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Attractors of talent - Universities, regions, and alumni entrepreneurs

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Attractors of talent

Universities, regions, and alumni entrepreneurs

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Abstract

In this paper we investigate how universities may affect regional entrepreneurship through the localisation decisions of entrepreneurial alumni. Empirically, we use a comprehensive, individual-level dataset from Sweden for the period 2003-2005. Our results suggest that even when controlling for their spatial history, individuals have an increased propensity to set up in the region where they studied. This effect is found to substitute for both urbanisation economies and localisation economies as drivers of regional-level entrepreneurship. Thus, our analysis provides evidence on how universities affect regional economic development that complements the strong focus on spin-off activities by university researchers in previous studies.

Keywords: university entrepreneurship, regional impact, location choice analysis

JEL-codes: I23, L26, O18, R30

1. Introduction

The importance of universities for regional economic development has been analysed from different economic perspectives (Andersson et al., 1990; Felsenstein, 1995; Phelps, 1998; Chesire & Malecki, 2004). These studies typically find that regional economic growth is linked to the presence of institutions of tertiary education. A common caveat is that this effect is mediated by different regional characteristics such as the density of population and business activity (Varga, 1998; Goldstein & Drucker, 2006) and the region's industrial structure (Braunerhjelm, 2008). However, the mechanisms through which universities affect regional growth and the specific reasons for the heterogeneous impact of universities across regions have not yet been pinned down. The literature on the regional role of universities is dominated by studies which aggregate over sectors, firm sizes or scientific disciplines and which are therefore not able to disentangle completely the different roles that a university may have in its local economic environment (Audretsch et al., 2006).

Universities have been ascribed several different functions in the regional economy. Most straightforward, it has been noted that universities attract national and international funds into a region. Through the direct purchases of the university, and through the purchases of students and faculty, the institution creates local jobs and revenues (Florax, 1992). Furthermore, universities are perceived as important actors in at least certain types of regional economies in their capacity as research and teaching organisations. While the economic impact remains very difficult to estimate with any accuracy, universities are associated with productivity gains and innovation in existing firms, with effects on new firm-formation and industry location choices and therefore with long-term regional growth (Goldstein & Renault, 2004).

In attempts to disentangle the role of higher education institutions for regional growth, entrepreneurship has been suggested to play an important role. This connection has attracted considerable policy interest (Feldman, 2001), based on expectations that universities should take on the task "to create a support structure for firm formation and regional growth" (Etzkowitz & Klofsten, 2005). However, almost all studies of the university-entrepreneurship linkage focus on the case of academic entrepreneurship, i.e. on academic researchers' engagement in start-up ventures (Lindholm-Dahlstrand, 1997; for a review, see Rothermael et al., 2007). There is only very limited disaggregated evidence on the impact of higher education institutions on regional entrepreneurship in the wider sense of alumni entrepreneurship. A notable exception is Bania et al. (1993), who find a positive association between university R&D and firm formation in the electrical and electronic equipments industry, but not for the instruments manufacturing industry. Mainly, however, non-faculty entrepreneurship activities have only been examined insofar as it has taken a path over university-owned science parks and incubators (Hisrich & Smilor, 1988; for a review, see Link & Scott, 2007). This paper

addresses the relatively unexplored phenomenon of alumni entrepreneurship, which may explain more of the measured impact of universities on a region than what has hitherto been acknowledged.

In particular, we investigate how universities may affect regional entrepreneurship through the localisation decisions of entrepreneurial alumni. Our assumption that there may be such a connection is based on entrepreneurship theory, in which entrepreneurial activity is considered to be a truly regional phenomenon (Sternberg & Wennekers, 2007). On the one hand, (necessity-based) entrepreneurship may be a response to the desire of the individual to live in a certain region, and a failure to find a suitable job in existing firms. On the other, (opportunity-based) entrepreneurship may arise as a consequence of the recognition of opportunities in markets with which the nascent entrepreneur is familiar. For both types of entrepreneurship, the location choice is likely to be conditioned by personal networks. Familiarity with a region and its different markets as well as personal contacts is particularly valuable in the establishment-phase of a new venture (Stam, 2007). Therefore, this paper tests the hypothesis that higher education institutions may bolster entrepreneurship in a region simply by pulling talented people to the region, where they may then choose to remain – possibly in a role as an entrepreneur. We furthermore analyse the role of alumni entrepreneurship in regional economic development, considering the relationship between alumni entrepreneurship and the theoretical concept of agglomeration economies. We ask two questions, related to urbanisation and localisation economies, respectively. Does a university affect regional entrepreneurship the most in urban or non-urban regions? Does alumni entrepreneurship strengthen industrial clustering effects, or does it provide a means for diversification of the regional economy?

Our analysis is one of the first studies to explore differences in entrepreneurship across regions utilising individual-level data, following the path pioneered by Evans & Leighton (1989). This approach allows us to deal with the problem of the counterfactual in a satisfactory way. Establishing a suitable counterfactual and quantifying the effects is a typical problem for all kinds of impact studies, which is particularly difficult to solve in studies of the impact of universities (Siegfried et al., 2007).

