, and agents choose whether to be an entrepreneur or a worker. The timing of each period is as follows.

1. All firms draw the same project with return K_t from the uniform distribution on $[0, 2]$. There is no time dependence, that is, a project at time

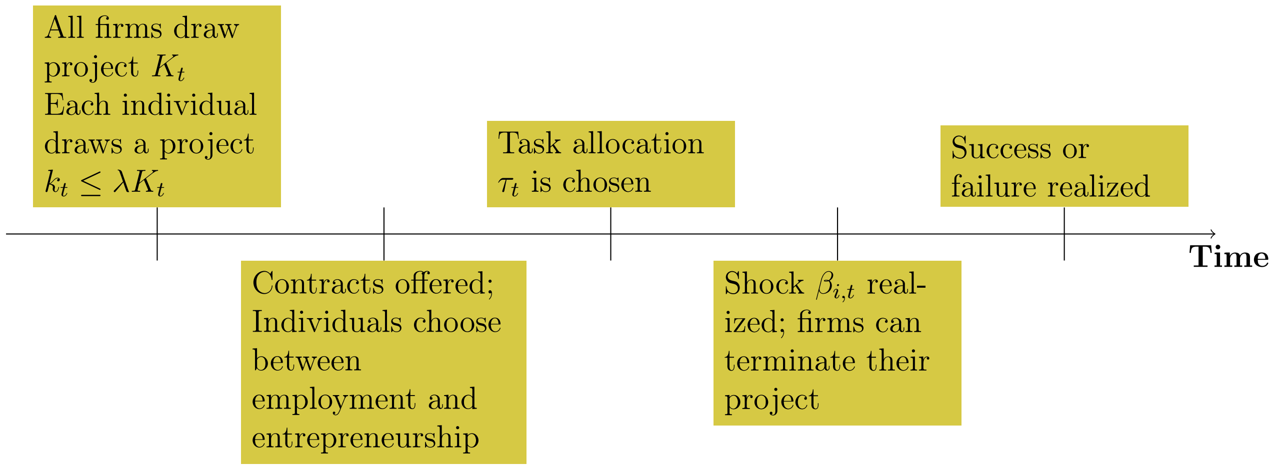

Fig. 1: Timing within period t

2 is independent of a project at time 1. The firms' projects are publicly observable. Because K_t is equal across firms, it is better interpreted as an aggregate (or average) productivity in a given period.

2. Each agent draws a project with return k_t from the uniform distribution $[0, \lambda K_t]$. The agents' projects are publicly observable. In the next section, we consider the case $\lambda = 1$, meaning that the returns of entrepreneurs are always lower than those of firms for a given task allocation.[10] In Section 4 we consider the general case, $\lambda \geq 1$, so that the return on an entrepreneurial project can be larger than the return on a firm's project.

3. Firms simultaneously offer contracts to all agents. A contract consists of a fixed payment f and a bonus payment b contingent on success. Each agent decides whether to be an entrepreneur, or to work for one of the firms.[11]

[10] The idea being that firms produce a "standard" product whose market return depends on demand shocks. If the standard technology also constrains the ability of individuals to find new ideas, there will be a bound on how much more profitable new ideas can be.

[11] We are implicitly assuming that firms can only use short term contracts, i.e., payments can be contingent only on success or failure during the current period. We relax this assumption in Appendix E.

4. After the contract is signed, the firm chooses the worker's task and entrepreneurs choose their own task.

5. A firm- and entrepreneur-specific idiosyncratic shock $\beta_{i,t}$ is realized. $\beta_{i,t}$ is uniformly distributed over $[\overline{\beta}, \underline{\beta}]$, with $\underline{\beta} < 1$ and $\overline{\beta} = 2 - \underline{\beta}$ (so that $E[\beta_{i,t}] = 1$). The realization of $\beta_{i,t}$ is private information to the firm (for projects carried out within that firm) and to the entrepreneur (for projects carried out by that entrepreneur).

6. Each firm and each entrepreneur can decide to terminate their projects. The termination of a project leads to a failure with probability one.

7. If the project is kept running, outcomes are realized and observed by everybody. In the case of success, a firm's output is $\beta_{i,t}K_t$, while an entrepreneur's output is $\beta_{i,t}k_t$.

The information structure is as follows. Outcomes and project values are perfectly observable and contractable. Idiosyncratic shocks are private information and therefore are not contractable. Furthermore, we assume that task allocation, and whether the project is terminated, are observable but not contractable.

The non-contractabality of task allocation 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). But we also consider, in Appendix D, the case of non-observable task allocation and project termination.[12]

The presence of the idiosyncratic shock $\beta_{i,t}$ prevents agents and firms from writing contracts in which firms are completely indifferent between success or

[12] Unobservable task allocation and project termination generate asymmetric learning, since at the beginning of period 2, the firm for which the agent worked previously is better informed than other firms regarding the agent's type. We show in the Appendix that, for some parameter values, firms can offer a menu of contracts that will screen workers depending on their previous task allocation. When screening is not possible, we show that the equilibrium with asymmetric information is qualitatively similar to the one derived here.

failure, and between project termination or project continuation. In particular, for sufficiently large bonus payments b, the firm may terminate the project whenever the realization of $\beta_{i,t}$ is low. Competition between firms guarantees that all contracts have a bonus payment b that is sufficiently low, so that there is never a project termination under any realization of $\beta_{i,t}$.

We interpret the parameter $\underline{\beta}$ as an index of contract completeness. Within a firm, the value of a success is $\beta_{i,t}K_t$, but contracts can be contingent only on K_t, and $\underline{\beta}$ measures the importance of this non-contractable component. Because the US and EU have sophisticated legal systems and courts, we focus below on the case where $\underline{\beta}$ is close to one. Lastly, we introduce labor market frictions by assuming that an agent receives no offer from firms with probability $1-\alpha$ and receives at least two offers with probability α.[13]

2.1 Learning

In period 2, the probability that the agent is of type 1 conditional on period 1 task allocation and period 1 outcome is

$$\text{pr}\{\theta = 1|\tau_1 = 1, s_1\} = \begin{cases} 1 & \text{if } s_1 = 1 \\ \frac{p_0(1-q)}{1-p_0 q} & \text{if } s_1 = 0 \end{cases} \tag{1}$$

$$\text{pr}\{\theta = 1|\tau_1{=}0, s_1\} = \begin{cases} 0 & \text{if } s_1 = 1 \\ \frac{p_0}{1-q(1-p_0)} & \text{if } s_1 = 0. \end{cases}$$

On a success, agents learns their types perfectly. On failure at task $\tau_1 = 0$, the agent is more likely to be of type 1 since $\frac{p_0}{1-q(1-p_0)}$ is greater than 1/2. Intuitively, because the agent is ex ante more likely to be of type 1, after failing at task 0 the agent becomes even more convinced that the agent is of type 1. In case of a failure at task $\tau_1 = 1$, the agent may conclude that the agent's most likely type is 1, or may conclude that the most likely type is 0,

[13] Hence there is a zero probability of receiving a single offer. If the probability of an agent's receiving a single offer were positive, firms would design their contracts knowing that, with a small probability, they might have monopsony power over the agent. This significantly complicates the firm's problem but does not modify our qualitative results.

since $\frac{p_0(1-q)}{1-p_0 q}$ may be greater than or less than 1/2.

It follows that the task allocation maximizing the period 2 probability of success, given the history of task allocation and successes/failures, is

- If $\tau_1 = 1, s_1 = 1$, the agent is of type 1, and therefore $\tau_2 = 1$ is optimal.
- If $\tau_1 = 1, s_1 = 0$, the agent is more likely to be of type 1 when $p_0(2-q) > 1$ and therefore $\tau_2 = 1$; but if $p_0(2-q) < 1$, the agent is more likely to be of type 0 and therefore $\tau_2 = 0$ is optimal.
- If $\tau_1 = 0, s_1 = 1$, the agent is of type 0 with probability one and therefore $\tau_2 = 0$ is optimal.
- If $\tau_1 = 0, s_1 = 0$, the agent is more likely to be of type 1 and therefore $\tau_2 = 1$ is optimal.

The probability of success in period 2, assuming that the agent will be allocated to the task with the highest probability of success, is

$$\text{pr}\{s_2 = 1 | \tau_1 = 1, s_1\} = \begin{cases} q & \text{if } s_1 = 1 \\ q \max\left\{\frac{p_0(1-q)}{1-p_0 q}, \frac{1-p_0}{1-p_0 q}\right\} & \text{if } s_1 = 0 \end{cases}$$
$$\text{pr}\{s_2 = 1 | \tau_1 = 0, s_1\} = \begin{cases} q & \text{if } s_1 = 1 \\ \frac{q p_0}{1-q(1-p_0)} & \text{if } s_1 = 0. \end{cases}$$

If $s_1 = 0$, the probability of success at time 2 is greater if the agent has worked on task 0 initially. Intuitively, a failure at task $\tau_1 = 0$ increases the belief that the agent is of type 1, and hence increases the future probability of success. Regarding a failure at task 0, a failure at task $\tau_1 = 1$ makes the agent's type more uncertain (i.e., the posterior probability that the agent is of type 1 is closer to 1/2) and lowers the future probability of success. Overall, simple algebra shows that at the time of task allocation, the expected probability of success in period 2 is greater when the agent is allocated to $\tau_1 = 0$ than $\tau_1 = 1$. However, this increase in the expected probability of success in period 2 has a static cost, because $\tau_1 = 0$ reduces the probability of success in period

1 relative to $\tau_1 = 1$. There is therefore a basic trade off between the task allocation maximizing the current probability of success and the task allocation maximizing the future probability of success.

3 The Learning Motive for Entrepreneurship

Because entrepreneurs have control over their task allocation, an agent may choose entrepreneurship to work on task $\tau_1 = 0$ (which is the most informative task) whenever a firm would instead choose $\tau_1 = 1$. To highlight this learning motive for entrepreneurship, we ignore in this section any potential advantage that entrepreneurs could have in terms of project returns, and remove the possibility of firms' internalizing the benefits of learning. We therefore make the following assumptions.

