CESIS Electronic Working Paper Series

Paper No. 292

University choice and entrepreneurship

Zara Daghbashyan

Björn Hårsman

December 2012

The Royal Institute of technology
Centre of Excellence for Science and Innovation Studies (CESIS)
http://www.cesis.se

University choice and entrepreneurship[1]

Zara Daghbashyan[2], Björn Hårsman[3]

Abstract

This paper aims at shedding light upon the impact of universities on graduates' entrepreneurial choice. Previous studies (Dale and Krueger, 2002, Brand and Halaby, 2006, McGuinness, 2003) have analyzed the relationship between the choice of university and labor market success of graduates in terms of their subsequent wages, employability or over-education, whereas the possible link between the choice of university and entrepreneurial choice has been neglected.

Using 1998-2008 data on graduates from Swedish higher education institutions (HEI), the paper finds significant variation in the impact of universities on the career choice of graduates. The results suggest that graduates with degrees in the social sciences, natural sciences, medicine and teacher education from more prestigious universities systematically differ from others in their entrepreneurial choice. At the same time, no statistically significant difference is found for technical science graduates.

Keywords: universities, education, entrepreneurship, graduates,

JEL classification: L26, M53, M54

[1] We would like to thank P. Braunerhjelm from the Royal Institute of Technology for providing comments on the earlier version of this paper.

[2] Industrial Economics and Management, Royal Institute of Technology, Stockholm; email: zarad@kth.se

[3] Industrial Economics and Management, Royal Institute of Technology, Stockholm; email: bjorn.harsman@indek.kth.se

1. Introduction

One of the motivations for acquiring higher education is the prospect of better future careers, which are usually measured in terms of wages earned, over-education or employment possibilities after graduation. Obviously these dimensions do not account for the career outcome in terms of entrepreneurial choice. Nonetheless, people exposed to entrepreneurship frequently express that they have more opportunity to exercise creative freedoms, higher self-esteem, and an overall greater sense of control over their own lives, which means that entrepreneurship should be regarded as a rather successful career outcome for the most people (Parker, 2009). Furthermore, wealth and a high majority of jobs created by small businesses started by entrepreneurially minded individuals, many of whom go on to create big businesses, makes entrepreneurship important not only from personal but also national prospective (Acs, 2006). Van Praag and Versloot (2007) provide an encompassing review of the empirical literature showing that entrepreneurship has important effects for employment creation, innovation and productivity growth.

Given the importance of entrepreneurship as a career choice and for the society at large, this paper is focused on graduate entrepreneurship. As suggested in Nabi and Holden (2008, p.548) graduate entrepreneurship is rapidly increasing and should be given more attention due to its importance "as a source of competitiveness and the engine for economic growth and development". Many empirical studies which examine the relationship between education and entrepreneurship performance have provided evidence of the importance of graduate entrepreneurship. Educated entrepreneurs have been shown to be more likely to start bigger companies, more frequently in innovative and R&D intensive branches, and to perform better in terms of profits (Luthje & Franke, 2002). Bergman and Stenberg (2007) find that higher education matters for the performance of "opportunity" but not "necessity-based" entrepreneurs.[4] Poshke (2008) notes that individuals with higher education are less likely to belong to the group of so-called "necessity-based" entrepreneurs driven by push-factors[5], and that being "opportunity-based" they are more likely to exhibit better performance of business operation.

If education is positively associated with the performance of entrepreneurs, as well as with the formation of opportunity-based entrepreneurs in an economy, how instrumental are

[4] The latter is defined in the annual report of Global Entrepreneurship Monitor, Reynolds et al. (2002), to measure the rate of entrepreneurial activity. Opportunity-based entrepreneurship involves those who choose to start their own business by taking advantage of an entrepreneurial opportunity. Necessity-based entrepreneurship involves people who start a business because other employment options are either absent or unsatisfactory.

[5] Gilad and Levine (1986) make a distinction between positive factors that "pull" and negative situational factors that "push" people into entrepreneurship.

universities, being the main suppliers of higher education, in promoting entrepreneurs and entrepreneurial attitudes? For instance, graduates of successful US universities such as MIT and Stanford University are known for nurturing the start-up of many innovative and successful companies. According to a MIT report, if 4000 companies established by MIT alumni formed an independent nation, they would make that nation the 24th largest economy in the world. Similarly Stanford university graduates have established many innovative companies in Sillicon Valley (BostonBank, 1997). The question is whether we observe such a pattern only for a limited number of the most successful universities.

The ambition of many universities to raise entrepreneurial aspirations among the faculty and students, and thus become entrepreneurial[6] is currently included in the agenda of many HEIs[7]. It is particularly well documented in the "KTH Entrepreneurial Faculty Project" (2005), within the scope of which a large number of case studies were conducted in leading international universities, such as MIT, Cambridge University, Technical University of Delft in the Netherlands, the University of Surrey in the UK, EPF Lausanne in Switzerland etc., to study their intention and experience in encouragement of entrepreneurship. The results evidence the aspiration of these universities to become entrepreneurial by means of offering courses in entrepreneurship and restructuring of the organisational structure to allow for the active promotion of entrepreneurship among students and faculty.

This study aims at shedding light upon the impact of universities on the formation of graduates' entrepreneurial choice. Given the importance of education for nurturing the entrepreneurial motivations and performance of graduates and that most universities invest in fostering entrepreneurship among their students and faculties, we are particularly interested in understanding whether some universities are more successful in raising graduates' interest in entrepreneurship than others. Hence, the question addressed in this paper is whether the entrepreneurial interest of university graduates[8] is influenced by university choice.

Previous research has mainly focused on whether there is a relationship between university choice and the subsequent labor market outcome of graduates. The results for the US suggest that university quality, measured by university reputation or selectivity indicators, matters for graduates' subsequent earnings (Dale and Krueger, 2002, Brand and Halaby, 2006).

[6] "The entrepreneurial university is a term now being used to refer to universities which possess a wide range of new infrastructural support mechanisms for fostering entrepreneurship within the organisation as well as packaging entrepreneurship as a product. "(Jacob et al., 2003, p.1556)

[7] See for example Högskoleverket Report 2004:38 R for Swedish HEIs and Herrmann et al. (2008) for UK universities.

[8] While universities may also foster academic entrepreneurship by conducting applied research and commercializing the product (see Braunerrhjelm, 2007, Stuart and Ding, 2006), the focus of this study is on entrepreneurship among graduates.

McGuinness (2003) finds that labor market success in the UK job market, measured by job quality and earnings, is more dependent on the subject studied and the degree obtained than on the university attended. Research on the impact of universities on the performance of Italian graduates finds significant differences among universities, with more research-oriented universities providing better career possibilities in terms of earnings, over-qualification and employability (Di Pietro and Cutillo, 2006, Ciriaci et al. 2010). Using Swedish data, Lindahl and Regner (2005) and Lundin (2006) find that earnings of graduates from old Swedish universities are higher.

Thus, to our knowledge, previous studies are concerned with finding the effect of university choice on the career development of graduates measured in terms of wages, over-qualification, employability, but less frequently on their occupational choice (Lucas, 1978, Kihlstrom and Laffont, 1979, Lazear, 2005). In particular, the relationship between graduates' choice of entrepreneurship and university choice seems to be neglected (Nabi and Holden, 2008).

Using 10-year panel data for graduates from Swedish universities and colleges[9] we find that the frequency of becoming an entrepreneur is about twice higher for graduates from more prestigious universities as compared to graduates from other universities. If graduates of universities with higher quality of education are more successful in the labor market, then they might be less interested in entrepreneurial occupations. The opposite pattern, evidenced by our data, might imply that graduates of universities with higher quality of education are interested in entrepreneurial activities irrespective of being in a better position in the labor market. Given that education provides future entrepreneurs with technical competence and mastery of currently available tools and also stimulates creativity and imagination for their utilization (Baumol, 2009), this might signal differences in university education as regards provision of competences and stimulation of creativity and hence the ability to boost entrepreneurship inclinations among graduates. Several mechanisms may be behind this effect. For instance, the quality of education might be one aspect that effects graduates' entrepreneurial intentions. Individuals with good education might be more aware of existing problems and solutions and hence have higher chances to find their own market niche via introduction of an innovative solution (Luthje & Franke, 2002). Furthermore Lazear's (2005) idea of entrepreneurs being "jacks-of all-trades", who possess a balanced portfolio of cognitive and non-cognitive skills, suggests that education with extra-circular activities might be more important for enhancing entrepreneurial endowments than traditional education.

[9] Though Swedish HEIs comprise universities, university colleges and colleges, we use HEI and universities interchangeably.

Along this line, Falck & Woessmann (2011) have argued that university competition forces universities to be more innovative with regard to courses, teaching methods, extra-curricular activities and hence create incentives for the quality of education not only in terms of academic but also non-academic measures, such as entrepreneurial traits. This suggests that universities with a wider set of extra-curricular activities and higher quality in terms of non-academic measures might be more successful in fostering entrepreneurship among graduates. Sobel and King (2008) argue that students entrepreneurial intentions might be also influenced by the entrepreneurial environment in universities and university-industry connections. As mentioned in Braunerhjelm et al. (2012) Swedish academics seem positively inclined towards the commercialization of research with marked differences across universities. According to them these differences are primarily related to university culture and the extent to which universities are well connected to industry.

This study is an attempt to empirically estimate the relationship between the quality of university education and graduates' subsequent decision to become entrepreneurs. Using Swedish data, we analyze whether there is any systematic difference in the career choice of graduates from internationally ranked and non-ranked universities. The results of applying a random effects generalized ordered probit model suggest significant variation in the impact of universities on the entrepreneurial choice of graduates. In particular, graduates with a degree in social, medical, natural sciences and teacher education from internationally ranked universities are found to be more interested in entrepreneurial activities than graduates from other universities. As to technical science graduates, the results show no evidence of systematic difference in the entrepreneurial preferences of graduates from these two groups of universities.

Our contribution to the existing literature is twofold. Firstly, we use unique Swedish data on graduates' career outcomes to analyze whether universities differ in their ability to foster entrepreneurship among their graduates. Thereby, we bridge the two literature streams: on occupational choice and university-labor market relationship. Secondly, in order to broaden the common definitions used to measure entrepreneurship, we suggest a typology to make it possible to differentiate various types of entrepreneurs.

The following section is a short summary of the two streams of literature relevant for our analysis, and the third section describes our entrepreneurship typology and the data used. The fourth section discusses the model and the choice of variables. The estimation method and related problems are found in section 5. The results are presented in section 6 and the final remarks are contained in section 7.

2. Literature review

Two streams of literature are relevant for the discussion of the relationship between the university choice and subsequent career choice. First, the occupational choice literature which models the individual's decision to become an entrepreneur, with a particular emphasis on the impact of education on entrepreneurship selection. Second, the literature examining the relationship between university quality and graduates' labor market outcomes. We aim to bridge these two streams to see if there is a link between occupational choice and university of graduation.

