The value of an educated population for an individual's entrepreneurship success

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Abstract:

Human capital obtained through education has been shown to be one of the strongest drivers of entrepreneurship performance. The entrepreneur's human capital is, though, only one of the input factors into the production process of her venture. The value of other input factors, such as (knowledge) capital and labor is likely to be affected by the education level of the possible stakeholders in the entrepreneur's venture. The education distribution of the (local) population may thus shape the supply function of the entrepreneur. Likewise, the demand function faced by the entrepreneur is also likely to be shaped by the taste, sophistication and thus the education level of the population in their role as consumers. In other words, a population with a higher education level may be associated with (i) a working population of higher quality; (ii) more and/or higher quality universities with a positive effect on research and development (R&D) and knowledge spillovers leading to more high tech and innovative ventures; and finally, (iii) a more sophisticated consumer market. Based on this, we formulate the following proposition: The performance of an entrepreneur is not only affected positively by her own education level but in addition, also by the education level of the population. We test this proposition using an eight years (1994-2001) panel of labor market participants in the EU-15 countries from which we select individuals who have been observed as entrepreneurs. We find strong support for a positive relationship between enrolment rates in tertiary education in country *j* and year *t* and several measures of the performance of individual entrepreneurs in that same country and year, including survival and the probability that an entrepreneur starts employing personnel and maintains as an employer for a longer period of time. An implication of our novel finding is that entrepreneurship and higher education policies should be considered in tandem with each other.

Keywords: entrepreneurship, performance, survival, personnel, education

Acknowledgement: The paper has been written with financial support of ACE (UvA) and the research program SCALES (www.entrepreneurship-sme.eu). At the time of writing the paper André van Stel was also affiliated with ACE.

1. Introduction

Recent empirical research has demonstrated that the returns to human capital are high for entrepreneurs and even higher than for employees (Hartog *et al.*, 2010b; Van Praag *et al.*, 2009a, Van der Sluis *et al.*, 2008; Bates, 1990). Human capital obtained through education has been shown to be one of the strongest drivers of entrepreneurship performance, irrespective of whether earnings, survival, employment or sales growth have been used as the measure of the entrepreneur's performance (cf. the overview in Van der Sluis *et al.*, 2008). Citing the conclusion in Parker's handbook following an encompassing review of the empirical literature of the drivers of entrepreneurship performance:

Overall, the literature suggests that human capital is the major determinant of entrepreneurs' earnings (van Praag, 2005, p. 9). Few other explanatory variables, including ethnicity, family background, social capital, business strategy, or organisational structure of the venture, possess much explanatory power, Parker (2009), p. 582.

The human capital of the entrepreneur herself is, though, only one of the input factors into the production process of her venture (Van Praag and Cramer, 2001). In this paper we will analyze to what extent the education levels of other (potential) stakeholders affect the entrepreneur's performance. The education level of consumers may shape the demand function for an entrepreneur's output, whereas the education level of employees may affect the entrepreneur's productivity and thereby shape her supply function. In addition, a high share of people in a region holding tertiary education is an indicator for the presence of universities (Card, 1999) and the knowledge spillovers associated with universities may also influence the entrepreneur's productivity. So the question we address here is *What is the effect of the education distribution of the local population on an entrepreneur's venture performance (on top of the effect of the entrepreneur's own education level)?* The study of this question results in a novel perspective on the relationship between education and entrepreneurship.

We expect, in particular, that a higher share of people with high levels of education, i.e., tertiary education, has a positive impact on the performance of the average entrepreneur. In other words, a population with a higher share of people with high education levels may, ceteris paribus, be associated with (i) a working population of higher quality; (ii) more and/or higher quality universities with a positive effect on research and development (R&D) and knowledge spillovers

leading to more high tech and innovative ventures; and finally, (iii) a more sophisticated consumer market. Based on this reasoning, we develop and test the following proposition in this paper: The performance of an entrepreneur is not only affected positively by her own education level but in addition, also by the share of highly educated individuals in the (local) population.

We test this proposition empirically by estimating discrete choice models and hazard models, including both single and competing risks frameworks, on an eight years (1994-2001) panel of labor market participants in the EU-15 countries. We select from this Eurostat European Community Household Panel (ECHP) survey those labor force participants who have been observed as entrepreneurs for at least one spell during the period of observation. The richness of the dataset enables us to obtain the relationship between education and entrepreneurship outcomes at the micro-level while controlling for individual specific characteristics. The entrepreneurship outcomes that can be obtained from this data source and that we estimate are (i) the duration of any entrepreneurship spell; (ii) the likelihood that any entrepreneur starts employing personnel and thus becomes an employer; and (iii) the duration of these particular employership spells who recently hired employees. We append to these data a harmonized set of macro-variables per country and year obtained from various sources such that we can establish the main relationship of interest, i.e., between the performance of individual entrepreneurs and the population distribution of education in their country and year of operation, while controlling for other relevant sources of heterogeneity between countries and over time. The population distribution of education is measured in terms of the enrolment rate in tertiary education in country *j* and year *t*.

We find strong and unambiguous support for a positive impact on enrolment rates in tertiary education in country *j* and year *t* on the various measures of the performance of individual entrepreneurs in that same country and year. All performance measures studied, i.e., venture survival and the probability that an entrepreneur starts employing personnel and maintains as an employer for a longer period of time are affected significantly and positively by the share of people enrolled in university and college programs. To the best of our knowledge this is the first study of this, in our opinion, interesting relationship. The estimated effect of the population distribution of education on individuals' entrepreneurship performance may be policy relevant for various reasons.

First, the population distribution of education is a driver of entrepreneurship *performance* rather than of entrepreneurship *numbers* (cf. Van Praag and Van Stel, 2010). Recent studies have shown that only a small share of entrepreneurs, i.e., those that are innovative and grow fast, is responsible for the major share of economic growth and innovation (e.g. Henrekson and Johansson, 2010). Thus, policy measures aimed at encouraging high quality entrepreneurship are more beneficial for economic growth and innovation and thus more policy relevant than is, for instance, subsidizing the formation of the 'typical start-up'. Scott Shane expresses these insights clearly in his Prize Lecture upon the receipt of the 2009 Global Award for Entrepreneurship Research:

Policy makers often think that creating more start-up companies will transform depressed economic regions, generate innovation, and create jobs. This belief is flawed because the typical start-up is not innovative, creates few jobs, and generates little wealth. Getting economic growth and jobs creation from entrepreneurs is not a numbers game. It is about encouraging the formation of high quality, high growth companies. Policy makers should stop subsidizing the formation of the typical start-up and focus on the subset of businesses with growth potential. (Shane, 2009, p. 141).

Indeed, many European countries have started to convert policy measures that were aimed at just developing more entrepreneurship to increasing the quality of the stock of entrepreneurs. Our study implies that educational policies may be viewed as an additional instrument to develop high quality entrepreneurial businesses. The appeal of this instrument to develop high quality entrepreneurship is that it does not require to 'pick winners' upfront, which is obviously difficult, if not impossible. An education system that results in a higher share of people with tertiary education levels will produce more productive entrepreneurs together with more productive employees where the latter will benefit the former in their role as high quality employees, and the former will benefit the latter in their role as providers of high quality jobs and producers of goods and services that satisfy consumer wants. Admittedly, few policy makers will have doubted the value of education. The novelty of our result lies in the fact, though, that the education level of the population can be viewed and used as a direct instrument to develop high quality entrepreneurship irrespective of the labor market choices that these educated people make (i.e., entrepreneurship versus wage employment).

The organization of the paper is as follows. Section 2 discusses the theory relevant to our proposition. Section 3 describes the data we employ to test our proposition empirically and discusses the empirical methodology used. In Section 4 we present and discuss the results. Section 5 concludes.