- k_t is drawn from a $[0, K_t]$ uniform distribution. In other words, the agent's project is always of lower value than the firm's project.
- The labor market is frictionless, that is, agents get wage offers with probability one: $\alpha = 1$.

Period 1 workers. Recall that a contract consists of a fixed payment f and a bonus payment b contingent on success. Because the idiosyncratic shock $\beta_{i,t}$ is not observable, when b is greater than the lowest project value $\underline{\beta} K_t$, the project might be inefficiently terminated by the firm. Therefore, efficient contracting requires a bonus $b \leq \underline{\beta} K_t$.[14]

An agent who worked for a firm and succeeded in period 1 will generate an expected revenue for the firm equal to $K_2 E(\beta) \cdot q$. Due to competition,

[14] Because $\beta_{i,t}$ is private information to the firm, renegotiation of the bonus payment after the shock $\beta_{i,t}$ is realized does not avoid inefficient project termination. If project termination is a credible threat for some realizations of $\beta_{i,t}$, the firm may propose to renegotiate the bonus, and the worker will accept or reject the offer based solely on the size of the bonus and on the firm's strategy. It is easy to see that in equilibrium the worker will reject the offer to renegotiate with positive probability, leading to inefficient project termination for some $\beta_{i,t}$. Termination is efficiently avoided only if the firm prefers project continuation for every realization of $\beta_{i,t}$.

the contract $\{b, f\}$ offered by firms to this agent must satisfy $b \leq \underline{\beta} K_2$. In addition, because $E(\beta) = 1$, the expected payoff earned by the worker in case of accepting the contract must be

$$w_2(s_1 = 1) = K_2 \cdot q.$$

By the same reasoning, following a period 1 failure, there are two possible expected payoffs to the worker, depending on the period 1 task allocation:

$$w_2(s_1 = 0, \tau_1 = 1) = K_2 \cdot q \cdot \max\left\{\frac{p_0(1-q)}{1-p_0 q}, \frac{1-p_0}{1-p_0 q}\right\}$$
$$w_2(s_1 = 0, \tau_1 = 0) = K_2 \cdot q \cdot \frac{p_0}{1-q(1-p_0)}.$$

Because workers are free to change firms in period 2, a period 1 employer needs to pay its worker the market wage in period 2. Hence, all firms (including period 1 employers) earn zero profits in period 2. It follows that the task choice in period 1 is the one that maximizes period 1 profit given the contract signed.

Lemma 1. *Firms optimally choose task allocation to maximize short-run profits and set* $\tau_1 = 1$

Proof. To avoid project termination, the equilibrium contract requires $b \leq \underline{\beta} K_1$. Therefore, for every realization of $\beta_{i,1}$, the firm maximizes the probability of success in period 1 by assigning the worker to task 1.

□

Period 1 entrepreneurs. Consider an entrepreneur in period 1. For a given k_1, the total expected payoff over two periods, which we call the "dynamic payoff," of choosing task 1 in period 1 is

$$V(\tau_1 = 1) = qp_0\,(k_1 + q) + (1 - qp_0) \cdot q \cdot \max\left\{\frac{p_0(1-q)}{1-p_0 q}, \frac{1-p_0}{1-p_0 q}\right\},$$

and the dynamic payoff of choosing task 0 in period 1 is

$$V(\tau_1 = 0) = q(1 - p_0)\,(k + q) + (1 - q(1 - p_0))\frac{qp_0}{1 - q(1 - p_0)}.$$

Because an entrepreneur is the residual claimant, an entrepreneur never shuts down a project. Therefore, $\tau_1 = 0$ is chosen when $V(\tau_1 = 0) \geq V(\tau_1 = 1)$, that is, when

$$k_1 \leq \min\left\{\frac{q(1 - p_0)}{2p_0 - 1}, 1 - q\right\}. \tag{2}$$

This condition holds when the value k_1 of the project is low or when p_0 is close to 1/2.

Equilibrium career choice. Consider a project k_1 such that an entrepreneur would set $\tau_1 = 0$. When $k_1 = K_1$, the agent strictly prefers entrepreneurship to working for a firm, because as entrepreneur, $\tau_1 = 0$ can be set and then a greater dynamic surplus can be enjoyed than if the task allocation was $\tau = 1$. Therefore, by continuity, the agent will decide to choose entrepreneurship even if the agent's project has a strictly lower return than that of the firm.

Lemma 2. *(i) An agent becomes an entrepreneur in period 1 if and only if*

$$k_1(1 - p_0) > K_1 p_0 - \min\{q(1 - p_0), (2p_0 - 1)(1 - q)\}.$$

(ii) Entrepreneurs always choose task 0*.*

An increase in k_1 always increases the desire to be an entrepreneur. However, the desire to become an entrepreneur is not monotonic in $p_0 \in [1/2, 1]$. When p_0 is close to 1, agents have a strong prior belief regarding their optimal task allocation and do not value learning, implying that working for a firm is optimal. If p_0 is close to 1/2, the two tasks are almost equally informative, and the agent is unwilling to pay the opportunity cost $K_t - k_t$ and become an entrepreneur. Figure 2 is an illustration of this non-monotonicity.

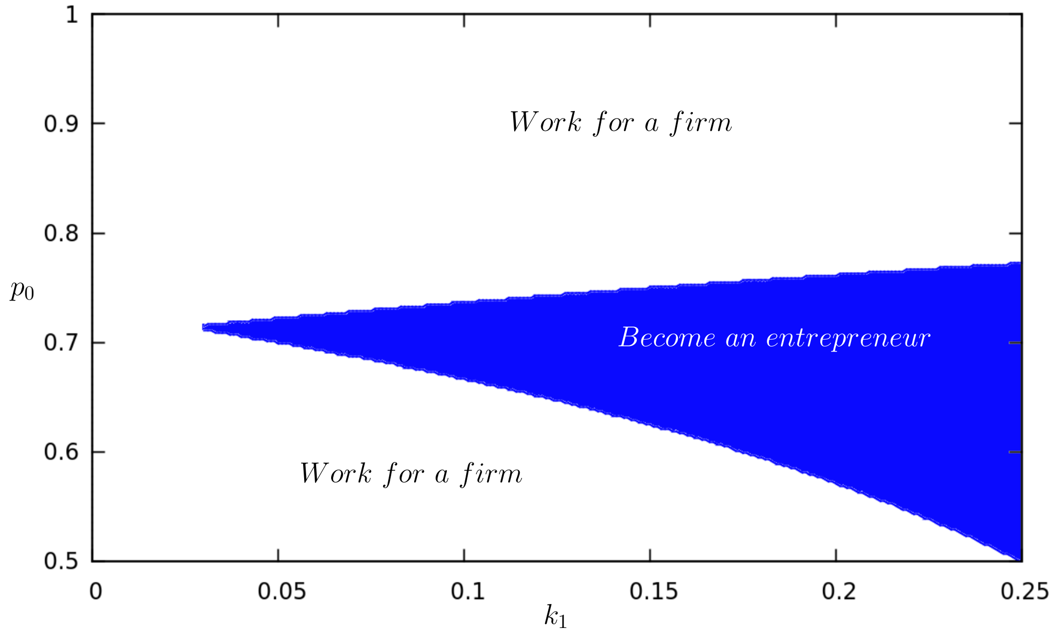

Fig. 2: Range of p_0 and k_1 leading to entrepreneurship when $K_1 = 0.25$ and $q = .6$

Comparing the Career Paths of Workers and Entrepreneurs. We have established that agents who work for a firm are allocated to the short run profit-maximizing task $\tau_1 = 1$ but that agents who choose entrepreneurship favor the learning-maximizing task $\tau_1 = 0$. Therefore, compared to workers, entrepreneurs work on projects of lower value and are more likely to fail. Overall, the period 1 payoff to entrepreneurs is lower than the period 1 payoff to workers. In addition, direct comparison shows that the average period 2 wage of a period 1 entrepreneur is always greater than the average period 2 wage of a period 1 worker.[15]

These results are consistent with the empirical evidence for the US described in the Introduction. Using US data, Hamilton (2000) shows that yearly earnings of entrepreneurs are lower than yearly earnings of workers

[15] A period 1 entrepreneur earns an expected period 2 wage of $K_2 \cdot q\,(q(1-p_0)+p_0)$, while a period 1 worker earns an expected period 2 wage equal to $K_2 \cdot q\,(qp_0 + \max\{p_0(1-q), 1-p_0\})$.

(with the exception of a few "superstar" entrepreneurs), but at the same time entrepreneurs who leave entrepreneurship and re-enter the labor market after a few years of entrepreneurship earn higher wages than comparable workers. Our model suggests that people value entrepreneurship because they have control over their task even if this comes at the cost of a lower initial payoff than workers.

Finally, note that the assumption that the entrepreneurs' output is always inferior to the firms' output ($k_t \leq K_t$) is sufficient but by no means necessary for entrepreneurs to choose the most informative task allocation: what matters is whether condition (2) holds. In the model just discussed, the selection into entrepreneurship is such that condition (2) always holds for entrepreneurs. The next section explores a more general case, in which some entrepreneurs may set $\tau_1 = 1$.

4 General Analysis

In this section, we introduce the possibility that entrepreneurs may have projects of greater value than firms, by assuming that $k_t \sim U[0, \lambda K_t]$ with $\lambda \geq 1$. This assumption creates an additional motive for entrepreneurship, because some agents may become entrepreneurs to pursue high-value projects and maximize short-run profits.

