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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, though, is only one of the input factors into the production process of her venture. 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 and the knowledge spillovers associated with universities that may also influence the entrepreneur's productivity. Based on this, we hypothesize that 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 find empirical support for this hypothesis using an eight years (1994-2001) panel of labor market participants in the EU-15 countries. An implication of our finding is that entrepreneurship and higher education policies should be considered in tandem with each other.

Keywords: entrepreneurship, performance, survival, personnel, (tertiary) education, production function, knowledge spillovers

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1. Introduction

Human capital obtained through education has been shown to be one of the strongest drivers of entrepreneurship performance (cf. the overviews in Unger *et al.*, 2011 and Van der Sluis *et al.*, 2008). Citing the conclusion in Parker's handbook from 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 as 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. 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)?*

We expect that a higher share of people with high levels of education (to be defined more precisely) has a positive impact on the performance of the average entrepreneur. In other words, a population with a higher education level 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 and diverse consumer market. Based on this reasoning, we develop and test the following hypothesis: *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 hypothesis empirically based 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 entrepreneurship outcomes that can be obtained from this data source and that we estimate are (i) the duration of any entrepreneurship spell; (ii) the earnings as an entrepreneur; (iii) the likelihood that any entrepreneur starts employing personnel and thus becomes an employer; and (iv) the duration of 'employership' spells. We append to these data a harmonized set of annual data on national level variables including indicators of educational attainment as well as a set of regional education variables. Thus, 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 (or region) and year of operation, while controlling for other relevant sources of heterogeneity between countries (regions) and over time.

In particular, the availability of *skilled* or *advanced* human capital is important for growth and innovation in developed countries (Czarnitzki and Hottenrott, 2009, Vandenbussche et al., 2006). We therefore employ as our main measure of education a population's share of individuals with *tertiary* education. This is the measure of (skilled) education that is more crucial than the average educational attainment for innovation and endorsing economic growth in developed economies (Hanushek and Woessmann, 2008). A second measure of the education level of the population that we employ, also to avoid a somewhat elitist view, includes the population share of individuals with at least upper secondary education. Thus we measure the population distribution of education in terms of the share of the active population with tertiary (or upper secondary) education in country (or region) *j* and year *t*.

We find support for a positive impact of a population's share of highly educated individuals (in particular those with tertiary education) in country or region *j* and year *t* on the various measures of the performance of individual entrepreneurs in that same country (region) and year. All performance measures studied, i.e., venture survival, earnings and the probability that an entrepreneur starts employing personnel and remains an employer are affected significantly and positively by the share of highly educated individuals.

Our study implies that educational policies may be viewed as an additional instrument to develop high quality entrepreneurial businesses. The appeal of this instrument is that it does not require to 'pick winners' upfront, which is obviously difficult, if not impossible (Shane, 2009). Admittedly,

few policy makers will have doubted the value of education. The contribution 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 hypothesis. Section 3 describes the data and discusses the empirical methodology. 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

The relation between a firm's input and output can be described by means of a production function. As an example, we take the traditional Cobb-Douglas production function which 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. It may be modeled 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 factors 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 presence and quality of educational and

research institutions, i.e., mainly universities and colleges. These 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 for instance, Bates, 1990; Barringer *et al.*, 2005; Colombo and Grilli, 2005, 2010; Burke *et al.* (2000); Cooper *et al.*, 1994; Davidsson and Honig, 2003; Robinson and Sexton, 1994; Toole and Czarnitzki, 2009; Zarutskie, 2010 and Van Praag *et al.*, 2013, as well as the meta-analyses of Unger *et al.*, 2011 and Van der Sluis *et al.*, 2008).

Schooling is not only acknowledged for its productive effect, as assumed by Mincer, but also for its value as a signal of productive ability in labor markets without complete information (Spence, 1973). This may lead to positive returns to education as well. 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).

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, *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).

The theoretical justification for a positive impact of the human capital of employees on firm performance is probably best rooted in the resource based view of the firm (Wernerfelt, 1984): The competitive advantage of firms is based on the valuable resources at their disposal. Human capital is one of the critical resources in the development of innovations and, ultimately, the creation and maintenance of a competitive advantage (e.g., Barney and Wright, 1998). A substantial share of the human capital of firms resides with the workforce (e.g., Subramaniam and Youndt, 2005) and is obtained through formal education.

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 firms that employ more educated workers are more productive. Both Toole and Czarnitzki (2009) as well as Andries and Czarnitzki (2013) show further evidence of the relationship between the human capital of workers (obtained through, among others, education) and the performance of the firm at the individual firm level. Toole and Czarnitzki (2009) show that specific aspects of the human capital of biomedical scientists developed during their work in academia contributes to firm performance. Andries and Czarnitzki (2013) measure the impact of employees' ideas on small firms' innovative performance, where ideas depend, among others on human capital obtained through formal education and experience. Czarnitzki and Hottenrott (2009) show in a study of Flemish regions that the innovation performance of regions critically depends on the availability of skilled labor. Survey evidence suggests that, in general, small and medium-sized enterprises have difficulties finding and attracting personnel relative to larger firms, 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). Entrepreneurs view the limited availability of highly educated personnel as a severe bottleneck for further growth of their venture (Van Praag *et al.*, 2009). The implied scarcity of highly educated employees in SMEs suggests that those entrepreneurs who are able to attract sufficient numbers of employees with higher levels of education perform better (Haltiwanger *et al.*, 1999).

All in all, we expect that the presence of a higher educated local workforce may increase the competitiveness of firms (as the productivity of labor inputs in the production function is potentially higher) and thereby benefit the performance of (employer) entrepreneurs. Admittedly, a better workforce has little to do with self-employed entrepreneurs who do not employ personnel and their survival. We expect the effect on firm performance to be demonstrated by higher survival chances of firms with personnel as well as a higher likelihood, in general, that firms (start) employ(ing) personnel at all and obtain high incomes.

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' (Audretsch and Feldman, 1996) and they benefit the technological possibilities frontier. Universities are, among others, important sources of knowledge spillovers (for example, Abel and Deitz, 2012; Audretsch and Feldman, 1996). Universities 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; Jaffe et al., 1993). Knowledge spillovers facilitate the innovation efforts of entrepreneurs in the region and thereby their business performance (Colombo et al., 2010). 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. Researchers may also decide to exploit knowledge and diminish the 'knowledge filter' between the creation and exploitation of knowledge by deciding to become entrepreneurs. Entrepreneurship may be one of the main channels through which new economic knowledge can be commercialized (Parker, 2009, p. 74; 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 (Abel and Deitz, 2012). 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).

Universities are not only beneficial to local entrepreneurs because of knowledge spillovers, but also because they can increase the supply of human capital through the education and development of skilled employees that entrepreneurs may employ.[1] Moreover, universities stimulate a skilled environment ('skilled cities') which attracts also other skilled people which benefits entrepreneurs (Berry and Glaeser, 2005).

All in all we expect a positive relationship between the proximity of universities and the business performance of entrepreneurs. Universities benefit local entrepreneurs through two channels. First, they produce R&D whose fruits reach entrepreneurs through knowledge spillovers. Second, universities produce and attract larger shares of more highly educated individuals (Abel and Deitz, 2012; Berry and Glaeser, 2005; Florida et al., 2008), who, in turn, are employed by innovative entrepreneurs in the region where the university is located. We do not measure the proximity of universities directly but instead view our central variable of interest in this paper, a region's share of individuals holding tertiary education, as an indicator for the presence of universities (Card, 1999). We thus expect a positive relationship between the share of the population with tertiary (university) education and the performance of entrepreneurs in a region.

