



# Inferring the unobserved human capital of entrepreneurs

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# Inferring the unobserved human capital of entrepreneurs\*

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## Abstract

The goal of this paper is to study the role of unobserved human capital in entrepreneurial choice and its impact on the survival of newly created firms. Our starting point is that, when starting a new business, an entrepreneur's labor market situation (e.g. employed or not) reflects how his human capital may be valued through salaried labor. This in turn affects the entrepreneurial decision so that, an entrepreneur's human capital should be correlated with the state at which he decided to start a new firm. We illustrate this point with descriptive statistics computed from a survey of French startups. These statistics show that the impact of education on the new firm's survival is most pronounced for firms created by individuals salaried in their preferred branch of activity while it is rather limited if the entrepreneur was in the wrong branch or newly unemployed. In this paper we argue, both theoretically and empirically, that these results may be explained by some unobserved heterogeneity in the entrepreneur's human capital that is correlated both with the initial labor market situation and with some observable measures of human capital such as education or experience.

We first present a simple model of entrepreneurial choice that provides predictions about an entrepreneur's actual human capital as a function of human capital observed by the econometrician as well as the individual's state in the labor market when the firm was created. The model allows for some information asymmetry on the labor market as well as other sources of inefficiencies such as incentive problems due to moral hazard. It also allows in a simple way for some dynamic considerations on the part of the entrepreneur regarding potential depreciation of his human capital. We argue that the

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data may be best explained by a model where employer's information on employee's human capital is sufficiently poor and where there is a strong concern about human capital depreciation for those with a high level of observed human capital.

We then run some duration analysis on our data on new firms' survival by estimating a proportional hazard Cox model with partial maximum likelihood. The estimation results are coherent with the descriptive statistics on the impact of education on survival for different initial states of the entrepreneur. This econometric analysis will be completed with additional regressions that allow for correcting for unobserved heterogeneity in order to evaluate its magnitude and nature. We have done some preliminary work where unobserved heterogeneity is modelled through random effects (frailties) for different subgroups of individuals according to education level and experience that have a gamma distribution. Our preliminary results show that there is significant unobserved heterogeneity but the estimates of the frailties are consistent with the results obtained by running a standard Cox estimation.

**Keywords:** Entrepreneurship, Labor Market, Human Capital Valuation, Information Asymmetries, Duration of the New Firm.

**JEL:** J24, L25, D8, C41

# 1 Introduction

The decision to start a business is most of the time associated with a decision to become self-employed<sup>1</sup>. It is not only a choice about how to invest financial capital but it is also a decision about the proper allocation of one's labor force<sup>2</sup>. The choice of self-employment implies that the entrepreneur anticipates better returns on his human capital by running his own firm than what he could obtain by selling it in the labor market. The existing theoretical literature on entrepreneurship usually assumes that it requires some specific human capital, the managerial ability, which may not be sold in the labor market (see Lucas, 1978, Jovanovic, 1982, Evans and Jovanovic, 1989, Fonseca *et al.*, 2001). Those who have the highest managerial abilities choose to become entrepreneurs<sup>3</sup>. In this paper we argue that entrepreneurship is to a large extent the result of inefficiencies in the labor market. More specifically, we consider two categories of inefficiencies. First, actual human capital is usually imperfectly rewarded by the labor market because of information asymmetries or incentive concerns. Second, frictions in the labor market may prevent individuals from allocating their human capital optimally, either because they stay unemployed or they stay in a position with which they are poorly matched.

Our starting point is that any human capital that is put into setting up a new firm would be valuable to a potential employer. Here human capital should be viewed in a very broad sense as including any knowledge that the entrepreneur may have that will contribute

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<sup>1</sup> The propensity to set up or to take over a new firm in France is much more important in the population of unemployed people (around 4 times more than in the working population according to Abdesselam, Bonnet and Le Pape, 2004). Moreover 82% of the new created firms start their activity without any employee in 2004.

<sup>2</sup>According to Moskowitz, Vissing-Jorgensen (2002), the returns of the financial initial investment of the entrepreneur is not higher than the one he would obtain on the financial markets. So if the individual has the motive to value his wealth it would be the best for him to invest it in the financial markets since the entrepreneurial investment does not allow to diversify his risk.

<sup>3</sup>Even when managerial abilities are not explicitly introduced, as in Khilstrom and Laffont (1979), it is assumed that self-employment involves some specific risky rewards that may not be captured while holding a wage position. Then it is the heterogeneity in risk aversion that determines which individuals become entrepreneurs.

to making his business successful<sup>4</sup>. If this human capital is perfectly observable, since the individual may sell all of the information he may have on the profitability of the new project to an employer, he might as well invest whatever wealth he has in the financial markets rather than start his own business. In a world of perfect and complete markets, it is not clear why anybody would become an entrepreneur<sup>5</sup>. Apart from information asymmetries, there are various other inefficiencies that may induce lower rewards for human capital in the labor market than in self employment. In particular, self employment eliminates inefficiencies due to the separation between ownership and control that lead to inefficient levels of effort for incentive reasons. Furthermore, even if human capital is perfectly observable and there are no incentive problems, an individual may be prevented from getting a job with which he has a good match due to various labor market rigidities. Here we consider a simple model of entrepreneurship that allows for a varying degree of asymmetric information, potentially different rewards on human capital in the labor market and in self-employment and labor market rigidities.

In order for an individual to be able to obtain the right reward on his human capital, it is necessary that employers evaluate it correctly. This is unlikely to be the case, especially for an individual who has not held a position for very long.<sup>6</sup> Actual human capital may therefore be undervalued all the more so in the case of potential entrepreneurs who may have some unusual and novel management, commercial or technological skills. Potential employers base their employment and wage offer decision on what could be called their “beliefs” about human capital which are derived from the information in the vitae and some additional

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<sup>4</sup>Even abilities that one might usually interpret as specifically related to entrepreneurship may be exploited within a salaried position. In large corporations this is illustrated by the concept of “intrapreneurship”. This concept enable to value any entrepreneurial skills of individuals inside the firm by giving a large autonomy to a team to achieve a project. Even in small firms some management tasks are often delegated to employees that are perceived as having some entrepreneurial abilities such as a sense of responsibility and independence.

<sup>5</sup>Of course there is room for psychological explanations such as McClelland’s need of achievement (1961), Shapero’s locus of control (1975) or Pinfold’s overconfidence (2001).

<sup>6</sup>Stern (1989) has explored the implications of such information imperfection on the duration of unemployment.

insights obtained from job interviews and pre-employment tests. Although this information is not perfect, it is presumably better than that available in a survey of entrepreneurs such as the one exploited in this paper. Our modelling allows for such a difference in information, where the employers' information may be anywhere between perfect and as bad as that of the survey. Even if information is perfect, human capital may still be rewarded differently in the labor market and in self-employment. Entrepreneurship is then a means of overcoming some under valuation of human capital. There is some empirical evidence supporting this view. For instance, Evans and Leighton (1989) find that the probability of going into self-employment is much larger for "unemployed workers, lower-paid wage workers or men that have changed jobs a lot" (p.521).

