Higher education experiences and new venture performance

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Abstract:

Human capital theory suggests that higher education, as a means of capability creation and of ability screening, is positively associated with individuals' success as entrepreneurs. This paper argues that social capital perspectives, in particular the theory of local embeddedness and team formation theory, complement human capital theory in explaining the relationship between higher education attainment and entrepreneurial success. However, human and social capital perspectives apply to different domains. While the former is appropriate for knowledge-based entrepreneurship, the latter is primarily valid in contexts where specialized analytical knowledge plays a less accentuated role. These propositions are supported by an investigation of survival and growth of entrepreneurial ventures in Sweden.

Keywords: higher education, entrepreneurship, universities, entrepreneurial performance

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1. Introduction

Human capital theory is a cornerstone in the literature on new venture performance. While a series of refined conceptualisations and empirical operationalisations have been developed over the years (see e.g. Unger et al, 2011, for an overview), formal education maintains a central role as source of and indicator of human capital. Consistent with this view, a wide empirical literature reports that for the average new venture, higher education attainment of entrepreneurs is positively related to entrepreneurial performance (Gilbert et al., 2006; van der Sluis and van Praag, 2008). There remain, however, unresolved contradictions between different attempts to analyse the contingencies of this relationship. Colombo and Grilli (2005) suggest that in the context of Italian technology-based firms, the field of study of the founders determines the impact of education on venture growth. Doms et al. (2010) identify non-linear relationships between the length of higher education and venture performance and a contingency between entrepreneurs' education attainment and local labour market education levels among US self-employed. Backes-Geller and Werner (2006) find evidence that among German start-ups, educational attainment facilitates recruitment and credit obtainment in innovative ventures only. The latter relationship is furthermore only valid for entrepreneurs who managed to complete their degrees faster than average. Ambiguities of these kinds pose the most plausible explanation to the fact the frequent occurrence of studies which, contrary to the majority of empirical studies, report insignificant or non-robust impact of higher education on entrepreneurial performance (Storey, 1994).

In its original form, the concept human capital encompasses skills and abilities acquired both in formal education, through on-the-job training and through work experience (Becker, 1962).[1]Interestingly, the latter manifestation of human capital has repeatedly been analysed in relation to a related (and thriving) theoretical perspective: that of social capital.

Human and social capital theories provide complementary perspectives on what kind of capabilities and resources that allow entrepreneurs to identify and capitalize on extant market opportunities. In particular, they provide important underpinnings for the literature on entrepreneurial teams. Eisenhardt and Schoonhoven (1990) established the view that work experience does not only provide skills and experiences, but also potentially valuable linkages between individuals, as they reported that in a sample of U.S. semiconductor ventures, funding team composed of people with joint experiences outperformed other ventures in terms of firm growth. The view of human and social capital creation as simultaneous processes has in recent literature linking team formation to venture performance been developed and refined (Kor, 2003; Zheng, 2012). However, this connection has only been made for the case of work experience. Relationships been the most traditional manifestation of human capital – higher education attainment – and social capital creation has been left unexplored.

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[1] Becker, in his 1962 paper, mentions "medical care, vitamin consumption, and acquiring information about the economic system" as further ways through which individuals increase their human capital.

In this paper, we argue that social capital perspectives – in particular the theory of local embeddedness and team formation theory –complement human capital theory in explaining the relationship between higher education attainment and entrepreneurial success. However, human and social capital perspectives apply to different domains. While the former is appropriate for knowledge-based entrepreneurship, the latter is primarily valid in contexts where specialized analytical knowledge plays a less accentuated role. These findings are supported by an investigation of survival and growth of entrepreneurial ventures in Sweden between 2002 and 2008.

This study adds to the extant literature on team characteristics and entrepreneurial performance by expanding the potential role of higher education for entrepreneurship from its well-established role as a source of human capital (i.e. generation of specific skills, general capabilities and accreditation) to a view of higher education as a source of internally oriented social capital (i.e. common norms, language, mutual competence screening abilities) as well as externally oriented social capital (i.e. networks beyond the firm). By pointing out the differential roles of these potential resources in knowledge-intensive and less knowledge-intensive contexts, respectively, this study also points towards opportunities to achieve convergence in a literature currently sprawling with different conceptualisations, findings and interpretations as regards the importance of these capital concepts for entrepreneurial venturing.

The remainder of this paper is organised as follows. Section 2 reviews three possible roles of higher education for entrepreneurial performance in light of previous empirical literature and discusses study design choices. Section 3 delineates the data and methods used and Section 4 reports the preliminary econometric results of the empirical analysis. In Section 5, the findings are commented and avenues for further development of the present analysis are briefly discussed.