In addition, we introduce labor market frictions, modeled as a probability $\alpha \leq 1$ of receiving a wage offer. This assumption has two implications. First, whenever a worker does not receive a wage offer at time 2, the previous employer can hold up the worker and extract a positive surplus. This holdup problem is anticipated and, because of competition, in period 1, firms offer wages that reflect the expected profits derived from the holdup. While neutral from an expected payoff point of view, holding up implies that firms may implement task $\tau_1 = 0$ at time 1 because firms expect to capture some of the benefits of learning about their worker. Second, labor market frictions create the possibility that some agents become "involuntary" entrepreneurs because they do not receive any job offer.

We structure our analysis in the following way. First, we will derive the equilibrium task allocation of period 1 workers and period 1 entrepreneurs as a function of α. We will show that as α decreases, entrepreneurs are more likely to choose $\tau_1 = 1$ over $\tau_1 = 0$, while the opposite is true for workers. Second, we will look at the period 2 wage, conditional on former occupation. Because period 1 task allocation determines period 2 market value, as α decreases, the period 2 wage of former entrepreneurs decreases and the period 2 wage of former workers increases. We therefore replicate the two regimes described in the Introduction, in which a low degree of labor market frictions (high α) corresponds to a positive wage premium for former entrepreneurs (the "US" case), and a high degree of labor market frictions (low α) corresponds to a negative wage premium for former entrepreneurs (the "EU" case). Third, we will endogenously derive the period 1 occupational choices and show that, under some restrictions on the parametrs, entrepreneurial activity is higher under the "US" regime than under the "EU" regime.

4.1 Equilibrium Task Choice

Period 1 workers. Consider a period 1 worker. We assume that whenever the holdup problem arises, the firm and the worker split the surplus equally.[16] Call p_1 the probability of being type 1 at the beginning of period 2. If there is no outside offer at the beginning of period 2, a period 1 employer enjoys a payoff equal to

$$q \max\{p_1, 1 - p_1\} \max\{(K_2 - k_2), 0\}/2.$$

Since workers receive outside offers with probability α, taking expectations with respect to k_2 and K_2, the expected profits of the firm in the second period are

$$(1 - \alpha)\frac{q \max\{p_1, 1 - p_1\}}{4\lambda}.$$

[16] Using Nash bargaining is without loss of generality. What matters is that the firm is able to pay a wage lower than the worker's expected productivity.

Because $E[\max\{p_1, 1-p_1\}]$ is larger when $\tau_1 = 0$ than when $\tau_1 = 1$, the expected period 2 profits are larger when $\tau_1 = 0$ than when $\tau_1 = 1$. In other words, the firm can appropriate part of the benefit of learning between periods 1 and 2, and this benefit increases as α decreases.

In addition, contrary to the simple model discussed in the previous section, a project termination here has a negative impact on period 2 profits in the form of forgone learning. As a consequence, firms can offer period 1 contracts with a bonus component b that is greater than $\underline{\beta}K_1$, and still not trigger project termination under any realization of $\beta_{i,t}$. The maximum such bonus is a decreasing function of α.

Note that the higher is b, the more likely is the firm to allocate a worker to task $\tau = 0$. From a static point of view, the expected profits derived from task 1 are $p_0(K_1 - b)$, and from task 0, they are $(1-p_0)(K_1 - b)$. Therefore, the static opportunity cost of choosing task 0 is $(2p_0 - 1)(K - b)$, which is decreasing in b. Hence, as b increases, the static cost eventually falls below the learning benefit coming from period 2 profits.

By choosing b, firms effectively commit to assigning a worker to a given task. Because firms compete for workers, the choice of b will be made in order to maximize the expected payoff to the worker under the non-termination constraint. The no-termination maximum value of b is a decreasing function of α, which implies that a worker will be assigned to task 0 more often when α is small. We confirm this in the following proposition.

Proposition 3. *Let*

$$K(\alpha) \equiv \left(\frac{(1-\alpha)}{4\lambda(1-\underline{\beta})} \min\left\{1, \frac{p_0 q}{2p_0 - 1}\right\}\right)$$

and

$$\overline{K} \equiv \frac{1}{2}\left(\frac{1}{\lambda} + \lambda\right) \min\left\{\frac{q(1-p_0)}{2p_0 - 1}, 1-q\right\}.$$

(i) Firms implement task $\tau_1 = 0$ *if and only if* $K_1 \leq \min\{K(\alpha), \overline{K}\}$.

(ii) There exists $\alpha^* \in (0,1)$ *such that* $K(\alpha) > \overline{K}$ *if and only if* $\alpha < \alpha^*$.

(iii) The task allocation within a firm maximizes a worker's total expected payoff when $\alpha < \alpha^*$.

(iv) If instead $\alpha > \alpha^*$ when $K_1 \in (K(\alpha), \overline{K})$, workers' total expected payoff is larger if they are allocated to task 0, but firms implement task 1.

Period 1 entrepreneurs. Consider a period 1 entrepreneur. The expected payoffs from choosing task 0 or 1 are

$$\begin{aligned} V(\tau_1 = 1) &= qp_0 \left(k_1 + q\left(\alpha E\left[\max\{K_2, k_2\}\right] + (1-\alpha)E\left[k_2\right]\right)\right) \\ &\quad + \left(\alpha E\left[\max\{K_2, k_2\}\right] + (1-\alpha)E\left[k_2\right]\right)(1 - qp_0) \cdot q \cdot \max\left\{\frac{p_0(1-q)}{1-p_0 q}, \frac{1-p_0}{1-p_0 q}\right\} \\ V(\tau_1 = 0) &= q(1-p_0)\left(k_1 + q\left(\alpha E\left[\max\{K_2, k_2\}\right] + (1-\alpha)E\left[k_2\right]\right)\right) \\ &\quad + \left(\alpha E\left[\max\{K_2, k_2\}\right] + (1-\alpha)E\left[k_2\right]\right)(1 - q(1-p_0))\frac{qp_0}{1-q(1-p_0)} \end{aligned}$$

where

$$E\left[\max\{K_2, k_2\}\right] = \frac{1}{2}\left(\frac{1}{\lambda} + \lambda\right),$$

and

$$E\left[k_2\right] = \frac{\lambda}{2}.$$

As α decreases, the period 2 expected project value decreases, learning becomes less valuable, and the entrepreneur is more likely to choose task $\tau = 1$. Indeed, $V(\tau_1 = 0) - V(\tau_1 = 1)$ is positive if

$$k_1 \leq \left(\frac{\alpha}{2}\left(\frac{1}{\lambda} + \lambda\right) + (1-\alpha)\frac{\lambda}{2}\right)\min\left\{\frac{q(1-p_0)}{2p_0 - 1}, 1-q\right\}. \tag{3}$$

The right hand side is an increasing function of α.

4.2 Market wage conditional on previous occupational choice.

As α changes, the task allocations of workers and of entrepreneurs change in opposite directions. As α increases, workers are more likely to be allocated to task $\tau = 1$ while entrepreneurs are more likely to choose task $\tau = 0$. We therefore obtain two regimes, wherein former entrepreneurs who go back to the labor market either have higher or lower expected period 2 wages than former workers.

Lemma 4. *The expected period 2 wage of a period 1 entrepreneur is increasing in α. The expected period 2 wage of a period 1 worker is decreasing in α. There exists an α^* such that the period 2 wage of a former entrepreneur is greater than the wage of a former worker if and only if $\alpha > \alpha^*$.*

Note that the two regimes are determined by a cut-off value of α. This is the main result of the present paper: labor market frictions determine the wage of former workers and former entrepreneurs in a way that is consistent with the empirical evidence available for the US and the UE. This implies that differences in labor market frictions can explain differences in the correlation between an entrepreneurial failure and the success of a new venture.

4.3 Occupational Choice

We have argued that when the probability of receiving a wage offer α is large, firms assign workers to the task that maximizes short run profits, and individuals who receive a wage offer may become entrepreneurs in order to choose their own task. However, for a higher degree of labor market frictions, depending on $\underline{\beta}$, firms may be able to allocate workers to task 0, and individuals who receive a wage offer choose entrepreneurship only if they have a very valuable project. Hence, among those who receive a wage offer, the probability of becoming an entrepreneur increases with α. At the same time, the fraction of "unintentional entrepreneurs," i.e., agents who become entrepreneurs for lack of a wage offer, decreases with α. Therefore, α has two opposite effects on the probability of becoming an entrepreneur. The next proposition characterizes the relation between labor market frictions and the probability of being an entrepreneur, for the case where the index of contract completeness $\underline{\beta}$ is large.

Proposition 5. *There exists a* $\underline{\beta}^* < 1$ *such that whenever* $\underline{\beta} \geq \underline{\beta}^*$*, there is a 'U'-shaped relation between* α *and the probability of becoming an entrepreneur in period 1.*

As we have already discussed, $\underline{\beta}$ and α jointly determine whether task 0 can be implemented within firms for a given K_1. In particular, for given $\alpha < 1$, the larger is $\underline{\beta}$, the easier it is to implement task 0. A larger $\underline{\beta}$ implies that a firm and a worker can sign a contract in which most of the wage payment is contingent on success, so that the cost to a firm of choosing one task over the other is low. However, for $\alpha = 1$, firms always implement task 1, for any $\underline{\beta} < 1$. Hence, the closer is $\underline{\beta}$ to one, the stronger is the effect of decreasing α from 1 to something slightly below 1 on the task allocation of firms and on the selection into entrepreneurship.

Whenever $\underline{\beta}$ is sufficiently large, three regimes emerge. For $\alpha = 1$, there is a relatively high level of entrepreneurial activity which is mainly motivated by the desire to learn. For lower α, the level of entrepreneurial activity decreases because learning can occur within firms. In this regime, agents become entrepreneurs mainly because they have a valuable project that they want to explore. Finally, for α very small, most agents become entrepreneurs, because they do not receive wage offers. These involuntary entrepreneurs engage in projects that have, on average, very small returns.

When, instead, $\underline{\beta}$ is low, the probability of becoming an entrepreneur may decrease monotonically with α. In this case, the number of agents who choose entrepreneurship to learn their type is large for α strictly below one. The main effect of a decrease in α is to increase the number of involuntary entrepreneurs.