It is unlikely that the above-described differences in rewards on human capital account for all potential inefficiencies in the labor market resulting in a choice to switch into self-employment. We therefore introduce labor market rigidities which may prevent a worker from attaining his or her preferred job. These rigidities have both static and dynamic implications. From a static point of view, they imply that earnings in the labor market are not as large as what could be expected given observed human capital, since workers are unemployed or in a position where their productivity is low. They have therefore higher incentives to choose self-employment regardless of potential asymmetries on actual human capital or incentive issues. There is also a dynamic impact resulting from the potential depreciation in human capital that should be expected for those who are unemployed or working in a branch of activity which does not suit their skills so well. Entrepreneurship may then be a way to keep working in the preferred sector, thus preventing such a depreciation. That entrepreneurship may be a response to labor market rigidities is confirmed by the over representation of the unemployed among new entrepreneurs (in France in 1994, the share of the unemployed among entrepreneurs was about three times the unemployment rate) . Furthermore, the fact that "business experience has just about the same return in wage work

as in self-employment” (Evans and Leighton, 1989, p. 520) suggests that entrepreneurship is an effective means of preventing depreciation even if the worker ends up returning in wage employment.

Observed human capital of the entrepreneur is typically found to have a large impact on the new firm’s survival (see Bates for the significant impact of educational level, 1990, Bosma and ali., 2004, for the impact of the acquired experience). Our data shows that the magnitude of this impact of education on survival is much stronger for those who were employed and did not change their branch of activity when they became self employed than for those who were previously employed in a different branch or unemployed. We argue that these differences may be explained by differences in the rewards to human capital in the labor market prior to entrepreneurship. Those who were employed in the new firm’s branch of activity are likely to have had a better return on human capital in their previous occupation than those who switched branch or were unemployed and these differences in returns to human capital are more significant for highly educated people. We first construct a theoretical model to argue that the data is best accounted for by allowing for enough information asymmetries in the labor market and by assuming that entrepreneurs who were unemployed or badly matched try to a large extent to circumvent depreciation of their human capital. Then we carry duration analysis for firms created by entrepreneurs with different initial situations and find that the results are consistent with our theoretical predictions.

The paper is organized as follows. Section 2 presents some descriptive statistics of the impact of human capital on firm’s survival. Section 3 presents a simple entrepreneurial choice model and show that the choice of self-employment provides information about actual human capital. Section 4 presents with a duration model the impact of observed human capital on the survival of the new firm according to different sub-populations of entrepreneurs.

## 2 Some descriptive statistics

We first present and discuss some simple statistics regarding the impact of an entrepreneur's education level on the firm's survival and how this impact relates to the entrepreneur's previous situation in the labor market. The data is extracted from the SINE 94<sup>7</sup>, survey, which was conducted by the French National Institute of Statistical and Economic Studies<sup>8</sup> in 1994. It provides qualitative data on entrepreneurship and, more specifically, variables pertaining to the entrepreneur and the circumstances in which entrepreneurship occurred. A second survey carried out in 1997 (SINE 97) gives information about the situation of the same firms (closed down or still running; when closed down, the date of the discontinuation). The surveyed units belong to the private productive sector in the field of industry, building, commerce and services.

Since we wish to highlight the labor market motivations for entrepreneurship, we only consider firms set up by an individual. We have excluded take-overs for which the entrepreneurial choice may be somewhat specific. Furthermore, Bates (1990) points to some important reasons why a firm which is taken over is more prone to remain in business than a new one. The new owner "may benefit from established managerial practices that are embodied in the firm". In order to ensure some homogeneity in labor supply behavior, we narrow down the sample further to French male middle aged (aged 30-50) entrepreneurs who started a business in metropolitan France.

The data base SINE 94 provides information about whether the individual was employed or not. For unemployed individuals it indicates whether the unemployment spell is short (less than one year) or long (beyond one year). For those who were employed, the data provides information about the entrepreneur's experience in the branch of activity or the new business or in some other branch. The SINE questionnaire includes a question on such

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<sup>7</sup>"Système d'informations sur les nouvelles entreprises" (Information system on new firms)

<sup>8</sup>Insee (Institut National des Statistiques et des Etudes Economiques).



previous experience. Though it is not clear however that it corresponds to the last position held, we will assume that it does and we interpret a change in the branch of activity as a move towards a job where the individual is better matched. We will refer to this sub-group as mismatched individuals. This information allows us to distinguish four different sub-groups (employed in the same branch, employed in a different branch, unemployed for less than one year, unemployed for more than one year). For each of these sub-groups we compare the survival rates of newly created firms for two extreme populations of entrepreneurs: those holding a degree obtained after two years of higher education (whom we label as having a high education level) and those who hold no degree at all (labeled as having a low education level). Combining these two groups we obtain a sample size of 1856 entrepreneurs. Table 1 provides survival rates according to the education level for each of the four subgroups corresponding to the four previous situations of the entrepreneur<sup>9</sup>.

Our statistics show that the survival rates for miss matched or unemployed people are lower than that of people who were previously working in their preferred branch of activity (respectively 47,96%, 54,87% against 67,49%). From these findings it is not so much the difference between employed and unemployed individuals that matters. Rather these results show that having been employed in the right branch of activity provides a significant advantage in terms of duration of the newly created firms. Benefit from experience in the same sector is significantly higher for employed or recently unemployed individuals than for long term unemployed individuals. Survival rates are with and without experience in the same sector: 67,63% versus 48,33% for employed; 62,12% versus 41,92% for short term unemployed; 54,23% versus 43,31% for long term unemployed.

Next we observe that the spread in survival rates between entrepreneurs with high and low education level for the entire sample is 13.07 percentage points in favor of the former.

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<sup>9</sup>The survival rates are weighted to take into account the over representation of some sub groups (characterized by geographic or sectorial differences) in the original SINE sampling method.

For employed people with an experience acquired in the same branch of activity the gap is of 14,28%. By contrast we find a much smaller spread for those who, when they chose self-employment, were either unemployed or mismatched. For those who were previously unemployed, the results show that the spread in survival rate falls to 8,93 percentage points and for those who were unemployed for less than a year it is only 5.05%. In the population of individuals who were employed in a different branch of activity the gap in survival rates is only 4,26%.

As in the previous literature we find that a higher level of education improves the firm's duration. The interesting new insight is that the extent of this positive impact strongly depends on the previous labor market situation of the entrepreneur. We argue in the remainder of the paper that these differences may be explained by viewing entrepreneurship as a response to labor market inefficiencies that we highlight in the introduction. More specifically, we want to argue that the varying impact of education on survival across the four subgroups reflects some unobserved heterogeneity in human capital that is to some extent correlated with the entrepreneur's initial situation in the labor market. These different situations correspond to different states of under-evaluation of the individual's human capital by the labor market so that entrepreneurship reflects different information about the individual's unobserved human capital.