We empirically test our assumptions using a comprehensive individual-level dataset from Sweden. The results of the analysis support the hypothesis that entrepreneurs will exhibit an increased propensity to start their firm in their place of studies. This tendency appears to be stronger in more peripheral areas of Sweden than in the three major urban centres. Our analysis also indicates that the pull effect of universities substitutes rather than complements that of localization externalities. Together, these findings suggest that universities, through the mechanisms of alumni entrepreneurship, play a particularly interesting role for the renewal of non-urban regional economies.

The rest of the paper is organized in the following manner: Section 2 discusses the influence of universities on regional entrepreneurship and presents our hypotheses while

section 3 presents the approach we apply to empirically test them. Section 4 presents and discusses the results of the econometric analysis and section 5 summarizes and concludes the paper.

2. The influence of universities on regional entrepreneurship

As noted by Drucker & Goldstein (2007), the role of universities for personal mobility has not been well-researched. Huffman & Quigley (2002) study 950 graduates of two California universities (business school, engineering school), and their propensity to stay in the state after graduation. Similar studies, both covering single U.S. universities, are presented by Blackwell et al. (2002) and Felsenstein (1995). Groen (2004) uses data on 30 selective colleges and universities and reports only a modest link between attending college in a state and working in the state. There is also considerable evidence from case-study research suggesting that universities may play a significant regional role as attractors of talent. Most famously, Saxenian & Hsu (2001) acknowledged that mobility of academic talents from Taiwan to Californian universities had a critical role to play for understanding the success of Silicon Valley.

The assumption underlying our research is that young individuals that choose to relocate in order to attend a specific university find themselves in a novel environment, “cut-off” from friends and family, and subsequently proceed with building an entirely new social network. This network may well exceed the strict confines of the halls of a university but is still centred in their new place of residence. Greve and Salaff (2003) discuss the importance of social networks for entrepreneurship. They stress how entrepreneurs require information, capital, skills, and labor to start their business activities and while they hold some of these resources themselves, they often complement their resources by accessing their contacts (Aldrich and Zimmer, 1986; Aldrich et al., 1991; Cooper, Folta and Woo, 1995; Hansen, 1995). Johannisson (1988) suggests that the key to entrepreneurial success is to be found in the ability to develop and maintain a personal network. Hence, the personal history of the entrepreneur can be expected to influence his or her localisation choice when establishing a new firm. In particular, the entrepreneur can be expected to be biased towards setting up in his or her place of birth and in regions where he or she has previous working experience. These types of historical ties can create social capital that a person may turn to during the development and establishment stage of a new venture. However, we postulate that the networks that individuals develop in the formative years of their university studies are important enough to affect future business venturing, both directly (direct utilisation of university-based networks) and indirectly (i.e. that the individual’s choice of location for working may be influenced by her or his choice of location for studies). These assumptions lead us to formulate the following hypothesis:

H1: Controlling for their place of birth and their recent employment history start-up founders have an increased propensity to set up in the region where they studied

Considering the heterogeneous impact of universities on economically well-developed and less-developed regions that has been identified by previous studies, an important extension to our analysis is to examine to what extent such differences can be explained by university-induced entrepreneurship. In this analysis, the main question is how the alumni-effect interacts with the traditional pull-factors of localisation analysis, in particular with so called agglomeration economies. Through this analysis, our study adds to an emerging branch of studies that have been able to analyse the role of agglomeration economies in location decisions alongside with individual-level factors (Figueiredo et al., 2002; Dahl and Sorensen, 2009).

The impact of agglomeration on firm decisions is typically considered to be twofold (Johansson, 2004), a division that goes back to Ohlin (1933). First, large agglomerations are seen as attractive milieus for entrepreneurial ventures due to existence of a rich and diverse labour pool, a big local consumer market, and well developed infrastructure, including public facilities and an abundance of secondary services. These effects, which accrue across sectors, are usually labelled as urbanisation economies. Secondly, firms are believed to be able to benefit from co-location with other firms in related sectors through the presence of localisation economies. Following Marshall (1920) and Myrdal (1957), localisation economies have been considered to arise from the agglomeration of firms, which allows suppliers to specialise, increases the supply of specialised labour and spurs local demand. The virtuous circle of agglomeration economies will make the regions with strong agglomerations of related industries evermore attractive for new firms (Boschma & Wenting, 2007).

Recently, the nature of localisation economies has been re-examined and their role for entrepreneurship re-interpreted. Traditionally, following the new economic geography theories of e.g. Krugman (1991), entrepreneurs have been assumed to be affected by the forces of agglomeration when making location choices (Keeble & Walker, 1994). However, Rosenthal & Strange (2001) found that agglomeration economies are mainly benefiting co-localised firms through labour market pooling benefits, which would suggest that agglomeration economies are more important for the growth of existing firms than for the success of very new firms. This interpretation can also be supported by the findings of Duranton & Puga (2000, 2001) who find that while new plants tend to be attracted to set up in diversified areas, relocations are more likely to go to specialised areas. Recently, Klepper (2007), Buenstorf & Guenther (2007) and Buenstorf & Klepper (2009) have suggested that localisation economies should not be understood as a phenomenon that gives any new firm an incentive to locate close to firms in related industries. Industrial clustering can in this interpretation rather be understood as the observed outcome of localised processes of heritage. This explanation for the clustering of industries emphasises spin-off dynamics from existing firms in combination with a

tendency to locate new firms close to where the entrepreneur lived and worked at the time of firm start-up.