Corollary 6. *If* $\underline{\beta} \geq \underline{\beta}^*$*, the probability of becoming an entrepreneur in both periods (*serial entrepreneurship*) and the probability of becoming an entrepreneur in at least one period are in a 'U'-shaped relation with* α*.*

Since there is no value to learning in period 2, the probability of becoming an entrepreneur in period 2 is independent of the period 1 career choice. Hence, the probability of being a serial entrepreneur is simply the product of the probability of becoming an entrepreneur in period 1 with the probability of becoming an entrepreneur in period 2. Similarly, the probability of becoming an entrepreneur in either period 1 or period 2 is simply the sum of the probability of becoming a entrepreneur in period 1 and the probability of becoming an entrepreneur in period 2.

The probability of becoming an entrepreneur in period 2 decreases with α. At the same time, by Proposition 5, the probability of becoming an entrepreneur in period 1 increases in α for α close to one. We show in the proof of Proposition 5 that the rate at which the probability of becoming an entrepreneur in period 1 increases with α, and can be made arbitrarily large by choosing a $\underline{\beta}$ sufficiently close to 1. Therefore, whenever $\underline{\beta}$ is large, the probability of being a serial entrepreneur and the probability of being an entrepreneur in at least one period are increasing with α for α close to one.

Corollary 7. *If $\underline{\beta} \geq \underline{\beta}^*$, there is a 'U'-shaped relation between the total output and α.*

If $\underline{\beta}$ is sufficiently close to one, even a very small amount of labor market frictions can induce firms to choose the task allocation that maximizes output. In this case, learning can happen within firms, and agents choose entrepreneurship only if their project has a higher return than the firm's project. The fraction of agents not receiving a wage offer will negatively impact the total output, but the size of this effect is negligible because α is close to 1.

A last result follows from the observation that, for a given entrepreneurial project k_1, fewer entrepreneurs choose $\tau_1 = 0$ and learn their type as α decreases. Furthermore, as α decreases, fewer agents become entrepreneurs when receiving a wage offer. Therefore as α decreases, entrepreneurs pursue only projects with large returns, those with which the entrepreneur is more likely to set $\tau_1 = 1$.

Proposition 8. *The probability of succeeding as an entrepreneur in period 2 following a period 1 failure is increasing in α.*

5 Conclusion

We show that the intensity of labor market frictions determine the proportion of different types of entrepreneurs in the economy, the relative wages of former entrepreneurs and former workers, and the probability of becoming an entrepreneur, in a way that is consistent with evidence both for the US and for the EU. The US and the EU regimes differ because labor market frictions make European firms more willing to maximize long-run rather than short-run profits.

While we are confident that our qualitative results are robust, we are more reluctant to use our model to make quantitative predictions. For instance, we assumed that the distributions of returns for firms and entrepreneurs are the same in the US as in the EU, which implies that the output per worker as well as the total output are larger in European firms than in US firms (Corollary 7). This result should be taken with a (big) grain of salt, and may in fact be counterfactual. Indeed, as labor market frictions increase, firms will have unfilled vacancies, will not operate at the efficient scale, and may have to use technologies that are not at the frontier. Therefore, the distribution of project returns for firms, and entrepreneurs, should be different in the US and in the EU. It follows that the overall effect of labor market frictions on output is ambiguous since there are two opposite forces at work: on the one hand, EU firms have higher worker productivity than US firms (when they have the same project returns); on the other hand, EU firms may not be on the technological frontier.

In order to focus on the learning motive for entrepreneurship, we have ignored other important determinants of entrepreneurial activity, such as financial constraints, skill acquisition, learning by doing, or differential ability of agents to become entrepreneurs.

Financial constraints are likely to reduce entrepreneurial activity but cannot by themselves generate the differential value of entrepreneurial failures. Indeed, if the labor market is frictionless, firms' competition insures that workers are able to appropriate the full benefit of learning. Hence firms adopt a less informative task allocation independently of the importance of financial constraints. However, when there are labor market frictions, financial constraints limit the exit of workers into entrepreneurship and therefore increase the ability of firms to appropriate the benefit of learning.[17] Hence, labor market frictions and financial constraints are complementary since they increase the likelihood of being in the EU regime.

There is an element of learning by doing in our model since agents acquire information about their comparative advantage, are 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. Our results stand as long as this increase in productivity is small compared to the benefit of learning one's comparative advantage.

We have abstracted from other motives for entrepreneurship. For instance, Lazear (2004) assumes that workers work at a single task, while entrepreneurs work at multiple tasks, and he shows, both theoretically and empirically, that people with a more balanced skill set enter entrepreneurship.[18] Unless we assume that this motive is more pronounced in the US than in the EU, it is unlikely that such extensions would produce, on their own, a differential treatment in the value of failure between the US and the EU. But our model could accommodate such extensions.

Lastly, as we have noted, if α is very small, many agents pursue low value projects generating a low average output in the economy because they cannot find employment. One might be tempted to interpret a low α as illustrative of developing countries, and there is indeed ample evidence that many entrepreneurs in developing countries are "reluctant entrepreneurs."[19] We re-

[17] 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 they may prevent, when long term contracts are not possible, optimal talent discovery in firms.

[18] Note that a prior closer to 1/2 could be interpreted as a more balanced set of skills in our model: the closer the prior is to 1/2, the more entrepreneurship there is. It would be of interest to extend the model to situations where agents have different priors.

[19] In fact, this is the title of Chapter 9 of the Duflo and Banerjee (2011) book, *Poor Economics*.

frain from this temptation, however, because while the US and the EU are relatively similar in their contracting abilities, the development of their financial markets, and their level of human capital, this is hardly the case for developing countries. These other dimensions are not part of our model but are likely to affect the type, frequency and market rewards of entrepreneurial failures in developing countries.

A Mathematical appendix

Proof of lemma 2

The value of entrepreneurship is:

$$\max\{V(\tau_1 = 1), V(\tau_1 = 0)\}$$

Where

$$V(\tau_1 = 1) = qp_0\left(k_1 + q\right) + (1 - qp_0) \cdot q \cdot \max\left\{\frac{p_0(1-q)}{1 - p_0 q}, \frac{1 - p_0}{1 - p_0 q}\right\},$$

and

$$V(\tau_1 = 0) = q(1 - p_0)\left(k + q\right) + (1 - q(1 - p_0))\frac{qp_0}{1 - q(1 - p_0)}.$$

are the values of working on task 1 and 0 respectively for a given entrepreneurial project k_1. The vale of working for a firm is

$$V_w = qp_0\left(K_1 + q\right) + (1 - qp_0) \cdot q \cdot \max\left\{\frac{p_0(1-q)}{1 - p_0 q}, \frac{1 - p_0}{1 - p_0 q}\right\},$$

The lemma follows by solving for

$$\max\{V(\tau_1 = 1), V(\tau_1 = 0)\} > V_w.$$

Proof of Lemma 3.

To start, let's derive the worker-preferred task allocation. Despite the presence of labor market frictions, in period 1 the worker is the short side of the market and captures the entire surplus of working for a firm. Hence, the benefit of each task allocation is the total surplus generated by that allocation. For task 1 total surplus is

$$\begin{aligned} V(\tau_1 = 1) =& qp_0 \left(K_1 + E\left[\max\{K_2, k_2\}\right] q\right) + \\ & E\left[\max\{K_2, k_2\}\right](1 - qp_0) \cdot q \cdot \max\left\{\frac{p_0(1-q)}{1-p_0 q}, \frac{1-p_0}{1-p_0 q}\right\}, \end{aligned}$$

where

$$\begin{aligned} E\left[\max\{K_2, k_2\}\right] =& E\left[E\left[\max\{K_2, k_2\} | \, K_2\right]\right] \\ =& E\left[\frac{K_2}{\lambda} + \left(1 - \frac{1}{\lambda}\right)\left(\frac{K_2 + \lambda K_2}{2}\right)\right] = \frac{1}{2}\left(\frac{1}{\lambda} + \lambda\right). \end{aligned}$$

For task 0 total surplus is:

$$\begin{aligned} V(\tau_1 = 0) =& q(1-p_0)\left(K_1 + \frac{1}{2}\left(\frac{1}{\lambda} + \lambda\right) q\right) + \\ & \frac{1}{2}\left(\frac{1}{\lambda} + \lambda\right)(1 - q(1-p_0))\frac{qp_0}{1 - q(1-p_0)}. \end{aligned}$$

Hence, the worker prefers $\tau_1 = 0$ if and only if

$$k_1 \leq \frac{1}{2}\left(\frac{1}{\lambda} + \lambda\right) \min\left\{\frac{q(1-p_0)}{2p_0 - 1}, 1 - q\right\} \equiv \overline{K} \tag{4}$$

Assume first $V(\tau_1 = 1) \geq V(\tau_1 = 0)$: the worker prefers task 1. This task is implementable if there is a bonus payment b such that the firm prefers to allocate the worker to task 1 (incentive compatibility) and the project is never terminated. The incentive compatibility constraint is

$$qp_0\left(K_1 - b + \frac{q(1-\alpha)}{4\lambda}\right) + \frac{q(1-\alpha)}{4\lambda}\max\left\{p_0(1-q), 1-p_0\right\}$$
$$\geq (1-p_0)q\left(K_1 - b + \frac{q(1-\alpha)}{4\lambda}\right) + \frac{p_0 q(1-\alpha)}{4\lambda}$$

$$\Leftrightarrow (2p_0-1)\left(K_1 + \frac{q(1-\alpha)}{4\lambda}\right) + \left[\max\left\{p_0(1-q), 1-p_0\right\} - p_0\right]\frac{(1-\alpha)}{4\lambda} \geq b(2p_0-1),$$

simple algebra shows that whenever $V(\tau_1 = 1) \geq V(\tau_1 = 0)$ the LHS of the above expression is positive. The IC constraint is satisfied at $b = 0$. The non termination constraint is

$$qp_0\left(\underline{\beta}K_1 - b + \frac{q(1-\alpha)}{4\lambda}\right) + \frac{q(1-\alpha)}{4\lambda}\max\left\{p_0(1-q), 1-p_0\right\} \geq \frac{p_0 q(1-\alpha)}{4\lambda}$$

which is satisfied at $b = 0$. Hence, whenever the worker prefers task 1, this task is implementable by signing a contract with $b = 0$.