2.1 The impact of education on occupational choice

The occupational choice literature aims at explaining an individual's decision to become an entrepreneur against the alternative of wage employment (e.g. van Praag & Cramer, 2001, Evans & Jovanovic, 1989, Blanchflower & Oswald, 1998 etc). The starting point in this literature is the assumption that individuals choose the occupation associated with the highest perceived utility, which in turn depends on the assessment of expected rewards and risks from each occupation as well as individuals' personal characteristics and labor market conditions (Parker, 2009).

One of the early versions of occupational choice model was suggested in Lucas (1978), who modeled entrepreneurship as a function of heterogeneous entrepreneurial ability with the implication that individuals with higher ability are more successful. However, in Lucas' model the entrepreneurial ability is given exogenously without any explained provenance. Later empirical studies assumed that entrepreneurship might derive from human capital accumulated through education or experience (Van Praag, 2001). Unfortunately, the empirical evidence does not point to any unambiguous results concerning the relationship between the level of education and selection into entrepreneurship, where one explanation is the dual effect of education. On the one hand education improves individuals' innate abilities and knowledge, making them more aware about business opportunities and entrepreneurial processes and hence more prone to entrepreneurship. On the other hand, education increases the chances of finding less risky wage employment and lowers the interest in entrepreneurship. At the same time the positive relationship between education and entrepreneurial performance is a robust finding in many studies. For example, Burke et al. (2002) estimate the effect of human capital on the probability of self-employment, and find that education tends to depress the probability of self-employment, but that it improves the performance measured by income and the number of jobs created. They conclude that human capital has different effects on

entrepreneurial choice and performance. Van Der Sluis et al. (2010) provide a meta-analytical review of 94 studies on the impact of education on the probability of being or becoming an entrepreneur and on entrepreneurship performance. They conclude that there is no systematic relationship between level of education and the probability of being or becoming an entrepreneur, but that the impact of education on performance is positive and significant. Poschke (2008) argues that this happens because the relationship between abilities and entrepreneurship is non-linear. He suggests that when educational attainment is used as a proxy for ability, there is a U-shaped relationship between education and entrepreneurship. Self-employment rates are higher for people with relatively high or low levels of education and lower for people with intermediate levels of education.

The majority of the above studies discuss the relationship between entrepreneurship and education in general, whereas Verheul et al. (2010) provide an insight into how entrepreneurship-specific education may affect an individual's engagement in entrepreneurship [10]. Their empirical findings indicate that entrepreneurship education positively relates to engagement in opportunity-driven entrepreneurial activities. Reviews of the literature on entrepreneurship education programs also provide evidence that these programs are successful in encouraging entrepreneurship (McMullan et al., 2002). However, as noted in Peterman (2003), these studies have some methodological limitations since they do not measure pre- and post-program entrepreneurial intentions and achievements.

There have been a few studies that compared entrepreneurial intentions of graduates from different education systems. Gold et al. (2011) analyses the entrepreneurial intentions of graduates from the socialist GDR regime and from West Germany and finds that graduates of an education system that embraced the values of market economy are more inclined to entrepreneurship. Falck et al. (2011) exploits the effect of school competition on students entrepreneurial intentions and finds that a 10% increase in private school shares within each national school system raises students' entrepreneurial intentions by 0.3-0.5%. Sobel and King (2008) observe that voucher programs in the US create greater rates of entrepreneurship relative to traditional public schools without such programs.

The relationship between education and entrepreneurship as occupational choice is not the only concern of occupational choice literature; many studies attempt to explain occupational choice by individuals' pecuniary and non-pecuniary incentives, personality traits, and demographic as well as microeconomic characteristics (see Parker, 2009 for a detailed review

[10] Entrepreneurship education is measured by a dummy variable , which is 1 if the individual agrees to the statement "my school education helped me to develop my sense of initiative".

of the literature). Van Praag & Cramer (2001) look at another aspect of entrepreneurship and claim that entrepreneurial choice is associated with the highest expected rewards from each occupation, which in turn depend on the assessment of individual ability and risk attitude. They conclude that risk aversion is a serious impediment to entrepreneurship. Amit et al. (1993) review the role of psychological factors in entrepreneurship research and single out four main personality traits that have attracted substantial research interest: risk attitudes, need for achievement, internal locus of control, tolerance of ambiguity.

Evans & Jovanovic (1989) estimate a model of entrepreneurial choice and find that access to capital is crucial for entrepreneurial decisions. Åsterbro & Bernhardt (2003) show that the magnitude of credit constraints is conditioned by the relative productivity of human capital. Their empirical analysis suggests that entrepreneurs with high human capital have a higher level of access to capital and that human capital relaxes financial constraints due to its greater productivity.

Other studies focus on individual characteristics such as age, gender and family background. Evans & Leighton (1989) examine the process of selection into self-employment and self-employment earnings, and reveal that the probability of entering self-employment is independent of age or experience during the first 20 years of employment. Blanchflower (2000) examines the role and influence of self-employment across the OECD countries and finds that, common to most countries, the probability of being self-employed is higher among men than women and rises with age.

Summarizing entrepreneurial choice literature, Le (1999) concludes that the entrepreneurial choice is often expressed as a function of such "traditional" variables as education, experience, age, job stability, access to capital, occupational status, labor market, spouse's educational attainments and employment status, and number of children. Some studies also include psychological and group characteristics.

Thus, the occupational choice literature sheds light upon many aspects of entrepreneurial choice, leaving, however, the link between the choice of university and formation of entrepreneurial perceptions open.

2.2 The impact of university choice on labor market outcome

This stream of literature intends to investigate the possible variation in the labor market outcomes of graduates from different universities. The labor market outcome is traditionally measured in terms of wages earned, occupations attained or employment possibilities after graduation (Smart,1986, Brand et al., 2006), thereby neglecting the career outcome of those

choosing entrepreneurship. To examine the possible relationship between career outcome and university attended, some studies have tried to determine university-specific structural and organizational characteristics that subsequently have effects on graduates' earnings or employability (Black and Smith, 2006, McGuinness, 2003, Ciriaci et al., 2010). Others have linked university reputation, prestige or selectivity to graduates' labor market outcomes (Dale and Krueger, 2002, Brand and Halaby, 2006).

This strand of research mainly suggests that there is a variation in the labor market success of graduates from different universities. Hoekstra (2009), Dale & Krueger (2002), Monks (2000), Brewer et al. (1999) find that graduates of elite or selective US colleges have higher productivity than others. Ciriaci et al. (2010) estimate the probability of employability for graduates of Italian universities, and show that university quality measured by ranking indicators matters. Lindahl and Regner (2005) use Swedish sibling data and reveal that earnings of graduates from old colleges are higher. Hence, the general finding seems to be that the university of graduation matters for the subsequent career outcome.

The main problem in these studies is the non-random character of university choice. There is a selection issue for both the student and the university. Individuals choose universities based on the expected payoff from the labor market, whereas universities aim to give admission to "better" students; hence, this potential systematic selection should be taken into account to get unbiased and consistent estimates. The majority of studies (Long, 2008; Lindahl and Regner, 2005, McGuinnes, 2003) have tried to correct for the non-random nature of university choice by using the selection on observables approach (Heckman and Robb, 1985).

The second group of studies use matching methods to cope with the selectivity problem.

Brand et al. (2006) estimate the average treatment effect of elite college attendance on educational and career achievements. They find that attending elite colleges yield an advantage with regard to educational achievement and occupational status, but report mixed results for wages. Eliasson (2005) estimates the causal effect on earnings of graduating from old Swedish universities rather than new ones, and finds no systematic variation. Black and Smith (2004), using OLS specification, find a positive effect of college quality but insignificant effects when using matching mechanisms.

Brewer et al. (1999) use the Lee (1983) model to control for selection bias; they first estimate college choice, calculate the selectivity corrected term for each university and use it in the wage equation. They report that, even after controlling for the selectivity of college, there is a significant economic return to attending a private institution.

The majority of the abovementioned studies focus on differences in the career outcomes of graduates from different universities without explaining the reasons. As mentioned in Lindahl and Regner (2005), there can be various reasons explaining why college quality may influence earnings, among them peer effects, curricular design, instructional quality, quality of teachers and other quality-related indicators. There are also so-called signaling and screening effects as shown in signaling and screening models (see Brown and Sessions, 2004). Signaling models assume that employees obtain education to signal their enhanced productivity, while screening models assume that employers screen the labour market by setting a required signal for potential employees. As noted in Harmon and Walker (2003) there is a fundamental difficulty in identifying the extent to which the education just signals the enhanced productivity or truly enhances productivity. These authors compare the wages of employed and self-employed to empirically test the existence of signaling effects in the UK labor market, with the motivation that, as the self-employed know their own productivity, there is no need for them to signal to themselves. They conclude that the signaling effect is rather small. Overall, the recent empirical literature suggests that there is a role of signaling in explaining returns to education, but it is of a modest magnitude (Hermansson, 2011). Education can signal productivity to potential employers who do not have the time or opportunity to reveal the real competences. However, the value of the signal will be revised later based on true credentials.

3. Entrepreneurship typology and data

The data used in this study are provided by Statistics Sweden (SCB) and referred to as FAD, an acronym for "Firms And Establishment Dynamics"[11]. It covers the whole working population and firms in Sweden from 1986 to 2008. For the purpose of analysis we use an unbalanced panel with 1998-2008 data due to a superior data quality and restrict the analysis to individuals with higher education, i.e. university graduates. To control for specifics of various education areas, a separate analysis is performed for graduates in six education fields: social sciences, medical sciences, natural sciences, technical sciences, teacher education and arts & humanities.

3.1. Entrepreneurship typology

In trying to understand "what makes an entrepreneur", extensive empirical research over the past 30 years has used self-employed statistics to classify entrepreneurs. Empirically useful as it may be, such a definition is quite restrictive. As underlined by e.g. Wennekers and

[11] in Swedish: Företagens och Arbetsställenas Dynamik

Thurik (1999), entrepreneurship has many dimensions and refers to a set of abilities rather than being synonymous with being or becoming self-employed. Hence, measures such as the frequency of self-employed among graduates can only serve as a rough proxy for a broader characterization of their entrepreneurial abilities (van Stel, 2005). Admitting that "self-employment is the simplest kind of entrepreneurship" (Blanchflower and Oswald, 1998, 2000), we follow other authors by using "entrepreneur" and "self-employed" interchangeably.

Most studies focusing on the choice of becoming or of being an entrepreneur treat it as a dichotomous choice between two occupations: entrepreneur or wage employee. Van Praag and Cramer (2001), Rees and Shah (1986) and Hammarstedt (2001) all model the decision as a binary choice between wage employment and entrepreneurship related to the perceived utility associated with each alternative. One drawback of using a binary model is that employees combining wage employment with entrepreneurship are left out by definition, or are wrongly classified as either wage employees or entrepreneurs. To handle this problem, Folta et al. (2010) introduce the notion of "hybrid entrepreneurs", i.e. individuals with a primary wage job and a secondary job in self-employment, and show that hybrid entrepreneurs represent a significant share of entrepreneurial activity, rather distinct from full self-employed as a group.