2. Higher education as a source of both human and social capital

2.1 Human capital: Skills, capabilities and signaling

The human capital perspective on business venturing offers several related arguments for why entrepreneurs' higher education attainment can be expected to positively affect the performance of new ventures. Four main lines of argument can be identified. 1) As suggested already in the first treatments of human capital, the individual acquires skills and abilities through education (Becker, 1962). In particular, in certain educational contexts students acquire discipline-specific knowledge which is difficult to build up through on-the-job experience. In some contexts of practice, certification of skills through academic degrees even serves as a formal accreditation for practioneers (e.g. in medical and juridical practice). 2) Education facilitates future learning (Heckman, 2000). The most important things taught in universities, it can be argued, is the ability to process complex information and the training of effective routines for learning (Heijke et al., 2003). Education also serves as a signal of high ability of both kinds described above. Irrespective

of what skills and abilities the individual actually learned at university, the ability to be accepted into and successfully complete studies signals competence to stakeholders. Such signaling may help entrepreneurs raise capital (Bates, 1990; Gimmon and Levie, 2010) and reduce market frictions by facilitating relationship building with customers and potential employees (Bakes-Geller and Werner, 2006). 4) Since highly educated individuals enjoy in general a wage premium, their reservation wage associated with the choice to pursue entrepreneurship will be higher than that of the non-educated (Gimeno et al., 1997). That is, firms founded by highly educated people are associated with higher expectations on returns, all else equal.[2]

Skeptics have argued that there may also exist balancing negative relationships between higher education and entrepreneurial performance. Holding an individual's age fixed, the benefits of time spent in education may be off-set by decreased time spent accruing work experiences. Since the type of human capital accrued through on-the-job training and work experience is at least as strong a predictor of entrepreneurial performance as that created through education, the net marginal benefits of schooling can be argued to become negative at some point. Furthermore, it has been suggested that the characteristics of the cognitive abilities developed through academic studies are poorly matched to the demands of successful entrepreneurship. For example, Davidsson and Honig (2003) report that highly educated individuals are more likely to identify opportunities for entrepreneurship, but not to set up viable active firms.

Recent research has emphasised the need to understand the contingencies of all the relationships outlined above. In particular, the conceptualisation of higher education as a source of skills and abilities with substantial value for entrepreneurial venturing seems to apply primarily to contexts where continuous absorption, use and communication of complex, specialised knowledge form a basis for competitiveness. In contexts where the demand for knowledge processing is generally low, or where the knowledge relevant to business development is of a very context-specific nature, the trade-off between investments in academic and job experiences described above can be expected to balance out on much lower levels of education than for knowledge-intensive contexts. This conjecture is in line with, but more general than, suggestions that the type of human capital that is created by higher education primarily is valuable for venturing in "innovative" (Backes-Geller and Werner, 2006) or "high-technology" (Unger et al., 2011) contexts.

Hypothesis 1: In knowledge-intensive business contexts, founding teams consisting of people with higher education degrees perform better than teams without such merits.

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[2] This argument has a double-sided implication for venture survival prospects. Since a higher reservation wage also means a lower tolerance with underperformance. Ventures founded by highly educated entrepreneurs may therefore survive either longer (since they are founded on higher expectations) or shorter (since they are abandoned quicker if expectations are not met) than ventures founded by non-educated individuals.

2.2 Internal social capital: Education-based ties between team members

Social ties between firm founders can be claimed to facilitate the start-up process drawing on two sets of literature. As suggested by labour economists, pre-existing contacts increase founders' ability to appropriately judge the skills of each other, thereby facilitating team formation processes (Montgomery, 1991). Research in psychology and management has shown how shared cognition between founding team members bolsters the performance of new ventures (Tsai and Ghoshal, 1998). Shared norms and language will help founding team members to work efficiently towards a joint vision, for example by facilitating the creation of routines within the new firm. A founding team where social ties exist between team members may even have pre-existing routines that can be implemented in their new venture. More generally, socially based ties increase the level of trust between members and the ability to screen motivational factors and abilities between individuals in processes of team formation (Aldrich and Kim, 2007). While very few firms are founded by people who are total strangers to each other, social ties are typically not symmetrically strong among all pairs or team members. Teams where ties are shared by many – or all – members of a team (such as e.g. teams formed of people who previously worked together) will on the margin have enhanced capacity for coordination and collaboration.

Empirical tests of the importance of internally oriented social capital for entrepreneurial performance, that proxy shared cognition with previous shared working experience, strongly support these theoretical arguments for the importance of pre-existing social ties in venture creation. Eisenhardt and Schoonhoven (1990) found that within the U.S. semiconductor industry, founding teams with joint prior work experience had higher levels of growth than teams with less overlapping experience. Beckman (2006) and Timmermans (2010) report evidence that joint experience, as captured by founders' joint affiliation to the same organization, was associated with improved innovation performance among young Silicon Valley firms and better survivability of new Danish firms, respectively.

In spite of these findings, the corresponding social aspects of higher education experiences have long remained largely unexplored in economic contexts. We suggest that higher education experiences create ties between persons and shared cognition that can be valuable in entrepreneurial activities. Education brings young people together for an extended period of time, giving rise to social ties between individuals. Such ties can be expected to arise most strongly between people attending similar courses, suggesting that shared cognition between students in many cases may be the combined result of social interaction and curriculum-based indoctrination into a specific epistemic community (Colombo and Grilli, 2005). Nonetheless, many students develop social ties that extend beyond educational boundaries, e.g. by participating in cross-disciplinary courses, by engaging in student societies and by the chances of dorm life. Social ties founded on any of these student-life experiences can be expected to help teams when launching a new venture, drawing on the arguments of shared cognition, trust and enhanced screening opportunities that have been outlined above.