2. Theory and literature

2.1 The supply function of the entrepreneur's product

Economic theory has not yet departed from the classic notion that the entrepreneur's production function determines the relationship between a firm's inputs and outputs (e.g., Zellner *et al.*, 1966). The traditional Cobb-Douglas production function can be represented as:

$$Y = AL^{\alpha_1}K^{\alpha_2}$$

where Y, L and K represent quantities of output, labor and capital inputs, respectively. A is usually defined as the entrepreneur's productivity or efficiency to create outputs from inputs and may be modelled as the product of two parameters (Zellner *et al.*, 1966; Calvo and Wellisz, 1980). The first is a parameter (A_0 which can be defined as Total Factor Productity (TFP)) that defines the technological and knowledge development in the region assuming that all individuals in a region have access to a common pool of general knowledge and an individual factor E_x that represents the technical knowledge, the productive effectiveness or the ability of acquiring new knowledge of individual entrepreneur x (e.g., Calvo and Welliz, 1980).

The individual production function of an entrepreneur thus readily reveals the potential importance of education for the performance of entrepreneurs through three mechanisms that will be discussed in more detail below. The first is the entrepreneur's education level that will affect E_x and thus the entrepreneur's productive performance positively. The second is the productivity of a unit of labor, L, which is measured by α_1 and is likely to be dependent on the human capital and thus the education of the worker. The third is the local number and quality of educational and research institutions, i.e., mainly universities and colleges that will be associated with increased levels of A_0, the technical and knowledge development in a region that will affect the entrepreneur's productive performance positively.

THE ENTREPRENEUR'S EDUCATION LEVEL

A basic proposition derived from human capital theory is that education leads to higher productivity and thus to higher income (Mincer, 1958; Becker, 1964). It has been contended that, in general, previously acquired knowledge plays a critical role in intellectual performance, also assisting in the integration and accumulation of new knowledge as well as the adaptation to new situations (Weick, 1996, Aidis and Van Praag, 2007). This proposition has been widely supported empirically for the employment probabilities and incomes of wage employees (Ashenfelter *et al.*, 1999) and for the business performance and incomes of entrepreneurs (see Davidsson and Honig, 2003; the meta-analysis of Van der Sluis *et al.*, 2008; and Van Praag *et al.*, 2009a).

Schooling is not only acknowledged for its productive effect, as assumed by Mincer, but also has value as a signal of productive ability in labor markets without complete information (Spence, 1973; Riley, 2002), leading to positive returns to education as well (even if education *per se* had no productive value). Recent studies show that entrepreneurs may use their education as a signal toward suppliers of capital (Parker and Van Praag, 2006) or (prospective) customers and highly qualified employees (Backes-Gellner and Werner, 2007). The limited though unambiguous empirical evidence suggests that the returns to education are even higher for entrepreneurs than for employees (Van Praag *et al.*, 2009a; Van der Sluis *et al.*, 2008).

All in all, we expect that the education level of the entrepreneur has a positive association with her business performance.

THE WORKERS' EDUCATION LEVEL

Human capital theory predicts that workers with higher levels of human capital obtained through education are more productive. Empirical evidence abounds (Ashenfelter *et al.*, 1999). However, they have to be remunerated accordingly by entrepreneurs so the effect on the performance of the entrepreneur's venture when employing personnel with higher levels of education is not clear-cut. More in general, little is known about the effects of the characteristics of employees on business outcomes:

Although a large empirical literature suggests that worker outcomes are associated with firm characteristics …., very little is known about the converse- the process by which business outcomes are associated with the characteristics of their employees (Haltiwanger *et al.*, 1999, p. 94)

Haltiwanger *et al.* (1999) use matched employer-employee data to show which workforce characteristics are associated with productivity levels in firms, while controlling for firm characteristics. They conclude that

Perhaps the most striking result is that firms which employ more educated workers are more productive. The results on education clearly suggest that high productivity workplaces are also high skill workplaces. This result is consistent not only with a human capital model where more skilled workers make the firm more productive, but also with the sorting and matching models … which suggest that business and worker heterogeneity are apt to be linked, as both businesses and workers seek to find the best fit on several dimensions. (Haltiwanger et al., 1999, p. 97)

Survey evidence strongly suggests that, in general, small and medium-sized enterprises have difficulties finding and attracting personnel with higher levels of education, among others due to the well known phenomenon of the employer size wage effect (e.g., Elfenbein *et al.*, 2010; Schmidt and Zimmermann, 1991; Brown and Medoff, 1989), especially for workers with higher levels of education (Hollister, 2004). Thus, highly educated employees are scarce in SMEs and those entrepreneurs who are able to attract sufficient numbers of employees with higher levels of education perform better than those who do not succeed in attracting these employees (Haltiwanger *et al.*, 1999). Entrepreneurs view the limited availability of highly educated personnel as the utmost bottleneck for further growth of their venture (Van Praag *et al.*, 2009b).

All in all, we expect that the non-scarce availability of (potential) employees with high levels of education benefits the performance of entrepreneurs. Therefore, we expect a positive relationship between the performance of entrepreneurs in a region and the share of the population in that region with a higher level of education.

THE NUMBER AND QUALITY OF EDUCATIONAL AND RESEARCH INSTITUTIONS

There is a tendency for knowledge and ideas to become public goods, whose benefits are only partially captured by their creators. These positive externalities are commonly referred to as 'knowledge spillovers' (Parker, 2009, p. 73) and they benefit the technological possibilities frontier. Universities are, among others, important sources of knowledge spillovers (Parker, 2009,

p. 73). Universities, as public research institutions, benefit local entrepreneurs and contribute to innovation processes in their region by absorbing knowledge from outside of their region and making it available to local firms (Fritsch and Schwirten, 1999). Knowledge spillovers facilitate the innovation efforts of entrepreneurs in the region and thereby their business performance. Knowledge also tends to spill over from one entrepreneur to the other which reinforces the positive effect of the presence of research institutes on the performance of entrepreneurs. Knowledge can also be exploited by researchers who decide to become entrepreneurs such that they can diminish the 'knowledge filter' between the creation and exploitation of knowledge (Parker, 2009, p. 73). Entrepreneurship may very well be one of the main channels through which new economic knowledge can be commercialized (Parker, 2009, p. 74; Block *et al.*, 2009, Braunerhjelm *et al.*, 2010).

Knowledge spillovers tend to be geographically bounded and exploited locally by entrepreneurs, partly because the costs of transmitting tacit knowledge increase with distance (Audretsch and Feldman, 1996). There is evidence that knowledge- and technology-based new ventures tend to locate close to universities and corporate research laboratories (Parker, 2009, p. 141; e.g., Audretsch *et al.*, 2006) to benefit from their production of tacit knowledge as well as their graduates. Moreover, a venture's proximity to a university has been shown to speed up the process from start-up to growth and even the event of a stock market listing (Parker, 2009, p. 141).

All in all we expect a positive relationship between the business performance of entrepreneurs and the proximity of universities. Since a tight (positive) relationship has been measured between the number of universities in a region and the share of people with tertiary education levels (Card, 1999) we expect a positive relationship between the performance of entrepreneurs in a region and the share of the population in that region with a higher level of education.