2.2 The demand function for the entrepreneur's product

Consumer demand is also a determining (but often neglected) factor of the entrepreneur's performance, measured by profit (Witt, 2001, Buenstorf, 2003). Consumer demand is shaped by various characteristics of the consumer population. Consumer education has been put forth, besides consumer wealth (Jackson, 1984) as an important factor affecting preferences for variety and innovative products and services (Witt, 2001). Education, besides experience, develops the (subjective) consumption knowledge of individuals (Witt, 2001). Witt concludes that cognitive learning leads to new ways of satisfying innate wants, and, in particular, satisfying them in new combinations. Moreover, the set of wants which people have is not invariant and also affected by non-cognitive learning (Witt, 2001). Cognitive and non-cognitive learning reinforce each other (Witt, 2001; Cunha and Heckman, 2010).

[1] However because university graduates are highly mobile, this effect is probably only seen when the definition of a region is not too narrow (Abel and Deitz, 2012).

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, 2001, pp. 30-31) and may thereby shape the demand for innovation. Education also features the desire of individuals to develop an identity that leads 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).

This may imply 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 will likely be affected positively by the demanded development of new and alternative products and services due to a higher educated (consumer) population.

Interestingly, we can deduce the same relationship between consumer education and consumption diversity on the one hand and entrepreneurial opportunities on the other hand from a separate but well known recent literature: The one on the development of successful cities or regions in the spirit of Florida (Florida, 2000, 2002, 2004, Florida et al., 2008) and Glaeser (Glaeser, 2011; Glaeser and Saiz, 2004; Glaeser et al., 2010). They arrive at this same relationship based on a different underlying mechanism.

The argument starts with the claim that knowledge and human capital have a crucial role in generating economic growth (Florida, 2000, 2002, 2004). Florida (2004) paraphrases Romer to note that "what is important for growth is integration not into an economy with a large number of people, but rather into one with a large amount of human capital" (Florida, 2004, Romer, 1990). This has become even more important in the 'new economy' which is driven by human capital and has even evoked a 'war for talent' (Florida, 2004), whereas initial levels of human capital foster the development of even higher levels of human capital (Berry and Glaeser, 2005). Human capital is highly correlated with Florida's measures of creative class or creative capital (Florida 2002, 2004), whose definition is based on occupational categories. This creative class has been acclaimed by many to be a necessary ingredient of economic development and innovation (e.g., Florida, 2002). It does not only consist of people with high levels of human capital but also

of diverse groups of individuals; diversity is associated with higher rates of innovation and growth (e.g., Florida et al., 2008).

However, high human capital individuals are highly mobile (e.g., Florida 2004, Florida et al., 2008, Glaeser, 2011) and increasingly scarce, in particular in specific sectors such as IT (Florida, 2000). Thus firms and organizations around the globe have become concerned with their ability to develop, attract and retain diverse and high human capital individuals. Attracting (diverse) human capital requires, besides market based forces, i.e., industries and firms that employ human capital, a set of place-based characteristics including diverse bundles of amenities, lifestyle options and a variety of people. Talented people select a place to work not only based on financial criteria but also this kind of place-based characteristics (Florida 2000, Glaeser, 2011). The more diverse options a place can offer to many different contributors of talent and the more open and tolerant it is to new ideas, new people and diversity, the lower its barriers for human capital and the more talent it will capture (Mellander and Florida, 2006). This set of diverse options and the tolerant and open attitude towards diversity and new ideas do not only attract (diverse) human capital, but are also likely to attract and foster (innovative) entrepreneurs and their opportunities (Berry and Glaeser, 2005; Glaeser et al., 2010). We thus expect a positive relationship between the share of the population in a region with a high education level and the performance of entrepreneurs in that region.

2.3 Hypothesis

We have motivated that three mechanisms potentially explain the expected positive relationship between the share of the population with a high (tertiary or upper secondary) education level and the business performance of entrepreneurs. First, a higher share of individuals with high education will increase the likelihood that entrepreneurs can attract employees with high education -as they like- and thus grow and prosper with the help of this input into the production process. Second, a higher share of people with a tertiary education level tends to go together with a higher density of universities which benefits the productivity and business outcomes of individual entrepreneurs through knowledge spillovers. Third, a population with a higher share of individuals with high education implies a more differentiated consumer demand and a higher level of demand for innovative products and services. This affects business opportunities and performance positively. We formulate the following hypothesis:

There is a positive relationship between the share of the population with a tertiary (or upper secondary) level of education in a certain region and year and the business outcomes of individual entrepreneurs in the same region and year.

In the next section, we discuss the measurement of business performance, the population education and regions.

3. Empirical methodology and data

3.1 Data

The panel 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[2] 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 and years (see Peracchi, 2002, for a discussion).

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 (within-year changes are not recorded). Entrepreneurship is equated to business ownership and a distinction is made, on an annual basis, between business owners with and without employees. Entrepreneurs without personnel are labeled own-account workers and those with employees, employers. The data further allow a distinction between non-employment and paid employment. Hence, each individual is observed in a particular year in one of these four labor market statuses.

The sample we use is restricted to individuals who have been observed as entrepreneurs in at least one of the years 1994-2001. We further restrict the sample to men and women aged 21 to 59

[2] 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. In our exercises, the minimum number of countries included is 11, while the number of years is 7 (period 1994-2001). Hence the minimum number of different country-year observations is 77, which is sufficient, considering the number of country-level variables in our model (6).

to exclude any possible exits out of entrepreneurship due to retirement. As usual, the agricultural industries are excluded from the analysis because of structural sector differences with the rest of the economy. Finally, we exclude entrepreneurs from the sample who work part-time (less than 15 hours per week).[3]

3.2 Defining and explaining business performance

We are interested in explaining variations in the business performance of individual entrepreneurs. First, we consider the usual performance measures 'business duration', by measuring the length of the spell in entrepreneurship. Second we employ the variable 'earnings as an entrepreneur' (in natural logarithm). This variable is defined by the self-employment income earned in the year prior to the interview (in euro's of 1996) and made comparable across countries (by a correction based on the Purchasing Power Parity) and over time (by applying the Harmonised Consumer Price Index). Third, we consider the performance measure 'switch from own-account worker to employer'. The fourth performance measure is the length of the spell in employership given that an entrepreneur has reached the state of employer from own-account work. All these measures are constructed using data from the ECHP.

Earnings equations are estimated by means of tobit regressions, while clustering standard errors on individuals.[4] To study the transition probability from own account work (entrepreneur without personnel) to employer (entrepreneur with personnel) a standard binary logit model is estimated. The survival probabilities as entrepreneur (own account worker and employer) and as employer are estimated using survival models. We distinguish two competing exit destinations from the status of entrepreneur: To unemployment/inactivity and to paid employment. The survival model of employership is estimated in a single risk framework, combining all exit routes into a single category.[5] For the estimation of both survival models we use the logistic hazard

[3] The main results are not sensitive to the chosen threshold level. We also performed all analyses using a threshold level of 30 hours/week. This reduced the sample and disproportionally so for female entrepreneurs. The coefficients of the relevant education variables, though, are similar when estimated on this more restricted sample.