Notably, however, entrepreneurs who are strongly influenced by socially based ties in the process of forming entrepreneurial teams may run the risk of narrowing down search more than what is appropriate (c.f. Aldrich and Kim, 2007). In knowledge-intensive business contexts, within-team variety and complementarity of competence is a key factor for venture success (Colombo and Grilli, 2005). In such contexts, founders should be expected to be more likely to go beyond immediate social ties to assemble optimal teams. Reliance on social ties may even be interpreted as signaling a lack of ability or ambition to arrange optimal conditions for venture success. Therefore, we suggest that the potential advantages of education-based social ties between founders that are outlined above are primarily relevant in less knowledge-intensive business contexts.

Hypothesis 2: In less knowledge-intensive business contexts, founding teams with shared higher education background perform better than teams without such experiences.

2.3 External social capital: Education-based local networks

For a new venture, founders' socially embedded network ties constitute an important resource base (Hite and Hesterley, 2001; Lechner and Dowling, 2003). Over the last two decades, entrepreneurship research has demonstrated that various measures of a new firms' social capital, as constituted by social contacts robustly and positively predicts business success (see e.g. Brüderl and Preisendorfer, 1998; Hoang and Antoncic, 2003). In recent literature on the economic impact of social networks, experiences from education - and particularly higher education experiences - have become recognised as highly important venues for network formation. Cohen et al. (2008) and Cohen et al. (2010) report that mutual fund investors and financial analysts, respectively, are able to draw on educational network linkages to firm managers to achieve superior economic performance. Lerner and Malmendian (2008) find that peer effects among students at Harvard Business School affects the performance of graduates who pursue entrepreneurship. Localised social ties originating in higher education experiences have also been suggested to affect the localization decisions of entrepreneurs, in effect increasing the attractiveness of the "home" university region (Heblich and Slavtchev, 2013; Baltzopoulos and Broström, 2013).

In this study, we add to this emerging evidence by exploring the role of social ties created through education for entrepreneurial performance. Education-based contacts, in particular those of a "weak ties" nature, are more likely to prove economically useful in early-stage venturing activities when locally accessible (c.f. Schutjens and Stam, 2003). We therefore suggest that the extent to which founders of a new venture have localised access to people with whom they have studied at university is a useful approximation of the amount of external education-derived social capital available to that venture. But we posit that also this second kind of social capital constitutes a substantial source of competitive advantage only in less knowledge-intensive business contexts. This expectation is, somewhat paradoxically, based on the view of networking as a more critically important activity in more knowledge-intensive business contexts than in other business settings (Sweeny, 1987). Verifying this notion, entrepreneurs in such contexts have

been found to strategically develop professional rather than socially based local ties (Johanisson, 1998; Vissa, 2011). Hence, while contacts developed during educational experiences may be useful also for entrepreneurs in knowledge-intensive business contexts, we expect that the limitations of education-based social networks will render them useful primarily in more mundane settings.

Hypothesis 3: In less knowledge-intensive business contexts, founding teams with greater local access to alumni that have studied with team members perform better than other teams

3. Data and Methods

3.1 Operationalisation of key concepts

The three hypotheses developed above concern three concepts which need to be empirically operationalised to allow formal testing. The first concept is that of knowledge-intensive vs. less knowledge-intensive business contexts. Following the literature on firm performance (c.f. Almus and Nerlinger, 1999), we proxy this concept with existing classifications of industries. For the manufacturing industry, we use the sectoral classification of OECD into low-tech and high-tech sectors. For service sectors, we distinguish between knowledge-intensive business services (KIBS; traditionally identified by NACE-codes 72-74) and the rest. The high-tech manufacturing and KIBS sectors are for the purpose of this paper referred to as knowledge-intensive (KI) and the remainder or the sectors as less knowledge-intensive (LKI). The primary and public sectors are excluded from the analysis

We next turn to defining an empirical equivalent to a founding team of a new firm. In the first generation of studies on founding team composition, the empirical focus lay on the composition of co-owners of new ventures. Campbell (2005) argue for the inclusion of early-phase employees into the analysis of the linkage between founder team composition and new firm performance. In many types of firms – in particular those who are active in knowledge and competence intensive industries – early employees could be expected to influence firm performance in similar ways as founding owners. In a new venture, founding owners must coordinate their activities not only among themselves, but also with early employees. Entrepreneurial efforts may therefore benefit from the presence of common norms, language and experiences between any members of the founding team (owners and employees alike). In particular, this assumption seems plausible for new ventures in the Scandinavian countries, where management styles are typically more oriented towards consensus building and the role model for managers is often described as "primus inter pares" (first among equals) (Warner, 2000). Firm performance may also be expected to be positively affected by managers' abilities to screen potential employees, and by the ability of potential employees' to assess the competence of founders (and thereby increasing their

willingness to take on a position in a new venture).[3] A joint background between founders and employees would seem to facilitate all these needs (Timmermans, 2010). In view of this discussion, we define the *founding team* of a new firm to consist of both owners who actively work in the firm and any employees who are recruited to the new firm during its first year in existence.