2.2 The demand function for the entrepreneur's product

The entrepreneur's profit depends on her outputs and inputs and their respective prices based on demand and supply (e.g., Zellner *et al.*, 1966). The price the entrepreneur receives for her output Y is –obviously– not only determined by the aggregate supply of the product by entrepreneurs in the market, but also by the demand for the product from consumers (in the region). Consumer

demand is thus also a determining factor of the entrepreneur's performance as measured by profit, although it has often been neglected (Witt, 2001, Buenstorf, 2003):

In the theory of economic growth little notice is usually taken of what is going on in the demand side of the markets in the process of economic growth. (Witt, 2001, p. 23)

Consumer demand is shaped by various characteristics of the consumer population. Consumer wealth (a macro control in our models) has been shown to affect consumer preferences and demand by increasing their preferences for variety (Jackson, 1984). On top of this, consumer education has also been put forth as an important factor affecting preferences for variety and innovative products and services (Witt, 2001). Education, besides experience, develops the consumption knowledge of individuals. 'Individuals' consumption activities are contingent on the state of their subjective knowledge of the consumption technology and may therefore change if their knowledge changes.' (Witt, 2001, p. 28). Thus, as Witt concludes, cognitive learning impacts the evolution of consumption.

More specifically, 'consumption activities change as a result of two kinds of learning. On the one hand, new ways of satisfying innate wants, and, in particular, satisfying them in new combinations, become feasible through cognitive learning. On the other hand, the set of wants which people have is not invariant. Through non-cognitive learning in the form of conditioning that starts from a limited number of innate wants, a structure of subjective wants is formed.' (Witt, 2001, p. 28). Cognitive and non-cognitive learning reinforce each other (Witt, 2001, p. 30 and Cunha and Heckman, 2010). For example, and in line with Witt's reasoning, it may be possible to acquire a want for Iphone applications without knowing much about them. In most cases, 'people with an emerging taste of [a] kind can be observed to start collecting relevant information, and they often develop a highly differentiated knowledge. Indeed, cognitive learning of this kind is the basis of the advanced and most sophisticated consumption technologies of present day economies' (Witt, 2001, p. 29). And in today's highly differentiated consumer markets, 'there is too much information about consumption technology offered to the individual consumer to allow her/him to understand, memorize, or even process all of it.' (Witt, p. 30).

The selective collection of information is required and this is exactly one of the core competencies taught in schools nowadays. Thus, cognitive learning as developed in school has a

direct and an indirect effect on the formation of consumption activities. Both consumer wants and consumption knowledge become more detailed and induce specialization in consumption (Witt, p. 30-31). 'The formation of acquired wants usually adds new elements to already existing combinations of wants.' (Witt, p. 34) and may thereby have a great effect on the demand for innovation. Education also features the desire of individuals to develop an identity and self-image that leads, again, to specific and detailed preferences (Benn, 2004). Preferences for variety or differentiation have a positive effect on business opportunities through the demanded development of new and alternative products and services in new (often niche) markets (Wennekers *et al.*, 2010).

The eminently educated taste and musical skills of the opera lover keep expensive opera houses in business. At the same time, the wants and the secret knowledge of techno fans support an entire industry of scenic discos. (Witt, 2001, p. 34)

We conclude that consumer wants are formed, among others, by the education level of consumers and that higher levels of education lead to more differentiated consumer demand and to a higher level of demand for innovative products and services. As a consequence, business opportunities and performance are affected positively by the demanded development of new and alternative products and services due to a higher educated population. Therefore, we expect a positive relationship between the performance of entrepreneurs in a region and the share of the population in that region with a higher level of education.

2.3 Proposition

Overall we conclude that three mechanisms potentially explain the expected positive relationship between the business performance of entrepreneurs and the share of the (local) population with a higher level of education (besides the effect that the entrepreneur's own education level will affect her business performance positively). First, a higher share of more highly educated individuals in the population will increase the likelihood that entrepreneurs can attract employees with higher levels of education -as they like- and thus grow and prosper with the help of this high quality input into the production process. Second, a higher population share of people with a tertiary education level tends to go together with a higher density of universities, high tech and knowledge intensive firms and thus benefits the productivity and business outcomes of individual entrepreneurs in the region through geographically bounded knowledge spillovers. Third, a

population with a higher education level implies a more differentiated consumer demand and a higher level of demand for innovative products and services. This affects business opportunities and performance positively. Therefore, we expect a positive relationship between business outcomes and the share of the (local) population with a higher level of education. In the next section, we discuss the measurement of business performance, the population education and regions. Based on these definitions, we shall be able to formulate the main proposition more specifically and in an empirically testable manner.

3. Data and Empirical Methodology

3.1 Data source, entrepreneurial performance measures and sample design

The data used are taken from the European Community Household Panel (ECHP). The ECHP is a standardized multi-purpose annual longitudinal survey carried out at the level of the EU-15[1] covering the period 1994-2001. It was centrally designed and coordinated by the Statistical Office of the European Communities (Eurostat). Every year, all members of the selected households in each country are interviewed about demographics, education, labor market status and outcomes. The same questionnaire is used for all countries, which makes the information directly comparable.[2]

From the self-reported annual labor market status information we construct a variable that indicates whether one is an entrepreneur in each of the years.[3] Entrepreneurship is equated to business ownership and a distinction is made between business owners with and without employees. We label entrepreneurs without personnel own-account workers and entrepreneurs with employees employers. We are interested in explaining variations in individual business performance of entrepreneurs. We consider the usual performance measure 'business duration' by measuring the spell in entrepreneurship. Besides, we consider the performance measure

[1] Sweden is excluded from all analyses due to missing values for relevant variables. France and Luxembourg are excluded from our analyses on transitions from own-account worker to employer, and employership survival because relevant data are missing. The Netherlands is also excluded from the analysis of employership survival due to the low number of new employers detected.

[2] See Peracchi (2002) for a review of the organization of the survey, and a discussion of the issues a researcher may face when using these data.

[3] The labor market status is observed once per year. Within-year changes in status are not registered.

'switch from own-account worker to employer'. The third performance measure we analyze is the length of the spell in employership given that an entrepreneur has reached the state of employer.

For the analysis of survival in entrepreneurship or employership, it is important to note that we only consider individuals who first became entrepreneur or employer during our sample period (i.e. in the period 1994-2001), hence we do not have left-censored observations in our sample. This also implies that the number of transitions from own-account worker to employer we identify for the second measure of performance coincides, by definition, with the number of spells in employership we analyze within our third measure. As regards right-censoring, the sample includes both completed entrepreneurship and employership spells and spells that are still in progress at the end of the observation window 1994-2001. These latter spells are treated as right-censored observations.

Our final sample includes solely individuals who have been observed as entrepreneurs in at least one of the years 1994-2001. We restrict the sample further to men and women aged 21 to 59, because we wish to exclude any possible exits out of entrepreneurship due to retirement. The agricultural industries are excluded from the analysis because of structural sector differences with the rest of the economy. Finally, we make the common selection decision to exclude entrepreneurs who only work part-time —that is, those working under 30 hours per week—.[4]

3.2 Methodology

In this paper we follow entrepreneurs over time. Considering our three measures of entrepreneurial performance, we are interested in which variables are associated with individuals' transition probabilities between own-account worker and employer and which variables with survival probabilities within entrepreneurship in general and within employership. In order to study these transition and survival probabilities, binary logit and survival models are used. The data allow us to distinguish between four activity statuses: non-employment (unemployment/inactivity), paid employment, entrepreneurship without personnel (own-account work), and entrepreneurship with personnel (employership).

To study the probability that entrepreneurs start hiring personnel, we estimate binary choice models where the variables to be explained are the transitions from own-account worker to

[4] This is the usual choice (see for instance Hartog *et al.*, 2010b).

employer. To analyze whether entrepreneurs in general and employers remain to be so for a longer time we estimate survival models. For survival in entrepreneurship we apply a competing risk framework where entrepreneurs may exit to the statuses of paid-employment and non-employment. For survival in employership we estimate a single risk model. That is, we do not distinguish between different exit routes of employers (own-account work, paid-employment, non-employment) but combine the exit routes into a single category.[5] For a technical description of these types of models we refer to the Appendix to this paper.