We now discuss at an intuitive level how these differences may be understood by thinking about the individual's strategy regarding the allocation of his human capital. As argued in the introduction, the decision to start a business may best be understood by taking into account labor market imperfections. From a static point of view, entrepreneurship is a means of insuring that the individual's human capital is rewarded appropriately. From a dynamic point of view, entrepreneurship may be a strategy to avoid depreciation of his human capital

Intuitively the under-valuation motive is more a concern for entrepreneurs coming from

unemployment or from a different branch of activity. For individuals with a low level of human capital, the earnings are not strongly sensitive to the state in the labor market (unemployed, well or mismatched). If these individuals choose self-employment we can infer either that entrepreneurship is a way to value some skills, either that their opportunity cost to start a business is weak. Yet for individuals with a high level of human capital employed in their right branch of activity, becoming an entrepreneur is a positive signal on their entrepreneurial skills. This positive signal is less when the individual comes from unemployment or was mismatched in the labor market. As a consequence the predictive value of human capital on actual human capital (and thus on the survival of the new firm) is more pronounced for individuals who previously had a good match in the labor market. The depreciation motive reinforces this result because it mainly affects individuals with a high level of human capital unemployed or mismatched. So depreciation weakens all the more the predictive power of the level of the human capital on the survival of the newly created firm when the individuals were unemployed or mismatched.

The fact that the reduction in spread is more pronounced for those who have not stayed unemployed too long supports the view that this reduction is to a large extent explained by a depreciation motive for those with a high human capital. Indeed, if they are worried about depreciation, they should not wait too long to do something about it. The same explanation holds for individuals concerned with a sector switch.

We may loosely control for some alternative explanations by checking some of the characteristics of the populations under consideration. One possible explanation would be that, for the subpopulations where the spread is small, those with low observed human capital start businesses in sectors where survival rates are high whereas those with a high level of observed human capital would get involved in sectors where new firms tend to die rapidly. Although it is true that the choice of a sector for the new firms depends very much on the

observed level of human capital<sup>10</sup> this sectorial difference does not seem to depend much on the previous status (employed/unemployed) or on whether the previous sector was different. Another possible explanation could be that in order to fight unemployment, the government subsidises primarily individuals who have some difficulties to enter in a salaried position, so mainly individuals with a low level of human capital. In the french context, it is not the case. Government subsidies which, for the unemployed, affects duration positively (see Abdesselam, Bonnet and Le Pape, 2004) benefit as much to highly educated as to uneducated entrepreneurs.

### 3 A simple model of Entrepreneurial choice with labor market imperfections

We now present a stylized model of entrepreneurship which highlights the two motives for choosing self employment:

- (i) circumventing undervaluation of human capital by the labor market;
- (ii) avoiding human capital depreciation resulting from frictions on the labor market.

#### 3.1 Entrepreneurial choice and labor market inefficiencies

Consider an individual whose actual human capital denoted  $K$  is either high or low,  $K \in \{H, L\}$ ,  $H > L$ . This human capital however may not be perfectly observed by employers. Rather, they assign a probability  $\rho$  to a high human capital. This imperfect observability is coherent with a situation where the potential entrepreneur is unemployed or has been holding a job for a limited time. Presumably, for individuals holding a position with a long enough tenure this information asymmetry would be greatly reduced<sup>11</sup>. At any rate,

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<sup>10</sup>Low observed human capital is associated with businesses in commerce, transportation or construction while high level of observed human capital leads to doing business in services to firms.

<sup>11</sup>The reduction in the asymmetry of information does not prevent an undervaluation of human capital if skills or competencies are firm-specific (Lazear, 2003) or if the small size of the firm does not allow to

the information available to the firm is very different from what might be observed by an econometrician (i.e. education level or work experience). To account for this difference between the information of the employers and that available in the data we allow for  $\rho$  to depend on the actual realization of human capital  $K$ , where  $\rho_K$  denotes the employer's beliefs if actual human capital is  $K$ . We denote by  $\mu = E_K \rho_K$  the probability assigned to a high human capital based on the information available in the data. We will refer to the probability  $\mu$  as the agent's observed human capital. It is also the beliefs of the employer when he has no more informations on the actual human capital regarding the interviews or the tests the individual might have passed on. Our prior on human capital is given by observed human capital measured by  $\mu$ ; given this prior we expect the employers' prior to be either  $\rho_L(\mu) \leq \mu$  if actual human capital is low or  $\rho_H(\mu) \geq \mu$  if actual human capital is high. We assume that in average the revision process for a high observed human capital is positive while it is negative for a low observed human capital. In doing this we assume that the part of human capital observed by the employer is more informative than  $\mu$ .

The two extreme cases are when there is no information asymmetry, in which case  $\rho_L(\mu) = 0$  and  $\rho_H(\mu) = 1$  for all  $\mu$ , and when employers have no more information than we do in which case  $\rho_L(\mu) = \rho_H(\mu) = \mu$  for all  $\mu$ .

When deciding on whether or not to go into self employment, the individual may be in one of three situations. Either he is unemployed (state 0), either he holds a salaried position in a sector where he is highly productive (state 1) or he holds a salaried position in a sector where his productivity is poor (state 2). Though the second situation is clearly preferable to the other two, the agent may be unable to reach it because of frictions on the labor market. The potential benefits from entrepreneurship should be compared by the individual to the expected future benefits if he chooses to stay in his current position. Entrepreneurial choice is the outcome of a dynamic program where the agent anticipates correctly, but with 

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 promote individuals at a level where the wage correctly values the actual human capital.

uncertainty, all future consequences of his current choice and in particular, the evolution of his career. Here we specify ad hoc value functions associated with each potential choice which depend for the most part on expected income in the current situation or expected income in the newly created business. It seems reasonable that the value functions should be monotonically increasing in these earning levels. We will in part account for other factors, in particular by introducing a potential depreciation of human capital when the individual is stuck in a bad state.

If the individual is employed in state  $i = 1, 2$ , he is paid a wage equal to his expected marginal productivity, given the employer's beliefs on his actual human capital. Thus the expected value of staying in state  $i$  is clearly increasing in the employer's beliefs,  $\rho$ , and it is larger in state 1.

The individual's expected earnings when unemployed is also increasing in  $\rho$  since unemployment benefits may depend on past wages and the agent may end up finding a new job where he will be paid according to his observed human capital.