A third concept that needs to operationalized is that of entrepreneurial performance. Our point of departure is to consider firm growth, treating exits as a truncation of the growth measure. In other words, we consider exit from the market and growth rates of surviving firms to be governed by the same process (that is, a parallel relationship between measures of survival and growth and the independent variables). However, not all firms have an ambition to grow substantially. Loss of control, increased work-load and personal preferences ("life-style entrepreneurship") of managers may hold firms back from expanding, even when expansion would be attractive from a strict business perspective. Such attitudes have been shown to be common among both manufacturing and service sectors, and for both knowledge-intensive and less knowledge-intensive sectors (Tether, 1997; Hurst and Pugsley, 2011). In view of such evidence, analysis of survival per se provides a useful alternative measure of firm performance.[4] In particular, this double operationalisation of entrepreneurial performance allows us to indirectly explore whether higher education-derived characteristics affect the performance of "lifestyle" entrepreneurs differently compared to the full set of entrepreneurs.

3.2 Data

We empirically explore the impact of three measures of education-derived benefits for entrepreneurial performance using census data covering all working individuals matched to annual data on all firms in the Swedish economy between 1985 and 2008. Data constructed from the same sources has been used in a range of previous related studies (Delmar et al., 2003; Folta et al., 2010; Wennberg, 2010).

Deploying this rich data source has several advantages. First of all, firm dynamics are monitored and reported in great detail. This allows us to identify whether a new firm has been the result of a split or a merger of previously existing firms or whether it is a greenfield start-up. Second, individuals are matched to the workplace where they are most active, in terms of income, either as owners or as employees. In this paper, active owners of new firms and first-year employees are our empirical equivalents of a founding team. Using this database, we are able to identify all active owners of new start-ups and all employees that are present already in the first year of existence of the new firm. The history of these individuals in the Swedish labour market can be traced back over time. Third, the database also contains information on the level and type of education of all individuals. In particular for people that received a university education in

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[3] It is widely accepted that social networks has an important role to play in labour market matching and that networks crucially facilitate successful recruitment of firms. For a review, see Marsden and Gorman (2001).
[4] If the strategic intention of entrepreneurs was somehow observable, it would be possible to model firm growth as a two-stage situation (desire to grow, ability to grow). However, as no reliable predictors of strategic intention are available to us, this approach has not been feasible.

Sweden after the year 1985, the year and place of graduation are reported virtually without fail thanks to a national system of registration of education results.

We focus on private firms started in 2002. Firms in sectors in which higher education has a function of direct accreditation (healthcare, legal sectors, education) are excluded from the sample. From this group, we select firms with at least two people engaged in the firm either as owners or employees. These are slightly more than 8.000 individual firms.

Survival of firms is based on register information. Firms may leave the sample in three different ways; they may make plain exits (i.e. fail to show up in the register for a certain year and onwards), they may split up into two or more firms, and they may merge with another firm. In view of our ambition to study entrepreneurial performance, the latter type of exit would seem to merit special treatment. A merger may, from the firm's point of view, be considered a means to enhance survival and growth opportunities (DeTienne, 2010). Therefore, we consider mergers a survival, where the new firm to which a majority of the old firm's employees have moved in the year after the merger is considered the heir of the old firm. Data on firm growth are calculated using data on the new firms' employment multiplied by the size of the new firm divided by the size of the old firm at the time of the merger.

3.3 Key dependent variables

The key dependent variables of the analysis are the measures deployed for capturing the effect of the three distinct education-derived benefits described earlier. The *share of people with higher education in founding team* is the measure used to capture the significance of human capital acquired in higher education (item IV in Diagram 1). Only educations corresponding to a bachelor or higher degree are considered. In order to parse the effect of education-derived internally oriented social capital (item VI) we construct a *joint education experience index* which is a continuous variable that takes values between 0 and 1. A value of 0 means that no two individuals in the founding team have a common education background while a value of 1 means all founders have a common education history. Analytically the *joint education experience index (jeei)* is calculated as follows:

$$jeei = \frac{\sum_i \sum_j x_{ij}}{(n-1)n} \tag{1}$$

where x_{ij} is a dichotomous variable $=1$ if person i graduated from the same university as person j within a timeframe of three years; and $=0$ if not, or if $i=j$, for $i,j=1,...n$. The third and last key variable refers to item V, externally oriented social capital. The measure used to capture that dimension of education-derived benefits is named *regional access to related alumni* and is constructed in the following way. For each individual founder we identify all working individuals that have graduated from the same place and assume they represent the relevant generalized alumni network. The percentage of the members of that network that currently work in the same region

as the new start-up is found are used as a measure of regional access to the network. Averaging across all founders produces the value of the firm's *regional access to related alumni*.

3.4 Control variables for entrepreneurial performance

Newly created firms often undergo rapid transformations. Nonetheless, it is widely accepted that the initial conditions have significant influence on early years' performance of new firms. The extant literature on entrepreneurship provides a number of fixed (i.e. fixed from time of entry) industry-, firm- and entrepreneur-specific factors which have been identified as determinants of new firm performance.