This evidence seems to suggest that the kinds of networks and experiences that are accumulated in higher education would not increase the likelihood that an alumni entrepreneur chooses to start a firm in the specific kinds of industries that are already clustered in the region. Rather on the contrary, university-induced networks could provide an alternative to networks accrued in working life, and entrepreneurial opportunities that are recognised during studies could provide an alternative to entrepreneurial opportunities that are recognised when working in a region. We formulate the following hypothesis:

H2: The interaction between the pull effect of universities on the location decisions of university alumni entrepreneurs and the pull effect of localisation economies is negative

We next turn to the issue of how the pull effect of universities interacts with urbanisation economies in the location decisions of alumni entrepreneurs. Urban regions have advantages for new firms that are particularly well articulated for the type of knowledge-based service firms which are the hallmark of entrepreneurs with higher education (Wagner & Sternberg, 2004; Lee et al., 2004). There are therefore reasons to expect that the alumni effect will have a stronger impact on entrepreneurial alumni from urban regions than on other alumni; entrepreneurial impulses and networks created during education may not be sufficient to encourage local entrepreneurship if the region does not offer sufficient market size and advanced demand. However, there are also plausible arguments for a reversed relationship. From the point of view of the alumni of non-urban regions, self-employment may act as a substitute for the richer labour market opportunities of urban regions. Entrepreneurship may thus become attractive for those with strong preferences against leaving their region. This view is supported by Figueiredo et al. (2002) who find that urbanization economies are only a significant factor for the localization decisions of entrepreneurs who move from their previous location, and not for entrepreneurs who stay on. Interestingly, Figueiredo et al. present the only evidence on this issue that similar to our analysis explores the level of individual decisions rather than more aggregate regional measurements. In lack of more in-depth guidance on this issue, we hence propose that the total effect goes towards strengthening the effect of universities on entrepreneurship in non-urban regions. We formulate the following hypothesis:

H3: The interaction between the pull effect of universities on the location decisions of university alumni entrepreneurs and the pull effect of urbanisation economies is negative

When controlling for other characteristics of a region that may affect the location choices of entrepreneurs, it is interesting to note that when modelling this choice on the individual level, several conceptually separate factors can be grouped together under a general control for regional heterogeneity. Among such factors, that can be considered equally important for all types of entrepreneurs, are heterogeneous incentive structures

for entrepreneurship across regions such as tax structures (Wagner & Sternberg, 2004), characteristics of the local population and institutional factors characterising the regional economic milieu (Armington & Acs, 2002).

The notion that several regional characteristics may be meaningfully grouped together in location choice analysis is supported by the striking finding of cross-regional differences in entrepreneurship as a highly persistent phenomenon over time. Evidence for such cross-regional patterns is convincing for several countries (Acs & Armington 2004, US; Fritsch & Mueller, 2007, Germany; Andersson & Koster, 2009, Sweden). In part, this pattern is to be expected, as most of the identified determinants of entrepreneurship change slowly over time. However, even when controlling for this, Andersson & Koster (2009) find evidence for path-dependence in the start-up process itself. There exist evolutionary arguments for the persistence of regional differences in start-up rates over time. These state that entrepreneurship as a process generates new entrepreneurial opportunities, most notably so on the regional level (Audretsch & Keilbach, 2004).

3. Methodology

Data

We empirically test our hypotheses using census data from Sweden that describe the country's business and employment dynamics over the period 1985 to 2005. The massive database is compiled by Statistics Sweden under the title "Företagens och arbetsställdas dynamik" (hereafter, FAD) which translates into "Firms and establishments dynamics". FAD is an extremely comprehensive micro-database covering all working individuals in the Swedish economy. All individuals are matched to the firms and establishments they own or are employed in.

There are several aspects of FAD that are key to our research. 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. In this paper an entrepreneur is defined as the owner of a Greenfield start-up. Second of all, FAD includes information on the geographic location of the place of residence, work, and birth of each individual at the municipality level, allowing for extremely detailed labour mobility analyses. And thirdly, FAD contains information on the level and type of education of all individuals. In particular for people that received a university education in Sweden, the year and place of graduation are reported without fail.

We wish to mainly test whether an individual entrepreneur will show an increased propensity to choose to set up his firm in the region where he attended a university

program. We focus on entrepreneurs starting a new firm in the period 2003-2005¹. These are roughly 80 000 individuals. We further exclude from our analysis individuals born outside Sweden (roughly 18 000) since a main concern in our setup is whether the place of studies will exert a stronger pull on entrepreneurs than their place of birth, an analysis that is not possible for immigrant entrepreneurs. Lastly we are forced to exclude individuals born before 1961 (roughly 28 000) since we lack detailed information on the location of birth of those older cohorts. Therefore, our analysis is carried out on all entrepreneurs, born in Sweden, of 45 or fewer years of age starting a firm in the period 2003-2005. This amounts to 35 187 individuals. We do not consider excluding cohorts born before 1961 a major drawback since any pull effect the region of studies might exert on an entrepreneur is expected to fade away so many years after graduation. Besides, the population of entrepreneurs identified remains a large one despite this exclusion.