We farther assume that when unemployed or employed in state 2, the agent's human capital depreciates. This depreciation of actual human capital affects future employers' beliefs, and it is for the most part through these beliefs that it affects future earnings. We therefore assume that depreciation is all the more a concern that current employers' beliefs are more favorable, independent of actual human capital.<sup>12</sup>

To summarize let  $W_i(\rho)$  be the expected benefits from staying in state  $i$ ,  $i \in \{0, 1, 2\}$ . The expected benefits measured by  $W_i$  are positively affected by employers' beliefs to the extent that more favorable beliefs induce higher potential wages in salaried positions. However, for those in states 0 or 2, there is also a negative impact of improved employers' beliefs due to depreciation. The negative impact of depreciation should be interpreted as measuring the

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<sup>12</sup>This assumption seems reasonable as long as an individual who chooses not to start a business today, does not anticipate that he will become an entrepreneur with a high probability in the future.

difference between the earnings that the agent will obtain in the future if he does not start a business today, and the earnings he will obtain returning to salaried employment after having been self-employed thus avoiding depreciation. Self-employment is a means of circumventing depreciation because the new firm will be started in the sector where the individual is most productive. This potential return to a wage position by entrepreneurs is empirically very relevant. Evans and Leighton (1989) find that half of a cohort of entrepreneurs have returned to wage employment after seven years.

Given the above discussion we have  $W_1(\rho) > W_i(\rho)$  and  $W_1'(\rho) > W_i'(\rho)$ , for  $i \in [0, 2]$ . The difference in slope is the result of the difference in the direct impact of employers' beliefs on earnings since the worker is most productive in state 1, but it also reflects the impact of depreciation for those who are not in state 1; the more depreciation, the larger the difference in slope will be. Finally, the difference in expected values between state 1 and the other states should remain limited for those whose human capital is identified by employers as being low:  $\rho$  close to zero. In such a case, the expected productivity of labor is independent of the sector of activity, and there is not much to lose in being unemployed since the returns to working are low. We therefore assume that  $W_0(0) = W_1(0) = W_2(0)$ .

The value associated with creating a new business for an individual with actual human capital  $K$  is  $v(K) + \nu$ , where  $\nu$  is a random variable which the agent perfectly observes<sup>13</sup>. This random term reflects any factor that may affect entrepreneurial choice, other than human capital. In particular, it may reflect some taste parameters like the taste for independence or risk aversion. Regarding attitude towards risk, one dimension in  $\nu$  is the agent's expected utility from the income earned running his own business. We denote  $F$  the cumulative distribution function of  $\nu$  and assume that it satisfies the increasing hazard rate property which holds for most common distribution functions. We assume that the value of becoming

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<sup>13</sup> $v(K)$  is closely related to the wage that the individual could obtain in a situation where his actual human capital is perfectly observed and correctly rewarded.

an entrepreneur only depends on actual human capital since earnings when self-employed are directly affected by human capital rather than indirectly through the beliefs of the employer.

In subsequent sections we use the above model to infer some information on the individual's actual human capital from his entrepreneurial choice. In doing this we assume that the random term  $\nu$  and the actual human capital are unknown to us. Predictions will differ depending on the extent of information asymmetries on the labor market.

### 3.2 Inferring actual human capital for new entrepreneurs

We characterize the posterior distribution of actual human capital as a function of the initial state and observed human capital, conditional on the choice of self-employment.

From the entrepreneurial choice model, an agent in state  $i$  with actual human capital  $K$  will start a new business if

$$v(K) + \nu > W_i(\rho_K(\mu))$$

which happens with probability

$$P_i(\mu, K) = 1 - F[W_i(\rho_i(\mu)) - v(K)].$$

Thus, from Bayes' Law, the probability of a high human capital given that a firm has been created is

$$\mu_{e,i}(\mu) = \frac{\mu P_i(\mu, H)}{\mu P_i(\mu, H) + (1 - \mu) P_i(\mu, L)}$$

We have  $\mu_{e,i}(0) = 0$ , and  $\mu_{e,i}(1) = 1$ .

Entrepreneurship will be a positive signal about actual human capital if and only if  $\mu_{e,i}(\mu) > \mu$ . This requires that  $P_i(\mu, H) > P_i(\mu, L)$  which holds if and only if

$$W_i(\rho_H(\mu)) - W_i(\rho_L(\mu)) < v(H) - v(L) \tag{1}$$

This means that the benefits from having a high human capital are larger for a self-employed individual than what they would be on the labor market. This seems reasonable for skills



that are especially valuable to ensure that a new business is successful; these are precisely the kind of skills we will be interested in in our empirical investigation. When employers do not benefit from any additional information about human capital over what is known by the econometrician, then  $(\rho_H(\mu) = \rho_L(\mu) = \mu)$ , so that the right hand side of (1) is 0 and entrepreneurship is always a positive signal on actual human capital.

We first investigate how, for some observed human capital  $\mu$ , the posterior distribution of human capital is more or less favorable depending on the initial state of the entrepreneur. This critically depends on the magnitude of information asymmetries on the labor market. First suppose that human capital is perfectly observed by employers, so that  $\rho_L(\mu) = 0$  and  $\rho_H(\mu) = 1$  for all  $\mu$ . Then, we have

$$P_i(\mu, L) = 1 - F[W_i(0) - v(L)]$$

which depends neither on  $\mu$  nor on  $i$  (recall that  $W_i(0)$  does not depend on  $i$ ) and

$$P_i(\mu, H) = 1 - F[W_i(1) - v(H)]$$

which does not depend on  $\mu$  and satisfies  $P_1(\mu, H) < P_i(\mu, H)$ , since  $W_1(1) > W_i(1)$  for  $i = 0, 2$ . Then we have  $\mu_{e,i}(\mu) > \mu_{e,1}(\mu)$  for  $i = 0, 2$ .

Thus, if employers observe human capital perfectly, an entrepreneur who was well matched in his job when he started a business, state 1, should be expected to have a lower human capital than an entrepreneur who was unemployed, state 0, or stuck in a job where his productivity was low, state 2. This is because, an individual with a high human capital has a stronger incentive to become self-employed if his state is bad so that rewards on his human capital in the labor market are low, whereas the incentives of a low human capital individual to start a business are independent of his initial state since the labor market rewards his human capital equally poorly in all situations. These predictions are derived while holding  $\mu$ , the prior of the econometrician constant.

Now consider the other extreme situation where employers have no more information than what is in the data so that  $\rho_L(\mu) = \rho_H(\mu) = \mu$ . Then

$$P_i(\mu, K) = 1 - F[(W_i(\mu) - v(K))].$$

for both high and low human capital individuals. Then, for a given level of observed human capital,  $\mu$ , the incentives to start a business are lower for individuals employed with a good match, state 1, than in the other two states, whether actual human capital is high or low. This is because, earnings in the labor market are independent of actual human capital since they are fully based on observed human capital. Note that the initial state only affects the posterior probability of a high capital through the values  $W_i(\mu)$ . The derivative of  $\mu_{e,i}$  with respect to  $W_i$  has the sign of

$$\frac{f(W_i(\mu) - v(L))}{1 - F(W_i(\mu) - v(L))} - \frac{f(W_i(\mu) - v(H))}{1 - F(W_i(\mu) - v(H))}$$

which is positive from the monotone hazard rate property. Thus, since  $W_1(\mu) > W_i(\mu)$ , for  $i \neq 1$ ,  $\mu_{e,1}(\mu) > \mu_{e,i}(\mu)$ ,  $i \in \{0, 2\}$ , for all  $\mu \in [0, 1]$ .