First, we control for the characteristics of the founders, following the view developed throughout the previous sections that their human and social capital affect the performance. We control for human and externally oriented social capital through measures of the share of the founders that had attained experience working in a related sector, as entrepreneurs and as managers, respectively, considering the three-year period preceding the time of founding.[5] Such measures have typically been found to capture human capital of a kind that drives entrepreneurial performance (see e.g. Colombo and Grilli, 2005; Baptista et al., 2007; Dahl and Reichstein, 2007; van der Sluis et al., 2008; Gimmon and Levie, 2010). Furthermore, measures capturing mean income before firm foundation and the share of people above the age of 40 in the firms are included as controls, in view of both variables as reasonable proxies for human capital of firm founders (Cressy, 1996). The income of founders prior to startup is also a proxy of personal wealth as well as related opportunity costs; we expect to be able to partly control for differences in financial capital across firms though this variable.

Attempting to capture differences in founders' social capital, we include a measure of the share of founders with local origins. Founders born in the same functional region where the firm is founded can be expected to have wider and deeper localized networks that may prove useful in entrepreneurial activities.[6]

In addition, we introduce two controls for homophily within the founding team originating from other sources than those that stand in focus in this paper. A measure of *educational homophily -* similarities in educational background - is introduced in order to weed out the cognitive aspects from the purely social aspects of similarity in the education background of the entrepreneurial

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[5] We consider previous work experience in a firm which falls within the same main section classification in NACE-codes as the new firms a related sector experience.
[6] We do not include measures of work-derived local networks, as these do not vary significantly between teams. Firms founded by a team of at least two people are with few exceptions founded in the region where a majority of the founders have worked (Dahl and Sorensen, 2009) and/or studied (Baltzopoulos and Broström, 2012) previous to start-up.

team. This measure is constructed as a normalised Hirschman-Herfindahl index H_i based on a categorisation of education into ten wide fields[7]:

$$H_i = \frac{\sum_{r=1}^{r_i}\left(\frac{s_{ri}}{n_i}\right)^2 - \frac{1}{r_i}}{1-\frac{1}{r_i}} \tag{2}$$

where s_{ri} is the number of founders in firm i with educational background of type r, n_r is the total number of people in the founding team of firm i and r_i is the number of educational categories represented in the team of firm i. That is, a team where everyone has the same education is assigned the value 1 and a team of founders where no founders represent the same education category is assigned the value 0.

An index capturing joint work experience between the entrepreneurs in the founding team is also introduced as a complementary measure of internal social capital. The variable *joint work experience index* is a measure of how closely tied together by previous work history the persons in the founding team are. The *joint work experience index (jwei)* is calculated as follows:

$$jwei = \frac{\sum_i \sum_j \sum_k x_{ijk}}{m(n-1)n} \tag{3}$$

where x_{ijk} is a dichotomous variable $=1$ if person i worked at the same establishment as person j in year k before firm foundation ($k=1,...m$); and $=0$ if not, or if $i=j$, for $i,j=1,...n$. In empirically constructing data for the *joint work experience index*, we consider m=3 years of previous work history.

A second set of controls capture other characteristics of the founding team that might affect entrepreneurial performance. Previous studies in the field of industrial organisation have showed that entry size is positively associated with both better survival odds and higher growth rates (Evans, 1987a, b; Mata and Portugal, 1994; Audretsch and Mahmood, 1995; Mata et al., 1995; Hart and Oulton, 1996, Cabral and Mata, 2003). We therefore control for *founding team size*. Furthermore, the share of *male founders* in the team is used as a control.

Characterisations of the region of a new venture represent a fourth category of control that has been identified in previous literature as related to entrepreneurial performance (Fritsch et al., 2006). Two measures of regional characteristics are introduced: the *size of the region* (a measure of regional population, thought to reflect the varying intensity of business dynamics across regions) and the *change in the number of active entrepreneurs in the region between 2002 and 2008* (thought to reflect the variations in business climate of the region in the period under study here). In constructing these variables, 72 labour market regions, defined by commuting patterns of active workers, are distinguished.

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[7] The ten categories are: basic education; teaching; arts and humanities; social science and law; science; engineering; forestry and animal care; medicine, health and social care; services; other.

Table 1 reports summary statistics for the operationalisation of all variables in our data.

INSERT TABLE 1 ABOUT HERE

3.5 Estimation method

In assessing survival previous studies (see e.g. Audretsch and Mahmood, 1994; Mata and Portugal, 1994; Honjo, 2000) have applied the proportional hazard model proposed by Cox (1972). Since our data allows us to distinguish between different kinds of exits, we prefer to apply a strongly related but more flexible competing risks estimator (see e.g. Lunn and McNeil, 1995). Since our data only contains one observations per year, a discrete time formulation of the estimator is applied. Standard errors are clustered on firm identity.

Analysis of the determinants of firm growth must account for firm exit patterns. We assume that firm growth and firm survival are driven by the same underlying process (i.e. by the same relation with the independent variables). We therefore apply the well-known Tobit estimator; that is, we assume the existence of a latent variable y_i^* which is linearly dependent on a vector of independent variables $\mathbf{x}_i$, but only observed (as y_i) if larger than the threshold value 0.

$$y_i = \begin{cases} y_i^* & \textit{if } y_i^* > 0 \\ 0 & \textit{if } y_i^* < 0 \end{cases}$$

(4)

$$y_i^* = \beta x_i + u_i, u_i \sim N(0, \sigma^2)$$

(5)

4. Results

This section reports empirical results on entrepreneurial performance for the model specifications described above. Tables 2 and 3 report three models through which the three hypotheses developed in section 2 are tested. Due to inherent multicollinearity problems that arise when two naturally related variables *regional access to related alumni* and the *joint education experience index* are expected to have the same type of impact on the dependent variable, these variables are included separately.