Suppose now that $V(\tau_1 = 1) \leq V(\tau_1 = 0)$: the worker prefers task 0. The IC constraint is

$$(2p_0-1)\left(K_1 + \frac{q(1-\alpha)}{4\lambda}\right) + \left[\max\left\{p_0(1-q), 1-p_0\right\} - p_0\right]\frac{(1-\alpha)}{4\lambda} \leq b(2p_0-1),$$

and the non-termination constraint is

$$q(1-p_0)\left(\underline{\beta}K_1 - b + \frac{q(1-\alpha)}{4\lambda}\right) + \frac{p_0 q(1-\alpha)}{4\lambda} \geq \frac{p_0 q(1-\alpha)}{4\lambda}$$

$$\Leftrightarrow b \leq \underline{\beta}K_1 + \frac{q(1-\alpha)}{4\lambda}.$$

By plugging the highest b for which there is no termination into the IC constraint we get that $\tau = 0$ is implementable if

$$K_1 \leq \frac{(1-\alpha)}{4\lambda(1-\beta)}\min\{1, \frac{p_0 q}{2p_0 - 1}\} \equiv K(\alpha).$$

Hence, as α decreases, the set of K_1 for which it is possible to implement

$\tau = 0$ expands. Finally, by using condition 4, we establish that $\tau = 0$ will be implemented if and only if

$$K_1 \leq \min \left\{ \overline{K}, K(\alpha) \right\}.$$

Proof of lemma 4

The fact that the expected period 2 wage of former entrepreneurs increases continuously with α and the expected wage of former workers decreases continuously with α follows from the way in which α changes the optimal task allocation within professions for given K_1 and k_1.

In case $\alpha = 1$ all workers set $\tau_1 = 1$, while entrepreneurs set $\tau = 0$ with positive probability. Hence the expected wage of a former entrepreneur is above the expected wage of a former worker.

We want to show that there exists an α sufficiently small such that workers are more likely to set $\tau_1 = 0$ than entrepreneurs, so that former workers receive a higher wage than former entrepreneurs. Consider the case $\lim_{\alpha \to 0} \alpha$. If an agent works for a firm, she is allocated to task $\tau_1 = 0$ if and only if

$$K_1 \leq \frac{1}{2} \left(\frac{1}{\lambda} + \lambda \right) \min \left\{ \frac{q(1-p_0)}{2p_0 - 1}, 1 - q \right\} \equiv \hat{K}.$$

At the same time, entrepreneurs set $\tau_1 = 1$ if and only if

$$k_1 \leq \lambda \min \left\{ \frac{q(1-p_0)}{2p_0 - 1}, 1 - q \right\} \equiv \hat{k} \leq \hat{K}.$$

It follows immediately that if all agents who receive a wage offer become workers, the probability that a worker is allocated to $\tau = 0$ is greater than the probability that an entrepreneur is allocated to $\tau = 0$

To conclude the proof, we show that among the agents who receive a wage offer, those who choose to work for a firm are more likely to be allocated to task $\tau = 0$ than those who choose entrepreneurship. Note that an agent who receives a wage offer chooses to work for a firm rather than being an entrepreneur if

$$\max\left\{ qp_0\left(k_1+\lambda q\right)+\lambda(1-qp_0)\cdot q\cdot \max\left\{\frac{p_0(1-q)}{1-p_0q},\frac{1-p_0}{1-p_0q}\right\} \right.$$
$$\left. q(1-p_0)\left(k_1+\lambda q\right)+\lambda(1-q(1-p_0))\frac{qp_0}{1-q(1-p_0)}\right\}\geq$$
$$\max\left\{ qp_0\left(K_1+\frac{1}{2}\left(\frac{1}{\lambda}+\lambda\right)q\right)+\frac{1}{2}\left(\frac{1}{\lambda}+\lambda\right)(1-qp_0)\cdot q\cdot \max\left\{\frac{p_0(1-q)}{1-p_0q},\frac{1-p_0}{1-p_0q}\right\},\right.$$
$$\left. q(1-p_0)\left(K_1+\frac{1}{2}\left(\frac{1}{\lambda}+\lambda\right)q\right)+\frac{1}{2}\left(\frac{1}{\lambda}+\lambda\right)(1-q(1-p_0))\frac{qp_0}{1-q(1-p_0)}\right\}$$

Therefore, for every K_1, there is a threshold $k(K_1)>K_1$ such that for every $k_1\geq k(K_1)$ the agent becomes an entrepreneur, and for every $k_1\leq k(K_1)$ the agent becomes a worker. Suppose that $K_1\leq\hat{K}$, so that all workers are allocated to $\tau=0$. It is easy to see that entrepreneurs are allocated to task $\tau=1$ with positive probability. Suppose instead that $K_1\geq\hat{K}$, so that workers are allocated to task $\tau=1$. Again, because $k(K_1)>K_1>\hat{k}$ all agents who become entrepreneurs also set $\tau=1$. It follows that, among agents who receive an offer, the unconditional probability (i.e., for any K_1, k_1) of being allocated to task 0 is greater for workers than for entrepreneurs.

Proof of Proposition 5

The probability of becoming an entrepreneur is equal to

$$\text{pr}\{\text{entrepreneurship}\}=(1-\alpha)+\alpha\text{pr}\{\text{entrepreneurship}\mid\text{wage offer}\}$$

Where pr{entrepreneurship | wage offer} is the probability of choosing entrepreneurship given that the agent received a wage offer. It follows that

$$\frac{\partial\ \text{pr}\{\text{entrepreneurship}\}}{\partial\alpha}=$$
$$-1+\alpha\frac{\partial\text{pr}\{\text{entrepreneurship}\mid\text{wage offer}\}}{\partial\alpha}+\text{pr}\{\text{entrepreneurship}\mid\text{wage offer}\}$$

The above derivative is positive if

$$\frac{\partial \text{pr}\{\text{entrepreneurship} \mid \text{wage offer}\}}{\partial \alpha} > \frac{1 - \text{pr}\{\text{entrepreneurship} \mid \text{wage offer}\}}{\alpha}$$

and decreasing otherwise.

We compute the probability of becoming an entrepreneur in case of a wage offer as a function of K_1:

- In case $K_1 \leq \min\{K(\alpha), \overline{K}\}$ (where $K(\alpha)$ and $\overline{K}$ are defined in lemma 3), the firm will choose $\tau_1 = 0$, which is the worker-preferred task allocation given K_1. Hence the agent will choose entrepreneurship only if $k_1 \geq K_1$, which happens with probability $1 - 1/\lambda$.

- similarly to the previous case, when $K_1 \geq \overline{K}$ the firm will choose $\tau_1 = 1$, which is the worker-preferred task allocation given K_1. Again, the agent will choose entrepreneurship only if $k_1 \geq K_1$, which happens with probability $1 - 1/\lambda$.

- whenever $K(\alpha) \leq K_1$, the firm will implement τ_1, but the agent-preferred task allocation is $\tau_1 = 0$. Hence, the agent may choose entrepreneurship also for some $k_1 \leq K_1$. More precisely, the benefit of working for a firm is

  $$p_0 q \left(\frac{q\left(\lambda + \frac{1}{\lambda}\right)}{2} + K_1 \right) + q\left(1 - p_0 q\right) \max\left(\frac{1 - p_0}{1 - p_0 q}, \frac{p_0\left(1 - q\right)}{1 - p_0 q} \right) \left(\lambda + \frac{1}{\lambda} \right) \frac{1}{2}$$

  the benefit of being an entrepreneur is

  $$\left(\left(1 - p_0\right) q^2 + p_0 q\right) \left(\frac{\alpha\left(\lambda + \frac{1}{\lambda}\right)}{2} + \frac{\left(1 - \alpha\right)\lambda}{2} \right) + k_1\left(1 - p_0\right) q$$

  the agent chooses entrepreneurship if

  $$k_1 \geq k(\alpha, K_1) \equiv \frac{\max\{1 - p_0, p_0(1 - q)\}(\lambda^2 + 1) - (q + p_0 - 2p_0 q)(\lambda^2 + \alpha) + 2p_0 \lambda K_1 + (1 - \alpha)p_0 q}{2(1 - p_0)\lambda}$$

note that
$$\frac{\partial k(\alpha, K_1)}{\partial \alpha} = -\frac{p_0 + q - p_0 q}{2(1-p_0)\lambda} < 0,$$
that
$$\frac{\partial k(\alpha, K_1)}{\partial K_1} = \frac{p_0}{1-p_0} > 0,$$
and that $k(\alpha, K_1) \geq 0$ if and only if
$$K_1 \geq \tilde{K}(\alpha) \equiv \frac{(q + p_0 - 2p_0 q)(\lambda^2 + \alpha) - (1-\alpha)p_0 q - \max\{1-p_0, p_0(1-q)\}(\lambda^2+1)}{2p_0\lambda}$$