In line with this approach we propose an entrepreneurship typology reflecting the possibility of being more or less involved in entrepreneurial activities. To be useful from an empirical perspective, such a typology requires a definition and a way of measuring "involvement". This can obviously be done in several ways. One option is to define and measure the entrepreneurial activities of an employee by the fraction of time he or she devotes to business activities. Another approach is to define it in terms of business income and wage income. Since we have access to individual data on both business and wage incomes, this is the alternative chosen here.

The database we are relying on classifies all employees as belonging to one of three categories: wage employees, self-employed and co-owners of close companies. Any wage employee might also have a business income, and any self-employed owner or co-owner might also have a wage income. If their business income is larger than their wage income, they are classified as self-employed or co-owners, depending on the type of business they have, and otherwise as wage employed.[12] Since we have individual data on both business and wage incomes, we can divide the wage employees into two subsets: those with only a

[12] Statistics Sweden multiplies the reported business income by 1.6 in order to adjust for an observed tendency by business owners to underestimate their business income.

wage income and those with both a wage income and a business income. Likewise the self-employed are split into two groups: those with only a business income and those with both a business income and a wage income.[13] The income of co-owners of close companies is registered as salary and for this category we have no possibility of distinguishing between salary from own business and salary from employment in other companies, if any. For the sake of argument we assume that co-owners combining business with wage employment are no less entrepreneurial than co-owners not engaged in wage employment. Thus, in this paper we distinguish the following occupational categories:

- employees, i.e. individuals with wage income only
- mixed employees, i.e. wage employees with some business income
- mixed entrepreneurs, i.e. self-employed with some salary from wage employment
- entrepreneurs, i.e. self-employed with no wage income and/or co-owners[14].

Figure 1 shows the frequency of choosing each category within different educational groups.

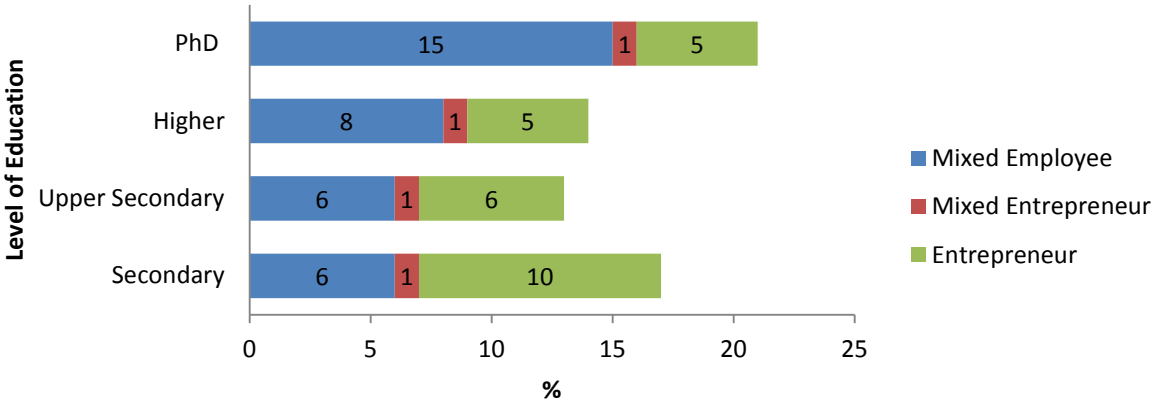

Figure 1. Entrepreneurship profile within groups of employees with different levels of education. 2007 (%).

The relationship between the fraction of entrepreneurs and the level of education seems to be U-shaped: it first decreases and then increases when going from secondary education (at most two years in upper secondary school) to the PhD level. The percentage number of "full-time" entrepreneurs is lower the higher the level of education; from 10 percent among those with a secondary education to some 5 percent among those with a PhD degree. The fraction of mixed entrepreneurs is roughly the same in all educational groups. However, the relationship is reversed for the category mixed employees; 15 percent of PhDs and 8 percent of those with a higher education as compared to 6 percent among those with lower levels of education.

[13] The incomes derived from profits are not included, since they are categorized as capital income.
[14] With or without wage income

In addition to counting the frequency of mixed employees and mixed entrepreneurs, it is important to have an indication of their entrepreneurship activities as compared to "full-time" entrepreneurs. One way of providing such an assessment is to make use of the available income data at the individual level and compute an index by dividing business income with the sum of business income and wage. Provided all business incomes were positive, this ratio would be zero among employees and one among entrepreneurs, and it would fall in between zero and one for the mixed categories. By definition, we would furthermore expect it to be – on average – lower among mixed employees than among mixed entrepreneurs, since business income is the main source of income for the latter. Since some employees have a negative business income we have used the absolute value of the business income. It is of course arguable whether identical absolute values of a negative and a positive business income reflect the same volume of entrepreneurial activity. However, we think the resulting index can serve as an, admittedly rough indicator of differences in entrepreneurship activity across our occupation categories.[15] Table 1 shows the resulting index for mixed employees and mixed entrepreneurs with different levels of education.

Table 1. Index of entrepreneurial activity among mixed employees and mixed entrepreneurs by levels of education. Percent

Education level	Mixed employee	Mixed entrepreneur
PhD	10,5	65
Higher education	14,1	68,1

As expected, or rather by definition, the index indicates a larger volume of entrepreneurial activity among mixed entrepreneurs than mixed employees; on average 66 percent as compared to 15 percent among all mixed employees. In both categories the entrepreneurial activity seems to decrease with increased levels of education.

So far, according to the suggested typology, the level of entrepreneurial activity is highest for entrepreneurs, followed by mixed entrepreneurs, mixed employees and the lowest for employees.

3.2. Entrepreneurial choice by university alumni

To describe the entrepreneurial choices of graduates from different universities, we can either compare the career choice of graduates from all universities of interest, or find a way to aggregate them. Earlier Swedish studies (Lindahl and Regner, 2005) classified universities

[15] Like Statistics Sweden has done for self-owning entrepreneurs, we have multiplied the reported business income of mixed employees by 1.6 provided it is larger than zero.

into old and new ones, and hence have not focused on the labor market outcomes of university quality as such. Instead, they attempt to estimate the effects of graduating from different universities or groups of universities. As mentioned in Eliasson (2006) although the emphasis on quality is generally less pronounced in these papers, the applied classifications are often perceived to approximate various aspects of college quality. University quality indicators commonly used in the literature are prestige and ranking indexes, tuition fees, average admission scores and student rejection rates, as well as some organizational characteristics such as load per teacher, average salary etc. In general, all these indicators are highly correlated. For example Dale and Krueger (2002, 2011) estimate the effect of university quality using the Barron's magazine ranking as well as college average SAT score. Robst (1995) uses prestige ranking developed by Coleman as an alternative measure of university quality.

We aggregate Swedish higher education institutions (HEI) based on international rankings. The latter are calculated based on commonly accepted university quality indicators and allow controlling for different aspects of university education. Thus, we classify Swedish HEIs into two groups. The first group consists of HEIs, which are listed in international rankings[16], and the second group contains all other Swedish HEIs. The former comprises all old HEIs and only 2 relatively old ones, thereby allowing us to follow the Swedish tradition of classifying universities by means of a different classification indicator. Compared to the old universities, the new institutions are characterized by considerably lower shares of faculties with doctoral degrees. They also tend to have limited access to state funding for research. As mentioned in Eliasson (2006), the weak link between education and research at the new institutions could result in a lower quality of education which, in turn, might have negative impacts on students' labor market outcomes[17].

Given the ambition of many modern universities to be entrepreneurial, we hypothesize that traditional university quality indicators captured by international rankings imply a superior entrepreneurial culture and tradition and hence we expect graduates of ranked universities to be more inclined to entrepreneurial occupations. The difference in the frequency of entrepreneurial choice of alumni from ranked and non-ranked HEIs for six education areas is presented in the figure below:

[16] The lists of Swedish universities and colleges appearing in different ranking systems are presented in Appendix 1.

[17] Universities also differ in students' pre-enrollment quality. The median grade point average (GPA) score in upper secondary school is above 15 for students of internationally ranked universities and below 14 for the others.

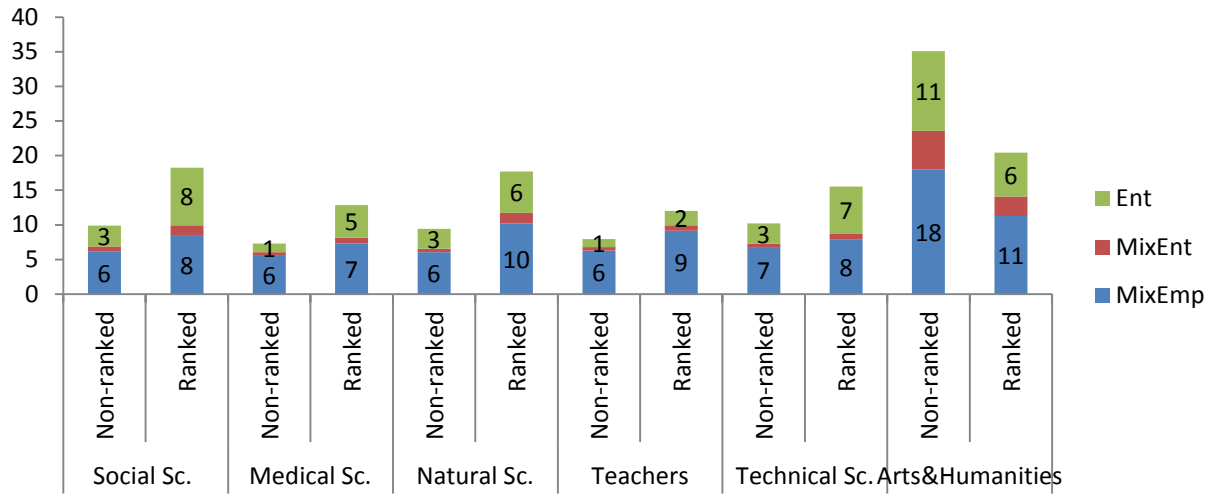

Figure 2. The entrepreneurial choice of graduates from different universities and disciplines. 2007 (%).