The procedure described above results in three performance measures. Each is used in the empirical analysis to estimate the effect of the share of a (local) population with higher education on the business performance of individual entrepreneurs. In this paper, the 'local' population is considered to be a country. Even though countries within the EU-15 differ in size, countries are still a natural demarcation, considering the three mechanisms brought forward in Section 2 that theoretically explain a positive relation between the business performance of entrepreneurs and a population's share of highly educated individuals. In particular, since labor markets and consumer markets are to a large extent domestically oriented, and since knowledge spillovers are constrained by distance and often also by language barriers, we consider the country a natural demarcation for the 'local' population.

Our three measures of entrepreneurial performance are also assumed to be associated with a set of observed characteristics of the individuals. In addition, the impact of the duration of the spell (as entrepreneur or employer) on the exit probabilities is tested, as usual. Finally, because the individuals in the dataset are from different countries and years, various measures of macroeconomic conditions, besides the population's education level, are included as explanatory variables as well.[6]

3.3 Main explanatory variable: Tertiary education

The main explanatory variable of interest in this study is tertiary education at the macro level, observed per country *j* and per year *t*. The empirical measure of tertiary education that we use is the gross enrolment rate for tertiary education, published by the World Bank in their EdStats

[5] For this exercise we do not use a competing risk model because the number of transitions from employer to non-employment statuses is too low.

[6] For each of the three analyses, Table 5 (Appendix) summarizes the mean values of all variables in our sample, distinguishing by different destination states.

dataset. It is defined as the number of pupils enrolled in tertiary education, regardless of age, expressed as a percentage of the population of the five-year age group following on from the secondary school leaving age.[7] Measures of school enrolment are the usual measures of human capital in macroeconomic research (Krueger and Lindahl, 2001; Hanushek and Woessmann, 2008).

3.4 Control variables

The empirical models include a set of explanatory variables at the individual (micro) level which are known to influence entrepreneurial performance. These are gender (most previous studies observe that female entrepreneurs show significantly higher failure rates and lower job creation rates; see e.g. Taylor, 1999; Boden and Nucci, 2000 and Burke *et al.*, 2002), age and age squared (the relation between age and persistence in entrepreneurship is often found to be non-linear; see e.g. Taylor, 2004 and Block and Sandner, 2009), cohabiting status (being married is associated with a lower likelihood of leaving entrepreneurship; see Georgellis *et al.*, 2007 and Haapanen and Tervo, 2009), the number of (young) children in the household (the empirical evidence regarding the effect of children on entrepreneurship duration is mixed; see Williams, 2004), and relatives working as entrepreneurs (as a proxy for intergenerational transfers of entrepreneurial human capital and ability; see Haapanen and Tervo, 2009). Besides, the education level of the respondents is included as well (education is found to be strongly associated with entrepreneurial success; see e.g. Bates, 1990; Brüderl *et al.*, 1992; Cooper *et al.*, 1994; Robinson and Sexton, 1994; Kangasharju and Pekkala, 2002; Barringer *et al.*, 2005; Saridakis *et al.*, 2008; Van der Sluis *et al.*, 2008; Block and Sandner, 2009; Van Praag *et al.*, 2009a; Baptista *et al.*, 2011 and Hartog *et al.*, 2010b). All these micro level variables are taken from the ECHP. For a more extensive literature review of the role of these variables in determining entrepreneurial performance, we refer to Parker (2009) and Millán *et al.* (2011).

We also include several determinants at the macro level. First, we include (real) GDP per capita. This variable may have a negative impact on the *number* of entrepreneurs as the 'safe' wage earnings increase with economic development (Lucas, 1978). However, insofar a higher level of economic development is associated with a labor force with higher entrepreneurial ability levels, GDP per capita may be associated positively with the *quality* of entrepreneurs, and hence with

[7] The gross enrolment rate for secondary education is defined analogously.

entrepreneurial performance. Second, we include the unemployment rate that varies per country and year. This variable may be negatively associated with entrepreneurial performance, as it increases necessity entrepreneurship but decreases opportunity entrepreneurship (Thurik *et al.*, 2008). Also unemployment is likely to impact survival chances, as it is an indicator of the demand for products and services. Third, we include the variable Rule of Law. This variable describes the 'rules of the game' in societies, including rules relevant to entrepreneurs such as the extent of patent protection and intellectual property rights.[8] On the one hand, these rules enhance (formal sector) entrepreneurship, on the other hand it may be argued that these rules favor bigger firms which have legal departments capable of exploiting narrowly defined 'rules of the game' (Hartog *et al.*, 2010a). Fourth, we include the share of services in the economy.[9] As capital requirements in services are lower, a high share of services may favor entrepreneurship (Audretsch *et al.*, 2002). However, not only entry levels may be higher in the services sector, but also exit levels, since entry and exit levels are strongly correlated (Geroski, 1995). Fifth, next to tertiary education enrolment we also include secondary education enrolment. In highly developed, knowledge-based economies the importance of secondary education for economic performance may be smaller compared to tertiary education (Vandenbussche *et al.*, 2006). By including both secondary and tertiary education in the models, these assumed differences can be tested empirically.

Regarding data sources of the macro level variables, GDP per capita and standardized unemployment rates are taken from OECD sources.[10] The variable Rule of Law is taken from the World Bank Worldwide Governance Indicators (WGI) data base (see Kaufmann *et al.*, 2009), while the variable share of services is derived from OECD Labour Force Statistics. Gross secondary and tertiary enrolment rates are taken from the World Bank EdStats data base.

4. Results

[8] The World Bank includes in this time-varying index several indicators that measure the extent to which agents have confidence in and abide by society's rules. These include perceptions of the incidence of crime, the effectiveness and predictability of the judiciary, and the enforceability of contracts. Together, these indicators measure the success of a society in developing an environment in which fair and predictable rules form the basis for economic and social interactions and, importantly, the extent to which property rights are protected (Kaufmann *et al.*, 2009).

[9] This variable measures the share of services (broadly defined) in total employment. It contains the sectors of Wholesale and retail trade, restaurants and hotels; Transport, storage and communication; Finance, insurance, real estate and business services; and Community, social and personal services.

[10] National Accounts and Main Economic Indicators; in case of missing data supplemented by information from OECD Labour Force Statistics.

As explained in Section 3, the hypothesized positive effect of the share of a (local) population with higher education on the business performance of entrepreneurs is tested by means of binary logit and survival models. The estimation results are presented in Tables 1 to 3, where each table corresponds to one of the three measures of entrepreneurial performance. Each of the three tables contains four model variants. Model (I) only includes the explanatory variables at the micro level. Model (II) also includes country dummies, as a simple way to account for structural differences between countries (in terms of different transition or survival probabilities). Country dummies provide insight in the existence of structural differences between countries but they do not explain why countries differ. Therefore, models (III) and (IV) also include macroeconomic variables. Our main variable of interest, the gross tertiary enrolment rate, is only included in the fourth variant in order to facilitate evaluating the separate impact of including this variable in the model. This fourth variant also includes the secondary enrolment rate. As the macroeconomic variables mainly capture variations between countries (and vary less strongly over time), models (III) and (IV) do not include country dummies.

We present our results in the following manner: at the top of Tables 1 to 3, the number of observations and, spells or transitions involved, are reported. Below, each specification shows corresponding predicted probabilities for sample means of continuous and discrete explanatory variables. Each specification is presented in a two-column format, where marginal effects (and not coefficients) and t-statistics are reported. In addition, to be able to interpret the magnitude or strengths of the relationships between the independent variables and the dependent, continuous variables have been standardized.