[4] We use tobit because a considerable proportion of observations (about 15%) are zeros. In these cases the entrepreneur only earns just enough to cover business expenses. As a robustness check, we estimated the earnings equations using (clustered) OLS and using the between estimator, and estimation results are similar. Since the panel is unbalanced and the average number of observations (years) per individual is low (2.4), panel data estimators such as fixed effects or random effects are not appropriate. Besides, the macroeconomic variables included in our model mainly capture variations between countries, and vary less strongly over time. Therefore we use a class of estimators exploiting mainly the cross-sectional variation in the estimation sample (but controlling for correlation between observations by clustering standard errors on individuals).

[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.

function (as opposed to, for instance, a generalized gamma function)[6] to cope with the discretely measured duration data we have.[7]

By means of these four estimation models we can estimate the effect of the share of a (local) population with tertiary (or secondary) education on the four measures of business performance of individual entrepreneurs. In the main specifications, the 'local' population is considered to be a country's population. Even though countries within the EU-15 differ in size, they are still a natural demarcation, considering the three mechanisms discussed in Section 2 that theoretically explain a positive relation between a population's share of people with tertiary (or secondary) education and the business performance of entrepreneurs. Labor and consumer markets are to a large extent domestically oriented and knowledge spillovers are constrained by distance and often also by language barriers. Nevertheless, we acknowledge that in countries as large as the UK, Germany and France, some types of knowledge spillovers may be exploited by entrepreneurs at a lower, more local geographical level of aggregation than the national level. Therefore, we will also perform our empirical exercises using education indicators at the regional (NUTS-1) level. A limitation of our study is that we implicitly ignore the possibility of cross-border migration of workers where common languages prevail (e.g., Austria and Germany; UK and Ireland; Belgium and France) and that some entrepreneurs may be servicing the needs of non-domestic markets either in part or whole.

3.3 Main explanatory variables: Educational attainment at the macro level

Our main explanatory variable is the share of the active population holding tertiary education, observed per country (region) *j* and year *t*. The empirical measure of tertiary education that we use is published by Eurostat. It is defined as the percentage of the active population from 25 to 64 years with at least first stage of tertiary education. It relates to the UNESCO *International Standard Classification of Education (ISCED)-1997* categories 5 and 6, i.e., from the first stage of tertiary education and onwards.

[6] We use the multinomial logit model when considering two competing hazards, given the discrete values of the choices involved. It assumes that the categories of a model's dependent variable are distinct from each other, i.e., the independence of irrelevant alternatives (IIA). Unfortunately, there is no reliable test for this IIA assumption (see Long and Freese, 2006, and Cheng and Long, 2007). Based on this we rely on the early contributions by McFadden (1974), who argued that MNL 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 similar terms, Amemiya (1981) suggests that the MNL model works well when the alternatives are dissimilar. We assume this is the case here.

[7] The survival analyses only include individuals who first became entrepreneur or employer during the sample period (i.e. in the period 1994-2001). Therefore, there are no left-censored observations. The sample does include right-censored observations, though, besides completed entrepreneurship and employership spells. The right-censored observations are the spells that are still in progress in 2001.

As we motivated earlier, we consider secondary education as an additional determinant of the individual performance of entrepreneurs. Thus, as an alternative to our main predictor described above, we also use the percentage of the active population from 25 to 64 years with at least upper secondary education *(i.e. ISCED-1997* categories 3 to 6). Finally, as mentioned earlier, we also consider both these educational attainment indicators at the regional level (observed at NUTS-1 level). We note though that these regional data are of a somewhat lower quality than the education indicators at the country level, so that results need to be interpreted with care. First, the regional indicators were not available for all years so that we needed to estimate the data for the remaining years. This implies that, for the regional indicators, the cross-regional variation is more reliable than the variation over time. Second, for four (mostly smaller) countries, regional data were not available. In these cases we included the country-level values. Third, the number of observations when estimating with these educational attainment indicators at the regional level is slightly smaller because for some regions there is not a fully correct matching between the regional data offered by Eurostat and regions available in the ECHP data base. Further information about the regions we include in the analysis is available in Table C in the Appendix.

3.4 Control variables

The empirical models include a set of explanatory variables at the individual (micro) level that are known to influence entrepreneurial performance (see Parker, 2009, and Millán *et al.*, 2012, for overviews). Most importantly, we estimate the association between the individual education level of the entrepreneurs and their performance. We distinguish by means of a set of dummy variables secondary and tertiary education levels from primary education. As discussed earlier, we expect a positive association between education and business performance.

In addition, the regression equations include common controls for gender (most previous studies observe significantly higher failure rates for female entrepreneurs, i.e., Boden and Nucci, 2000), age (the relation between age and persistence in entrepreneurship is often found to be non-linear), cohabiting status (associated with a lower likelihood of leaving entrepreneurship), the number of (young) children in the household (where the evidence of the effect on entrepreneurship duration is mixed), and relatives working as entrepreneurs. In addition, we include (in some of the specifications underlying some of the robustness checks) a dummy variable which indicates whether an entrepreneur is active in an 'innovative' sector, i.e., a sector

with above-average R&D-intensity (we refer to Table A of the Appendix for the exact operationalization). Audretsch and Mahmood (1995) find that the exposure of new establishments to risk tends to be greater in highly innovative environments. In the present paper, we are particularly interested in the role of the interaction terms between this dummy and educational attainment at the macro level. Thus, entrepreneurs who are active in more innovative sectors may possibly benefit more from the availability of employees and consumers who are more highly educated. Moreover, they may also be likely to benefit more from knowledge spillovers from universities and knowledge institutes. Finally, the impact of the duration of the spell (as entrepreneur or employer) on the exit probabilities is tested, as usual. These micro level variables are taken from or cretaed by means of the ECHP. Their definitions and descriptive statistics are shown in the upper halves of Tables A and B in the Appendix, respectively.

Besides, we include several measures of macroeconomic conditions as controls in the analyses employing data on multiple countries and years. First, we include (the logarithm of real) GDP per capita. 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 entrepreneurial performance.[8] 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 and decreases opportunity entrepreneurship (Thurik *et al.*, 2008; Román *et al.*, 2011, 2013). 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.[9] The effect of these rules is that the opportunities for (formal sector) entrepreneurship are increased (Nyström, 2008) although the alternative occupational choice, i.e., wage employment, may also become more attractive if a high 'Rule of Law' translates into an environment with better job security. Fourth, we include the share of services in the economy.[10] As capital requirements in services are lower, a high share of

[8] While the level of GDP per capita may be seen as a measure of economic development, growth of GDP per capita may be seen as primarily capturing business cycle effects. We checked if the main results are sensitive to the inclusion of GDP per capita expressed in growth rates (besides the level of per capita GDP or instead of it). They are not.

[9] 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).

[10] 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.

services may favor entry into entrepreneurship, as well as exit, due to the positive correlation between entry and exit levels (Geroski, 1995).

Regarding data sources of the macro level variables, GDP per capita and standardized unemployment rates are taken from OECD sources.[11] 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. The educational attainment variables are taken from Eurostat. The definitions and descriptive statistics of these macro-variables are shown in the bottom halves of Tables A and B in the Appendix, respectively.