The data suggest that graduates of non-ranked universities have a lower frequency of being in any of the entrepreneurial categories in all education areas except for arts & humanities, where we observe the opposite pattern. By way of example, the share of full-time entrepreneurs from ranked universities is 8 percent against 3 percent for non-ranked universities for social science graduates. The difference in the choice of mixed entrepreneurship is less visible, but the difference in the frequency of mixed employment seems to be quite obvious and fluctuates from 1 percent to 7 percent. The different pattern for arts-educated might be due either to specifics of this type of education or to labor market conditions for individuals with an education in the arts and humanities. Furthermore, we would like to note that none of the Swedish arts-oriented universities are included in international rankings, and the education in arts and humanities provided by internationally ranked universities is mainly about the history of arts and humanities or the science of arts and humanities. "Real" arts courses are mainly provided by the non-ranked universities. Hence, the different pattern of entrepreneurial choice for arts and humanities graduates might be due to different types of arts education provided by the ranked and non-ranked universities. So far the data suggest that graduates of internationally ranked universities are more inclined toward entrepreneurial occupations. The difference in the entrepreneurial choice of graduates from ranked and non-ranked universities might indicate either higher interest in entrepreneurship or inferior career possibilities in wage employment. Given that graduates of internationally ranked universities have higher productivity in terms of wages and employment possibilities (e.g. Lindahl and Regner, 2005, Lundin, 2006), the former seems to be more plausible.

It is worth noting that about 80 percent of graduates with degrees in the social, natural and technical sciences, as well as in the arts and humanities, are from internationally ranked universities. The share of graduates from ranked and non-ranked universities is relatively similar for medics and teachers (50 percent).

4. The econometric model and choice of variables

To examine the relationship between graduates' career choice and university of graduation, we assume that each individual ($i = 1,2,3 \ldots n$) makes the choice based on the unobserved attitude or sentiment (Y*) toward each alternative of occupational choice ($j = 1, 2, 3,4$). The alternatives are ordered in accordance with the level of entrepreneurial activity, with entrepreneurs being the highest and employees the lowest. For very low values of Y* the choice is wage employment, for very high values it is entrepreneurship. We assume that the unobserved attitude to each alternative is affected by the area of education, level of education and the university where the individual was educated. The unobserved attitude of individual *i* at time *t* is modeled as follows:

$$Y_{it}^{*} = f(Uni_i, IndChar_i, LabM_{it}, Year_{it},)+\alpha_i + \varepsilon_{it} \quad (1)$$

where

- $\boldsymbol{Uni_i}$ is a dummy variable to indicate the university of graduation. As mentioned earlier, universities are classified into internationally ranked and non-ranked. We hypothesize that graduates of internationally ranked universities are more inclined toward entrepreneurial occupations.
- $\boldsymbol{IndChar_i}$ is a vector of individual characteristics such as gender, ethnic background, age, level of education, abilities. A dummy variable is included to control for individuals' national background, with 1 indicating Swedish origin, and a continuous variable for age. We distinguish between two levels of education, higher education and PhD level. As a measure of individuals' abilities, we use grade point average (GPA) from secondary school. GPA is a proxy of abilities before university and hence allows controlling for pre-enrollment differences.

Following previous literature, such as Reynolds et al. (1994) and Audretsch and Fritsch, (1994), we further assume that the attitude to each alternative is affected by the labor market conditions $\boldsymbol{LabM_{it}}$, which, in our setup, vary, by time and labor market,[18] and control for the following:

[18] Though we use an individual index, the variable varies by labor market and is the same for all individuals working in the same labor market.

- The size of labor market where the individual works. It is measured as the log of number of employees in each of 81 Swedish labor markets. The effect of this variable is hard to predict; though large regions have bigger markets and more opportunities for business activities[19], they also have tougher competition.
- The number of firms operating in each of 81 labor markets normalized by the total number of employees in the respective region. This is assumed to indicate the intensity of regional business activity. We expect a positive relationship between the interest in entrepreneurship and business intensity.

To control for year effects we include

- $\boldsymbol{Year_{it}}$, which is the vector of year dummies.

Finally we assume that

- $\boldsymbol{\alpha_i}$ is the individual-specific time invariant random component.
- $\boldsymbol{\varepsilon_{it}}$ is the time and individual-specific error term.

It is worth mentioning that our choice of variables is in line with existing occupational choice literature. Among the traditional variables that should have been controlled for, we have left out the access to financial resources and risk measures; we cannot control for it due to data unavailability. It would be also desirable to control for individuals' labor market experience (Evans & Leighton, 1989). Still, this is problematic since we are interested in the university effect on entrepreneurial choice, and the inclusion of such a variable may underestimate the university effect, since universities may have also affected the earlier choice of individuals. Another shortcoming is the lack of data on psychological characteristics.

More on data and descriptive statistics

As mentioned earlier we use an unbalanced panel on graduates of Swedish universities working in the Swedish labor market in 1998-2008. The analysis is restricted to individuals below the age of 65. To control for education specifics, a separate analysis is done for graduates of 6 education areas, i.e social sciences, natural and technical sciences, medical sciences, teacher education and arts & humanities. Sample means of independent variables included in the model are presented in table 2 for social science graduates.[20] Individual characteristics are shown for each choice.

[19] We have also tried to control for the industrial composition of regions by including a variable indicating the share of service-oriented industries. However, the correlation coefficient between the number of regional employees and the share of service-oriented industries is 0.82, which results in collinearity problems and biased estimates.

[20] Descriptive statistics of variables for graduates from other education areas can be requested from the authors.

Table 2. Sample means of independent variables in the choice model for Social Science graduates.

Category	Variable	Mean	Std. Dev.	Min	Max
Employee	Gender (Man)	0.42	0.49	0.0	1.0
	Native background	0.95	0.32	0.0	1.0
	Age	36.0	6.60	21.0	64.0
	GPA	15.0	2.31	9.0	20.0
	PhD Level	0.02	0.12	0.0	1.0
Mixed Employee	Gender (Man)	0.55	0.49	0.0	1.0
	Native	96	0.28	0.0	1.0
	Age	38	6.84	23.0	64.0
	GPA	14.9	2.34	9.0	20.0
	PhD Level	0.07	0.25	0.0	1.0
Mixed Entrepreneur	Gender (Man)	0.52	0.50	0.0	1.0
	Native	0.94	0.31	0.0	1.0
	Age	38	10.58	23.0	64.0
	GPA	14.96	2.40	9.0	20.0
	PhD Level	0.03	0.28	0.0	1.0
Entrepreneur	Gender (Man)	0.64	0.47	0.0	1.0
	Native	0.95	0.30	0.0	1.0
	Age	40	9.36	23.0	64.0
	GPA	14.7	2.36	9.0	20.0
	PhD Level	0.08	0.25	0.0	1.0
Regional Characteristics	No of firms/No of employees	0.1	0.09	0.1	0.2
	Size of region in ths.	365	4.05	1.2	1,202
	No of observations	838,706			

The table shows, among other things, that men more frequently choose entrepreneurial occupations than women; moreover, their share is the highest, 64percent, among full-time entrepreneurs. The average age in all entrepreneurial categories is higher than in the category of employees and fluctuates from 38 to 40. When it comes to national background, the data suggest that the share of those with foreign backgrounds is almost the same in all categories (5percent). Furthermore the share of individuals with PhD degree is considerably high for mixed employees and entrepreneurs, suggesting that highly educated individuals prefer either a combination of wage employment and business activities or just the latter. As to differences in grade point average, the measure of individuals' ability, we observe that it is almost identical in all entrepreneurial categories.

The regional characteristics are presented in the bottom panel of the table. To account for the intensity of regional business activity we control for the number of firms in each of the 81 labor markets normalized by the number of the working population. The data suggest no difference in min and mean business intensities, whereas the variable is twice as high for the

most business intensive regions. Furthermore, according to our data, the size of labor markets, measured by the number of employees in each region, varies from 1,200 to 1,202,000 with a mean of 365,000.

5. The estimation method

There are two possible approaches for the estimation of the choice model described above. The first is to consider four occupational choices described above as four ordered categories and use an ordered choice model[21]. Another possibility is to describe the choice using the index of entrepreneurial activity, introduced in chapter 3.1, as a dependent variable and use tobit type regressions developed for censored but continuous dependent variables. We choose the first option as a main alternative since the index of entrepreneurial activity also captures the level of success and size of business for mixed categories, which is not our major interest. However, to check for robustness of our results we will try both approaches.

5.1 Ordered choice models

In ordered choice models the choice decision is based on an unobservable latent variable, which measures the "sentiment" toward the ranked alternatives (Hill et al., 2007). It is assumed that the choices we observe are based on a comparison of sentiment toward each choice relative to certain thresholds[22]. For the four alternative ordered model *(j=1,2,3,4)* the observation mechanism can be expressed as:

$$y_{it} = j \; if \; \mu_{j-1} < Y_{it}^{*} < \mu_j \; , j = 1,2,3,4$$

Where y_{it} is the observed choice of individual *i* at time *t*, $\mu_{j-1} \; and \; \mu_j$ are the corresponding threshold values to be estimated, Y_{it}^{*} is the unobserved sentiment and *j* is the alternative chosen. The probability of each choice can be estimated once an assumption about the distribution of the latent sentiment variable or equivalently random error term is made. Assuming that errors have standard normal distribution with 0 mean and a constant variance, we can use ordered probit models. Normally these models assume that the estimated coefficients do not vary between categories, which is known as parallel line assumption. This implies that threshold values are the same for all individuals and hence the individual heterogeneity is not accounted for (Pfarr et al., 2011). To cope with this problem, one can use generalized ordered probit models, where all threshold parameters depend on covariates. This specification allows for individual heterogeneity in coefficient estimates that leads to

[21] One can also use unordered multinomial models, which do not account for the ordered structure of the categorical variable.

[22] For more details see Hill et al, 2007.

heterogeneity across the categories of the dependent variable. In contrast to usual ordered models, generalized models cannot identify threshold values separately, but estimate the effect of each variable on each outcome category. This approach leads to estimation of *j-1* binary probit models, where the first model estimates category *1* vs *2,3..j*, the second model does the same regarding categories *1,2* vs *3…j* etc. However, as noted by many authors, while the first model disregards the heterogeneity problem, the assumptions made in the second are rather strong. Generalized ordered probit approach with an autofit procedure was developed to identify the variables meeting parallel line assumption and hence testing the assumption of heterogeneous thresholds (Williams, 2006, Pfarr et al., 2011). The procedure is based on the Wald test, which is applied to each variable to prove whether the coefficients differ across equations[23]. Generalized probit models are developed for both cross-section and panel data, with the latter allowing us to account for unobserved individual heterogeneity.

Thus, we use a random effects generalized probit model to capture two kinds of heterogeneity: First, the unobserved individual-specific heterogeneity not captured by cross sectional models and, second, differences in threshold values and therefore the heterogeneity in the reporting of categorical variables.

5.2 Non-random selection of universities

The main caveat with the estimation of equation (1) is in the violation of the assumption on randomness of independent variables. Individuals do not choose universities randomly, and there is some selection mechanism from both individuals and universities; if the factors affecting the selection of universities also affect the entrepreneurial attitude, then our estimates might be biased.

Hence, the possible selection problem[24], which arises due to correlation between the error term and selection variable needs to be controlled for.