In the regional dimension we need to divide Sweden in a set of regions that will constitute a relevant set of alternatives from which an entrepreneur can choose when setting up his or her firm. The basis of our regional breakdown is the division of Sweden into 81 functional regions, constructed from labour commuting statistics of 2003. For the purpose of this study, we have aggregated those functional regions into 12 regions². Both sets of regions are depicted in Figure 1. The main principle in this process has been to merge more sparsely populated functional regions that lack major centres of higher education to the geographically adjacent university centre, based on student registration statistics from the Swedish national agency for higher education. A secondary principle has been to preserve the status of the three major urban functional regions of Stockholm-Uppsala, Gothenburg, and Malmö-Lund. Table 1 offers a description of these 12 regions. The dominant role of the Stockholm-Uppsala region is easily observed, exhibiting three times the number of employees and new entrepreneurs (but fewer than three times the number of students) of the other two major urban centres of Gothenburg and Malmö-Lund.

Table 1 somewhere around here

Figure 1 somewhere around here

We next take a closer look at the group of entrepreneurs. Table 2 describes the trends in location choices apparent among the identified group. Roughly two thirds of the total population of entrepreneurs establish their firms in the same region they were born (see group 1). Of the total, 29.6% have attended a Swedish university and while 15.4% studied in the same region they were born, 14.2%, a total of 4 979 individuals, studied away from

¹ The data covers the entire private sector of the economy including both service and manufacturing industries. Data on the public sector, although available, was excluded from our study.

² The reason such a broad aggregation was used was to be able to apply an econometrically correct methodology. See below for a more detailed explanation and in section 4 for a discussion on a more fine regional aggregation that was later implemented as a robustness check.

home (see group 2). Group 3 consists of entrepreneurs with a university degree that studied in their place of birth, 5 429 individuals. Interestingly enough 4 622 of those chose to start their firm in their place of birth while only 807 chose to set up somewhere else. Comparing these figures to group 1 we can see that entrepreneurs that studied in their place of birth have a greater tendency to start their firm there compared to the total. We next turn to those individuals with a university degree that studied away from home (group 4). Out of these 4 979 individuals only 1 389 will return to their place of birth to start a firm, while almost half of them (2 357 entrepreneurs) will set up their firms in their place of studies. The remaining 1 233 representing 3.6% of the total will choose to start a firm in a region that they neither studied nor were born in.

Table 2 somewhere around here

These summary statistics seem to support our underlying assumptions. Not only do universities seem to attract alumni entrepreneurs to stay in their place of studies when establishing a new firm, but an entrepreneur studying in his place of birth will also be less likely to start a business somewhere else.

Econometric model

In order to formally test our hypotheses we examine the location choice of the individual entrepreneur conditional on a vector of independent variables. We let u_{im} stand for the utility individual i receives from alternative m . Then,

$$u_{im} = \mathbf{x}_{im}\boldsymbol{\beta} + \varepsilon_{im} , \quad m = 1, \dots, J \quad , \quad J = 12 \quad (1)$$

where \mathbf{x}_{im} represents a vector of alternative-specific regional characteristics for alternative m and case i , $\boldsymbol{\beta}$ is the vector of coefficients capturing the weight the average individual assigns to the elements of \mathbf{x}_{im} , and ε_{im} is a random, normally distributed error term. The probability of choosing alternative m from among J different alternatives is:

$$\begin{aligned} \Pr(y_i = m) &= \Pr(u_{im} > u_{ij}, \forall j \neq m) = \\ &= \Pr(\mathbf{x}_{im}\boldsymbol{\beta} + \varepsilon_{im} > \mathbf{x}_{ij}\boldsymbol{\beta} + \varepsilon_{ij}, \forall j \neq m) , \quad j = 1, \dots, J \end{aligned} \quad (2)$$

We calculate these probabilities by applying a conditional logit model (CLM) (Long and Freese, 2006). In the CLM the predicted probability of observing outcome m is

$$\Pr(y_i = m | \mathbf{x}_i) = \frac{\exp(\mathbf{x}_{im}\boldsymbol{\beta})}{\sum_{j=1}^J \exp(\mathbf{x}_{ij}\boldsymbol{\beta})} \quad \text{for } m = 1 \text{ to } J \quad (3)$$

The elements in $\boldsymbol{\beta}$ are calculated through maximum simulated likelihood methods. Two important shortcomings of the CLM need be addressed. First of all the CLM does not take into account individual heterogeneity and the attributes of the entrepreneur are assumed to not affect the predicted choices. Second of all, and most importantly, the CLM depends on the Independence of Irrelevant Alternatives (IIA) assumption. Formally, the IIA assumption states that for individual i the error terms across the different choices are uncorrelated. Analytically,

$$\text{cor}(\varepsilon_{ik}, \varepsilon_{il}) = 0, \quad \forall k \neq l, \quad k, l \in (1, \dots, 12) \quad (4)$$

What this means is that an individual's preference between two of the alternatives in the choice set is not affected by the rest of the alternatives available. This is a rather strong assumption, especially in our current setup. We control for both of these shortcomings by comparing our results to those from an alternative specific multinomial probit model (ASMPM) that allows for case-specific (that control for individual heterogeneity) as well as alternative specific controls and relaxes the assumption of uncorrelated error terms³. The ASMPM's major drawback is that estimations are extremely time demanding given our current processing power and that a maximum of 20 different choices can be implemented given current software capabilities. The need to thoroughly control for the limitations of the conditional logit model was the main reason that led us to choose the broad aggregation of 12 regions which is within the ASMPM's capabilities. We will return to this point in the next section when discussing the results of the econometric analysis.