4. Results

The estimation results are presented in Tables 1 to 4, where each table corresponds to one of the four measures of entrepreneurial performance. All tables show the results from five model variants. Model (I) serves as a benchmark and only includes the explanatory variables at the micro level and those macroeconomic variables that serve as controls. Models (II) to (V) are used to test the hypothesis by means of our four different measures of educational attainment (covering two dimensions: At least first stage of tertiary education versus at least upper secondary education; and country level versus regional level) at the macro level described in subsection 3.3. Each specification is presented in a two-column format, where marginal effects, expressed in relative terms (with respect to predicted values of dependent variables for sample means), and t-statistics are reported. We discuss the estimates for each of the outcome measures below in separate subsections. For each outcome variable, we first discuss individual variables (education and controls) and then regional/national variables (education and controls). We conclude this section with a summary of these results.

4.1 Entrepreneurship survival

Table 1 presents the estimation results of the competing risk model for survival in entrepreneurship. The two 'risks' considered are exit to paid-employment and exit to non-employment. Regarding education at the individual level, entrepreneurs with secondary or tertiary

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

level of education have lower chances to end up in unemployment or inactivity, compared to those with only primary education. Tertiary education is not associated with transitions to paid-employment. Secondary education though seems to increase the likelihood that an individual remains an entrepreneur when only considering paid employment as an alternative.

The control variables at the individual level paint the usual picture when considering non-employment as the competing risk. Male entrepreneurs are less likely than females to switch to non-employment, while having young children makes it more difficult to run a business as it increases the chance to switch to non-employment. Having relatives working as entrepreneurs increases the chance of survival indicating that these relatives might transfer their entrepreneurial human capital or make their networks and other resources available. A less clear picture results when considering the effects of individual characteristics on the hazard of entrepreneurship relative to paid employment. As usual in hazard models for entrepreneurship, the duration dependence variable affects the probability of switching negatively. The longer someone is entrepreneur, the bigger the chance that he or she continues in this state.

To test our hypothesis, we consider models II to V and focus on the effect of the population's share of individuals with tertiary and/or secondary education in a specific country (region) and year. We see that a higher share of highly educated individuals decreases the probabilities of switching to paid-employment and non-employment, i.e. it increases survival chances of entrepreneurs. These results are considerably stronger when only including individuals with tertiary education in the definition of 'highly educated individuals' than when using a combination of tertiary and secondary education. Considering the three theoretical channels we identified by which a highly educated population may affect an individual's entrepreneurship performance, this result would suggest that mainly knowledge spillovers from universities explain the result (as this channel specifically relates to tertiary education and not to secondary education). We conclude that our hypothesis is not rejected based on this first measure of entrepreneurial performance.

The magnitude of the effects may be understood as follows. As an example, consider the effect of tertiary education in Model II. The marginal effect relative to the exit probability to paid employment (evaluated in the sample means of the independent variables) is -2.83. This means that an increase of 5 percent points in the percentage of the active population holding tertiary

education (for instance, from 20% to 25%) decreases the exit probability to paid employment with 14.15%. Hence, as a result of such an impulse, the predicted exit probability to paid employment would change from 0.0998 (see second row of Table 1) to 0.0853.

We now discuss the coefficients of the control variables at the country level. As expected, GDP per capita relates positively to the survival chances of entrepreneurs. Thus, in higher developed countries, entrepreneurs have higher survival chances, 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 can be explained likewise: 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 (relative to paid employment). 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 Earnings as self-employed

Table 2 shows that entrepreneurs with secondary or tertiary education have higher earnings compared to those holding only primary education. This is consistent with earlier studies that we discussed in the Introduction. Furthermore we see that female entrepreneurs earn less than male entrepreneurs. Entrepreneurs with relatives working as entrepreneurs also have lower earnings (probably due to sharing the income from the same venture).

Regarding educational attainment levels, our hypothesis is rejected when focusing on tertiary education only. However, it is not rejected when the population's share holding at least upper secondary education is considered. According to Model III in Table 2, an increase in the share of population holding at least upper secondary education of 5 percent point (e.g. from 50% to 55%) would increase predicted earnings evaluated in the sample means of the independent variables with 24%. The 24% corresponds to about 2,800 euros of 1996 price level.

Regarding the macro level controls we see that in high Rule of Law countries, self-employment earnings are lower. This may reflect a higher security (and hence attractiveness) of wage jobs in high Rule of Law countries, relative to entrepreneurship.

-Insert Table 2 about here-

4.3 From own-account worker to employer

Table 3 tabulates results for the outcome measure 'transitions from own-account worker to employer'. The education level of the entrepreneur is an important determinant of switching from own-account worker status to the status of employer. Both secondary and tertiary education levels have a positive association with the likelihood of employing personnel.

The coefficients of the control variables at the individual level show the same pattern as in Table 1: Male entrepreneurs are more likely than females to employ personnel (Verheul, 2005), cohabiting and the presence of relatives working as entrepreneurs are both associated with a higher likelihood of hiring employees.

Concerning the macro level variables, the result that stands out is the strong positive effect of the population's share holding tertiary education. Our hypothesis is not rejected for this third measure of entrepreneurial performance. Concerning the magnitude of the effect, results for Model II imply that an increase of 5 percent points in the percentage of the active population holding tertiary education (for instance, from 20% to 25%) increases the predicted probability of switching from own-account worker to employer (evaluated in the sample means of the independent variables) with almost 30%, from 0.1218 to 0.1578.

As for the macroeconomic control variables, Table 3 shows that the coefficients for per capita income vary across specifications. A negative relationship may be explained by the Lucas (1978) hypothesis: Higher per capita income implies higher wages and thus higher wage costs, whereas a positive relationship may indicate that economic circumstances are favorable to expand the business. 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 (and entrepreneurs may even be inclined to become paid employee themselves, as we

saw in Table 1). 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 3 about here-

4.4 Employership survival

Table 4 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. The table shows that employers with higher levels of education, both (upper) secondary and tertiary, are more likely to survive as employers.

Also for this performance measure, the results are consistent with a positive effect of the population's share holding tertiary education on individual performance. In this exercise the difference between tertiary and secondary education is somewhat less clear-cut though (in particular when the regional indicators are considered). Concerning the magnitude of the effect, results for Model II imply that an increase of 5 percent points in the percentage of the active population holding tertiary education (for instance, from 20% to 25%) decreases the predicted probability of exiting employership (evaluated in the sample means of the independent variables) with 11.65%, from 0.1864 to 0.1647.

For the individual controls, male employers have a higher likelihood to survive as employers than females, and entrepreneurs with relatives working as entrepreneurs have higher probabilities of surviving in employership. Concerning macro-level variables, 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.

- Insert Table 4 about here -

4.5 Summary of main results

The main results from Tables 1 to 4 can be summarized as follows. A population's share of highly educated individuals has a positive impact on all measures of individual 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. Besides, entrepreneurs in countries (regions) with higher educated populations enjoy higher earnings. The results are similar when using regional education data to these obtained using national education data. Most of our analyses indicate that in modern (EU-15) economies it is particularly tertiary education that feeds the environment in which entrepreneurs flourish. However, for earnings we find that both (upper) secondary and tertiary education contribute to higher earnings of individual entrepreneurs. The above-mentioned results for education at the macro level are independent of and additional to those for the education level of the respondents themselves.