In this situation of extreme information asymmetry, for a given level of  $\mu$ , Entrepreneurs who started out with a good match in the labor market should be expected to have a higher actual human capital than those who were unemployed or badly matched.

Let us now consider the impact of a change in observed human capital,  $\mu$  on the distribution of actual human capital conditional on the choice of becoming an entrepreneur. To this end we study the derivative of the posterior probability  $\mu_{e,i}$  with respect to the prior  $\mu$ . If employers have complete information it is given by

$$\mu'_{e,i}(\mu) = \frac{P_i(\mu, H)P_i(\mu, L)}{[\mu P_i(\mu, H) + (1 - \mu)P_i(\mu, L)]^2} = \frac{\lambda_i}{[\mu\lambda_i + 1 - \mu]^2} \quad (2)$$

where  $\lambda_i = \frac{P_i(\mu, H)}{P_i(\mu, L)}$  which is independent of  $\mu$  when employers observe human capital perfectly. Under assumption that  $P_i(\mu, H) > P_i(\mu, L)$ , (or equivalently if (1) holds)  $\lambda_i > 1$ , so that

the above expression is strictly decreasing in  $\mu$ . Thus posterior beliefs are concave functions of observed human capital. Recalling that with no information asymmetry,  $\mu_{e,i}(\mu) > \mu_{e,1}(\mu)$  for  $i \in \{0, 2\}$ , posterior beliefs for entrepreneurs in state 1 will be steeper than those for entrepreneurs in states 0 or 2 if  $\mu$  is sufficiently close to one as illustrated by figure 1a <sup>14</sup>

Once again, we now turn to the case where the information available to employers is limited to what is in the data. The slope of the posterior probability of a high human capital conditional on entrepreneurship is then given by

$$\mu'_{e,i}(\mu) = \frac{P_i(\mu, H)P_i(\mu, L) \left[ 1 + \mu(1 - \mu) \left[ \frac{\partial P_i}{\partial \mu}(\mu, H)}{P_i(\mu, H)} - \frac{\partial P_i}{\partial \mu}(\mu, L)}{P_i(\mu, L)} \right] \right]}{[\mu P_i(\mu, H) + (1 - \mu)P_i(\mu, L)]^2}$$

From the increasing hazard rate property, the term in the second bracket in the numerator has the sign of  $W'_i(\mu)$  and the term in the big bracket is larger if  $W'_i$  is larger. First suppose that  $W'_i = 0$  so that the term in the second bracket is zero then the slope of posterior beliefs is given by (2). Then once again it would be decreasing in  $\mu$  so that posterior beliefs would be concave as in perfect information case. However, as was shown above, contrary to the case of perfect information, entrepreneurship is a better signal about actual human capital for those in state 1 than for those in states 0 or 2. Then the situation will be as depicted in figure 1b, so that differences in observed human capital will correspond to larger differences in actual human capital in state 1 only if  $\mu$  is sufficiently low. However the above analysis was carried out assuming  $W'_i = 0$  for all  $i$ . In this setup where information asymmetries are most extreme, we must have  $W'_1 > 0$  since there is no depreciation motives for entrepreneurs in state 1, a higher observed human capital then translates into higher expected wages. We also now that  $W'_1 > W'_i$  for  $i \neq 1$  where  $W'_i$  may be 0 or even negative when the depreciation motive is so high that it wipes out the positive benefits of a higher observed human capital on expected wages. These properties allow for generating results that are consistent with

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<sup>14</sup>More specifically we can show that a sufficient condition is  $\mu \geq \frac{1}{2}$ . This can be shown by looking at the derivative of  $\mu'_{e,i}(\mu)$  with respect to  $\lambda_i$  which is negative as long as  $\lambda_i \geq \frac{1-\mu}{\mu}$  : this holds for  $\mu \geq \frac{1}{2}$  since  $\lambda_i \geq 1$ . To complete the argument, note that  $\lambda_1 < \lambda_i$ , for  $i \neq 1$ .

our empirical findings independent of the level of  $\mu$ . Of course  $\mu$  may not be too close to 1, in which case we have  $\mu'_{e,1} < \mu'_{e,i}$  for  $i \neq 1$  (so that the two curves hit 1 when  $\mu = 1$ ).

We now discuss how the above theoretical analysis may be used to explain the data presented in section 2.

### 3.3 Empirical predictions on firm survival

Recall that in Section 2, we presented data on differences in survival rates for entrepreneurs with different education levels: more than two years of higher education as opposed to no diploma. The available data on observed human capital is therefore education and clearly, a higher education corresponds to a higher  $\mu$ . A higher unobserved human capital should be expected to positively affect firm survival so that a higher posterior  $\mu_{e,i}$  should translate into a higher survival rate. Our theoretical model may therefore be used to relate survival rate and education level for entrepreneurs with different initial states denoted  $i$ .

First consider the differential survival rates across different initial states for a given education level. Statistics presented in Section 2 indicate that entrepreneurs who were employed and did not change their branch of activity when they started a business survive better than those who were unemployed or who were employed in a different branch. If we view the prior  $\mu$  as determined by education, the curve  $\mu_{e,1}$  should be above those corresponding to posterior beliefs for the two other initial states. This is consistent with the predictions of our model with strong information asymmetries for the employers but not with a model where employers have perfect information. Nevertheless, in the latter case, unemployment or a job with a bad match may indicate that employers are observing some detrimental information about the individual that is not in the data available to us. Then, for a given education level, the prior on human capital should be updated downwards for those entrepreneurs who started out in either of these two unfavorable states. The poor survival rates could therefore be explained by a bad prior on human capital for entrepreneurs in these

subgroups.

Our descriptive statistics also indicate that the positive impact of a higher education on survival is very strong for entrepreneurs who were initially well matched whereas it is rather limited for the two other groups. In order to obtain such predictions in our theoretical model, the curve describing posterior beliefs in state 1  $\mu_{e,1}$  should be steeper than the other two curves. The model with no information asymmetry only yields this result for high enough values of  $\mu$  as can be seen on Figure 1a. Yet we pointed out above that the prior on human capital for a given level of education should be lower for entrepreneurs with unfavorable initial states. Because of the concavity of the posterior  $\mu_{e,i}$ , differences in observed human capital should correspond to larger differences in actual human capital thus resulting in large differences in survival rates (see Figure 1a). Thus our data are not adequately explained by a model where employers are close to perfectly informed about human capital.