In any study of entrepreneurial performance, the limitations in researchers' ability to conceptualise and observe differences in entrepreneurial talent present a potential obstacle. In relation to studies of higher education, this problem may induce endogeneity bias. In particular, consider the case that higher education does increase performance, and even more so for those with high entrepreneurial talent than for other students. Talented people could then, well-aware of their higher-than-average expected return to such investments, be more likely to invest in higher education attainment. In order to control for this scenario, we seek to instrument the share of people with university education in the founding teams. As instrument, we use the share of people in the founding teams with high high-school grades (above 14 out of 20 on the

Swedish grading scale). A particular challenge is that the share of founders with higher education is a non-normally distributed variable, not only truncated between 0 and 1 but also heavily skewed towards both extremes. We therefore first translate the share of educated people in the founding team into a dichotomous variable demonstrating whether the share of educated people in the founding team of each firm is above (=1) or below (=0) the average of all identified firms. We thereafter generate predictions of this dichotomous variable using our instrument and all other independent variables from above. The share of people with high grades appears to be a valid (no correlation with the residual of the estimates above) and reasonably strong (z-statistic of 7.44; chi2-statistic 55.4 in logistic regression predicting above-average shares of educated founders) instrument. Using this instrument, a Durbin-Wu-Hausman test finds evidence of endogeneity problems in the survival model of knowledge-intensive firms (but not in any other models). The models are constructed accordingly.

Central in any survival analysis is the concept of the hazard function $h(t)$, returning the probability of survival beyond time t. A hazard rate equal to zero signifies no risk at all while a hazard rate approaching infinity signifies the certainty of failure. For growth analysis (Tobit model) positive estimates indicate an increased propensity that a firm will grow in terms of employment between 2002 and 2008. For survival analysis, hazard ratios are reported. Ratios significantly below 1.00 indicate a reduced risk for exit compared to the baseline hazard.

INSERT TABLE 2 ABOUT HERE

INSERT TABLE 3 ABOUT HERE

Table 2 reports, consistent with Hypothesis 1, that the share of *founders with higher education* is positively associated with growth and, most robustly, survival of new ventures in KI sectors. No corresponding relationship is found for ventures in LKI sectors (see Table 3).

Table 3 reports that for LKI sectors, both the *joint education experience index* and *regional access to related alumni* are associated with improved entrepreneurial performance. These results provide support for hypotheses 2 and 3. Neither of the two variables representing social capital are found to impact entrepreneurial performance in KI sectors (see Table 2).[8]

Tables 2 and 3 indicate that the control variables capture a significant portion of the variation in survival and growth. The estimates seem to chiefly confirm findings from previous literature. Perhaps most importantly, previous entrepreneurial experience and joint work experience in the founding team are clearly positively associated with entrepreneurial performance. This finding confirms the results of Beckman (2006). Since we control for industry-specific experience, we

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[8] The variable *regional access to related alumni* is affecting survival on the significance 10% level. However, even this limited significance disappears when robustness tested against multicollinearity between this variable and *founders with higher education.*

find support for the interpretation that this finding is indeed driven by the team-related factors as suggested – but not explicitly tested – in previous research.

The division between KI and LKI sectors also offers some interesting observations which seem to suggest that the relationship between team characteristics and venture success is moderated by the nature of the business context also beyond the particular subject of education-based linkages (c.f. Almus and Nerlinger, 1999). Industry-specific experience, for example, only impacts the growth outlooks of firms in KI sectors. Several further variables have different impact on firms in KI and LKI sectors and on our two alternative measures of entrepreneurial performance. Start-up size is reported to have positive influence on the survival of all firms and on growth prospects of firms in KI sectors, but negative influence on the growth of firms in LKI sectors. Higher wage income of founders before start-up is associated with higher growth outcomes in KI sectors and with better survival in LKI sectors. Male founders, older founders and founders who were born in the region perform better in LKI sectors only. Neither variable is significant for firms in KI sectors. We see these results as confirming the appropriateness of making a distinction between KI and LKI sectors when analyzing entrepreneurial performance.

Notably, educational homophily between founders is associated with better growth prospects for any kind of firm and with better survival chances for firms in KI industries. These findings seems to imply, in analogue with Colombo and Grilli (2005), that the beneficial role of heterogeneity in terms of previous experiences in the founding team (Eisenhardt and Schoonhoven, 1990; Beckman, 2006) does not carry over to educational background in a straightforward manner.