The literature mainly discusses the possibility of sample correction for the case of binary selection variables with continuous or bivariate outcome variable (Cameron and Trivedi, 2005). However, as noted in Train (2009), since choice models are nonlinear, an additional layer of complication can restrict the applicability of the methods to the above-mentioned cases. Train (2009) describes 3 approaches as a solution to the problem with endogenous variables: The Berry, Levinsohn and Pakes (1995) approach, Petrin and Train (2009) control function approach and Villas-Boad and Winer (1999) maximum likelihood approach, which is

[23] For more details about the random effects generalized probit model see Pfarr et al., 2011

[24] Also called endogeneity of explanatory variable

closely related to the control function approach. We employ the control function approach applied in Petrin and Train (2009) due to its suitability to our setup and ease of implementation as compared to other approaches.

The main idea of the control function approach suggested in Petrin and Train (2009) is to account for the correlation between observed selection and unobserved factors via incorporation of a control function as an extra explanatory variable. The correlation implies that the unobserved factors conditional to the observed variables do not have a zero mean, as required for standard estimation. A control function is a variable that captures this conditional mean, controlling for the correlation.[25] If this can be done, the remaining variation in the endogenous variable will be independent of the error term and standard estimation approaches will be consistent.

The procedure is implemented in two steps. First, the endogenous regression variable/selection variable is regressed against exogenous variables (at least one variable not used in the main equation is required), explaining the selection equation; then the estimated regression is used to create a new variable, i.e. control function, that is entered into the choice model. The choice model is then estimated with the original variables plus one, accounting appropriately for the distribution of unobserved factors conditional on both this new and original variables. As noted in Petrin and Train (2009), because the second step uses an estimate of error from the selection model as opposed to the true value, the asymptotic sampling variance of the second-step estimator needs to take this extra source of variation into account, which can be achieved by bootstrapping.

So far, the central issue with the control function approach is the specification of the control function and the distribution of the choice model conditioned on the distribution of the selection model.

In our setup we first estimate the university choice equation as a function of individual characteristics such as gender, background, abilities, measured by GPA from upper secondary school, as well as parents' education level. The latter may have an effect on the choice of individuals' university, but is less likely to affect the career choice. The choice of all these variables is quite standard in literature and might be further complemented by data on parents' income level and other ability measures, which we do not have access to.

Thus, the choice of university is modeled as follows:

$$Uni_i = w(Z_i) + \mu_{i,} \qquad (2)$$

[25] For a more sophisticated discussion see Petrin and Train (2009)

where Z_i is the vector of the abovementioned variables and μ_i is the normally distributed error term. Uni_i is a binary variable taking the value 1 if the individual is graduated from a ranked university and 0 otherwise. Assuming that error terms in the university choice equation are normally distributed, and estimating the university choice equation by the linear probability model, we can find estimates of μ_i. Despite the obvious shortcomings of using linear probability model (LPM) with binary outcome, we use it to avoid complications with non-linear character of binary logit and probit models and to keep the structure suggested in Pertin and Train (2009). As mentioned in Wooldridge (2002), linear probability models can give quite accurate estimates of structural parameters. Angrist and Pishke (2009) give several examples where the marginal effects of a dummy variable estimated by LPM and probit techniques are "indistinguishable", and conclude that, though non-linear model provides a better fit for limited dependent variable models, this matters little when it comes to marginal effects.

Following Petrin and Train (2009) we define the control function (CF) as

$$CF(\mu_i) = \lambda\mu_i \tag{3}$$

Where $\mu_i$are estimates from the university selection model, and λ is the parameter of the function. Inserting the control function into the choice model, we get

$$Y_{it}^{*} = f(Uni_i, IndChar_i, LabM_{it}, Year_{it},)+\lambda\mu_i+\alpha_i + \varepsilon'_{it} \tag{4}$$

The error term ε_{it} from equation (1) is decomposed into a general part that can be explained by control function $\lambda\mu_i$and the new residual ε'_{it}. This new equation can be estimated by probit techniques assuming that ε'_{it} and μ_i are jointly normal with 0 mean and constant covariance matrix and given that the estimated error term from the selection equation is not correlated with the error term in the choice model. We further assume that individual specific effects are normally distributed and not correlated with the error term and other variables, which is required for applying a random effects ordered probit model.

5.3 An alternative estimation methods with entrepreneurial index as dependent variable

As an alternative to the above approach, we describe the entrepreneurial choice using an entrepreneurial index, defined in section 3, as a dependent variable. The latter is a continuous variable, which is censored from both left and right sides. It is 0 for individuals choosing wage employment and 1 for full-time entrepreneurs. To cope with the censored structure of the entrepreneurial index, we use the random effects tobit estimation technique (see more in

Cameron and Trivedi, 2005)[26]. In this case the observed entrepreneurial index Y_{it} is related to the latent variable Y_{it}^* through the following rule

$$Y_{it} = \begin{cases} LL \; if \; Y_{it}^* < LL \\ Y_{it}^* \; if \; LL < Y_{it}^* < UL \\ UL \; if \; Y_{it}^* > UL \end{cases}$$

Where LL and UL are the points for right and left censoring respectively. In our setup LL is 0, indicating wage employees and UL is 1 indicating entrepreneurs. To handle the sample selection problem, we apply the same control function approach. As noted by Imbens and Wooldridge (2007), the advantage of the control function approach for solving endogeneity problems is that it can work in both linear and non-linear frameworks, and hence can be applied to both ordered choice and tobit type models.

6. Results

The coefficient estimates for the random effects generalized ordered probit model are presented in Table3-8 for graduates of 6 education fields.[27] Applying the autofit procedure mentioned earlier, we have identified that the only variables that have equal slope across all categories are year dummies[28]; the coefficient estimates of all other variables vary across categories. The reported coefficients are the ones corresponding to the best model suggested by the Wald test on validity of parallel line assumptions. The coefficient estimates in each column compare the probability of each outcome to the probability of lower alternatives. Thus the coefficients reported in column 1 compare the probability of being in category 1 versus 2,3,4, whereas the coefficients reported in column 3 do the same for category 1,2,3 against 4. A positive coefficient means that the variable increases the probability of being in higher categories and the negative coefficient points to the opposite. Though the magnitude of coefficients does not say much about the absolute change in the likelihood of each outcome, it allows making judgments about the sign and significance as well as about the increasing or decreasing effect of the variable. The marginal effects are reported in table 1 of Appendix 2.
In the following we discuss the results for graduates of each education area separately.

[26] As a third alternative we have also used a treatment effects model with pooled data. Though this approach disregards the skewed distribution of the dependent variable, it allows estimating the treatment effect, i.e. the effect of graduating from a ranked university.

[27] We have also tried ordered and multinomial probit models with pooled samples and the results are identical. The comparison of pooled and panel estimates provide support for the latter, which is evidenced by rho coefficient estimates reported in the tables.

[28] In some cases parallel line assumption is also fulfilled for the control function variable estimated from the university choice model.

6.1 Social Science graduates

The coefficient estimates for social science graduates are presented in Table 3. The first thing to note is that the coefficients of university effect are strongly positive throughout the categories. This means that individuals graduated from internationally ranked universities are more likely to choose more entrepreneurial occupations. The effect is the lowest when comparing alternative 1 versus alternatives 2-4, and the highest for alternatives 1-3 versus 4. The marginal effect presented in table 1 of Appendix 2 ranges from 0.2 percent to 0.6 percent. Thus, though the absolute value of probability change is rather small, it is statistically significant with university effect being the strongest for the choice of mixed employment and entrepreneurship. In order to exclude the possibility of aggregation mistakes we have tried the same model with smaller subgroups, focusing on graduates of the same education program from ranked and non-ranked universities, and the results mainly support the presence of a positive university effect [29].

For social sciences graduates we further find that men are more interested in occupations with higher levels of entrepreneurial activity, and that the interest in entrepreneurial activities increases with age. When it comes to the difference in entrepreneurial attitudes of individuals with native and foreign backgrounds, the results indicate that native-born graduates are less interested in entrepreneurial occupations. Interestingly, our measure of abilities, i.e. grade point average from secondary school, is found to be insignificant, suggesting that entrepreneurial preferences are not affected by pre-university levels of abilities. At the same time the results indicate that individuals with PhD degrees are more likely to choose entrepreneurial occupations, but are more inclined to choose mixed employment rather than mixed or full-time entrepreneurship.

Table 3. Estimates of random effects generalized ordered probit model for social science graduates

VARIABLES	**Alt 1 vs 2,3,4**	**Alt 1,2 vs 3,4**	**Alt 1 ,2,3 vs 4**
Ranked University	0.256***	0.310***	0.300***
	(0.02)	(0.022)	(0.023)
Man	0.652***	0.724***	0.824***
	(0.02)	(0.021)	(0.022)
Native Background	-0.05	-0.114***	-0.072*
	(0.037)	(0.04)	(0.042)
Age	0.083***	0.090***	0.095***
	(0.001)	(0.001)	(0.001)

[29] We have done this exercise for the biggest subgroups. The results can be requested from the authors.

Table 3. (cont.)

VARIABLES	Alt 1 vs 2,3,4	Alt 1,2 vs 3,4	Alt 1 ,2,3 vs 4
GPA	0.005	-0.008	-0.001
	(0.005)	(0.006)	(0.006)
PhD degree	0.233***	-0.411***	-0.564***
	(0.018)	(0.021)	(0.025)
No of firms	4.846***	5.518***	4.364***
	(0.59)	(0.667)	(0.694)
No of employees (log)	-0.074***	-0.006	-0.003
	(0.005)	(0.006)	(0.006)
Control function	1.273***	1.658***	1.601***
	(0.124)	(0.132)	(0.136)
Constant	-8.521***	-9.745***	-10.320***
	(0.128)	(0.141)	(0.147)
rho	0.777***		
	(0.001)		
No of observations	838,706		

Standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)
Year dummies included

6.2 Medical Science graduates

The results for medical science graduates are reported in Table 4. We again find significant differences in entrepreneurial attitudes of graduates from ranked and non-ranked universities. Graduates of ranked universities are found to be more interested in occupations with higher level of entrepreneurial activity. The marginal university effect is highest for the choice of alternative 4, i.e. full-time entrepreneur, and equals 0.5 percent. We further find similar results for gender, age, native background and education level differences. At the same time, in contrast to social science graduates, the GPA score has a positive but decreasing effect, meaning that physicians with higher scores prefer entrepreneurship, but in inferior entrepreneurial categories.

Table 4. Estimates of random effects generalized ordered probit model for medical science graduates

VARIABLES	Alt 1 vs 2,3,4	Alt 1,2 vs 3,4	Alt 1 ,2,3 vs 4
Ranked University	0.335***	0.741***	0.825***
	(0.024)	(0.029)	(0.031)
Man	0.728***	0.716***	0.781***
	(0.035)	(0.039)	(0.04)
Native Background	-0.131***	-0.310***	-0.311***
	(0.04)	(0.043)	(0.045)
Age	0.315***	0.225***	0.269***
	(0.01)	(0.012)	(0.013)
GPA	0.053***	0.021**	0.017*
	(0.008)	(0.009)	(0.009)

Table 4. (cont.)