4.1 Entrepreneurship survival

Table 1 presents the estimation results of our competing risk model for survival in entrepreneurship. The two 'risks' considered are exit to paid-employment and exit to non-employment (unemployment or inactivity). Regarding gender, we see that male entrepreneurs are more likely than females to switch to paid-employment but less likely to switch to non-employment. Table 1 also shows that having young children makes it more difficult to run a business as it increases the chance to switch to non-employment. On the other hand, having relatives working as entrepreneurs increases the chances of survival indicating that these relatives might transfer their entrepreneurial human capital and ability. Regarding education at the

individual level, entrepreneurs with secondary or university level education have lower chances to end up in unemployment or inactivity, compared to those with only primary education. Interestingly, education does not influence transitions to paid-employment suggesting that among higher educated individuals entrepreneurship is not considered more attractive than paid-employment. As usual in hazard models for entrepreneurship, the duration dependence variable negatively affects the probability of switching. The longer someone is entrepreneur, the bigger the chance that he or she continues in this state.

Concerning the macro level variables, a higher enrolment rate in tertiary education decreases the probabilities of switching to paid-employment or non-employment, i.e. it increases survival chances of entrepreneurs. Our main proposition is thus supported by this first measure of entrepreneurial performance. Interestingly, regarding the risk of switching to paid-employment, secondary education enrolment does not influence survival chances in entrepreneurship suggesting that the benefits for entrepreneurs of a higher educated population as proposed in Section 2 apply only to tertiary education enrolment. GDP per capita relates positively to the survival chances of entrepreneurs. Thus, in higher developed countries, those individuals that do opt for entrepreneurship have higher survival chances. This may suggest that circumstances for entrepreneurs are better in higher developed countries, possibly because demand for new products and services is higher as a result of higher consumer wealth (Jackson, 1984). The negative association between the unemployment rate and entrepreneurship survival which is also reported in Table 1 can be explained along the same line of reasoning: In countries with higher unemployment rates, circumstances to run businesses are less benign. The positive sign of the variable Rule of Law (i.e. negative impact on survival) suggests that in countries with narrowly defined 'rules of the game' entrepreneurship is less attractive. Sector structure also impacts entrepreneurship survival when exits to non-employment are considered whereas exits to paid-employment are not affected.

-Insert Table 1 about here-

4.2 From own-account worker to employer

Table 2 deals with transitions from own-account worker to employer. What determines whether or not entrepreneurs working on their own account start recruiting employees? We see that males more often than females employ other people, consistent with the stylized fact in the literature

that male entrepreneurs run larger businesses (Verheul, 2005). Living together with a partner also increases the probability of employing personnel, possibly because the partner provides financial and moral support to the entrepreneur, which makes it easier to bear the risk associated with employing personnel. Again we find that the presence of relatives working as entrepreneurs might result in intergenerational transfers of human capital and ability, this time in favor of the decision to hire employees. The table also shows that the education level of the entrepreneur is an important determinant of switching from own-account worker status to the status of employer.

Concerning the macro level variables, the result that stands out is the strong positive effect of the tertiary enrolment rate. Our main proposition is strongly supported for this second measure of entrepreneurial performance. Per capita income has a negative impact, which may be explained by the Lucas (1978) hypothesis: Higher per capita income implies higher wages and thus higher wage costs. The negative effect of unemployment indicates that recessions are not a good time to start hiring personnel as demand for products and services is low. The sign of Rule of Law is negative. Apparently when there are relatively many rules in society entrepreneurs are hesitant to hire people. A big services sector is associated negatively with transitions to employership. This may reflect the lower scale of operations in services, reducing the need to hire personnel.

-Insert Table 2 about here-

4.3 Employership survival

Table 3 presents the results for survival in employership. This exercise uses the subsample of those entering employership from own-account work within the sample period 1994-2001. This exercise is particularly relevant because employers provide jobs. Hence one wants to know what determines whether employers keep providing these jobs. We see that males are less likely to switch to another labor force status, i.e. they are more likely to survive as an employer. We also find a negative non-linear impact of age on exits from employership where the turning point is reached at roughly the age of 42, indicating that past this age, people become more likely to opt out of this state. We also see that a higher education level of the employers increases their chances to survive. In line with previous results, the presence of relatives working as entrepreneurs makes employership survival more likely.

Concerning macro-level variables, we see that the tertiary education enrolment rate significantly increases survival chances of employers. Again, our main proposition is supported for this third measure of entrepreneurial performance. For secondary education this is not the case. Hence, in modern economies it is specifically participation in tertiary education, which creates an environment where entrepreneurs can perform well. Per capita income has a negative sign suggesting that in higher developed countries it is easier for employers to continue employing personnel. Unemployment has a positive sign indicating that in times of recession jobs are lost and hence that some employers can no longer provide jobs for their employees. Consistent with results in the other tables, Rule of Law decreases survival chances. Finally, consistent with Table 2, a large services sector reduces employer survival.

-Insert Table 3 about here-

4.4 Summary of main results

The main results from Tables 1 to 3 can be summarized as follows. A population's level of participation in tertiary education has a major positive impact on all aspects of entrepreneurship performance: It increases survival chances of entrepreneurs in general and employers in particular, while the impact on the probability of own-account workers to start employing personnel is particularly strong. The analysis also clearly indicates that in modern (EU-15) economies it is tertiary education rather than secondary education, which positively influences the environment in which entrepreneurs can flourish. The above-mentioned results for tertiary education at the macro level are independent of those for the education level of the respondents themselves.

5. Conclusions

Human capital obtained through education has been shown to be one of the strongest drivers of entrepreneurship performance, irrespective of the measure of the entrepreneur's performance. However, the human capital of the entrepreneur herself is only one of the input factors into the production process of her venture. The value of other input factors, such as (knowledge) capital and labor is likely to be affected by the education level of the possible stakeholders in the entrepreneur's venture, such as consumers and employees. Based on this reasoning, we formulate

and empirically test the following proposition: *The performance of an entrepreneur is not only affected positively by her own education level but in addition, also by the share of highly educated individuals in the (local) population*. The proposition is tested using several measures of individual's entrepreneurship success, including survival, the probability that an entrepreneur starts employing personnel and the duration that an entrepreneur remains an employer. The empirical results presented in this paper provide a novel perspective on the relationship between education and entrepreneurship.

We find strong and unambiguous support for a positive relationship between enrolment rates in tertiary education and all measures of an individual's entrepreneurship success. In other words, we obtain evidence that the population distribution of education is a driver of individual entrepreneurship performance, which may be policy relevant in a contextual framework where many European countries have started to convert policy measures that were aimed at just developing more entrepreneurship to increasing the quality of the stock of entrepreneurs. Thus, educational policies may be viewed as an additional instrument to develop high quality entrepreneurial businesses. In line with this, an education system that results in a higher share of people with tertiary education levels will produce more productive entrepreneurs together with more productive employees where the latter will benefit the former and vice versa. Therefore, the novel implication of our result, if anything, lies in the fact that the education level of the population can be viewed and used by policymakers as a direct route to develop high quality entrepreneurship irrespective of the labor market choices that these educated people make (i.e., entrepreneurship versus wage employment).