4.6 Robustness checks

We perform a couple of robustness checks. First, as indicated in footnotes 3 and 8, the results are independent of the definition of parttime work and the way GDP per capita is included in the models (level or growth rate). Second, we assessed to what extent the result hinges on the innovativeness of the sector in which the entrepreneur is active. Perhaps somewhat surprisingly, we find that the impact of a higher tertiary educational attainment rate on entrepreneurial performance is not stronger for entrepreneurs who are active in R&D-intense sectors (see Appendix Table A for the definition) than for other entrepreneurs.[12] As a third robustness check we replaced the continuous 'job tenure in entrepreneurship status (or employership status)' with a set of dummy variables where tenure in the current status of one year is the benchmark. We find increasingly negative coefficients indicating that the effect of tenure indeed increases the likelihood of survival monotonously. Fourth, using enrollment rates in secondary or tertiary education (instead of educational attainment levels of the active population), taken from the World Bank's EdStats data set, we find similar results as those presented in Tables 1-4.

5. Conclusion

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

[12] In particular, interaction terms between tertiary educational attainment and the innovative sector dummy are not significant.

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 hypothesis: *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 hypothesis is tested using several measures of individual's entrepreneurship success, including survival, earnings, the probability that an entrepreneur starts employing personnel and the duration that an entrepreneur remains an employer. The main limitation of our study is that we cannot assess the relative strengths of the distinct channels through which a highly educated population may affect an individual's entrepreneurship success (i.e., a higher quality working population, more knowledge spillovers from universities, and a more sophisticated consumer market).

We find support for a positive relationship between higher (primarily tertiary) educational attainment levels of the (local) population and all measures of an individual's entrepreneurship success. In other words, we obtain evidence that the population distribution of higher education is a driver of individual entrepreneurship performance. 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.

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

	Model I				Model II				Model III				Model IV				Model V			
Final state	Paid employment		Unemployment and inactivity		Paid employment		Unemployment and inactivity		Paid employment		Unemployment and inactivity		Paid employment		Unemployment and inactivity		Paid employment		Unemployment and inactivity	
Predicted probability (*y*)	0.1002		0.0416		0.0998		0.0411		0.0998		0.0416		0.0997		0.0423		0.0996		0.0424	
Independent variables (*x*)	$\frac{dy/dx}{y}\%$ [a]	t-stat.	$\frac{dy/dx}{y}\%$ [a]	t-stat.	$\frac{dy/dx}{y}\%$ [a]	t-stat.	$\frac{dy/dx}{y}\%$ [a]	t-stat.	$\frac{dy/dx}{y}\%$ [a]	t-stat.	$\frac{dy/dx}{y}\%$ [a]	t-stat.	$\frac{dy/dx}{y}\%$ [a]	t-stat.	$\frac{dy/dx}{y}\%$ [a]	t-stat.	$\frac{dy/dx}{y}\%$ [a]	t-stat.	$\frac{dy/dx}{y}\%$ [a]	t-stat.
Educational attainment (micro level)																				
Basic education [b] (*ref.*)																				
Secondary education [b]	-12.38	-2.08**	-21.39	-2.75***	-11.06	-1.84*	-18.95	-2.39**	-4.63	-0.73	-27.33	-3.22***	-11.76	-1.91*	-19.30	-2.40**	-8.79	-1.39	-20.40	-2.50**
Tertiary education [b]	-0.10	-0.02	-45.67	-5.80***	3.94	0.58	-40.36	-4.91***	5.46	0.80	-44.96	-5.14***	-1.10	-0.16	-41.58	-4.98***	-0.46	-0.07	-43.79	-5.31***
Demographics																				
Female [b]	-7.68	-1.45	152.40	13.86***	-7.93	-1.5	152.11	13.7***	-7.70	-1.46	142.42	12.1***	-6.50	-1.19	148.63	13.29***	-6.44	-1.18	149.1	13.36***
Age (*18-65*)	-0.90	-0.39	-22.84	-8.06***	-0.58	-0.26	-22.51	-7.87***	-0.27	-0.12	-21.90	-7.29***	-1.36	-0.60	-22.86	-7.85***	-1.23	-0.54	-23.04	-7.90***
Age (squared)	3.4E-03	0.13	0.24	9.20***	-4.1E-05	0.00	0.31	9.00***	-3.4E-03	-0.12	0.30	8.34***	1.1E-02	0.39	0.32	8.99***	9.5E-03	0.34	0.32	9.04***
Cohabiting [b]	-18.06	-2.51**	-15.87	-1.60	-16.63	-2.31**	-13.95	-1.41	-17.48	-2.44**	-16.25	-1.55	-17.83	-2.41**	-14.48	-1.44	-18.1	-2.45**	-14.59	-1.45
Number of children under 14	0.80	0.28	17.79	4.16***	0.80	0.27	17.42	4.04***	0.89	0.30	18.16	3.74***	0.89	0.29	16.00	3.60***	0.999	0.33	16.37	3.71***
Relative(s) working as entrepreneurs [b]	-20.86	-3.81***	-18.75	-2.58***	-20.33	-3.70***	-18.13	-2.49**	-22.22	-4.06***	-15.87	-2.03**	-22.51	-3.99***	-16.53	-2.23**	-23.39	-4.16***	-16.30	-2.19**
Duration dependence																				
Job tenure as entrepreneur (in logs)	-77.84	-16.50***	-103.37	-14.70***	-73.47	-15.20***	-95.93	-13.10***	-76.43	-16.10***	-106.89	-14***	-78.15	-15.98***	-103.35	-14.26***	-78.96	-16.19***	-104.68	-14.61***
Educational attainment (macro level)																				
Tertiary (ISCED97 5-6) (%; national data)					-2.83	-5.00***	-4.51	-5.20***												
Secondary + Tertiary (ISCED97 3-6) (%; national data)									-0.90	-4.45***	-1.13	-1.72*								
Tertiary (ISCED97 5-6) (%; regional data)													-1.09	-2.39**	-1.35	-2.06**				
Secondary + Tertiary (ISCED97 3-6) (%; regional data)																	-0.45	-2.39**	0.103	0.38
Macroeconomic variables																				
GDP per capita (in logs)	-44.51	-4.29***	-5.77	-0.42	-54.78	-5.29***	-26.55	-1.91*	-30.57	-2.79***	-9.85	-0.71	-50.72	-4.75***	-13.85	-1.00	-41.51	-3.90***	-6.24	-0.45
Unemployment rate (%)	2.50	3.30***	7.93	7.63***	4.52	5.50***	10.78	9.21***	2.61	3.64***	8.61	7.03***	3.16	3.97***	8.96	7.83***	2.23	2.94***	8.42	7.91***
Rule of law (from -2.5 to 2.5)	50.30	5.61***	1.44	0.13	97.14	7.97***	74.07	4.20***	66.61	6.93***	32.66	1.96**	71.57	6.27***	30.25	1.91*	61.18	6.25***	7.75	0.63
Services sector share (%)	-0.06	-0.34	1.20	4.10***	0.32	1.54	1.80	5.81***	0.13	0.65	1.15	3.65***	-0.12	-0.61	1.08	3.65***	-0.17	-0.87	0.983	3.39***
Number of observations	13,676				13,676				13,676				12,904				12,904			
Number of spells	6,347				6,347				6,347				5,972				5,972			
Number of censored spells	3,962				3,962				3,962				3,706				3,706			
Number of completed spells	1,501		884		1,501		884		1,501		884		1,415		851		1,415		851	
Log pseudolikelihood	-7,245.3				-7,219.1				-7,234.4				-6,853.7				-6,856.3			

Notes: [a] For continuous variables, *[(dy/dx)/y]%* captures marginal effects, but expressed in relative terms with respect to predicted probabilities for sample means. In the context of dummy variables, it reflects the impact for a discrete change of the dummy variable from 0 to 1.
[b] Dummy variable
* $0.1 > p \geq 0.05$; ** $0.05 > p \geq 0.01$; *** $p < 0.01$.