If employers only observe a very poor signal about the individual's human capital, there is not much need to update downwards the prior  $\mu$  for those entrepreneurs whose initial state was unfavorable. Then, the level of  $\mu$  for an individual may be derived from education alone. Recall that Figure 1b illustrates, a situation where  $W'_i = 0$ : then  $\mu$  needs to be small enough in order for  $\mu_{e,1}$  to be steeper than the other two curves. If we think of unobserved human capital for entrepreneurs as some rare abilities that will increase the likelihood of success for the new firm, then observed human capital should be expected to be relatively low even for those with high education levels. Reintroducing the impact of a change in  $\mu$  on the expected benefit from being in the labor market, because  $W'_1 > W'_i$  for  $i \neq 1$ , the curve  $\mu_{e,1}$  is likely to be steeper than the other two for a large range of initial beliefs  $\mu$ . This will be even more true if the depreciation concern for unemployed or poorly matched individuals is strong so that  $W'_i < 0$  for  $i \neq 1$ .

We may therefore conclude that the latter specification of our theoretical model is best suited to match the data in Section 2. Yet, in order to properly evaluate the empirical

implications of our theory we must develop a proper econometric treatment of our data; we do this next.

## 4 Empirical analysis

Our theoretical framework has two basic implications for a proper modelling of the impact on firms' survival of observed human capital variables such as education or experience: the impact of these variables should be differentiated according to the entrepreneur's initial state and the model should allow for some unobserved heterogeneity.

As was pointed out above, the firm's survival is affected by the entrepreneur's actual level of human capital. Our theoretical analysis shows that the distribution of actual human capital must be conditioned not only on observed human capital but also on the event that the individual became self employed while being in a given situation in the labor market. Our results suggest that there may be significant differences in the relationship between observed and unobserved human capital according to that initial situation of the entrepreneur in the labor market. In order to allow for such differences, we will introduce explanatory variables that cross the education level or experience of the entrepreneur with variables pertaining to the initial state (employed, unemployed, working in the branch of activity of the new firm or not).

in our analysis, education and experience should be viewed not so much as variables having a direct impact on survival but rather as providing some partial information about actual human capital that remains unobserved. there is therefore some unobserved heterogeneity, and the impact of education or experience on survival will differ for each individual depending on the realization of actual human capital. In order to account for this properly, it is necessary to introduce random effects associated with each education and experience level cross with the various possible initial states. because we are dealing with duration data, a

failure to model such unobserved heterogeneity will result an inconsistent estimation of the parameters of the hazard rate function. Nevertheless, we start by deriving as a bechmark the estimates for a model where the above mentioned random effects are replaced by fixed effects, so that unobserved heterogeneity is not corrected for.

#### 4.1 Partial likelihood estimation without unobserved heterogeneity

We are still using the SINE 94/97 data base. It provides a discontinuation date for all those firms that stopped business before December 1994 or indicates that the firm is still alive at the end of the period, in which case the data is right censored. Table 2 describes explanatory variable pertaining to observed human capital and the initial state of the entrepreneur and Table 3 lists the other explanatory variables, which are used as control variables. It should be noted that the length of experience is only available for those entrepreneurs whose experience is in the same branch of activity as that of the new firm.

Here we use a Cox proportional hazard model that may be described as follows. Consider a firm sample of size  $n$ . The rate of discontinuation at date  $t$  is measured by the hazard rate function  $h(t)$ . For each firm  $i$ , the data provides information on its life span  $t_i$  measured in months <sup>15</sup>, its individual characteristics  $(x_i)$ , and also whether the firm was still alive at the end of the period covered by the study. The latter information may be summarize by defining a binary variable  $(a_i)$  that indicates the right censor as follows.

$$a_i \left\{ \begin{array}{l} 0 : \text{ if the firm } i \text{ is still active at the time of the second survey in 1997} \\ 1 : \text{ if the firm } i \text{ ceased its activity between 1994 and 1997} \end{array} \right\}$$

The proportionnal hazard rate expression is given by:

$$h(t; x\beta) = h_0(t) \exp(x\beta),$$

where  $h_0(t)$  is an unspecified function of  $t$  called the baseline hazard and  $\beta$  is a vector of the estimated parameters.

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<sup>15</sup> $t_i$  is the difference between the date of cessation of activity and the date of setting up of the  $i$  firm.

Estimators are obtained by maximizing the following partial likelihood expression:

$$PL = \prod_{i=1}^n \left[ \frac{\exp(x_i\beta)}{\sum_{j=1}^n Y_{ij} \exp(x_j\beta)} \right]^{a_i}$$

where  $Y_{ij} = 1$  if  $t_j \geq t_i$  and  $Y_{ij} = 0$  if  $t_j < t_i$ . The  $Y$ 's are a convenient method to exclude from the denominator the individuals who already experienced the event and are thus not part of the risk set. The population concerned in the denominator has not ceased its activity before  $t_i$ . For censored individuals the exit time is not observed so that no probability of exit may be included in the partial likelihood. This is why  $a_i = 0$  for such individuals. The log of the partial likelihood is written as follows:

$$\text{Log}(PL) = \sum a_i \left\{ x_i\beta - \log \left[ \sum_{j=1}^n Y_{ij} \exp(x_j\beta) \right] \right\}$$

This expression is maximized with respect to  $\beta$  so as to obtain the maximum partial likelihood estimators  $\hat{\beta}$ . The estimation has been carried out using the ‘‘PHREG’’ procedure in SAS (see Allison, 1995).

In order to identify differences in the impact of observed human capital on survival across initial situations of the entrepreneur, we run four sub-samples: (i) individuals employed in the same branch of activity; (ii) individuals employed in different branches of activity; (iii) individuals unemployed for less than one year; (iv) individuals employed for more than one year.

Results are summarized in Table 4 where a positive  $\beta$  means that the group under consideration exits more than the reference group. Results on the impact of education are consistent with the descriptive statistics of Section 2. More education reduces significantly the hazard rate for individuals employed in the same sector or unemployed for more the one year. It has no significant impact or may even increase the hazard rate for individuals



employed in a different branch or unemployed for less than one year: in particular for individuals employed in a different branch, those with a high education level have a significantly higher hazard rate than those with an intermediate education level who are the reference group. Education being significant for long term unemployed individuals may be understood as reflecting a lack of depreciation concern for those who are highly educated: this is because their human capital has already depreciated. More generally, after such a long unemployment spell, the situation of the individual on the labor market no longer depends much on education.

On the contrary the results on the impact of experience are very different from those on education since a longer experience always significantly reduces the hazard rate. However, these results are somewhat difficult to interpret since we only have experience data for those individuals who have been working in the same branch of activity (which explains why there are no results for entrepreneurs who changed branch when they started a business).