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TABLES

Table 1. Survival model: Departure from entrepreneurship.
-Competing risk model: Exits to paid-employment vs. Exits to unemployment and inactivity-

	Prob [$T^{SE} = j \mid T^{SE} > j\text{-}1$]			
Number of observations	11,767			
Number of spells	5,349			
Number of censored spells	3,537			
Log likelihood	-5817.1	-5713.2	-5765.6	-5744

	RISK 1: EXITS TO PAID-EMPLOYMENT							
Number of completed spells	1,152							
Exercise	**(I)**		**(II)**		**(III)**		**(IV)**	
Predicted probability (y)	0.0892		0.0844		0.0882		0.0879	
Variables	**dy/dx**	**t-stat.**	**dy/dx**	**t-stat.**	**dy/dx**	**t-stat.**	**dy/dx**	**t-stat.**
Demographic characteristics								
Female	-0.0257	-4.72***	-0.0243	-4.69***	-0.0256	-4.76***	-0.0253	-4.71***
Age	-0.0178	-0.81	-0.0129	-0.62	-0.0162	-0.74	-0.0135	-0.62
Age (squared)	0.0118	0.53	0.0075	0.35	0.01	0.45	0.0076	0.34
Cohabiting (1)	-0.0124	-1.68*	-0.0109	-1.54	-0.0127	-1.72*	-0.0123	-1.66*
Number of children under 14	-0.0011	-0.36	-0.0001	-0.02	-0.0008	-0.27	-0.0008	-0.28
Relative(s) working as entrepreneurs	-0.0175	-3.07***	-0.0203	-3.74***	-0.0175	-3.05***	-0.0168	-2.91***
Education								
Secondary education (2)	-0.0097	-1.61	0.002	0.32	-0.0078	-1.29	-0.006	-0.97
Tertiary education (2)	0.0066	0.99	0.0131	1.86*	0.0067	0.98	0.0102	1.46
Macroeconomic variables								
GDP per capita					-0.0143	-4.31***	-0.0148	-4.66***
Unemployment rate					0.0093	3.37***	0.0118	4.32***
Rule of law (from -2.5 to 2.5)					0.0124	3.58***	0.0148	3.67***
Services sector share					-0.0002	-0.07	-0.0015	-0.55
Enrolment on secondary education rate							0.0026	0.82
Enrolment on tertiary education rate							-0.0125	-4.48***
Duration dependence								
Job tenure as entrepreneur (in logs)	-0.0425	-15.2***	-0.0394	-14.41***	-0.0395	-13.73***	-0.0374	-12.83***
Country dummies	No		Yes		No		No	
Reference categories: (1) Non-cohabiting individuals, (2) No education or primary education								

	RISK 2: EXITS TO UNEMPLOYMENT AND INACTIVITY							
Number of completed spells	660							
Exercise	**(I)**		**(II)**		**(III)**		**(IV)**	
Predicted probability (y)	0.0392		0.0365		0.0375		0.0366	
Variables	**dy/dx**	**t-stat.**	**dy/dx**	**t-stat.**	**dy/dx**	**t-stat.**	**dy/dx**	**t-stat.**
Demographic characteristics								
Female	0.0629	11.94***	0.0574	11.44***	0.0605	11.77***	0.0585	11.63***
Age	-0.0614	-5.06***	-0.0585	-5.08***	-0.0598	-5.07***	-0.0583	-5.03***
Age (squared)	0.0754	6.32***	0.0710	6.24***	0.0728	6.26***	0.0707	6.19***
Cohabiting (1)	-0.0053	-1.19	-0.0035	-0.84	-0.0037	-0.86	-0.0034	-0.81
Number of children under 14	0.0047	2.69***	0.0042	2.6***	0.0038	2.25**	0.0039	2.37**
Relative(s) working as entrepreneurs	-0.0101	-3.19***	-0.0084	-2.75***	-0.0089	-2.84***	-0.0081	-2.63***
Education								
Secondary education (2)	-0.0086	-2.5**	-0.0097	-2.81***	-0.0076	-2.26**	-0.0095	-2.85***
Tertiary education (2)	-0.0138	-3.88***	-0.0192	-5.87***	-0.0155	-4.57***	-0.0157	-4.7***
Macroeconomic variables								
GDP per capita					-0.0019	-0.97	-0.0044	-2.26**
Unemployment rate					0.0096	6.04***	0.0118	7.17***
Rule of law (from -2.5 to 2.5)					0.008	3.92***	0.0156	6.01***
Services sector share					0.009	5.65***	0.0078	4.88***
Enrolment on secondary education rate							-0.0085	-3.71***
Enrolment on tertiary education rate							-0.0033	-2.48**
Duration dependence								
Job tenure as entrepreneur (in logs)	-0.0227	-12.8***	-0.0219	-12.98***	-0.0203	-11.49***	-0.0198	-11.23***
Country dummies	No		Yes		No		No	
Reference categories: (1) Non-cohabiting individuals, (2) No education or primary education								

Notes: *** denotes significance at the 1% level; ** denotes significance at the 5% level; * denotes significance at the 10% level.

Table 2. Transitions from own-account worker to employer

	Prob [EMP_t | OA_{t-1}]							
Number of observations	14,075							
Number of transitions	2,113							
Exercise	**(I)**		**(II)**		**(III)**		**(IV)**	
Predicted probability (y)	0.1371		0.1244		0.1345		0.1203	
Variables	**dy/dx**	**t-stat.**	**dy/dx**	**t-stat.**	**dy/dx**	**t-stat.**	**dy/dx**	**t-stat.**
Demographic characteristics								
Female	-0.031	-4.54***	-0.0296	-4.88***	-0.0313	-4.61***	-0.034	-5.29***
Age	0.0065	0.23	-0.0102	-0.41	-0.008	-0.29	-0.0203	-0.75
Age (squared)	-0.0207	-0.73	-0.0047	-0.19	-0.0045	-0.16	0.0052	0.19
Cohabiting (1)	0.0213	2.52**	0.022	2.94***	0.0206	2.46**	0.0195	2.43**
Number of children under 14	-0.0022	-0.61	-0.0031	-0.96	-0.0005	-0.15	0.0001	0.04
Relative(s) working as entrepreneurs	0.0653	7.59***	0.0437	5.85***	0.0566	6.7***	0.0393	4.94***
Education								
Secondary education (2)	0.0269	3.45***	0.0146	1.97**	0.0394	4.85***	0.0169	2.21**
Tertiary education (2)	0.0177	2.01**	0.0285	3.22***	0.0412	4.2***	0.021	2.31**
Macroeconomic variables								
GDP per capita					-0.0043	-1.05	-0.0185	-4.56***
Unemployment rate					-0.0115	-3.47***	-0.0254	-6.95***
Rule of law (from -2.5 to 2.5)					-0.0295	-6.96***	-0.0375	-6.46***
Services sector share					-0.02	-5.77***	-0.0176	-5.08***
Enrolment on secondary education rate							-0.0298	-6.31***
Enrolment on tertiary education rate							0.062	17.21***
Country dummies	No		Yes		No		No	
Reference categories: (1) Non-cohabiting individuals, (2) No education or primary education								
Log likelihood	-5880.1		-5690.8		-5833.2		-5656.6	

Notes: *** denotes significance at the 1% level; ** denotes significance at the 5% level; * denotes significance at the 10% level.