Table 2. Earnings as self-employed (tobit estimations)

	Model I		Model II		Model III		Model IV		Model V	
Independent variables (*x*)	dy/dx [a]	t-stat.	dy/dx [a]	t-stat.	dy/dx [a]	t-stat.	dy/dx [a]	t-stat.	dy/dx [a]	t-stat.
Educational attainment (micro level)										
Basic education [b] (*ref.*)										
Secondary education [b]	0.80	5.90 ***	0.80	5.93 ***	0.38	2.71 ***	0.76	5.52 ***	0.54	3.94 ***
Tertiary education [b]	0.66	4.03 ***	0.67	4.08 ***	0.36	2.20 **	0.77	4.71 ***	0.60	3.65 ***
Demographics										
Female [b]	-1.33	-9.38 ***	-1.33	-9.39 ***	-1.32	-9.53 ***	-1.43	-10.12 ***	-1.42	-10.15 ***
Age (*18-65*)	0.19	3.36 ***	0.19	3.37 ***	0.15	2.63 ***	0.19	3.27 ***	0.16	2.85 ***
Age (squared)	-0.002	-3.12 ***	-0.002	-3.13 ***	-0.002	-2.46 **	-0.002	-2.98 ***	-0.002	-2.61 ***
Cohabiting [b]	0.21	1.25	0.22	1.28	0.17	1.02	0.27	1.56	0.26	1.50
Number of children under 14	-0.03	-0.38	-0.03	-0.36	-0.04	-0.54	-0.01	-0.18	-0.01	-0.17
Relative(s) working as entrepreneurs [b]	-0.94	-6.42 ***	-0.94	-6.41 ***	-0.85	-5.90 ***	-0.85	-5.83 ***	-0.77	-5.38 ***
Educational attainment (macro level)										
Tertiary (ISCED97 5-6) (%; national data)			-0.0074	-0.46						
Secondary + Tertiary (ISCED97 3-6) (%; national data)					0.048	10.10 ***				
Tertiary (ISCED97 5-6) (%; regional data)							-0.0068	-0.64		
Secondary + Tertiary (ISCED97 3-6) (%; regional data)									0.030	6.83 ***
Macroeconomic variables										
GDP per capita (in logs)	0.05	0.25	0.02	0.10	-0.63	-2.94 ***	0.05	0.21	-0.04	-0.20
Unemployment rate (%)	-0.04	-1.67 *	-0.03	-1.20	-0.08	-3.58 ***	0.00	-0.07	0.01	0.43
Rule of law (from -2.5 to 2.5)	-1.47	-7.22 ***	-1.33	-3.92 ***	-2.42	-10.61 ***	-0.98	-3.77 ***	-1.54	-7.34 ***
Services sector share (%)	0.00	-0.55	0.00	-0.30	-0.02	-2.89 ***	-0.01	-1.16	-0.01	-1.47
Constant	5.25	2.19 **	5.38	2.22 **	12.51	5.11 ***	4.67	1.84 *	4.99	2.07 **
Number of observations	7,417		7,417		7,417		7,016		7,016	
Number of left-censored observations	1,152		1,152		1,152		1,041		1,041	
Number of individuals	3,129		3,129		3,129		2,940		2,940	
Log pseudolikelihood	-18,952.5		-18,952.3		-18,870.1		-17,876.9		-17,834.8	

Notes: [a] *dy/dx* captures marginal effects on the uncensored latent variable, not the observed outcome. Given that our dependent variable is expressed in natural logarithms, these effects can be interpreted as the percent change in earnings with respect to predicted earnings for sample means in case of continuous variables. In the context of dummy variables, it reflects the percent change in earnings for a discrete change of the dummy variable from 0 to 1.

[b] Dummy variable

* $0.1 > p \geq 0.05$; ** $0.05 > p \geq 0.01$; *** $p < 0.01$.

Table 3. Transitions from own-account worker to employer

	Model I		Model II		Model III		Model IV		Model V	
Predicted probability (*y*)	0.1157		0.1218		0.1244		0.1211		0.1156	
Independent variables (*x*)	$\frac{dy/dx}{y}\%$ [a]	t-stat.	$\frac{dy/dx}{y}\%$ [a]	t-stat.	$\frac{dy/dx}{y}\%$ [a]	t-stat.	$\frac{dy/dx}{y}\%$ [a]	t-stat.	$\frac{dy/dx}{y}\%$ [a]	t-stat.
Educational attainment (micro level)										
Basic education [b] *(ref.)*										
Secondary education [b]	28.35	4.69 ***	24.03	3.83 ***	8.45	1.38	24.04	3.74 ***	24.45	3.65 ***
Tertiary education [b]	32.94	4.54 ***	23.71	3.20 ***	18.20	2.55 **	27.54	3.59 ***	38.21	4.62 ***
Demographics										
Female [b]	-26.01	-5.32 ***	-28.68	-5.63 ***	-28.95	-5.90 ***	-28.46	-5.47 ***	-28.34	-5.31 ***
Age (*18-65*)	-0.39	-0.16	-0.41	-0.18	-1.41	-0.60	-0.97	-0.41	-0.41	-0.17
Age (squared)	-9.3E-03	-0.35	-1.1E-02	-0.37	8.8E-04	0.03	-2.9E-03	-0.10	-1.1E-02	-0.38
Cohabiting [b]	16.59	2.69 ***	16.92	2.63 ***	17.26	2.76 ***	17.83	2.72 ***	19.86	3.00 ***
Number of children under 14	-1.01	-0.35	-1.36	-0.46	-0.49	-0.20	-2.13	-0.70	-3.33	-1.07
Relative(s) working as entrepreneurs [b]	41.12	6.90 ***	40.72	6.50 ***	45.44	7.35 ***	41.29	6.43 ***	37.19	5.72 ***
Educational attainment (macro level)										
Tertiary (ISCED97 5-6) (%; national data)			5.91	10.91 ***						
Secondary + Tertiary (ISCED97 3-6) (%; national data)					2.04	9.85 ***				
Tertiary (ISCED97 5-6) (%; regional data)							1.69	4.12 ***		
Secondary + Tertiary (ISCED97 3-6) (%; regional data)									0.51	2.81 ***
Macroeconomic variables										
GDP per capita (in logs)	-12.69	-1.33	9.51	0.92	-37.98	-3.80 ***	7.68	0.76	21.09	14.46 ***
Unemployment rate (%)	-2.26	-3.48 ***	-5.42	-7.25 ***	-2.26	-3.30 ***	-4.11	-5.72 ***	-3.70	-4.96 ***
Rule of law (from -2.5 to 2.5)	-59.11	-7.27 ***	-151.98	-12.60 ***	-96.88	-11.00 ***	-117.83	-10.70 ***	-146.87	-17.04 ***
Services sector share (%)	-1.17	-6.29 ***	-2.08	-9.79 ***	-1.98	-9.50 ***	-0.69	-3.44 ***	-1.24	-6.02 ***
Number of observations	14,900		14,900		14,900		13,709		13,709	
Number of transitions	2,167		2,167		2,167		1,918		1,918	
Log likelihood	-6,040.9		-5,981.6		-5,992.5		-5,381.5		-5,291.3	

Notes: [a] For continuous variables, *[(dy/dx)/y]%* captures marginal effects, but expressed in relative terms with respect to predicted probabilities for sample means. In the context of dummy variables, it reflects the impact for a discrete change of the dummy variable from 0 to 1.