Turning to the control variables and following the discussions above, the vector \mathbf{x}_{im} contains dummy variables describing whether individual i was *Born*, had *Studied*, had *Worked* or not in region m . Note that we only take in consideration the individuals' employment history of the last five years and while having information on their place of birth was required for the entrepreneurs to be included in our sample not all of them have recent work experience or have studied in a Swedish university. Moreover, we wish to include a measure of the localisation economies of each region in the particular industry branch an entrepreneur is entering. In order to capture the magnitude of those we include the production structure specialization index (PS)⁴ which measures the extent to which region j is specialized towards industry h :

³ See the Appendix for a description of the ASMPM.

⁴ A specification with the other commonly used in the relevant literature measure (Beaudry and Schiffauerova, 2009), the size of the industry, was also tested without altering the results.

$$PS_{hj} = \left[\frac{E_{hj}}{\sum_h E_{hj}} \right] / \left[\frac{\sum_j E_{hj}}{\sum_h \sum_j E_{hj}} \right] \quad (5)$$

where $h = 1, \dots, 43$ for each industry branch
 $j = 1, \dots, 12$ for each region
 E = employment

For practical purposes the PS-index is standardized using the formula $(PS-1)/(PS+1)$ to make it balanced and constrained within the interval $(-1,1)$. This way positive values of the PS-index refer to industries whose share of employment in a particular region is greater to this industry's share in national employment, while negative values refer to the exact opposite. Finally, a full set of dummy variables, one for each alternative, is included to control for the heterogeneous incentive structures across regions described in the last paragraphs of section 2. The reason we can lump together these regional characteristics is that they do not vary across individuals but provide all entrepreneurs with the same regional-specific base utility, which does vary across the alternative choices.

Therefore, in our basic specification the vector of control variables is:

$$\mathbf{x}'_{im} = [Born \quad Studied \quad Worked \quad PSindex \quad Alternative2 \quad \dots \quad \dots \quad Alternative12] \quad (6)$$

Of course one of the *Alternative* dummies needs to be excluded (in (6) that is *Alternative1*) and the corresponding region act as the reference choice. Since ranking the attractiveness of the inter-regional entrepreneurial incentives structures is not part of the goals of the current analysis (despite being an important control), we will not discuss this any further.

A final remark, before turning to the results of the analysis, concerns the high correlation among the binary control variables describing the relation of the entrepreneurs with each region (see table 3). Having mostly binary controls can result in biased estimates, especially when these exhibit a high degree of correlation. In such cases having a clear expectation of the direction of the bias helps mitigate the problem. In our setup we expect *Worked* to have the strongest effect on the location choice of the entrepreneur since it reflects the most recent location of the entrepreneurs prior to starting up their own firm. Most importantly we expect the inclusion of *Worked* to introduce a negative bias to the effect of *Born* and *Studied* since it is very rarely the case that an individual will choose self-employment when she first enters the job market (83.3% of the identified entrepreneurs held a job in the private sector of the economy in the last 5 years prior to starting up their own firm). So, if anything, we expect that our current specification might underestimate the significance of having studied in a region for the probability of choosing that location for starting a firm since part of that effect will be captured by the local employment history of the individual.

Table 3 somewhere around here

4. Results

The results of the main econometric analysis are summarized in table 4, while tables 5, 6 and 7 include important robustness checks. In table 4 a total of six different specifications have been estimated. Regression (I) is a bare bone specification controlling merely for the place of birth and studies of the individual. The effect of both dummy variables is positive and significant, controlling for regional heterogeneity (as in all specifications). Interpreting the results of the conditional logit estimation is rather straightforward. Exponentiation of the coefficients gives the change in the ratio of the odds of choosing a particular alternative over the rest from a discrete change of a dummy variable or a small change in a continuous variable. For example if we name the coefficient on the control *Born* as β_1 then the odds that an entrepreneur will choose to setup her firm in her place of birth over any other place is e^{β_1} . Regression (II) adds a control for the recent employment history of the entrepreneur. This test of the sensitivity of the results to the exclusion of *Worked* is necessary given the discussion in the last paragraph of Section 3. As expected, the coefficient on *Worked* in (II) is the largest one, and controlling for the individual's employment history reduces the impact of both *Born* and *Studied* that nevertheless remains strong and significant. Regression (III) further extends our model by including the *PS Index*, controlling for the impact of localisation externalities⁵. This inclusion does not significantly change the effect of our three main dummy controls. Interestingly enough, when considering the location choice of an entrepreneur, conditioning for regional heterogeneity and his personal ties to the different regions, localisation externalities seem to still exhibit a positive effect. So far, the evidence in support of our first hypothesis is rather robust. In regression (IV) an interaction term between *Studied* and *Born* is included in a further attempt to disentangle the two effects. The effect of this interaction term is negative and significant, and its inclusion does not affect the significance of *Born* or *Studied*. Even controlling for the recent employment history of the entrepreneurs, and their place of birth, they still exhibit an increased propensity of setting up in their place of studies. Moreover, the average entrepreneur is more likely to remain in his place of birth if he also attended a university program in the same region. All findings seem to support our first hypothesis.