Table 3. Survival model: Departure from work as employer
-Single risk model: Exits to own-account work, paid-employment, unemployment and inactivity-

	Prob [$T^{EMP} = j \mid T^{EMP} > j-1$]							
Number of observations	3,892							
Number of spells	2,110							
Number of censored spells	1,266							
Number of completed spells	844							
Exercise	**(I)**		**(II)**		**(III)**		**(IV)**	
Predicted probability (y)	0.1984		0.1857		0.1829		0.1821	
Variables	**dy/dx**	**t-stat.**	**dy/dx**	**t-stat.**	**dy/dx**	**t-stat.**	**dy/dx**	**t-stat.**
Demographic characteristics								
Female	0.0401	2.39**	0.0451	2.7***	0.0447	2.69***	0.0481	2.86***
Age	-0.1565	-2.77***	-0.1361	-2.47**	-0.1453	-2.66***	-0.1263	-2.3**
Age (squared)	0.1576	2.76***	0.1371	2.47**	0.1475	2.67***	0.1312	2.37**
Cohabiting (1)	-0.0383	-1.79*	-0.0354	-1.71*	-0.0366	-1.77*	-0.0388	-1.85*
Number of children under 14	0.0086	1.15	0.0042	0.57	0.0063	0.88	0.0065	0.89
Relative(s) working as entrepreneurs	-0.0584	-4.34***	-0.0658	-5.06***	-0.0562	-4.34***	-0.0528	-4.03***
Education								
Secondary education (2)	-0.0411	-2.84***	-0.032	-2.1**	-0.0418	-2.94***	-0.0362	-2.49**
Tertiary education (2)	-0.0139	-0.85	-0.0243	-1.47	-0.0322	-2.06**	-0.0296	-1.87*
Macroeconomic variables								
GDP per capita					-0.1042	-9.79***	-0.1025	-9.61***
Unemployment rate					0.0433	6.52***	0.0582	7.93***
Rule of law (from -2.5 to 2.5)					0.1138	10.08***	0.1322	10.53***
Services sector share					0.0213	2.9***	0.0222	2.93***
Enrolment on secondary education rate							0.0099	1.1
Enrolment on tertiary education rate							-0.0396	-4.97***
Duration dependence								
Job tenure as employer (in logs)	-0.0865	-11.94***	-0.0728	-10.13***	-0.0625	-8.48***	-0.059	-7.75***
Country dummies	No		Yes		No		No	
Reference categories: (1) Non-cohabiting individuals, (2) No education or primary education								
Log likelihood	-1,932		-1,864.8		-1,844.1		-1,831.2	

Notes: *** denotes significance at the 1% level; ** denotes significance at the 5% level; * denotes significance at the 10% level.

Appendix

The first part of this appendix, subsection A.1, focuses on the econometric framework used to study the decisions of own-account workers to hire personnel (i.e. transitions from own-account worker to employer). The second part of this appendix, subsection A.2, deals with the empirical framework used to study survival within a particular spell as an entrepreneur. To this aim, a competing risks framework is proposed in order to distinguish between the various routes out of entrepreneurship: paid-employment and non-employment (unemployment or inactivity). In addition, the single risk framework concerning the survival within employership is also reported. Finally, the last part of this appendix, subsection A.3, includes variable definitions and descriptive statistics for each of the three analyses.

A.1 Analysis of transitions

The probability of switching from the starting status (own-account worker) to the final status (employer) is assumed to depend on a set of individual characteristics and economic variables, *X*, observed at time *t-1*. Thus, an individual *i* who is own-account worker at time *t-1* will be observed as employer at time *t* if the utility derived from his new role as employer exceeds that obtained from own-account work. Consequently, the probability of switching can be written as:

$$\Pr\left(Y_{i,t}=1\right)=\Pr\left(U_{i,t}^{Emp}>U_{i,t}^{OA}\;\middle|\;U_{i,t-1}^{Emp}\le U_{i,t-1}^{OA}\right)=F\left(\beta' X_{i,t-1}+u_i\right)$$

where $Y_{i,t}$ = 1 if the individual who was own-account worker in period *t-1* becomes employer in period *t*, and $Y_{i,t}$ = 0 if the individual continues as own-account worker in period *t*. The vector $X_{i,t-1}$ represents individual characteristics and economic conditions in the year prior to moving into the new status, β is the associated vector of coefficients to be estimated, u_i is a disturbance term that includes the time-invariant unobserved heterogeneity (the person-specific effect)[11], and $F(\cdot)$ is specified as the logistic cumulative distribution function.[12]

[11] Following usual conventions, we model random individual effects and assume this term as a normally distributed random variable with mean 0 and variance u_n and independence with all observable characteristics.

[12] The same process has been repeated using a probit and a complementary log-log specification of *F*(.). These estimations do not alter our empirical conclusions in any significant way.

A.2 Survival analysis[13]

Due to the nature of our data (survival spells are recorded in *years* –i.e. we have grouped duration data–), discrete time specifications are considered. The length of the spell, T, is therefore assumed to be a discrete random variable.

A.2.1 Single risk model: survival as employer

We observe an individual *i's* spell from period *k*=1 through to the end of the j^{th} period, at which point individual *i's* spell is either complete $(c_i = 1)$ or right censored $(c_i = 0)$. The discrete hazard is

$$h_{ij} = \Pr\left(T_i = j \,|\, T_i \geq j\right),$$

where h_{ij} is the probability of being employer for exactly *j* years relative to the group of individuals who have been employer for at least *j* years.

The parametric model considered is a logistic hazard of the form

$$h_{ij} = Pr\left(T_i = j \,|\, T_i \geq j, x_{ij}, u_i\right) = F\left(ln(j) + \beta' x_{ij} + u_i\right)$$

where x_{ij} is a vector of conditioning variables, strictly exogenous (time-varying covariates); u_i is a disturbance term that includes the time-invariant unobserved heterogeneity (the person-specific effect)[14]; and $ln(j)$ captures duration dependence. Finally, F denotes the logistic cumulative distribution function.

Therefore, the likelihood contribution of a censored spell is given by:

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[13] This section draws especially on the *Stephen P. Jenkins' Lecture Notes* corresponding to the course *Survival Analysis* by Stephen P. Jenkins, provided by the University of Essex Summer School, among other universities and institutions.

[14] As before, we model random individual effects and assume this term as a normally distributed random variable with mean 0 and variance u_u and independence with all observable characteristics. This random effects correction also addresses the issue of repeated spells as an employer, which is relatively small in our sample (186 repeated spells over a total of 2,110 spells).

$$L_i = Pr(T_i > j) = S_i(j) = \prod_{k=1}^{j}(1 - h_{ik}) ,$$

while the contribution to the likelihood function of a complete spell is

$$L_i = Pr(T_i = j) = h_{ij}S_i(j-1) = \frac{h_{ij}}{1-h_{ij}}\prod_{k=1}^{j}(1 - h_{ik}) .$$

Thus, the likelihood for the whole sample is:

$$L_i = \left(\frac{h_{ij}}{1-h_{ij}}\right)^{c_i}\prod_{k=1}^{j}(1 - h_{ik}) = \left(\frac{h_{ij}}{1-h_{ij}}\right)^{c_i} S_i(j) .$$

A.2.2 Competing risks model: entrepreneurship survival

We consider the possibility of exit from entrepreneurship to one of the two following destination states: paid-employment and non-employment (unemployment or inactivity). Our reference category is the group of censored observations, as usual.[15] With the assumption of independence of the destination-specific hazard rates, the discrete hazard rate for exit at time *j* to any of the two destinations is simply the sum of the destination-specific discrete hazard rates:

$$h_{ij} = h_{ij}^{PE} + h_{ij}^{NE}$$

where h_{ij}^{PE} and h_{ij}^{NE} are the hazard rates of experiencing a transition from entrepreneurship to paid-employment and non-employment, respectively. Thus, there are three types of likelihood contributions for the discrete time model, the first one referring to the censored case and the other two corresponding to the different exits.