In verifying the robustness of the results of tables 2 and 3, we have paid particular attention to the two variables capturing social ties created through higher education experiences. These variables are by their very nature directly linked to the measure of higher education attainment. Hence, multicollinearity could potentially be suspected to drive the results reported in Tables 2 and 3. Beyond the separate testing of models with and without these two variables present, as already presented, we have therefore investigated alternative versions of the models. In particular, all models were re-estimated excluding the variable *founders with higher education*, for all firms with non-zero values of that variable. Since estimates on *regional access to related alumni* and *joint education experience index* remains roughly stable to this test, and since VIF-statistics for these variables in the original models range between 1.3 and 3.3, we conclude that the results reported above are not strongly affected by multicollinearity issues.

5. Conclusion

This paper has explored the role of higher education for entrepreneurial venturing. In contrast to previous research, which has associated higher education only with the attainment of skills and capabilities, this study presents a multifaceted view of entrepreneurs' utility of university studies.

Acknowledging that social networks originating in higher education experiences have been found to have economic significance for post-graduation economic activities of students, we point to and explore the possible connection between university-based social networks and entrepreneurial performance, in parallel with the role of higher education per se. We suggest that the role of higher education for entrepreneurial success must be given different interpretations: a creator of human capital in knowledge-intensive contexts and a creator of social capital in less knowledge-intensive contexts.

We test these propositions using data on the survival and growth of all Swedish ventures. Following an emerging tradition in firm performance studies, we draw on rich register data which allows us to control for the major factors found to determine entrepreneurial performance in previous studies and to avoid the typical sources of bias that arise from the exclusion of non-responding entrepreneurs and non-surviving firms in econometric analyses. Methodologically, this study also adds to the literature by developing and testing novel measures of social capital, and by deploying a flexible competing risks estimator which allows us to account for exits caused by re-organisations (splits, mergers) properly in survival analysis.

We find empirical support for the view of social and human capital, respectively, to constitute sources of competitive advantage in separate domains of business activities. Education experiences per se are found to have a significantly positive effect on firm performance in knowledge-intensive (KI) sectors, but not in less knowledge intensive (LKI) sectors. Founding teams with joint higher education experiences do better than other teams in LKI, but not in KI sectors. Similarly, founding teams with good localised access to alumni who studied at the same place, at the same time as the founding team members do better than other teams primarily in the LKI sector.

Our findings stand in direct dialogue with the recent results of Unger et al. (2011), whose meta-analysis fail to confirm the expectation that human capital-effects on entrepreneurial performance would be stronger in what they denote "high-technology industries" than in "low-technology industries". However, Unger et al. note that while effects in the former group were homogeneous, "effects in the low-technology group remained heterogeneous, suggesting that it would be useful to search for moderators". Our research identifies that the ability of firms to utilize social networks developed in parallel to human capital has such a moderating effect.

The results provided in this paper also have interesting implications for the discussion on entrepreneurship education and business incubation as an integrated component of higher education. In view of the positive impact of industry experience and of teaming up with former colleagues in entrepreneurial venturing into knowledge-intensive sectors, universities may be well-advised to focus on the encouragement of entrepreneurial attitudes and skills to prepare student for future entrepreneurial activities, rather than on the direct facilitation of new high-tech venture creation. Our results may furthermore be seen as providing support for the notion that student

incubation activities should avoid a narrow focus on high-tech entrepreneurship (Sjölundh and Wahlbin, 2008). While incubator-based student entrepreneurship may be thought of as suitable alternative to faculty entrepreneurship in achieving technology transfer from universities (Åstebro et al., 2012), we have shown that in general, venturing in knowledge-intensive sectors constitutes an exception to the rule that student teams perform better than other team.

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Tables

Table 1. Summary statistics for all small firms (2-21 persons actively working as founders) founded in Sweden in 2002.

Variable	Mean (s.d.)	Mean (s.d.)	min	max
	Knowledge-intensive sectors	*Less knowledge-intensive sectors*		
founders with higher education (%)	.51 (.39)	.17 (.27)	0	1
regional access to related alumni	.08 (.15)	.01 (.06)	0	.72
joint education experience index	.28 (.33)	.07 (.19)	0	1
educational homophily	.56 (.27)	.52 (.26)	.05	1
founders with industry experience (%)	.21 (.34)	.32 (.37)	0	1
founders with entrepreneurial experience (%)	.11 (.24)	.13 (.24)	0	1
founders with managerial experience (%)	.13 (.22)	.08 (.18)	0	1
foint work experience index	.29 (.34)	.18 (.29)	0	1
older founders (%)	.42 (.37)	.51 (.36)	0	1
male founders (%)	.70 (.31)	.65 (.36)	0	1
founding team size	1.13 (.59)	1.11 (.57)	.69	3.40
mean wage income of founders in 2001	11.4 (3.68)	10.1 (4.26)	0	15.3
regional size	13.5 (1.32)	13.1 (1.49)	8.09	14.6
change in number of active entrepreneurs in region between 2002 and 2008	-12.7 (4.72)	-13.0 (6.25)	-47.4	51.6
manufacturing sector	09 (.29)	07 (.26)	0	1
N	1666	6823		