Turning next to a formal test of our second hypothesis, regression (V) adds an interaction term between *Studied* and the *PS Index* to the specification of regression (III). As predicted in hypothesis 2, the effect of the interaction term is negative, and also significant.

⁵ We consider specification (III) as our core model upon which we build in order to test our hypotheses.

Table 4 somewhere around here

Finally, in regression (VI) an interaction term between *Studied* and an *Urban* dummy, as well as the *Urban* dummy on its own are added to our core model. The *Urban* dummy equals one for the three major urban centres of Stockholm-Uppsala, Gothenburg, or Malmö-Lund, and zero otherwise. The coefficient on the *Urban* dummy is positive and significant as expected, given the potential attractiveness of urbanisation economies for entrepreneurs. Hypothesis 3 predicted that the term *Studied* \times *Urban* should be negative and significant, which is indeed the case. Adding the interaction terms does not affect the significance of the original set of dummies controlling for the personal ties of the individuals with the different regions. Even if the pull effect of universities is stronger in non-urban regions, urban regions manage to also exert a similar effect on local entrepreneurial alumni.

We now return to the drawback of the CLM mentioned earlier. First of all the CLM does not control for individual heterogeneity but a check can be carried out by splitting the sample and comparing different groups of individuals. Given that this is a relatively unexplored field of research we find ourselves without references on which individual characteristics might impact the decision of the entrepreneur to stay close to his place of studies or not. We decide to split our sample according to the sex and age (younger or older than 35) of the entrepreneur in tables 5 and 6 respectively, and repeat the estimation of regressions (III), (V) and (VI) of table 4 that concern our three hypotheses. The results hold equally between males and females and older and younger entrepreneurs.

Turning to the problem of the IIA assumption, a simple way to test whether it is violated is to test whether the results are sensitive to excluding one alternative at a time from the choice set. Our results do pass this test but Cheng and Long (2007) suggest that such tests that are based on the estimation of a restricted choice set are unsatisfactory for applied work. We proceed by testing our results against those of the ASMPM described in the Appendix. The ASMPM allows controlling for individual heterogeneity more properly than sample splits by allowing the inclusion of individual specific controls as well as relaxing the assumption of uncorrelated error terms. The ASMPM estimation results, that are not presented here to save space and avoid confusion between the different estimation techniques, support the premises of our results from the CLM.

Finally, in order to test that our results do not depend on the regional aggregation we repeat the CLM analysis for the case of the original 81 functional regions, although verifying these results against an ASMPM estimation is not feasible. The results are presented in table 7. The direction and sign of all effects match exactly those in table 4 for the case of 12 large regions.

5. Conclusions

In this paper we suggest, and empirically test for the significance of, a mechanism through which universities contribute to the development of local economies. The point of departure of our analysis is the importance of social networks in the establishment and development of a new business that has been identified in the literature of entrepreneurship. We argue that the networks entrepreneurial individuals develop in and around the universities they attend are important enough to increase their propensity to choose the region they studied in as the location for their business ventures.

We empirically test our hypothesis by considering the location decision of 35 187 entrepreneurs born in Sweden after 1960 who founded a firm in the period 2003-2005. Controlling for regional heterogeneity, their place of birth and their recent employment history these individuals exhibit an increased likelihood of locating their firms in their place of studies providing evidence in support of our hypothesis.

We also relate the impact of universities on the localisation choices of entrepreneurs to the role of agglomeration economies for these decisions. This study adds to an emerging body of evidence on how individual-level factors interact with the forces of agglomeration economies in localisation decisions. On examination of urbanisation economies, the effect of universities on localisation decisions is found to be stronger in non-urban regions than in urban regions. Turning to localisation economies, our analysis indicates that the pull effect of universities may substitute that of localization externalities. In other words, alumni entrepreneurs tend to start firms in sectors that are previously underrepresented in the region. In view of recent re-interpretations of industrial agglomerations as outcomes of localised processes of heritage rather than as the outcome of generic localisation economies (Buenstorf & Klepper, 2009), this finding calls for further critical examination of the role of agglomeration economies for the location choices of entrepreneurs.

Our analysis highlights the role of universities as attractors of talent to a region, and points out both where (non-urban regions) and how (contributing to diversification rather than specialisation) alumni entrepreneurs are most likely to influence a regional economy. Turning to the policy implications of our analysis, it appears that the competition among universities for recruiting talented students should concern not only universities, but also regional authorities interested in stimulating entrepreneurship. Talent recruitment could be the first step into creating an entrepreneurial local environment or enhancing an existing one. Dahl and Sorensen (2009) suggest that entrepreneurs are embedded in the regions they have the strongest social ties with and governments need to give up the efforts to attract migrating entrepreneurs to a region and should focus on stimulating entrepreneurship in the local population. Acknowledging that social networks anchor entrepreneurs in particular regions universities may be a powerful tool in the disposal of

governments for shifting this anchoring. Regional governments may thus be motivated to stimulate the attractiveness of regional universities to mobile students, for example by supporting the higher education milieu and by encouraging the emergence of specialised study programs that are visible far beyond the borders of the region.