For α sufficiently close to 1, $K(\alpha) \leq \tilde{K}(\alpha) \leq \overline{K}$. Given this, for α sufficiently close to 1

$$\text{pr}\{\text{entrepreneurship} \mid \text{wage offer}\} = \frac{1}{2}\left(\frac{\lambda-1}{\lambda}\right)\left(K(\alpha) + 2 - \overline{K}\right) + \frac{1}{2}\left(\tilde{K}(\alpha) - K(\alpha)\right) + \frac{1}{2}\int_{\tilde{K}(\alpha)}^{\overline{K}}\left(1 - \frac{k(\alpha, K_1)}{\lambda K_1}\right) dK_1$$

$$\frac{\partial \text{pr}\{\text{entrepreneurship} \mid \text{wage offer}\}}{\partial \alpha} = K'(\alpha)\left(\frac{\lambda-1}{2\lambda} - \frac{1}{2}\right) + \frac{1}{2}\tilde{K}'(\alpha) + \frac{1}{2}\int_{\tilde{K}(\alpha)}^{\overline{K}} \frac{p_0 + q - p_0 q}{2(1-p_0)\lambda^2 K_1} dK_1 - \frac{1}{2}\tilde{K}'(\alpha) = -K'(\alpha)\frac{1}{2\lambda} + \frac{p_0 + q - p_0 q}{4(1-p_0)\lambda^2}(\log(\overline{K}) - \log(\tilde{K}(\alpha))) > 0$$

so that

$$\left.\frac{\partial \text{pr}\{\text{entrepreneurship} \mid \text{wage offer}\}}{\partial \alpha}\right|_{\alpha=1} > 1 - \text{pr}\{\text{entrepreneurship} \mid \text{wage offer}\}|_{\alpha=1}$$

becomes

$$
\begin{aligned}
&- K'(1)\frac{1}{2\lambda} + \frac{p_0 + q - p_0 q}{4(1-p_0)\lambda^2}(\log(\overline{K}) - \log(\tilde{K}(1))) > \\
&1 - \frac{1}{2}\left(\frac{\lambda - 1}{\lambda}\right)\left(2 - \overline{K}\right) - \frac{1}{2}\tilde{K}(1) - \frac{1}{2}\int_{\tilde{K}(1)}^{\overline{K}}\left(1 - \frac{k(1,K_1)}{\lambda K_1}\right) dK_1
\end{aligned}
$$

Note that $\underline{\beta}$ enters in the above equation only through $K'(1)$ which is equal to

$$
K'(1) = -\frac{1}{4\lambda(1-\underline{\beta})}\min\{1, \frac{p_0 q}{2p_0 - 1}\}
$$

Hence, for $\underline{\beta}$ sufficiently close to 1, the above inequality is always satisfied, and the probability of becoming an entrepreneur is increasing in α for α close to 1.

Proof of corollary 7

The expression for $K(\alpha)$ derived in proposition 4 shows that for every $\underline{\beta}$, there is an α such that firms implement the output maximizing task allocation. In addition, as $\underline{\beta}$ approaches 1, the α inducing the output maximizing task allocation approaches 1 as well. Hence, when $\underline{\beta}$ is arbitrarily close to 1, any arbitrary small amount of labor market frictions induces the output maximizing task allocation among workers, and the output-maximizing sorting into entrepreneurship and wage work. On the other hand, market frictions create an output loss, as some agents will not receive a wage offer and will work on low value projects, but this output loss is arbitrarily small if α is very close to 1.

Proof of Proposition 8

For given project value k_1 the probability that an entrepreneur sets $\tau_1 = 0$ 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 pursues by entrepreneurs. These projects are the ones for which the entrepreneurs are more likely to choose $\tau_1 = 0$. Overall, the probability of setting $\tau_1 = 0$ increases with α, which implies that the probability of succeeding in period 2 also increases with α.

B Uncorrelated Probability of Success across Tasks

So far, we have assumed that the agent is always productive at exactly one task, implying that the agent's expected productivity at different tasks is negatively correlated: when, after observing a failure, the probability of success at a given task is revised downward, the probability of success at the other task must be revised upward.

In this section, we assume that the probability of succeeding at a given task is independent of the probability of succeeding at the other task. This version of the model is closely related to Gibbons and Waldman (2004) who argue that talent and human capital are task specific, in the sense that by working on a given task, a worker increases her productivity at that specific task. Here, learning is task specific, in the sense that succeeding or failing at a given task is informative only regarding the future probability of success at that specific task.

We show that the learning motive for entrepreneurship may emerge in this case as well: agents may become entrepreneurs to learn their type, and to be rewarded in the future labor market. In addition, also here failures may be "good" signals and increase the probability of future success. The key assumption is that the task at which the agent is less likely to succeed when young is also more valuable in the long term.

Assume that each agent can be of type $\{\theta^0, \theta^1\}$ where $\theta^0 \in \{0, 1\}$ represents whether the agent can succeed at task 0 and $\theta^1 \in \{0, 1\}$ whether the agent can succeed at task 1. We assume that θ^0 and θ^1 are independent. Call p_0^0 the probability that a young agent is of type $\theta^0 = 1$, and call p_0^1 the probability that a young agent is of type $\theta^1 = 1$. For given beliefs p^1, p^0, the probability of success at a given task $\tau \in \{0, 1\}$ is:

$$\Pr\{s = 1|\tau, p^0, p^1\} = q^1 p^1 \cdot \tau + q^0 p^0 \cdot (1 - \tau).$$

The above formulation implies that, whenever $\text{pr}\{\theta^1\} = \text{pr}\{\theta^0\}$ the agent will be allocated to the task with the highest q. Intuitively, independently of the agent's type, one task is intrinsically more valuable than the other. Also here, we assume that a young agent is more likely to succeed at task 1: $q^0 p_0^0 < q^1 p_0^1$. However, we assume that task 0 is intrinsically more valuable than task 1: $q^0 > q^1$.

Similarly to the main model, there is a fundamental trade off between the task allocation maximizing short-run profits and the task allocation maximizing long-run profits. Because being productive at task 0 is more valuable than being productive at task 1, it may be optimal to allocate the agent to task 0 in period 1. However, this task allocation generates a short-run cost in the form of a higher probability of failing.[20]

We solve the model under the same assumptions made in section 3. In particular, k_t is drawn from a $[0, K_t]$ uniform distribution, and there is a perfect labor market. It is quite easy to see that lemma 1 holds here as well: in period 1 firms always allocate the agent to task 1.

If, in period 1, the agent chooses entrepreneurship, the payoff of choosing task 1 is:

$$V(\tau_1 = 1) = q^1 p_0^1 \left(k_1 + q^1\right) + (1 - q^1 p_0^1) \cdot \max\left\{\frac{q^1 p_0^1 (1 - q^1)}{1 - q^1 p_0^1}, q^0 p_0^0\right\}$$

and the payoff of choosing task 0 is:

$$V(\tau_1 = 0) = q^0 p_0^0 \left(k_1 + q^0\right) + (1 - q^0 p_0^0) \cdot q^1 p_0^1$$

Which implies that an entrepreneur set $\tau_1 = 0$ if and only if

$$k_1 \leq \frac{\min\{q^0 p_0^0 (q^0 - q^1 p_0^1), q^1 p_0^1 (1 - q^1)\}}{q^1 p_0^1 - q^0 p_0^0} \tag{5}$$

[20] The intuition is similar to several results in option-value theory: efficient discovery may require the agent to experiment first with the high-reward/high-probability-of-failing option.

Hence, an entrepreneur will choose $\tau = 0$ for some k_1 as long as $q^0 > q^1 p_0^1$, and always choose $\tau = 1$ otherwise.

Following the same steps as in the main model, we can derive the full dynamic payoff of a worker:

$$q^0 p_0^0 \left(K_1 + q^0\right) + (1 - q^0 p_0^0) \cdot q^1 p_0^1$$

Hence, if k_1 is sufficiently close to K_1 and K_1 satisfies equation 5, then the agent chooses to be an entrepreneur. In addition, entrepreneurs always set $\tau = 0$. Similarly to the previous model, the probability of success of period-1 entrepreneurs ($q^0 p_0^0$) is smaller than the probability of success of former entrepreneurs who failed ($q^1 p_0^1$). For workers instead, the probability of success in period 1 ($q^1 p_0^1$) is larger than the probability of success in period 2 following a failure ($\max \left\{ \frac{q^1 p_0^1 (1-q^1)}{1-q^1 p_0^1}, q^0 p_0^0 \right\}$). Finally, it is possible to show that the wage of a former entrepreneur is always greater than the wage of a former worker.

Similarly to section 4, also here, if labor market frictions are sufficiently large, the firm internalizes the benefit of talent discovery and may implement the worker-preferred task allocation. Hence, agents will choose entrepreneurship only if they have a valuable project, making them less likely than workers to choose task $\tau = 0$. The results derived in section 4 carry over qualitatively to this case as well.

C Vertical talent

We assume in the main text that talent is exclusively an horizontal characteristic: each type is equally productive provided that he/she is allocated to the right task. In this section, we introduce a vertical dimension; one of the two types is more productive at both tasks than the other type. We show that, as long as the task allocation problem remains relevant, all our results continue to hold.

As before, let us denote the set of types $\theta \in \{0, 1\}$ and the two possible tasks $\tau_t \in \{0, 1\}$ for $t \in \{1, 2\}$. The probabilities of success for different type-task allocations are given by:

$\tau\backslash\theta$	0	1
0	q	q'
1	0	Q

where $Q > q' \geq q$. Hence, type 1 is more productive than type 0, in the sense that, for any task allocation, her probability of success is superior to the probability of success of type 0; but type 0 still has a comparative advantage on task 0.

To simplify we consider the case $q' = q$ and assume that the initial probability that the agent is type 0 is $p_0 > \frac{Q-q}{Q}$, so that the period 1 probability of success is maximized when the agent is allocated to task 0. The model is otherwise identical to the one presented in Section 3.

This simple variation introduces a vertical dimension in the definition of types but maintains the key elements of our benchmark model:

1. There is a task allocation problem based on comparative advantages. While type 1 has an absolute advantage over type 0 at both tasks, type 1 has a comparative advantage at task 1 and type 0 has a comparative advantage at task 0. Hence, if types were known, to maximize the probability of success type 1 should work at task 1 and type 0 should work at task 0.

2. In the task allocation problem, there is a trade-off between maximizing the instantaneous probability of success and learning about types. In this specification, a success or a failure at task 0 is uninformative relative to the underlying type, while a success or a failure at task 1 is informative. As long as the value of learning cannot be captured by firms, they will choose $\tau_1 = 0$.