## **4.2 Accounting for unobserved heterogeneity**

If there is unobserved heterogeneity as our theoretical model predicts, running Cox maximum partial likelihood estimation that assumes a proportional hazard rate may lead to inconsistent estimates of the impact of covariates  $x$ . In order to address this concern, we have run a model that assigns a random effect term to each of 12 subgroups obtained by crossing the three education levels with the four initial states. We find that unobserved heterogeneity is significant but coefficients for covariates other than education and the initial state of the entrepreneur are not significantly altered by modelling it explicitly. Table 5 provides estimates for the log of frailties for each subgroup. They seem consistent with results obtained in the model with no unobserved heterogeneity.

**Discrepancies in survival rates for different education levels according to the situation at the time of creation.**

Levels of observed human capital of the entrepreneur	Low	High
Overall population Wsr*=58,85% (Uss**=6041)	Wsr=50,25% (Uss=557)	Wsr=63,32% (Uss=1299)

	Levels of observed human capital of the entrepreneur	
Employed	Low	High
Wsr=63,50% (Uss=2679)	Wsr=54,66% (Uss=232)	Wsr=68,37% (Uss=788)

	Levels of observed human capital of the entrepreneur	
Unemployed	Low	High
Wsr=54,87% (Uss=3362)	Wsr=46,68% (Uss=325)	Wsr=55,61% (Uss=511)

	Levels of observed human capital of the entrepreneur	
Experience acquired	Low	High
Same branch of activity Wsr=67,49% (Uss=2130)	Wsr=58,05% (Uss=162)	Wsr=72,33% (Uss=641)
Different branch of activity Wsr=47,96% (Uss=549)	Wsr=46,34% (Uss=70)	Wsr=50,60% (Uss=147)

	Levels of observed human capital of the entrepreneur	
Unemployment span	Low	High
Under one year Wsr=57,43% (Uss=2323)	Wsr=51,23% (Uss=221)	Wsr=56,28% (Uss=352)
Over one year Wsr=49,40% (Uss=1039)	Wsr=38,16% (Uss=104)	Wsr=54,09% (Uss=159)

\*Weighted survival rate after four years.

\*\*Unweighted sample size (alive and closed down firms).

**Table 2:****Explanatory variables**

<b>Human capital variables</b>	<i>Modalities</i>	<i>Abbreviation</i>
<b>Educational level</b>	<i>Diploma received after two years and more at University</i>	HIGH LEVEL
	<i>Professional diploma and Secondary School diploma*</i>	INT.LEVEL
	<i>No diploma</i>	LOW LEVEL.
<b>Occupation before the setting-up of the new firm</b>	<i>Unemployed more than one year</i>	UNEMPLOYED>1
	<i>Unemployed less than one year</i>	UNEMPLOYED<1
	<i>Salaried in the same branch of activity</i>	SAL.SAME BRANCH
	<i>Salaried in a different branch of activity*</i>	SAL.DIFF. BRANCH
<b>Experience acquired in the previous occupation</b>	<i>In the same branch of activity*</i>	SAME BRANCH
	<i>In a different branch of activity</i>	DIFF. BRANCH
<b>Duration of experience in the same branch of activity</b>	<i>Less than three years</i>	DE <3 years
	<i>Between three and ten years*</i>	3<DE<10 years
	<i>More than ten years</i>	DE>10 years
<b>Size of the enterprise where this experience has been acquired</b>	<i>Less than ten salaried</i>	SIZE <10 sal
	<i>Between 10 and 100 salaried people*</i>	10<= SIZE < 100 sal
	<i>More than 100 salaried people</i>	SIZE >= 100 sal

\*Reference class.

**Table 3: Control variables**

<b>Professional status before the setting-up of the firm</b>	<i>Manager or Executive</i>	MAN.+EXEC.
	<i>Craftsman, Shopkeeper, Middle management executive</i>	C.S.MME.
	<i>Skilled worker, Employee, Worker*</i>	SW.E.W.
	<i>Student</i>	STUDENT
<b>Age of the entrepreneur</b>	<i>Between 25 and 35 years old</i>	25 < AGE < 35
	<i>Between 35 and 40 years old*</i>	35 < AGE < 40
	<i>Between 40 and 50 years old</i>	40 < AGE < 50
<b>Belonging to an Entrepreneurship “milieu”</b>	<i>Yes (relatives and close relationships)*</i>	ENTR.”MILIEU”
	<i>No</i>	NO.ENTR.”MILIEU”
<b>Previous setting-up of new firms</b>	<i>Zero*</i>	ZERO.PREV.SETUP.
	<i>Once or more</i>	ONCE.PREV.SETUP. or MORE
<b>Main motivation when the entrepreneur sets-up its firm</b>	<i>New idea</i>	NEW IDEA
	<i>Opportunity, Taste for entrepreneurship</i>	OPP. TASTE ENTREP.
	<i>Without employ*</i>	WI. EMPLOY
	<i>Entourage example</i>	ENT. EXAMPLE
<b>Amount of money invested to set-up the firm</b>	<i>Less than 15245 Euros</i>	INVEST. <15245 €.
	<i>Between 15245 Euros and 76224 Euros*</i>	15245 €.<INVEST.<76224 €.
	<i>More than 76224 Euros</i>	INVEST.> 76224 €.
<b>Initial size of the enterprise</b>	<i>Zero and one salaried*</i>	SALARIED =0 or 1
	<i>More than one salaried</i>	SALARIED >1
<b>Obtaining a public financial aid in 1994</b>	<i>Public financial aid obtained</i>	PU. FI. AID OBTAINED
	<i>Public financial aid none obtained*</i>	PU. FI. AID NONE OBTAINED
<b>Asking for bank loans and obtained them in 1994</b>	<i>Demand and refusal</i>	DEM. AND REFUSAL
	<i>Demand and obtained</i>	DEM. AND OBTAINED
	<i>No demand*</i>	NO DEMAND
<b>Number of customers</b>	<i>Between 1 and 10 customers</i>	ONE.TEN.CUST.
	<i>More than ten customers*</i>	MORE.TEN.CUST.
<b>Legal status</b>	<i>Limited liability</i>	LIM. LIABILITY
	<i>Unlimited liability*</i>	UNLIM. LIABILITY
<b>French regions</b>	<i>Regions of high level of entrepreneurship*</i>	REG.ENTREPR.
	<i>Regions of low level of entrepreneurship</i>	REG.NO.ENTREPR.
<b>Branch of industry</b>	<i>Catering, Trade</i>	CAT. TRADE
	<i>Food industry, Industry</i>	FOOD IND., INDUSTRY
	<i>Construction, Transports</i>	CONSTRUCTION,TRANSPORT
	<i>Services enterprises, Household services*</i>	SERVICES