[b] Dummy variable

* $0.1 > p \geq 0.05$; ** $0.05 > p \geq 0.01$; *** $p < 0.01$.

Table 4. Survival model: Departure from work as employer
-Single risk model: Exits to own-account work, paid-employment, unemployment and inactivity-

	Model I		Model II		Model III		Model IV		Model V	
Predicted probability (*y*)	0.1861		0.1864		0.1848		0.1807		0.1806	
Independent variables (*x*)	$\frac{dy/dx}{y}\%$ [a]	t-stat.	$\frac{dy/dx}{y}\%$ [a]	t-stat.	$\frac{dy/dx}{y}\%$ [a]	t-stat.	$\frac{dy/dx}{y}\%$ [a]	t-stat.	$\frac{dy/dx}{y}\%$ [a]	t-stat.
Educational attainment (micro level)										
Basic education [b] (*ref.*)										
Secondary education [b]	-24.50	-3.29 ***	-23.4	-3.13 ***	-13.81	-1.72 *	-25.67	-3.24 ***	-22.93	-2.81 ***
Tertiary education [b]	-22.46	-2.79 ***	-20.24	-2.47 **	-16.04	-1.89 *	-20.10	-2.30 **	-17.61	-1.97 **
Demographics										
Female [b]	20.47	2.46 **	20.71	2.49 **	21.61	2.57 **	22.93	2.51 **	23.16	2.53 **
Age (*18-65*)	-8.06	-2.55 **	-7.82	-2.47 **	-6.97	-2.20 **	-7.29	-2.15 **	-7.11	-2.10 **
Age (squared)	9.7E-02	2.55 **	9.4E-02	2.51 **	8.5E-02	2.26 **	8.7E-02	2.17 **	8.5E-02	2.12 **
Cohabiting [b]	-18.05	-1.67 *	-18.69	-1.72 *	-18.91	-1.73 *	-9.82	-0.87	-9.49	-0.84
Number of children under 14	3.44	0.85	3.98	0.98	3.11	0.76	5.99	1.38	5.55	1.27
Relative(s) working as entrepreneurs [b]	-22.19	-3.25 ***	-21.52	-3.14 ***	-25.67	-3.74 ***	-19.16	-2.58 ***	-20.27	-2.73 ***
Duration dependence										
Job tenure as employer (in logs)	-61.85	-8.78 ***	-59.59	-8.39 ***	-59.111	-8.30 ***	-58.60	-7.97 ***	-58.24	-7.91 ***
Educational attainment (macro level)										
Tertiary (ISCED97 5-6) (%; national data)			-2.33	-2.84 ***						
Secondary + Tertiary (ISCED97 3-6) (%; national data)					-1.30	-4.60 ***				
Tertiary (ISCED97 5-6) (%; regional data)							0.01	0.02		
Secondary + Tertiary (ISCED97 3-6) (%; regional data)									-0.39	-1.68 *
Macroeconomic variables										
GDP per capita (in logs)	-171.52	-10.30 ***	-179.54	-10.80 ***	-164.99	-9.70 ***	-170.57	-9.85 ***	-169.69	-9.87 ***
Unemployment rate (%)	7.42	6.54 ***	10.19	6.80 ***	9.24	7.73 ***	7.76	6.08 ***	7.58	6.22 ***
Rule of law (from -2.5 to 2.5)	148.63	10.25 ***	188.59	9.36 ***	181.65	11.25 ***	155.61	8.61 ***	160.62	9.64 ***
Services sector share (%)	0.32	1.25	0.74	2.44 **	0.99	3.31 ***	0.27	0.97	0.37	1.30
Number of observations	4,023		4,023		4,023		3,637		3,637	
Number of spells	2,179		2,179		2,179		1,929		1,929	
Number of censored spells	1,303		1,303		1,303		1,163		1,163	
Number of completed spells	876		876		876		766		766	
Log likelihood	-1,919.3		-1,915.2		-1,908.7		-1,713.6		-1,712.17	

Notes: [a] For continuous variables, *[(dy/dx)/y]%* captures marginal effects, but expressed in relative terms with respect to predicted probabilities for sample means. In the context of dummy variables, it reflects the impact for a discrete change of the dummy variable from 0 to 1.

[b] Dummy variable

* $0.1 > p \geq 0.05$; ** $0.05 > p \geq 0.01$; *** $p < 0.01$.

Appendix: Variable definitions and descriptive statistics

Table A: Variable definitions

Variable	Description
	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.
Earnings as self-employed	Self-employment incomes earned during the year prior to the interview, converted to average € of 1996, being corrected by Purchasing Power Parity (across countries) and Harmonised Consumer Price Index (over time). This variable is expressed in natural logarithms.
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.
	Independent variables
Educational attainment (micro level)	
Basic education	Dummy equals 1 for individuals with less than second stage of secondary level education (ISCED-1997, 0-2).
Secondary education	Dummy equals 1 for individuals with second stage of secondary level education (ISCED-1997, 3).
Tertiary education	Dummy equals 1 for individuals with recognized third level education (ISCED-1997, 5 or 6).
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.
Duration dependence	
Job tenure as entrepreneur	Number of years as entrepreneur. Variable expressed in natural logarithms.
Job tenure as employer	Number of years as employer. Variable expressed in natural logarithms.
Educational attainment (macro level)	
Tertiary (ISCED97 5-6) (%; national data)	Percentage of the active population from 25 to 64 years with at least first stage of tertiary education: ISCED-1997 categories 5 and 6 (source: Eurostat). This variable is generated at the country level (source: Eurostat).
Secondary + Tertiary (ISCED97 3-6) (%; national data)	Percentage of the active population from 25 to 64 years with at least upper secondary education: ISCED-1997 categories 3 to 6 (source: Eurostat). This variable is generated at the country level (source: Eurostat).
Tertiary (ISCED97 5-6) (%; regional data)	Percentage of the active population from 25 to 64 years with first and second stage of tertiary education: ISCED-1997 categories 5 and 6 (source: Eurostat). This variable is generated at the regional level -NUTS 1- (source: Eurostat).
Secondary + Tertiary (ISCED97 3-6) (%; regional data)	Percentage of the active population from 25 to 64 years with at least upper secondary education: ISCED-1997 categories 3 to 6 (source: Eurostat). This variable is generated at the regional level -NUTS 1- (source: Eurostat).
Other macroeconomic variables	
National GDP per capita (levels)	Real GDP per capita expressed in PPP US$ of 1990 (source: OECD). Variable expressed in natural logarithms.
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).
Robustness checks	
National GDP per capita (growth rates)	Real GDP per capita expressed in PPP US$ of 1990 (source: OECD). Variable expressed in growth rates.
Active in innovative sector	Dummy equals 1 for entrepreneurs being active in an innovative sector, defined as a sector with above-average R&D-intensity: R&D-expenditures over R&D-employment (source: own calculations based on OECD statistics). The benchmark (average) R&D-intensity relates to the average R&D-intensity in 2001 over 12 countries and 14 sectors (i.e. 168 country-sector combinations). By means of the Nomenclature of Economic Activities (NACE-93), the following 14 sectors have been used: C+E Mining and quarrying + Electricity, gas and water supply. DA Manufacture of food products, beverages and tobacco. DB+DC Manufacture of textiles, clothing and leather products. DD+DE Manufacture off wood and paper products; publishing and printing. DF-DI Manufacture of coke, refined petroleum/chemicals/rubber/plastic and other non-metallic mineral products. DJ+DK Manufacture of metal products, machinery and equipment.