VARIABLES	Alt 1 vs 2,3,4	Alt 1,2 vs 3,4	Alt 1 ,2,3 vs 4
PhD degree	0.071***	-0.545***	-0.548***
	(0.017)	(0.021)	(0.022)
No of firms	6.680***	8.949***	6.800***
	(0.674)	(0.808)	(0.852)
No of employees (log)	-0.041***	0.034***	0.022***
	(0.006)	(0.007)	(0.008)
Control Function	0.698***	1.130***	1.246***
	(0.12)	(0.135)	(0.141)
Constant	-14.647***	-14.170***	-15.364***
	(0.242)	(0.297)	(0.329)
rho	0.810***		
	(0.002)		
No of observations	623,424		

Standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)
Year dummies included

6.3 Natural Science graduates

The results for natural science graduates are reported in Table 5. According to our estimates graduates of ranked universities systematically differ from graduates of non-ranked universities in this field. However the effect is decreasing and becomes negative and insignificant when comparing alternatives 1-3 to 4 , implying that while natural science graduates of ranked universities are more interested in mixed employment and mixed entrepreneurship, there is no statistically significant difference in the choice of full-time entrepreneurship. The marginal effect is decreasing from 1 to 0.1 percent. Similarly to social and medical science graduates, the interest in entrepreneurial occupations is higher for men and lower for those with a native background. Furthermore, the entrepreneurial attitude is increasing with age and decreasing with the level of education. The relationship between the GPA score and individuals' entrepreneurial attitude is found to be negative, meaning that, unlike physicians, natural science graduates with higher initial abilities prefer wage employment.

Table5. Estimates of random effects generalized ordered probit model for natural science graduates

VARIABLES	Alt 1 vs 2,3,4	Alt 1,2 vs 3,4	Alt 1 ,2,3 vs 4
Ranked University	0.235***	0.112**	-0.008
	(0.041)	(0.047)	(0.048)
Man	0.405***	0.419***	0.524***
	(0.028)	(0.032)	(0.034)
Native Background	0.022	-0.113*	-0.194***
	(0.057)	(0.063)	(0.065)

Table5. (cont.)

VARIABLES	Alt 1 vs 2,3,4	Alt 1,2 vs 3,4	Alt 1 ,2,3 vs 4
Age	0.226***	0.306***	0.342***
	(0.015)	(0.017)	(0.019)
GPA	-0.012	-0.065***	-0.073***
	(0.011)	(0.012)	(0.013)
PhD degree	-0.102***	-0.246***	-0.228***
	(0.015)	(0.018)	(0.019)
No of firms	8.932***	11.924***	8.587***
	(0.882)	(1.061)	(1.153)
No of employees (log)	-0.118***	-0.015*	0.037***
	(0.008)	(0.009)	(0.01)
Control Function	1.030***	1.563***	1.649***
	(0.207)	(0.236)	(0.249)
Constant	9.783***	12.601***	13.999***
	(0.368)	(0.429)	(0.451)
rho	0.800***		
	(0.003)		
No of observations	233,576		

Standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)
Year dummies included

6.4 Teacher Education graduates

The estimation results for teacher education graduates are reported in Table 6. The results show a systematic difference in the entrepreneurial attitudes of graduates from ranked and non-ranked universities, with university effect being highest for superior entrepreneurial categories. However, despite the significant statistical difference, the marginal difference, shown in table 2 of Appendix I2, is less than 0.2 percent.

Regarding other estimates, we find that the interest in entrepreneurship is higher for men and lower for individuals with a native background. Age is found to positively affect the entrepreneurial attitude. The results further suggest that teachers with a PhD degree prefer mixed employment, whereas other forms of entrepreneurship are less likely for them. Similarly to doctors, the GPA score has a positive effect on the formation of entrepreneurial attitude.

Table 6. Estimates of random effects generalized ordered probit model for teacher education graduates

VARIABLES	Alt 1 vs 2,3,4	Alt 1,2 vs 3,4	Alt 1 ,2,3 vs 4
Ranked University	0.098***	0.139***	0.117***
	(0.022)	(0.027)	(0.029)
Man	0.550***	0.353***	0.293***
	(0.049)	(0.053)	(0.054)

Table 6. (cont.)

VARIABLES	Alt 1 vs 2,3,4	Alt 1,2 vs 3,4	Alt 1 ,2,3 vs 4
Native Background	0.034	-0.129**	-0.231***
	(0.049)	(0.057)	(0.062)
Age	0.341***	0.239***	0.239***
	(0.011)	(0.014)	(0.016)
GPA	0.026**	0.015	0.002
	(0.012)	(0.012)	(0.013)
PhD degree	0.196***	-0.128	-0.172*
	(0.051)	(0.09)	(0.103)
No of firms	6.708***	5.314***	4.510***
	(0.647)	(0.834)	(0.885)
No of employees (log)	-0.061***	0.029***	0.004
	(0.006)	(0.008	(0.009)
Control function	2.363***	2.363***	2.363***
	(0.446)	(0.446)	(0.446)
Constant	-15.066***	-13.799***	-13.424***
	(0.257)	(0.34)	(0.392)
rho	0.807***		
	(0.002)		
No of observations	664,674		

Standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)
Year dummies included

6.5 Technical Science graduates

Table 7 reports the results for technical science graduates. The results suggest that, unlike graduates in other fields, technical science graduates of ranked universities do not differ from others in their entrepreneurial preferences. This means that university choice leaves no impact on further entrepreneurial choice of technical science graduates, i.e. technical education offered by internationally ranked universities is similar in terms of boosting entrepreneurial spirits and attitudes. It is worth noting that cross-sectional generalized ordered probit estimation as well as multinomial probit estimation confirm this result, implying no statistically significant difference between wage employment and other types of career choice for graduates from ranked and non-ranked universities in this field.

As for other estimates for this group, we find that men are more interested in entrepreneurial occupations, and individuals with a native background are less likely to choose mixed or full-time entrepreneurship. Like for all other groups the effect of age is positive and significant. The results of the GPA score are similar to those of natural scientists, i.e. those with higher scores are less interested in starting their own business. A PhD degree is negatively related to the interest in mixed or full-time entrepreneurship, but increases the probability of mixed employment.

Table 7. Estimates of random effects generalized ordered probit model for technical science graduates

VARIABLES	Alt 1 vs 2,3,4	Alt 1,2 vs 3,4	Alt 1 ,2,3 vs 4
Ranked University	-0.007	-0.007	-0.007
	(0.02)	(0.02)	(0.02)
Man	0.523***	0.598***	0.704***
	(0.032)	(0.035)	(0.036)
Native Background	-0.039	-0.128***	-0.098***
	(0.034)	(0.036)	(0.037)
Age	0.220***	0.279***	0.307***
	(0.008)	(0.009)	(0.01)
GPA	-0.014	-0.025**	-0.016
	(0.01)	(0.011)	(0.011)
PhD degree	0.088***	-0.187***	-0.207***
	(0.011)	(0.014)	(0.014)
No of firms	8.304***	9.294***	7.923***
	(0.587)	(0.67)	(0.694)
No of employees (log)	-0.049***	0.048***	0.056***
	(0.005)	(0.006)	(0.006)
Control function	0.863***	1.130***	1.034***
	(0.141)	(0.155)	(0.159)
Constant	-10.627***	-13.598***	-14.717***
	(0.193)	(0.224)	(0.233)
rho	0.800***		
	(0.002)		
No of observations	715,210		

Standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)
Year dummies included

6.6 Arts and Humanities graduates

The results for arts and humanities graduates are reported in Table 8 and are rather different. Here, graduates of ranked universities are found to be less interested in entrepreneurship than graduates of non-ranked ones. The model suggests significant but decreasing and negative coefficients for university effect, meaning that graduates of arts and humanities from ranked universities are less likely to choose categories with higher levels of entrepreneurial activity. The marginal effect is decreasing, from 6 to 2.5 percent, which is rather high compared to marginal differences for graduates of other disciplines. This, among other things, might mean that graduates of ranked universities have higher chances of wage employment and hence are less interested in starting their own business. Another possible reason is the heterogeneity of this education area. A closer look at education programs within this area indicates that ranked and non-ranked universities do not offer the same narrow specializations, implying that university effect might be caused by specialization differences. To shed light on

this issue we have tried to run the same regression for big subgroups with graduates from the same program in ranked and non-ranked universities. The results are ambiguous. For some education programs we find no university effect, and for others the effect is negative. Hence, one conclusion for arts and humanity graduates is that either graduates of internationally ranked universities do not differ from others or are less interested in entrepreneurial occupations, which, among other things, might be due to better employment possibilities.

Regarding the effect of other variables, the results indicate, as they do for graduates from other disciplines, that the entrepreneurial attitude increases with age and decreases with the level of education. However, in contrast to graduates of other education areas, men are found to be less interested in entrepreneurial occupations, though the marginal difference is less than 0.1 percent. Those with a native background are less interested in having their own business. Individuals with a higher GPA score show lower interest, thereby systematically differing from others in their choice of full-time entrepreneurship.

Table 8. Estimates of random effects generalized ordered probit model for arts and humanities graduates

VARIABLES	**Alt 1 vs 2,3,4**	**Alt 1,2 vs 3,4**	**Alt 1 ,2,3 vs 4**
Ranked University	-1.070***	-0.934***	-0.848***
	(0.034)	(0.036)	(0.038)
Man	0.023	-0.141***	-0.171***
	(0.042)	(0.044)	(0.046)
Native Background	-0.03	-0.209**	-0.177
	(0.095)	(0.104)	(0.113)
Age	0.258***	0.256***	0.325***
	(0.016)	(0.018)	(0.021)
GPA	-0.030**	-0.037***	-0.072***
	(0.012)	(0.012)	(0.013)
PhD	-0.179***	-0.595***	-0.546***
	(0.025)	(0.036)	(0.043)
No of firms	8.584***	10.043***	10.820***
	(1.17)	(1.288	(1.416)
No of employees (log)	0.091***	0.132***	0.098***
	(0.01)	(0.011)	(0.012)
Control function	4.260***	4.260***	4.260***
	(0.529)	(0.529)	(0.529)
Constant	-12.525***	-12.595***	-13.839***
rho	(0.462)	(0.507)	(0.573)
	0.791***		
	(0.003)		
No of observations	113,791		

Standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)
Year dummies included

6.7 Regional controls and control function

The impact of the number of firms in the region, which is included to control for the regional business intensity, is positive and significant in all regressions, suggesting that individuals' interest in entrepreneurship is higher in more business-oriented regions, which seems to be logical. The size of region, which is proxied by the number of regional employees, is positive for the arts and humanities, implying a higher likelihood of entrepreneurship in big regions for this group of people. However the results are rather ambiguous for graduates of other education areas, which might be due to the demand for businesses owned by graduates of different education areas.

As regards the estimates for the control function parameter included in the model, we would like to mention that it is significant and positive in all models, indicating the importance of controlling for unobserved factors that affect university choice. The linear probability estimates for university selection equation can be requested from the authors.