Therefore, the likelihood contribution of a censored spell is given by

[15] For persons with censored spells, all observations are censored; for persons with a completed spell, all observations are censored except the final one.

$$L_i^C = S_i(j)$$

while for $m = PE$ and NE the contributions to the likelihood function of a complete spell are:

$$L_i^m = \frac{h_{ij}^m}{1-h_{ij}} \prod_{k=1}^{j} (1-h_{ik}) = \frac{h_{ij}^m}{1-h_{ij}} S_i(j)$$

and the likelihood for the whole sample is:

$$L_i = \left(\prod_m (L_i^m)^{\delta^m} \right) (L_i^C)^{1-\sum_m \delta^m} = \left(\prod_m \left(\frac{h_{ij}^m}{1-h_{ij}} \right)^{\delta^m} \right) \prod_{k=1}^{j} (1-h_{ik})$$

where δ^m is a destination-specific censoring indicator that equals 1 if individual *i* exits to state *m* and 0 otherwise (exit to another destination or censored).

We assume a particular form for the destination-specific hazards:

$$h_{ik}^m = \frac{exp(\beta_m' X_{i,k-1})}{1 + \sum_m exp(\beta_m' X_{i,k-1})}$$

For the given hazard rate described above, the individual worker's likelihood contribution has the same form as the likelihood of a standard multinomial logit model (Allison, 1982).[16] Regarding

[16] The multinomial logit model imposes the assumption of independence from irrelevant alternatives (IIA), which implies that the probability of choosing between two outcomes is not affected by the characteristics of the other alternatives. In this regard, McFadden (1974) argued that multinomial logit models should be used only in cases where the alternatives can plausibly be assumed to be distinct and weighted independently in the eyes of the decision maker. In our view, the assumption of IIA in the context of our analysis is reasonable. In addition, Table 4 reports the results of a set of Wald and Likelihood Ratio tests used to examine the null hypothesis that the coefficients of the alternatives do not differ significantly from each other for all possible combinations. In both tests, none of the categories should be combined because the null hypothesis is rejected. Therefore, the multinomial logit specification seems to be appropriate.

the multinomial logit specifications, standard errors are adjusted for intra-individual correlation in order to control for the possible existence of unobserved heterogeneity.[17]

Results of statistical tests for the competing risk model

Table 4. Chi-squared tests for multinomial logit specifications

Wald and LR tests for combining outcomes H_0: All coefficients except intercepts associated with given pair of outcomes are 0 (i.e., categories can be collapsed).				
Wald test	**(I)**	**(II)**	**(III)**	**(IV)**
Combining paid employment & non-employment	295.236 (0.00)	376.381 (0.00)	318.849 (0.00)	329.673 (0.00)
Combining paid-employment & entrepreneurship	268.857 (0.00)	340.908 (0.00)	309.675 (0.00)	330.278 (0.00)
Combining non-employment & entrepreneurship	500.273 (0.00)	574.742 (0.00)	550.889 (0.00)	565.119 (0.00)
Likelihood Ratio test	**(I)**	**(II)**	**(III)**	**(IV)**
Combining paid employment & non-employment	316.982 (0.00)	415.288 (0.00)	344.564 (0.00)	357.358 (0.00)
Combining paid-employment & entrepreneurship	307.668 (0.00)	416.301 (0.00)	351.02 (0.00)	370.419 (0.00)
Combining non-employment & entrepreneurship	560.822 (0.00)	660.473 (0.00)	626.141 (0.00)	652.23 (0.00)

Note: p-values are shown in parentheses.

A.3 Variable definitions and descriptive statistics

Variable definitions are reported below.

Dependent variables

Survival as entrepreneur	Dependent variable equals 1 for individuals who are entrepreneur in period *t-1* and enter paid-employment in period *t*. The variable equals 2 for individuals who are entrepreneur in period *t-1* and enter unemployment or inactivity in period *t*. Finally, the variable equals 0 for individuals who are entrepreneur in periods *t-1* and *t*, or the information about the labor market status in *t* is censored.
Transition from own-account work to employer	Dependent variable equals 1 for individuals who are own-account worker in period *t-1* and become employer in period *t*. The variable equals 0 for individuals who are own-account worker in periods *t-1* and *t*.
Survival as employer	Dependent variable equals 1 for individuals who are employer in period *t-1* and exit employership in period *t*. The variable equals 0 for individuals who are employer in periods *t-1* and *t*, or the information about the labor market status in *t* is censored.

Demographic characteristics

Female	Dummy equals 1 for females.
Age	Age reported by the individual.
Cohabiting	Dummy equals 1 for cohabiting individuals.
Number of children under 14	Number of children younger than 14 living within the household.
Relative(s) working as entrepreneurs	Dummy equals 1 if there are any in the household.

Education

No education or primary education (reference category)	Dummy equals 1 for individuals with less than second stage of secondary level education (ISCED 0-2).
Secondary education	Dummy equals 1 for individuals with second stage of secondary level education (ISCED 3).
Tertiary education	Dummy equals 1 for individuals with recognized third level education (ISCED 5-7).

[17] This standard errors correction reflects associations across the spells and, therefore, addresses the issue of repeated spells of entrepreneurship. Let us stress that this issue is relatively small in our sample (384 repeated spells over a total of 5349 spells).

Duration dependence

Job tenure as entrepreneur	Number of years as entrepreneur.
Job tenure as employer	Number of years as employer.

Macroeconomic variables

National GDP per capita	Real GDP per capita expressed in PPP US$ of 1990 (source: OECD).
National unemployment rate	Harmonized annual unemployment rate (source: OECD).
Rule of law	Time-dependent index for the degree of regulation enforcement. This variable ranges from -2.5 to 2.5 (source: World Bank).
Services sector share	Share of services sector in total employment (source: OECD).
Enrolment on secondary education rate	Gross enrolment rate for secondary education (source: World Bank).
Enrolment on tertiary education rate	Gross enrolment rate for tertiary education (source: World Bank).

Table 5. Descriptive statistics for each of the three analyses

	Entrepreneurship survival			Transitions from own-account worker to employer		Employership survival	
Final destination	**Censored**	**Paid-employment**	**Non-employment**	**Observations not switching**	**Observations switching**	**Censored**	**Own-account work/paid or non employments**
Number of spells	3,537	1,152	660			1,266	844
Number of observations				11,962	2,113		
Demographic characteristics							
Females	30.93%	23.78%	56.82%	27.06%	24.37%	23.7%	25.36%
Average age	39.2 years	37.6 years	42.1 years	41.8 years	40.6 years	42.9 years	41.8 years
Cohabiting	74.55%	70.66%	75.91%	81.12%	82.02%	84.44%	81.52%
Number of children under 14	0.66	0.65	0.6	0.69	0.71	0.67	0.7
Relative(s) working as entrepreneurs	31.78%	24.31%	29.7%	23.24%	30.86%	36.89%	28.2%
Education							
No education or primary education	41.25%	41.23%	50.76%	49.82%	45.62%	43.21%	46.8%
Secondary education	33.16%	31.08%	28.79%	28.85%	32.61%	34.83%	30.21%
Tertiary education	25.59%	27.69%	20.45%	21.33%	21.77%	21.96%	22.99%
Duration dependence							
Average job tenure as entrepreneur	2.51 years	1.62 years	1.54 years				
Average job tenure as employer						2.12 years	1.43 years
Macroeconomic variables							
National GDP per capita (PPP US$ of 1990)	16,527.1	15,281.2	15,419.3	14,172.7	13,614.1	15,062.4	13,426.6
National unemployment rate	8.29%	9.57%	9.67%	10.10%	10.06%	8.56%	9.87%
Rule of law (from -2.5 to 2.5)	1.315	1.339	1.359	1.331	1.259	1.207	1.251
Services sector share	51.74%	51.18%	53.99%	53.41%	52.67%	52.47%	53.17%
Enrolment on secondary education rate	106.34%	107.25%	105.87%	108.61%	104.98%	104.3%	104.41%
Enrolment on tertiary education rate	53.27%	50.12%	49.92%	49.6%	51.72%	56.62%	53.35%