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Tables

Table 1. Characteristics of regions.

Region	Size⁽¹⁾	Working population⁽²⁾	Number of new firms⁽³⁾	Number of students⁽⁴⁾	Type
1. Stockholm-Uppsala	14,8	690	12 623	38 379	Urban
2. Gothenburg	7,3	301	4 360	16 293	Urban
3. Malmö-Lund	7,3	253	4 090	17 391	Urban
4. East Gothia	9,9	105	1 231	9 046	Non-urban
5. West Bothnia	55,2	59	777	8 381	Non-urban
6. North Bothnia	98,2	54	715	3 766	Non-urban
7. Blekinge-East Scandia	6,1	74	904	1 571	Non-urban
8. West Mälardalen	16,0	169	2 062	8 278	Non-urban
9. West Gothia	20,9	201	2 284	8 769	Non-urban
10. N. Svealand-S. Norrland	67,1	220	2 579	9 009	Non-urban
11. Småland-Gotland	35,3	230	2 327	7 533	Non-urban
12. Mid-Sweden	71,0	89	1 235	3 796	Non-urban

Source: Statistics Sweden and the Swedish National Agency for Higher Education

(1) In thousands of m²

(2) In thousands, 2003-2005 average

(3) 2003-2005 average

(4) Full time equivalent, 2005 values

Table 2. A scrutiny of the group of entrepreneurs.

Description of group	Number	Percentage of Total
(1) Total number of entrepreneurs	35 187	100
- <i>startup at place of birth</i>	23 870	67.8
- <i>startup away from home</i>	11 317	32.2
(2) Entrepreneurs that studied in a Swedish University	10 408	29.6
- <i>studied at place of birth</i>	5 429	15.4
- <i>studied away from place of birth</i>	4 979	14.2
(3) Entrepreneurs that studied at their place of birth	5 429	15.4
- <i>startup at place of birth</i>	4 622	13.1
- <i>startup away from place of birth</i>	807	2.3
(4) Entrepreneurs that studied away from place of birth	4 979	14.2
- <i>startup at place of birth</i>	1 389	3.9
- <i>startup at place of studies</i>	2 357	6.7
- <i>startup elsewhere</i>	1 233	3.6

Note: In each section of the table a group of entrepreneurs identified by a number from 1 to 4 is broken down in two or three subgroups identified by the dashed lines

Table 3. Pairwise correlation between regions in entrepreneur's history

	Region of startup	Region of birth	Region of studies	Region of work '03	Region of work '04	Region of work '05
Region of startup	1.00					
Region of birth	0.47	1.00				
Region of studies	0.58	0.50	1.00			
Region of work '03	0.84	0.42	0.55	1.00		
Region of work '02	0.86	0.43	0.56	0.94	1.00	
Region of work '01	0.83	0.42	0.56	0.91	0.95	1.00

Note: Applicable only for the 10 408 entrepreneurs that attended a university in Sweden

Table 4. Regression results of the CLM regression on the probability of choosing region $m \in (1,12)$

Variable	(I)	(II)	(III)	(IV)	(V)	(VI)
<i>Studied</i>	2.42*** [0.03]	1.76*** [0.04]	1.74*** [0.04]	2.38*** [0.05]	1.73*** [0.04]	1.95*** [0.06]
<i>Born</i>	2.94*** [0.01]	2.09*** [0.02]	2.10*** [0.02]	2.27*** [0.02]	2.10*** [0.02]	2.09*** [0.02]
<i>Worked</i>	-	3.80*** [0.02]	3.78*** [0.02]	3.77*** [0.02]	3.79*** [0.02]	3.78*** [0.03]
<i>Studied x Born</i>	-	-	-	-1.58*** [0.08]	-	-
<i>PS index</i>	-	-	0.76*** [0.07]	0.76*** [0.07]	0.85*** [0.07]	0.80*** [0.07]
<i>Studied x PS index</i>	-	-	-	-	-0.90*** [0.24]	-
<i>Urban</i>	-	-	-	-	-	0.35*** [0.05]
<i>Studied x Urban</i>	-	-	-	-	-	-0.36*** [0.08]

Additional controls	Full set of regional dummies	Full set of regional dummies	Full set of regional dummies	Full set of regional dummies	Full set of regional dummies	Full set of regional dummies
Pseudo R^2	0.54	0.75	0.75	0.76	0.75	0.75
Log-likelihood	-40489.56	-21691.21	-21632.64	-21423.90	-21624.51	-21550.13

Number of cases: 35 187; Number of observations: 422 244 (=35 187 x 12)

Standard errors in brackets

*Significance levels: *: 10%, **: 5%, ***: 1%*

Table 5. Regression results of the CLM regression on the probability of choosing region $m \in (1,12)$, comparing males to females