6.8 Random effects tobit model as a robustness check

As noted earlier, in order to check for the sensitivity of our results to the estimation method, we have also tried random effects tobit estimation, the results of which are summarized in Table 9. They mainly support the results of the random effects generalized ordered probit model, suggesting that graduates of ranked universities in the social and natural sciences, as well as teachers and physicians, are more likely to choose entrepreneurial occupations. No statistically significant difference is found for technical science graduates, whereas the university effect is negative for arts and humanities graduates.

Table 9. Results of random effects tobit model*

Variable/Field of education	Social SS	Medical SS	Natural SS	Teacher	Technical SS	Arts & Hum.
Ranked University	0.133***	0.189***	0.161***	0.057***	0.02	-0.443***
	(0.018)	(0.015)	(0.021)	(0.008)	(0.018)	(0.036)
Man	0.466***	0.366***	0.385***	0.197***	0.422***	0.119***
	(0.016)	(0.023)	(0.019)	(0.015)	(0.02)	(0.035)
Native Background	0.013	-0.047*	0.081	0.02	0.033	0.065
	(0.028)	(0.028)	(0.052)	(0.034)	(0.038)	(0.066)
Age	0.069***	0.051***	0.048***	0.031***	0.057***	0.024***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
GPA	0.005	0.021***	0.004	-0.003	-0.033***	-0.011
	(0.004)	(0.005)	(0.01)	(0.005)	(0.008)	(0.011)
PhD degree	0.008	-0.045***	-0.111***	-0.043	0.006	-0.097***
	(0.018)	(0.01)	(0.014)	(0.027)	(0.012)	(0.025)

Table 9. (cont.)

Variable/Field of education	Social SS	Medical SS	Natural SS	Teacher	Technical SS	Arts & Hum.
No of firms	3.680***	3.311***	3.336***	2.374***	6.089***	4.767***
	(0.481)	(0.548)	(0.642)	(0.28)	(0.602)	(0.672)
No of empl. (log)	-0.041***	-0.013***	-0.058***	-0.022***	-0.027***	0.046***
	(0.004)	(0.004)	(0.007)	(0.003)	(0.006)	(0.009)
Control function	1.129***	0.429***	0.697***	1.295***	1.114***	1.835***
	(0.114)	(0.086)	(0.162)	(0.197)	(0.113)	(0.476)
Constant	-6.601***	-4.997***	-4.619***	-3.348***	-5.934***	-4.467***
	(0.121)	(0.14)	(0.221)	(0.123)	(0.155)	(0.298)
No of observations	838,707	623,424	233,576	664,674	715,210	113,791

Standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)
Year dummies included
*The coefficients are interpreted as a partial derivative of the latent variable with respect to x.

7. Summary and final remarks

This study has aimed to analyze the relationship between the choice of university and graduates' subsequent interest in entrepreneurship. We have hypothesized that the quality of education might be associated with boosting entrepreneurship among graduates.

Using a 10-year panel on graduates from Swedish universities, we have analyzed the entrepreneurial choice of graduates from different universities and education fields. To describe the entrepreneurial choice, we suggest a typology of different types of entrepreneurship, the choice of which indicates individuals' preferences for entrepreneurial activities. We further classify Swedish universities into those ranked in international ranking lists and others. A random effects generalized order probit model is applied to estimate the relationship between entrepreneurial choice and university of graduation. We use a control function approach to account for university selection bias.

The results suggest that there is a systematic difference in the entrepreneurial choice of graduates from internationally ranked and non-ranked universities. In particular, graduates of ranked universities with degrees in the social, natural and medical sciences, as well as those educated as teachers, are found to be more interested in entrepreneurial occupations than graduates from non-ranked universities. In addition, there is no marginally significant difference in the entrepreneurial choice of graduates with a degree in technical sciences from ranked and non-ranked universities.

We conclude that the systematic difference in the career choice of graduates from ranked and non-ranked universities indicates that they either have different entrepreneurial preferences or different employment possibilities. If graduation from internationally ranked universities

means higher productivity and better employment possibilities ceteris paribus, then graduates from ranked universities should exhibit a lower frequency of entrepreneurial choices, as compared to graduates from non-ranked universities. This pattern emerges for arts and humanities graduates, suggesting that, among other things, their entrepreneurial attitude might be driven by lower possibilities of wage employment. However, for graduates of other disciplines, the difference in entrepreneurial choice must be attributed to their entrepreneurial preferences rather than employment possibilities. Hence, despite better employment prospects, they still show a preference for entrepreneurial occupations.

So far the results of this analysis suggest that university quality matters not only for the career development of alumni in terms of wages and employment possibilities, as also shown by other studies, but also for the formation of entrepreneurial preferences. Though the marginal effects are not big, they are statistically significant. We find that the ability of universities to enhance entrepreneurial aspirations is not the same for all types of education. The technical education of more prestigious universities is found to be no more entrepreneurial, implying that either the quality of technical education is not associated with educating more entrepreneurial graduates or that ranking indicators do not capture quality differences for this area of education.

Hence, this study suggests that, in general, the quality of education matters for graduates' career choice, implying that the ambition to boost the interest in entrepreneurship among graduates should be focused on improving the quality of education.

References

Acs, Z. (2006). How is entrepreneurship good for economic growth? *Innovations: Technology, Governance, Globalization,* 1(1), 97-107.

Amit, R., Glosten, L., Muller, E. (1993). Challenges to theory development in entrepreneurship research. *Journal of Management Studies*, 30: 815–834

Angrist, J., Pischke, J. (2008). Mostly harmless econometrics: An empiricist's companion. Princeton University Press.

Astebro, T., Bernhardt, I. (2003). Start-Up Financing, Owner Characteristics and Survival, *Journal of Economics and Business*, 55(4), 303—320.

Audretsch, D., Fritsch, M. (1994). The geography of firm births in Germany. Regional studies, 28(4), 359-365.

Baumol, W. (2009). Education for Innovation: Entrepreneurial breakthroughs vs. corporate incremental improvement. NBER Working Paper 10578

Bank Boston. (1997). MIT: The impact of innovation. A BankBoston Economics Department special report.

Bergmann, H., Sternberg, R. (2007). The changing face of entrepreneurship in Germany, *Small Business Economics* 28, 205-221

Black, D., Smith, J. (2004). How robust is the evidence on the effects of college quality? Evidence from matching. *Journal of Econometrics* 121 (1-2), 99-124.

Black, D., Smith, J. (2006). Estimating the Returns to College Quality with Multiple Proxies for Quality. *Journal of Labor Economics*.

Blanchflower, D., Oswald, A. (1998). What makes an entrepreneur? *Journal of Labor Economics*, 16 (1) , pp. 26–60.

Blanchflower, D. (2000). Self-employment in OECD countries. *Labor economics*, 7(5), 471-505.

Brand, J., Halaby, C. (2006). Regression and matching estimates of the effects of elite college attendance on educational and career achievement. *Social Science Research* 35 , pp 749–770.

Bratti, M. (2002). Does the choice of university matter? A study of the differences across UK universities in life sciences students´ degree performances. *Economics of Education Review* 21 (3), 431-443.

Braunerhjelm, P. (2010). Entrepreneurship, Innovation and Economic Growth – past experience, current knowledge and policy implications, Paper No. 224, *CESIS Working Paper Series.*

Braunerhjelm, P. (2007). Academic entrepreneurship: social norms, university culture and policies. *Science and Public Policy*, 34(9), 619-631.

Braunerhjelm, P., Broström, A., Åstebro, T. (2012). Does Academic Entrepreneurship Pay? Royal Institute of Technology, Paper No. 289. CESIS Working Paper Series

Brewer, D., Eide, E., Ehrenberg, R. (1999). Does it pay to attend an elite private college? *Journal of Human Resources* 34 (1), 105-123.

Broström, A., Källblad, E. (2005). The KTH Entrepreneurial Faculty Project. VINNOVA report, VR 2005:13.

Brown, S., Sessions, J.(2004). Signaling and Screening. In Geraint J. & Johnes J. (eds) *International Handbook on the Economics of Education*. Cheltenham. Edward Elgar

Burke, A., FitzRoy, F., Nolan, M. (2002). Self-employment, Wealth and Job Creation: The Roles of Gender, Non-pecuniary, Motivation and Entrepreneurial Ability, *Small Business Economics* 19: 255–270.

Cameron, C., Trivedi, P. (2005). *Microeconometrics: Methods and Applications.* Cambridge University Press.

Carree, M., Thurik, R. (2005). *Understanding the role of entrepreneurship for economic growth.* The Handbook of Entrepreneurship and Economic Growth.

Chevalier, A., Conlon, G. (2003). Does it pay to attend a prestigious university? *IZA Discussion Paper No. 848.*

Ciriaci, D., Muscio, A. (2010). Does university choice drive graduates' employability? *MPRA Working Paper No 22846.*

Dale S., Krueger, A. (2002). Estimating the payoff to attending a more selective college. An application of selection on observables and unobservables. *Quarterly Journal of Economics* 117 (4), 1491-1527.

Dale, S., Krueger, A. (2011). Estimating the return to college selectivity over the career using administrative earnings data. *Working Paper 17159. National Bureau of Economic Research*

Doms, M., Lewis, E., Robb, A. (2010). Local labor force education, new business characteristics, and firm performance. *Journal of Urban Economics* 67, pp 61-67.

Dunn, T., Holtz-Eakin, D. (2000). Financial capital, human capital, and the transition to self-employment: evidence from intergenerational links, *Journal of Labor Economics*, 18 pp. 282–305.

Eliasson, K. (2006). College Choice And Earnings Among University Graduates in Sweden. Umeå Economic Studies 693, Umeå University, Department of Economics.

Evans, D., Jovanovic, B. (1989). An Estimated Model of Entrepreneurial Choice under Liquidity Constraints. *Journal of Political Economy*, Vol. 97, No. 4 (Aug., 1989), pp. 808-827

Evans, D., Leighton, L. (1989). Some empirical aspects of entrepreneurship. *American Economic Review*, 79, 519±535.

Falck, O., Woessmann, L. (2010). School competition and students' entrepreneurial intentions: International evidence using historical Catholic roots of private schooling. *Small Business Economics*, 1-20.

Folta, T., Delmar, F., Wennberg, K. (2010). Hybrid Entrepreneurship. *Management Science*, Vol. 56, No. 2, pp. 253–269.

Fox, M. (1993). Is it a good investment to attend an elite private college? *Economics of Education Review* 12, no. 2:137-15.

Gilad, B., Levine, P. (1986). A behavioral model of entrepreneurial supply. *Journal of small business management*, 24(4), 45-53.

Glaeser, L. (2007). Entrepreneurship and the city, *NBER working paper no. 13551*.