More precisely, the probability of success in period 2, given a period-1 task allocation and a given period-1 outcome is:

$$
\begin{aligned}
\text{pr}\{s_2 = 1|\tau_1 = 1, s_1 = 1\} &= Q \\
\text{pr}\{s_2 = 1|\tau_1 = 1, s_1 = 0\} &= \max\left\{q, Q\frac{(1-Q)(1-p_0)}{1-Q(1-p_0)}\right\} \\
\text{pr}\{s_2 = 1|\tau_1 = 0, s_1 = 1\} &= q \\
\text{pr}\{s_2 = 1|\tau_1 = 0, s_1 = 0\} &= q.
\end{aligned}
$$

Because in period 1 firms always allocate the worker to task 0, the lifetime value of working for a firm is simply $q(K_1+1)$. The lifetime value of becoming an entrepreneur is $\max\{V(0), V(1)\}$, where

$$
\begin{aligned}
V(0) &= q(k_1+1) \\
V(1) &= (1-p_0)Qk_1 + (1-p_0)q_h^2 + (1-(1-p_0)Q)\max\left\{q, Q\frac{(1-Q)(1-p_0)}{1-Q(1-p_0)}\right\}
\end{aligned}
$$

As in the model in the text, for K_1 sufficiently low and k_1 sufficiently close to K_1, the agent chooses entrepreneurship in period 1 and works on task 1. Hence, in period 1, the instantaneous payoff of an entrepreneur is lower of that of a worker. However, because of learning, in period 2 a former entrepreneur working for a firm has a higher probability of success and earns a higher wage than a former worker. Hence, all results discussed in Section 3 continue to hold.

Our other results also hold; in particular, when labor market frictions are sufficiently high the firm internalizes the benefit of learning, and is more likely to allocate the worker to $\tau_1 = 1$. When this is the case, the learning motive for entrepreneurship disappears and agents will choose entrepreneurship only if they have a very valuable project. In their task allocation, entrepreneurs favor instantaneous success over learning, which implies that, in period 2, they have a lower probability of success than former workers. Hence, former entrepreneurs receive a lower wage than former workers.

D Unobservable Task Allocation

When past task allocation is not observable outside of the firm, at the beginning of period 2 there may be asymmetry of information between firms and any agent who did not work for the same firm previously. From the point of view of a firm, after observing a success, the agent is either type $p = 1$ or $p = 0$. After observing a failure, an agent can be one of two types, corresponding to the beliefs obtained under each task allocation as in (1).

In this situation, there are several possible equilibria, because firms' period 2 beliefs and period 2 wages affect period 1 task allocation, and vice versa. We consider two classes of equilibria: equilibria in which for every observable history, firms offer a menu of contracts (screening); and equilibria in which for every observable history, firms offer a single contract (no screening). We restrict our analysis to the case $k_t \in [0, K_t]$ and $\alpha = 1$.

Note that, whenever $\alpha = 1$, the fact that project termination is unobservable is not relevant. Remember that project termination leads to a failure with probability 1. For any market belief regarding the worker's productivity in case of failures, the worker prefers not to terminate the project, and strictly so if $b > 0$. Competition among firms assures that $b \leq \underline{\beta} K_1$. Hence, project termination never occurs in equilibrium: in case of failures, the only uncertainty is relative to period 1 task allocation.

Screening equilibria. Suppose that, for every observable history, in period 2 firms offer a contract for every possible type, where a contract has the form $\{b, f, \tau_2\}$ i.e., a bonus, fixed payment, and a task allocation. Clearly, if the agent produced a success in the previous period, a menu of contracts $\{b, f, \tau_2 = 1\}$ and $\{b', f', \tau_2 = 0\}$ such that $f + qb = f' + qb' = K_2$ is an equilibrium screening menu of contracts, because each firm makes zero profits, agents of different types prefer different contracts (strictly so if $b, b' > 0$), and the firm has no incentive to implement a task allocation that is different from that specified in the contract.[21]

[21] Note that this contract amounts to delegating task allocation to the worker. Delegation is possible because, in period 2, workers and firms have aligned preferences regarding task

If the agent produced a failure in period 1, then screening on the base of task allocation is possible only if agents who failed at task $\tau_1 = 1$ are the most productive at task 0 in period 2, i.e., if $p_0(2-q) < 1$. If we write the bonus payment as a fraction η of total output, and use the zero profit condition on each contract, incentive compatibility implies

$$1 > \mu'(1 - \frac{qp_0}{1-q(1-p_0)}) + (1-\mu')\frac{q(1-p_0)}{1-p_0 q}$$

$$1 > \mu(1 - \frac{q(1-p_0)}{1-p_0 q}) + (1-\mu)\frac{qp_0}{1-q(1-p_0)}$$

for some $\eta, \eta' \leq \underline{\beta}$, which is always satisfied. Therefore, for $p_0(2-q) < 1$ the firm can screen and learn each worker's previous task allocation. Instead, whenever $p_0(2-q) > 1$, it is not possible to use period 2 task allocation as a screening mechanism because following a failure, the agent should be allocated to task $\tau_2 = 1$ independently from period 1 task allocation.

More generally, we show here that there are no equilibria in which firms can screen for different types by only offering a menu of $\{b, f\}$. Define:

$$\pi \equiv q \max\{p_1, 1-p_1\}$$

Where p_1 is the belief regarding the agent's type at the beginning of period 2. Suppose that firms are screening by means of $\{b, f\}$ only. Consider two agents with the same observable history. Let $\{f, b\}$ be a contract intended for type π and $\{f', b'\}$ be a contract for type π'. Incentive compatibility requires that

$$\begin{aligned} U(\pi) &= f + b\pi \\ &\geq f' + b'\pi \\ &= U(\pi') + b'(\pi - \pi') \end{aligned}$$

if profits are zero on both contracts, we have $U(\pi) = \pi K_2$ and $U(\pi') = \pi' K_2$,

allocation.

so that

$$K_2(\pi - \pi') \geq b'(\pi - \pi'),$$

The above condition is trivially true whenever $\pi \geq \pi'$, but is never satisfied for $\pi' \geq \pi$ (remember that no-termination implies $b' < K_2$). Hence it is not possible to satisfy both incentive compatibility conditions and have zero profit on each type, because screening implies that firms will earn positive profits on the contract offered to the high types. It follows that a firm, instead of offering the entire menu of contracts, could deviate and offer only the contract that makes positive profits. Hence, screening never happen in equilibrium.

To sum up, if $p_0(2-q) < 1$ there is a screening equilibrium in which period 1 task allocation is revealed in period 2. Instead, whenever $p_0(2-q) > 1$ there is no screening equilibrium.

No screening equilibrium. We now restrict our attention to equilibria in which, in period 2, firms offer contracts of the form $\{b, f\}$, with $b = \eta K_2$ for $0 < \eta \leq \underline{\beta}$, and fixed payment f. We assume that the fraction of the project value paid as bonus is independent of observable history, but the fixed part depends on the observable history, where the observable history is period 1 occupation, success or failures, and project value k_1. We show that, when firms offer such contracts, the agent's type at the beginning of period 2 depends exclusively on her observable history, and therefore for every observable history there is a degenerate distribution of types.

The same argument made in the body of the paper guarantees that, in period 1, firms allocate their worker to task $\tau_1 = 1$. Therefore, the period 2 payoff of a period 1 worker who failed is

$$q \max \left\{ \frac{p_0(1-q)}{1-p_0 q}, \frac{1-p_0}{1-p_0 q} \right\} K_2$$

and the period 2 payoff of a worker who succeeded is qK_2.

The task allocation of entrepreneurs instead depends on firms beliefs in period 2 over their period 1 task allocation, and therefore can be determined only in equilibrium. We restrict our attention to equilibria in which an entrepreneur's period 1 allocation is a monotonic function of k_1.

Lemma 9. *Consider a period 1 entrepreneur. There exists an equilibrium in which this entrepreneur chooses task $\tau_1 = 0$ whenever $k_1 \leq k(\eta)$ and task $\tau_1 = 1$ otherwise, where*

$$k(\eta) \equiv \frac{1}{2p_0 - 1}\left(p_0 - q(2p_0 - 1) - \eta \cdot max\{p_0(1-q), 1-p_0\} - \frac{(1-\eta)p_0(1-qp_0)}{1-q(1-p_0)}\right) \tag{6}$$

Proof. To start, note that in period 2 part of the wage will be paid in the form of a bonus contingent on success, making learning in period 1 valuable. Following a success, the payoff of a former entrepreneur is always qK_2 and is independent of period 1 task allocation. Following a failure, for given period 2 contract $\{f, b\}$ the agent's payoff depends on period 1 task allocation.

The total expected payoff of choosing each task is:

$$V(\tau_1 = 1) = qp_0\,(k_1 + q) + (1 - qp_0)\left(E\left[\max\left\{q\ \eta K_2 \max\left\{\frac{p_0(1-q)}{1-p_0 q}, \frac{1-p_0}{1-p_0 q}\right\} + f_e(k_1, K_2), k_2 q \max\left\{\frac{p_0(1-q)}{1-p_0 q}, \frac{1-p_0}{1-p_0 q}\right\}\right\}\right]\right),$$

$$V(\tau_1 = 0) = q(1-p_0)\,(k_1 + q) + (1 - q(1-p_0))\left(E\left[\max\left\{q\ \eta K_2 \frac{p_0}{1-q(1-p_0)} + f_e(k_1, K_2), k_2 q \frac{p_0}{1-q(1-p_0)}\right\}\right]\right).$$

where $f_e(k_1, K_2)$ is $(1-\eta)K_2 \frac{qp_0}{1-q(1-p_0)}$ if $k_1 \leq k(\eta)$ (so that firms expect the entrepreneur to choose $\tau_1 = 0$), and is equal to $(1-\eta)qK_2 \max\left\{\frac{p_0(1-q)}{1-p_0 q}, \frac{1-p_0}{1-p_0 q}\right\}$ if $k_1 \geq k(\eta)$.