	DL-DN Other manufacturing. F Construction G Wholesale and retail trade; repair of motor vehicles, motorcycles and personal/household goods. H Hotels and restaurants. I Transport, storage and communication. J Financial intermediation. K Real estate, renting and business activities. L-Q Public administration and defence; compulsory social security; education; health and social work; other community, social and personal service activities; private households with employed persons; extra-territorial organizations and bodies.
Participation rates in education (macro level)	
Enrolment on secondary education rate	Gross enrolment rate for secondary education: ISCED-1997 categories 2-3 (source: World Bank).
Enrolment on tertiary education rate	Gross enrolment rate for tertiary education: ISCED-1997 categories 5-6 (source: World Bank).

Table B. Descriptive statistics for each of the four analyses

	Entrepreneurship survival			**Transitions from own-account worker to employer**		**Employership survival**		**Entrepreneurship earnings**
Final destination	Censored	Paid employment	Non-employment	Not switching	Switching	Censored	Own-account work/paid or non employments	---
Number of spells	3,962	1,501	884	---	---	1,303	876	---
Number of observations	---	---	---	12,733	2,167	---	---	7,417
Educational attainment (micro level)								
Basic education	41.39%	41.77%	52.49%	49.67%	45.59%	42.67%	47.49%	41.09%
Secondary education	32.86%	30.71%	29.41%	28.66%	31.98%	34.38%	29.68%	33.29%
Tertiary education	25.74%	27.51%	18.10%	21.67%	22.43%	22.95%	22.83%	25.62%
Demographic characteristics								
Females	35.46%	33.84%	63.12%	29.79%	26.17%	25.33%	27.28%	32.71%
Average age (years)	39.5 (9.95)	38.0 (9.79)	41.6 (11.62)	41.9 (9.33)	40.6 (9.35)	42.9 (9.29)	41.9 (9.55)	39.9 (9.57)
Cohabiting	74.26%	70.55%	73.53%	81.02%	81.91%	84.04%	81.62%	77.16%
Number of children under 14	0.66 (0.94)	0.69 (0.94)	0.65 (0.98)	0.69 (0.94)	0.72 (0.93)	0.66 (0.92)	0.70 (0.91)	0.72 (0.96)
Relative(s) working as entrepreneurs	34.40%	26.78%	33.71%	25.84%	33.87%	39.22%	32.53%	31.79%
Duration dependence								
Average job tenure as entrepreneur (years)	2.56 (1.76)	1.60 (1.00)	1.48 (0.92)	---	---	---	---	---
Average job tenure as employer (years)	---	---	---	---	---	2.13 (1.43)	1.45 (0.83)	---
Educational attainment (macro level)								
Tertiary (ISCED97 5-6) (%; national data)	21.86% (7.55)	21.18% (7.05)	20.33% (6.70)	20.98% (6.73)	20.91% (6.84)	21.76% (7.87)	22.36% (6.67)	21.34% (7.23)
Secondary + Tertiary (ISCED97 3-6) (%; national data)	56.79% (16.91)	53.87% (17.12)	52.62% (15.23)	52.37% (15.78)	52.76% (15.79)	55.67% (16.41)	53.24% (16.14)	56.23% (16.81)
Macroeconomic variables								
National GDP per capita (PPP US$ of 1990)	16,586.5 (4,642.5)	15,445.6 (4,028,8)	15,024.8 (4,182.3)	14,231.6 (4,099.0)	13627.1 (4,255.4)	15,117.6 (4,587.6)	13,415.1 (4,303.4)	16,117.5 (4,462.1)
National unemployment rate (%)	8.15% (3.38)	9.30% (3.84)	9.87% (3.82)	10.08% (3.95)	10.06% (3.20)	8.56% (2.76)	9.82% (3.16)	8.59% (3.35)
Rule of law (from -2.5 to 2.5)	1.322 (0.393)	1.366 (0.378)	1.301 (0.378)	1.336 (0.389)	1.258 (0.399)	1.208 (0.411)	1.249 (0.412)	1.312 (0.392)
Services sector share (%)	51.79% (13.68)	51.44% (13.59)	53.29% (13.23)	53.44% (13.81)	52.61% (14.45)	52.40% (14.28)	52.92% (15.19)	51.92% (13.75)
Robustness check								
Active in innovative sector [a]	35.41%	30.21%	30.50%	35.16%	36.96%	32.83%	33.50%	32.32%

Notes: Standard deviations for continuous explanatory variables in parentheses.

[a] Excluding Denmark and Luxembourg.

Table C. Regional information for the educational attainment level at the macro level

Country	Regional disaggregation –NUTS 1–
Austria	(i) Ostösterreich; (ii) Südösterreich; (iii) Westösterreich
Belgium	(i) Région Bruxelles-capitale/Brussels hoofdstad gewest; (ii) Vlaams Gewest; (iii) Région Wallonne
Denmark	(i) Denmark
Finland	(i) Etelä-Suomi (incl. Åland); (ii) Itä-Suomi; (iii) Pohjois-Suomi
France	(i) Île de France; (ii) Bassin Parisien; (iii) Nord - Pas-de-Calais; (iv) Est; (v) Ouest; (vi) Sud-Ouest; (vii) Centre-Est; (viii) Méditerranée
Germany	(i) Baden-Württemberg; (ii) Bayern; (iii) Berlin; (iv) Brandenburg; (v) Bremen; (vi) Hamburg; (vii) Hessen; (viii) Mecklenburg-Vorpommern; (ix) Niedersachsen; (x) Nordrhein-Westfalen; (xi) Sachsen; (xii) Sachsen-Anhalt; (xiii) Schleswig-Holstein; (xiv) Thüringen; (xv) Rheinland-Pfalz + Saarland
Greece	(i) Voreia Ellada; (ii) Kentriki Ellada; (iii) Attiki; (iv) Nisia Aigaiou, Kriti
Ireland	(i) Ireland
Italy	(i) Nord Ovest; (ii) Lombardia; (iii) Nord Est; (iv) Emilia-Romagna; (v) Centro; (vi) Lazio; (vii) Abruzzo-Molise; (viii) Campania; (ix) Sud; (x) Sicilia; (xi) Sardegna
Luxembourg	(i) Luxembourg
Netherlands	(i) Netherlands
Portugal	(i) Norte; (ii) Algarve; (iii) Centro; (iv) Lisboa; (v) Alentejo; (vi) Região Autónoma dos Açores; (vii) Região Autónoma da Madeira
Spain	(i) Noroeste; (ii) Noreste; (iii) Comunidad de Madrid; (iv) Centro; (v) Este; (vi) Sur; (vii) Canarias
UK	(i) Northwest; (ii) Yorkshire and The Humber; (iii) East Midlands; (iv) West Midlands: (v) East of England; (vi) South East; (vii) South West; (viii) Wales; (ix) Scotland; (x) Northern Ireland

Notes: Regional information is available for the period 1999-2001. For 1994-1998 we used the observation corresponding to 1999.
Denmark, Ireland and Luxembourg are NUTS 1 themselves.
Regional data for the Netherlands is not available at the ECHP (we use the country level values in the regional analysis).

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