Table 2. Entrepreneurial performance, knowledge-intensive sectors

Variable	Growth	Survival	Growth	Survival	Growth	Survival
founders with higher education (%)	.26**	.35***	.33*	.39**	.24*	.39***
	(.12)	(.13)	(.18)	(.14)	(.14)	(.14)
joint education experience index	-	-	-.11	.85	-	-
			(.21)	(.10)		
regional access to related alumni	-	-	-	-	.16	.57*
					(.33)	(.17)
educational homophily	.60**	.67***	.61***	.68***	.59***	.69**
	(.19)	(.10)	(.19)	(.10)	(.19)	(.10)
founders with industry experience (%)	.20	.85	.20	.80*	.20	.81*
	(.13)	(.09)	(.13)	(.10)	(.13)	(.10)
founders with entrepreneurial experience (%)	.21	.60***	.21	.60***	.21	.60***
	(.17)	(.10)	(.17)	(.10)	(.17)	(.11)
founders with managerial experience (%)	-.08	.81	-.08	.81	-.09	.82
	(.19)	(.14)	(.19)	(.14)	(.19)	(.14)
joint work experience index	.82***	.55***	.82***	.55***	.82***	.56***
	(.15)	(.08)	(.15)	(.08)	(.15)	(.08)
older founders (%)	-.06	1.06	-.05	1.09	-.06	1.07
	(.15)	(.13)	(.15)	(.14)	(.15)	(.13)
male founders (%)	-.02	1.02	-.02	1.03	-.02	1.03
	(.14)	(.13)	(.14)	(.14)	(.14)	(.13)
ln(founding team size)	.29***	.66***	.27***	.65***	.29**	.68***
	(.09)	(.06)	(.10)	(.06)	(.09)	(.06)
ln(mean wage income of founders in 2001)	.02*	.99	.02*	.99	.02*	.99
	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)
founders with local origins (%)	.20	.99	.21	.98	.20	.97
	(.17)	(.14)	(.17)	(.14)	(.17)	(.14)
ln(regional size)	-.07**	1.11***	-.07**	1.10***	-.08**	1.12***
	(.04)	(.04)	(.04)	(.04)	(.04)	(.04)
change in number of active entrepreneurs in region between 2002 and 2008	.01	.99	.01	.99	.01	.99
	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)
manufacturing sector	.39***	.47***	.40***	.47***	.39***	.47***
	(.15)	(.09)	(.15)	(.09)	(.15)	(.09)
Year dummies		YES		YES		YES
log likelyhood	-1700		-1700		-1700	

Growth: Tobit regression, coefficient estimates and robust standard errors. Survival: Competing risks regression, hazard ratios and clustered standard errors. *: $p<0.1$; **: $p<0.05$; ***: $p<0.01$

Table 3. Entrepreneurial performance, less knowledge-intensive sectors.

Variable	Growth	Survival	Growth	Survival	Growth	Survival
founders with higher education (%)	.04	.93	-.20	1.09	-.06	.99
	(.09)	(.06)	(.15)	(.10)	(.10)	(.07)
joint education experience index	-	-	.43**	.75**	-	-
			(.19)	(.10)		
regional access to related alumni	-	-	-	-	.91**	.54**
					(.38)	(.17)
education homophily	.25***	.88	.22**	.90	.23**	.89
	(.09)	(.07)	(.09)	(.07)	(.09)	(.07)
founders with industry experience (%)	.02	.93	.03	.93	.03	.93
	(.06)	(.05)	(.06)	(.05)	(.06)	(.05)
founders with entrepreneurial experience (%)	.46***	.61***	.46***	.61***	.46***	.61***
	(.09)	(.05)	(.09)	(.05)	(.09)	(.05)
founders with managerial experience (%)	.18	.73***	.19	.73***	.18	.73***
	(.11)	(.08)	(.11)	(.08)	(.11)	(.08)
joint work experience index	1.02***	.39***	1.02***	.38***	1.03***	.46***
	(.09)	(.03)	(.08)	(.03)	(.08)	(.03)
older founders (%)	-.38***	1.63***	-.39***	1.65***	-.37***	1.62***
	(.07)	(.09)	(.07)	(.09)	(.07)	(.09)
male founders (%)	.34***	.74***	.34***	.74***	.35***	.73***
	(.06)	(.04)	(.07)	(.04)	(.07)	(.04)
ln(founding team size)	-.10**	1.05	-.08*	1.04	-.10**	1.05
	(.05)	(.04)	(.05)	(.04)	(.04)	(.04)
ln(mean wage income of founders in 2001)	.01	1.00	.01	1.00	.01	1.00
	(.01)	(.00)	(.01)	(.00)	(.01)	(.00)
founders with local origins (%)	.30***	.79***	.29***	.80***	.29***	.79***
	(.08)	(.05)	(.08)	(.05)	(.08)	(.05)
ln(regional size)	-.04***	1.04***	-.04***	1.04***	-.05***	1.05***
	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)
change in number of active entrepreneurs in region between 2002 and 2008	.00	1.00	.00	1.00	.00	1.00
	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)
manufacturing sector	.19***	.83**	.18***	.83**	.19***	.84**
	(.08)	(.06)	(.08)	(.06)	(.08)	(.06)
year dummies		YES		YES		YES
log likelyhood	-5416		-5412		-5413	

Growth: Tobit regression, coefficient estimates and robust standard errors. Survival: Competing risks regression, hazard ratios and clustered standard errors. *: $p<0.1$; **: $p<0.05$; ***: $p<0.01$