Given this, the equilibrium task allocation of an entrepreneur is $\tau_1 = 0$ for given k_1 if:

$$q(1-p_0)\left(k_1+q\right)+(1-q(1-p_0))\frac{qp_0}{1-q(1-p_0)} \geq qp_0\left(k_1+q\right)+$$
$$(1-qp_0)\left(E\left[\max\left\{q\ \eta K_2 \max\left\{\frac{p_0(1-q)}{1-p_0 q}, \frac{1-p_0}{1-p_0 q}\right\}+\right.\right.\right.$$
$$\left.\left.\left.(1-\eta)K_2\frac{qp_0}{1-q(1-p_0)}, k_2 q \max\left\{\frac{p_0(1-q)}{1-p_0 q}, \frac{1-p_0}{1-p_0 q}\right\}\right\}\right]\right)$$

Note that, in period 2, the agent never chooses entrepreneurship: the market believes that the entrepreneur chose $\tau_1 = 0$, and therefore the agent's period 2 payoff is greater when working for a firm than as an entrepreneur (both on- and off-equilibrium). Hence the above expression simplifies to

$$k_1(2p_0-1) \leq p_0 - q(2p_0-1) - \eta \max\left\{p_0(1-q), 1-p_0\right\} - \frac{(1-\eta)p_0(1-qp_0)}{1-q(1-p_0)} \equiv A$$

The equilibrium task allocation of an entrepreneur is $\tau_1 = 1$ for given k_1 if:

$$qp_0\left(k_1+q\right)+(1-qp_0)\cdot q \cdot \max\left\{\frac{p_0(1-q)}{1-p_0 q}, \frac{1-p_0}{1-p_0 q}\right\} \geq q(1-p_0)\left(k_1+q\right)+$$
$$(1-q(1-p_0))\left(E\left[\max\left\{q\ \eta K_2\frac{p_0}{1-q(1-p_0)}+(1-\eta)qK_2 \max\left\{\frac{p_0(1-q)}{1-p_0 q}, \frac{1-p_0}{1-p_0 q}\right\},\right.\right.\right.$$
$$\left.\left.\left.k_2 q\frac{p_0}{1-q(1-p_0)}\right\}\right]\right).$$

or

$$k_1(2p_0-1) \geq 1-p_0-\max\left\{p_0(1-q), 1-p_0\right\}+$$
$$E\left[\max\left\{K_2\left(\eta p_0+(1-\eta)\frac{(1-q(1-p_0))}{(1-p_0 q)}\max\left\{p_0(1-q), 1-p_0\right\}\right), k_2 p_0\right\}\right] \equiv B$$

Note that $B \leq A$, because the continuation value whenever an agent chooses $\tau_1 = 0$ is greater than the continuation value whenever the agent chooses $\tau_1 = 1$. Hence we have multiple equilibria. For simplicity, we pick the simpler expression and focus on the equilibrium in which the entrepreneur chooses task $\tau_1 = 0$ whenever condition 6 holds, and task $\tau_1 = 1$ otherwise. □

It follows that, from a period 2 point of view, observing the occupational choice and the project k_1 is sufficient to infer the task allocation in period 1. There is no asymmetry of information in period 2. Note that the set of k_1 for which the entrepreneur chooses learning depends on whether period 2 wage is mostly paid as bonus for success or fixes payment. Because $k(\eta)$ is increasing in η, the larger the contingent part of the period 2 wage, the more likely the entrepreneur is to choose learning over short run profit maximization.

We can now derive the optimal period 1 career choice. Clearly, the agent will never choose entrepreneurship whenever $k_1 \geq k(\eta)$, because by working for a firm she would work on a project of greater value. If instead $k_1 \leq k(\eta)$ then the agent might choose entrepreneurship. The agents become entrepreneurs if the lifetime utility of being an entrepreneur is greater than the lifetime utility of working for a firm. We compared the two in lemma 2 and the condition derived there applies here as well.

Corollary 10. *The agent chooses entrepreneurship in period 1 if both* $k_1 \leq k(\eta)$ *and*

$$k_1(1-p_0) > K_1 p_0 - \min\{q(1-p_0), (2p_0-1)(1-q)\}$$

Note that the larger the contingent part of the wage in period 2, the more likely the agent is to choose entrepreneurship in period 1.

Therefore, when tasks are unobservable, there are multiple equilibria. Some of these equilibria are qualitatively similar to the equilibrium with observable task allocation: all entrepreneurs choose $\tau_1 = 0$ and all workers choose $\tau_1 = 1$. The only difference between observable and unobservable task allocation is in the thresholds determining the selection into entrepreneurship.

E Long Term Contracts

In the text we assume that long term contracts are not available. In this section, we relax this assumption by introducing the possibility that, in period 1, firms and workers can sign a contract specifying a wage for period 2.

To start, note that if firms can shutdown at no cost, long-term contracting cannot improve our sequence of short-term contracts. Long-term contracting may be valuable when it induces the firm to choose, in period-1, a task allocation that is not short-term profit maximizing. As long as workers can freely leave a firm, competition requires that firms' make zero profits in period 2.[22] But then, a firm is better off implementing the short-term profit maximization task allocation in the first period and shutting down the firm.

If instead firms can commit not to shut down, we show here that long term contracting does not affect our main qualitative result as long as workers are free to move across firms and occupations. Below, we limit our attention to the case $\alpha = 1$ (no labor market frictions).

When long term contacts are available, in period 1 the firm can promise to pay the worker in period 2 a wage—contingent on success or failure in period 1 and on period 2 project K_2—equal to the market value of this worker *in case she was allocated to task* 0 in period 1. Assume that such a contract is signed. When choosing the period 1 task allocation, the firm may deviate and choose instead $\tau_1 = 1$. This deviation will deliver a period 2 expected payoff equal to:

$$\begin{aligned} & - f(\lambda)q(1-p_0q)\left(\frac{p_0}{1-q(1-p_0)} - \max\left\{\frac{p_0(1-q)}{1-p_0q}, \frac{1-p_0}{1-p_0q}\right\}\right) \\ = & - f(\lambda)q\left(\frac{p_0(1-p_0q)}{1-q(1-p_0)} - \max\left\{p_0(1-q), 1-p_0\right\}\right). \end{aligned}$$

Indeed, in case a failure occurs, the firm will pay a wage that is greater than the agent's real value, discounted by $f(\lambda)$ which is the probability that the agent does not choose entrepreneurship in period 2 in this out-of-equilibrium play, where:

$$f(\lambda) = \text{pr}\left\{k_2 \max\left\{\frac{p_0(1-q)}{1-p_0q}, \frac{1-p_0}{1-p_0q}\right\} < K_2 \frac{p_0}{1-q(1-p_0)}\right\},$$

[22] This is the relevant case since we already show that when there are significant market frictions, short term contracting is efficient.

which can be simplified as

$$f(\lambda) = \min\left\{\frac{L}{\lambda}, 1\right\},$$

$$L := \frac{\frac{p_0}{1-q(1-p_0)}}{\max\left\{\frac{p_0(1-q)}{1-p_0q}, \frac{1-p_0}{1-p_0q}\right\}}.$$

$f(\lambda)$ is a decreasing function of λ. Instead, the period 2 expected payoff of staying on the equilibrium path and choosing $\tau_1 = 0$ is zero.

At the same time, as discussed in the main text, deviating to $\tau_1 = 1$ generates a period 1 benefit to the firm. Remember that, when period 1 task allocation is chosen, the firm's profit in case of success is $K_1 - b$, where b is the bonus to be paid in case of success. Because b can be at most $\underline{\beta}K_1$, the smallest expected period 1 benefit of choosing task 1 instead of 2 is:

$$p_0qK_1(1-\underline{\beta}) - (1-p_0)qK_1(1-\underline{\beta}) = (2p_0-1)qK_1(1-\underline{\beta})$$

Such a contract is effective in inducing the firm to allocate the worker to task 0 whenever the firm has no incentive to set $\tau = 1$, that is when

$$(2p_0-1)K_1(1-\underline{\beta}) \leq f(\lambda)\left(\frac{p_0(1-p_0q)}{1-q(1-p_0)} - \max\{p_0(1-q), 1-p_0\}\right). \quad (7)$$

From Proposition 3, it is efficient to set $\tau_1 = 0$ in a firm whenever the firm has a project return $K_1 \leq \overline{K}$, with

$$\overline{K} := \frac{1}{2}\left(\frac{1}{\lambda} + \lambda\right)\min\left\{\frac{q(1-p_0)}{2p_0-1}, 1-q\right\}.$$

As K_1 is small, in the long term contract, incentives to deviate in the first period are also small, and there exists a cutoff $\underline{K}$—the value of K_1 that binds (7)—such that there is no deviation when $K_1 \leq \underline{K}$. If $\underline{K} < \overline{K}$ firms have an incentive to deviate from the long term contract and not implement the dynamically efficient task allocation when $K_1 \in [\underline{K}, \overline{K}]$. It is enough to show that (7) fails for $K_1 = \overline{K}$, which happens when:

$$(2p_0 - 1)\frac{1}{2}\left(\frac{1}{\lambda} + \lambda\right)\min\left\{\frac{q(1-p_0)}{2p_0-1}, 1-q\right\}(1-\underline{\beta}) > \\ f(\lambda)\left(\frac{p_0(1-p_0q)}{1-q(1-p_0)} - \max\left\{p_0(1-q), 1-p_0\right\}\right).$$

It is easy to see that the above constraint holds, for instance, for λ sufficiently large.[23]

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[23] Numerical simulations show that for $\lambda \approx 2$, there are values of p_0, q, $\underline{\beta}$ and λ for which the above equation holds, and, in the main model, the learning motive remains the dominant motive for entrepreneurship in the sense that Proposition 5 also holds.

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