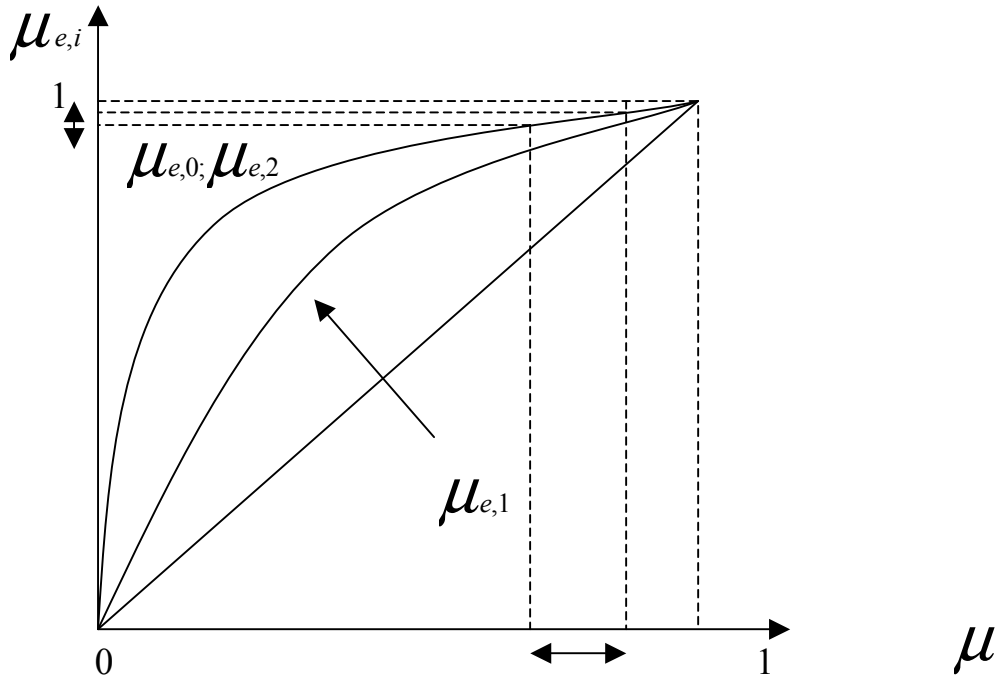
\*Reference class.

**Table 4: Survival analysis -Cox's model-**

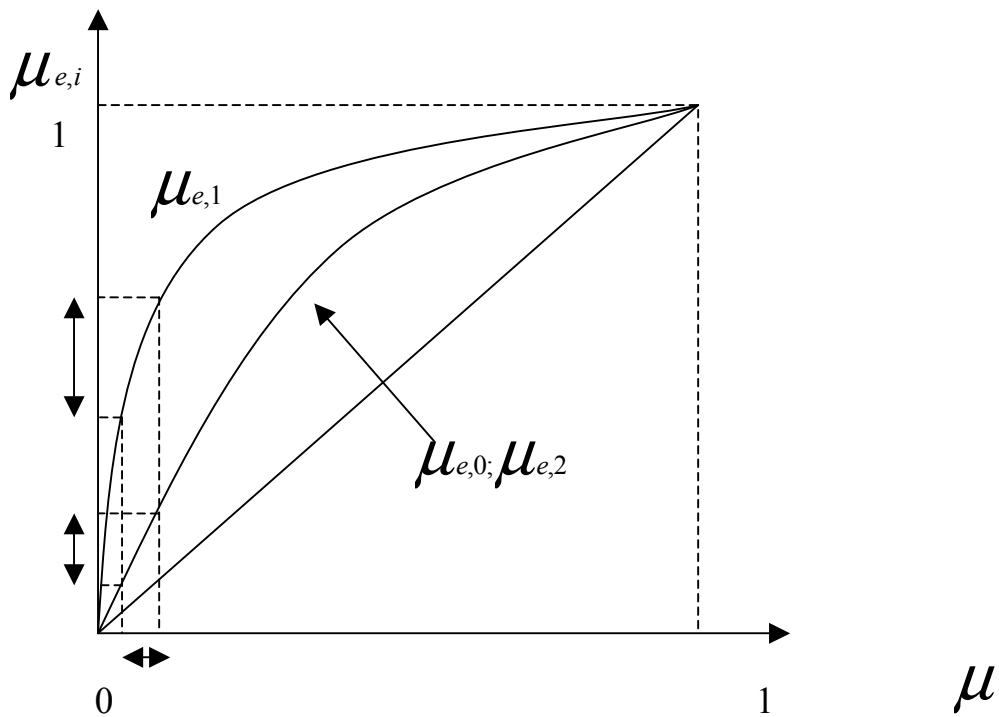
Variables	Start-up by French middle aged male entrepreneurs			
	Salaried Same branch experience	Salaried Diff. Branch experience	Unemployed less than one year	Unemployed more than one year
	$\beta$ (Pr>z)	$\beta$ (Pr>z)	$\beta$ (Pr>z)	$\beta$ (Pr>z)
HIGH LEVEL	-0.4274***(0.000)	0.2727***(0.001)	0,0248 (0.644)	-0.2894***(0.000)
INTERMEDIATE LEVEL	<b>Ref.</b>	<b>Ref.</b>	<b>Ref.</b>	<b>Ref.</b>
LOW LEVEL	0,239***(0.002)	0.1628(0.142)	-0.0136 (0.834)	0.1356*(0.104)
DE <3 years	0.1832***(0.003)		0.0243***(0.000)	0.1071(0.19)
3<DE<10 years	<b>Ref.</b>		<b>Ref.</b>	<b>Ref.</b>
DE>10 years	-0.2894***(0.000)		-0.2508***(0.000)	-0.3220***(0.000)
SIZE <10 sal	-0.2263***(0.000)		-0.4357***(0.000)	-0.3760***(0.000)
10<= SIZE <100 sal	<b>Ref.</b>		<b>Ref.</b>	<b>Ref.</b>
SIZE >= 100 sal	0.2220***(0.000)		-0.0316(0.600)	0.1996**(0.035)
LogL	-19445.78	-6518.50	-27953.25	-12771.216
LR statistic	701,40	299.89	1045,80	402
Number of firms	7045	1802	7070	3296
Percent Censored	67.63%	48.33%	57.45%	49.54%

**Table 5: Estimates of the  $\eta_i = \log(\alpha_i)$   
Survival analysis -Cox's model with shared frailties**

Unemployed more than one year		Low level	0,2733
		Intermediate level	0,1417
		High Level	-0,049
Unemployed less than one year		Low level	0,0903
		Intermediate level	0,0787
		High Level	0,0544
Salaried	Different branch	Low level	0,2581
	Different branch	Intermediate level	-0,0729
	Different branch	High Level	0,0779
	Same branch	Low level	-0,0028
	Same branch	Intermediate level	-0,26
	Same branch	High Level	-0,60



1a. Posterior beliefs conditional on entrepreneurship as a function of observed human capital.  
(Without information asymmetry)



1b. Posterior beliefs conditional on entrepreneurship as a function of observed human capital.  
(With information asymmetry)

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