Glaeser, L., Rosenthal, S., Strange, W. (2010). Urban economics and entrepreneurship. *Journal of Urban Economics*, Vol 67

Gold, R., Falck, O., Heblich, S. (2011). The Long Wind of Change. Educational Impacts on Entrepreneurial Intentions. In ERSA conference papers. European Regional Science Association.

Hammarstedt, M. (2004). Self-employment among immigrants in Sweden–an analysis of intragroup differences. *Small Business Economics, 23*(2), 115-126

Harmon, C., Osterbeek, H., Walker, I. (2003). The returns to education: Microeconomics. *Journal of Economic Surveys*, 17(2), 115-156.

Heckman, J., Robb, R. (1985). Alternative Methods for Evaluating the Impact of Interventions. In Heckman, J., B. Singer, eds., *Longitudinal Analysis of Labor Market Data.* New York: Cambridge University Press, pp. 156-245.

Herrmann, K., Hannon, P., Cox, J., Ternouth, P., & Crowley, T. (2008). Developing entrepreneurial graduates: putting entrepreneurship at the centre of higher education. Council for Industry and Higher Education (CIHE), National Council for Graduate Entrepreneurship (NCGE) and National Endowment for Science, Technology and the Arts (NESTA), London.

Hermansson, K. 2011. The overall economic impact of higher education institutions (HEI) on their host sub-regions: Multi-sectorial analysis for the city of Glasgow, *Dissertation*, Department of Economics, University of Strathclyde

Hill, R. C., Griffiths, W. E., & Judge, G. G. (2007). *Using Stata for principles of econometrics.* Wiley

Hoekstra, M. (2009). The effect of attending the flagship state university on earnings: A discontinuity-based approach. *The Review of Economics and Statistics*, *91*(4), 717-724.

Holmlund, L. (2009). The effect of college quality on earnings - Evidence from Sweden. *Umeå Economic Studies*, 781

Högskoleverket Report (2004).Cooperation with the surrounding community in higher education.

Imbens, J., Wooldridge J. (2007). What is new in Econometrics, NBER Lecture Notes 6, Italy.

Jacob, M., Lundqvist, M., Hellsmark, H. (2003). Entrepreneurial transformations in the Swedish University system: the case of Chalmers University of Technology. *Research Policy*, 32(9), 1555-1568.

Kihlstrom, R., Laffont, J. (1979). A general equilibrium entrepreneurial theory of firm formation based on risk aversion. *The Journal of Political Economy*, 719-748.

KTH Entrepreneurial Faculty Project" (2005). At http://www.vinnova.se/sv/Aktuellt--publicerat/Publikationer/Produkter/The-KTH-Entrepreneurial-Faculty-Project.

Lazear, E. (2005). Entrepreneurship. *Journal of Labor Economics*, Vol 23, No 4, pp 649-680

Lee, A. (1999). Empirical Studies of Self-Employment. *Journal of Economic Surveys*, Vol. 13, No. 4.

Lindahl, L., Regner, H. (2005). College Choice and Subsequent Earnings: Results Using Swedish Sibling Data. *The Scandinavian Journal of Economics*, Volume 107, Issue 3, pages 437–457.

Long, M. (2008). College Quality and Early Adult Outcomes. *Economics of Education Review*, 27(5), 588-602.

Lucas, R. (1978). On the Size Distribution of Business Firms. *The Bell Journal of Economics*, 508-523.

Lundin, M. (2006). Effects of college choice on incomes in Sweden. Swedish Institute For Growth Policy Studies, Working paper R2007:016.

Luthje, C., Franke, N.(2002). Fostering entrepreneurship through university education and training: Lessons from Massachusetts Institute of Technology. Paper presented at 2nd Annual Conference on: Innovative Research in Management, May 9 – 11, 2002, Stockholm, Sweden.

McGuinness, S. (2003). Graduate Overeducation as a Sheepskin Effect: Evidence from Northern Ireland. *Applied Economics*, 35(5), pp. 597–608.

McGuinness, S. (2003). University quality and labour market outcomes. *Applied Economics*, 35: 1943–1955.

McMullan, W., Chrisman, J., Vesper, K. (2002). Lessons from successful innovations in entrepreneurial support programming. In Chrisman, J.J., Holbrook, J.A.D., &Chua, J.H. (eds.), Innovation and Entrepreneurship in Western Canada: From Family Businesses to Multinationals. Calgary, Alberta: University of Calgary Press.

Monks, J. (2000). The returns to individual and college characteristics. Evidence from the national longitudinal survey of youth. *Economics of Education Review* 19 (3), 279-289.

Nabi, G., Holden, R. (2008). Graduate entrepreneurship: intentions, education and training. *Education+ Training*, 50(7), 545-551.

Parker, S. (2009). *The economics of entrepreneurship.* Cambridge University Press

Peterman, N., Kennedy, J. (2003). Enterprise education: Influencing students' perceptions of entrepreneurship. *Entrepreneurship theory and practice*, 28(2), 129-144.

Petrin, A., Train, K. (2009). A Control Function Approach to Endogeneity in Consumer Choice Models, *Journal of Marketing Research*, Vol XLVI.

Pfarr, C., Schmid, A., Schneider, U. (2011). Estimating Ordered Categorical Variables Using Panel Data: A Generalized Ordered Probit Model With an Autofit Procedure. *Journal of Economics and Econometrics*, Vol 54, No.1 pp-7-23.

Pietro, G., Cutillo, A. (2006). University quality and labour market outcomes in Italy. *Labour*, 20(1), 37-62.

Poschke, M. (2008). Who Becomes an Entrepreneur? Labor Market Prospects and Occupational Choice, *IZA Discussion Paper No. 3816*

Rees, H., Shah, A. (1986). An empirical analysis of self-employment in the U.K. *Journal of Applied Econometrics*, 1(1), 95-108.

Reynolds, P., Bygrave, W., Autio, E., Cox, L., Hay, M. (2002). Global Entrepreneurship Monitor, 2002 Executive Report.

Reynolds, P., Storey, D. J., Westhead, P. (1994). Cross-national comparisons of the variation in new firm formation rates. *Regional Studies*, 28(4), 443-456.

Robst, J. (1995). Career mobility, job match, and overeducation. *Eastern Economic Journal*, 21(4), 539-550.

Smart, J. (1986). College effects on occupational status attainment. *Research in Higher Education*, 24 (1).

Sobel, R., King, K. (2008). Does school choice increase the rate of youth entrepreneurship? *Economics of Education Review*, 27(4), 429-438.

Stuart, T., Ding, W. (2006). When Do Scientists Become Entrepreneurs? The Social Structural Antecedents of Commercial Activity in the Academic Life Sciences1. *American Journal of Sociology*, 112(1), 97-144.

Train, K. (2009). *Discrete Choice Models with Simulation*. Cambridge University Press

Van der Sluis, J., van Praag, M., Van Witteloostuijn, A. (2007). Why Are the Returns to Education Higher for Entrepreneurs than for Employees? *IZA WP No. 3058.*

Van der Sluis, J., Van Praag, M. (2004). Economic returns to education for entrepreneurs: The development of a neglected child in the family of economics of education? *Swedish Economic Policy Review*, 11.

Van der Sluis, J., Van Praag, M. (2010). Education and entrepreneurship selection and performance: a review of the empirical literature. *Journal of Economic Surveys*, 2010, Vol. 22, No. 5, pp. 795-841.

Van Praag, C., Versloot, P. (2007). What is the value of entrepreneurship? A review of recent research. *Small Business Economics*, 29(4), 351-382.

Van Praag, M., Cramer, J. (2001). The Roots of Entrepreneurship and Labour Demand: Individual Ability and Low Risk Aversion. *Economica* , 45-62.

Van Stel, A. (2005). COMPENDIA: Harmonizing business ownership data across countries and over time. *International Entrepreneurship and Management Journal*, 1(1), 105-123.

Verheul, I., Thurik, R., Hessels, J., & van der Zwan, P. (2010). Factors influencing the entrepreneurial engagement of opportunity and necessity entrepreneurs. *EIM Research Reports H*, *201011*, 1-24.

Wennekers, S., hurik, R. (1999). Linking entrepreneurship and economic growth. *Small business economics*, 13(1), 27-56.

Williams, R. (2006). Generalized ordered logit/partial proportional odds models for ordinal dependent variables. in: *Stata Journal*, 6(1), pp. 58–82.

Wilson, F., Kickul, J., Marlino, D. (2007). Gender, Entrepreneurial Self-Efficacy, and Entrepreneurial Career Intentions: Implications for Entrepreneurship Education. *Entrepreneurship Theory and Practice*, 31 (3), pp 387-406.

Wooldridge, J.(2002) *Econometric Analysis of Cross Section and Panel Data*. The MIT Press

Appendix 1

Table 1. Swedish HEIs listed in international university ranking (Academic Ranking of World Universities)

Chalmers University of Technology
Göteborg University
Stockholm School of Economics
Karolinska Institute
Royal Institute of Technology
Linköping University
Lund University
Stockholm University
Swedish University of Agricultural Sciences
Umeå University
Uppsala University

Appendix 2

Table 2. Marginal effects corresponding to random effects generalized ordered probit model reported in table 3-8*

Field of education	Occupational Choice	Ranked University	Man	Native Backgr	Age	GPA	PhD level
Social SS	Mixed empl.	0.006	0.017	0.000	0.002	0.001	0.026
	Mixed entr.	0.002	0.003	-0.002	0.001	0.000	0.001
	Entrepreneur	0.006	0.019	-0.002	0.002	0.000	-0.013
Medical SS	Mixed empl.	0.003	0.016	-0.001	0.008	0.002	0.008
	Mixed entr.	0.002	0.002	-0.001	0.000	0.000	-0.002
	Entrepreneur	0.005	0.005	-0.002	0.002	0.000	-0.003
Natural SS	Mixed empl.	0.011	0.014	0.004	0.006	0.001	0.000
	Mixed entr.	0.003	0.001	0.001	0.001	0.000	-0.002
	Entrepreneur	0.000	0.010	-0.004	0.007	-0.001	-0.004
Teachers	Mixed empl.	0.002	0.014	0.002	0.009	0.001	0.007
	Mixed entr.	0.001	0.001	0.000	0.001	0.000	0.000
	Entrepreneur	0.001	0.001	-0.001	0.001	0.000	-0.001
Technical SS	Mixed empl.	0.000	0.013	0.001	0.005	0.000	0.010
	Mixed entr.	0.000	0.000	-0.001	0.001	0.000	0.000
	Entrepreneur	0.000	0.016	-0.002	0.007	0.000	-0.005
Arts &Hum	Mixed empl.	-0.064	0.009	0.007	0.013	-0.001	0.012
	Mixed entr.	-0.024	-0.002	-0.005	0.003	0.000	-0.013
	Entrepreneur	-0.031	-0.005	-0.005	0.010	-0.002	-0.016

*The table reports the marginal probability effect of each variable on the respective entrepreneurial choice. For example the probability that a social science graduate will choose the occupation of entrepreneur will increase by 0.6 percent if the individual is a graduate of an internationally ranked university.