Variable	Males ⁽ⁱ⁾			Females ⁽ⁱⁱ⁾		
	(III)	(V)	(VI)	(III)	(V)	(VI)
<i>Studied</i>	1.72*** [0.05]	1.78*** [0.05]	1.89*** [0.07]	1.78*** [0.06]	1.78*** [0.06]	2.06*** [0.09]
<i>Born</i>	2.11*** [0.02]	2.11*** [0.02]	2.11*** [0.02]	2.09*** [0.04]	2.08*** [0.03]	2.08*** [0.03]
<i>Worked</i>	3.76*** [0.03]	3.75*** [0.03]	3.76*** [0.03]	3.88*** [0.05]	3.88*** [0.05]	3.88*** [0.05]
<i>Studied x Born</i>	-	-	-	-	-	-
<i>PS index</i>	0.71*** [0.08]	0.78*** [0.08]	0.75*** [0.08]	0.93*** [0.13]	1.08*** [0.14]	0.92*** [0.13]
<i>Studied x PS index</i>	-	-0.76*** [0.28]	-	-	-1.22*** [0.42]	-
<i>Urban</i>	-	-	0.24*** [0.06]	-	-	0.43*** [0.08]
<i>Studied x Urban</i>	-	-	-0.31*** [0.09]	-	-	-0.48*** [0.13]
Additional controls	Full set of regional dummies	Full set of regional dummies	Full set of regional dummies	Full set of regional dummies	Full set of regional dummies	Full set of regional dummies
Pseudo R^2	0.77	0.77	0.77	0.71	0.71	0.71
Log-likelihood	-15106.51	-15103.02	-21632.64	-6504.05	-6499.98	-6497.66

(i) Number of cases: 26 092; Number of observations: 313 104 (=26 092 x 12)

(ii) Number of cases: 9 095; Number of observations: 109 140 (=9 095 x 12)

Standard errors in brackets

Significance levels: *: 10%, **: 5%, ***: 1%

Table 6. Regression results of the CLM regression on the probability of choosing region $m \in (1,12)$, comparing younger to older entrepreneurs

Variable	Age $\leq 35^{(i)}$			Age $> 35^{(ii)}$		
	(III)	(V)	(VI)	(III)	(V)	(VI)
<i>Studied</i>	1.83*** [0.05]	1.82*** [0.05]	1.96*** [0.07]	1.61*** [0.06]	1.61*** [0.06]	1.92*** [0.10]
<i>Born</i>	2.11*** [0.02]	2.11*** [0.02]	2.11*** [0.02]	2.14*** [0.03]	2.14*** [0.03]	2.14*** [0.03]
<i>Worked</i>	3.41*** [0.03]	3.41*** [0.03]	3.41*** [0.03]	4.29*** [0.04]	4.29*** [0.04]	4.29*** [0.04]
<i>Studied x Born</i>	-	-	-	-	-	-
<i>PS index</i>	0.95*** [0.08]	1.03*** [0.09]	0.98*** [0.09]	0.41*** [0.11]	0.52*** [0.09]	0.46*** [0.11]
<i>Studied x PS index</i>	-	-0.71*** [0.28]	-	-	-1.15*** [0.31]	-
<i>Urban</i>	-	-	0.50*** [0.06]	-	-	0.20*** [0.06]
<i>Studied x Urban</i>	-	-	-0.23*** [0.12]	-	-	-0.54*** [0.13]
Additional controls	Full set of regional dummies	Full set of regional dummies	Full set of regional dummies	Full set of regional dummies	Full set of regional dummies	Full set of regional dummies
Pseudo R^2	0.73	0.73	0.73	0.79	0.79	0.79
Log-likelihood	-13301.28	-13298.14	-13298.34	-8143.48	-8140.01	-8135.78

(i) Number of cases: 19 935; Number of observations: 239 220 (=19 935 x 12)

(ii) Number of cases: 15 252; Number of observations: 183 024 (=15 252 x 12)

Standard errors in brackets

Significance levels: *: 10%, **: 5%, ***: 1%

Table 7. Regression results of the CLM regression on the probability of choosing region $n \in (1,81)$

Variable	(I)	(II)	(III)	(IV)	(V)	(VI)
<i>Studied</i>	3.15*** [0.02]	2.25*** [0.03]	2.24*** [0.03]	2.99*** [0.04]	2.21*** [0.03]	2.73*** [0.04]
<i>Born</i>	3.03*** [0.02]	2.24*** [0.02]	2.25*** [0.02]	2.81*** [0.03]	2.25*** [0.02]	2.24*** [0.02]
<i>Worked</i>	-	4.50*** [0.02]	4.48*** [0.02]	4.42*** [0.02]	4.48*** [0.02]	4.44*** [0.02]
<i>Studied x Born</i>	-	-	-	-1.85*** [0.06]	-	-
<i>PS index</i>	-	-	0.64*** [0.05]	0.63*** [0.05]	0.82*** [0.05]	0.65*** [0.05]
<i>Studied x PS index</i>	-	-	-	-	-1.33*** [0.13]	-
<i>Urban</i>	-	-	-	-	-	2.05*** [0.13]
<i>Studied x Urban</i>	-	-	-	-	-	-1.14*** [0.06]

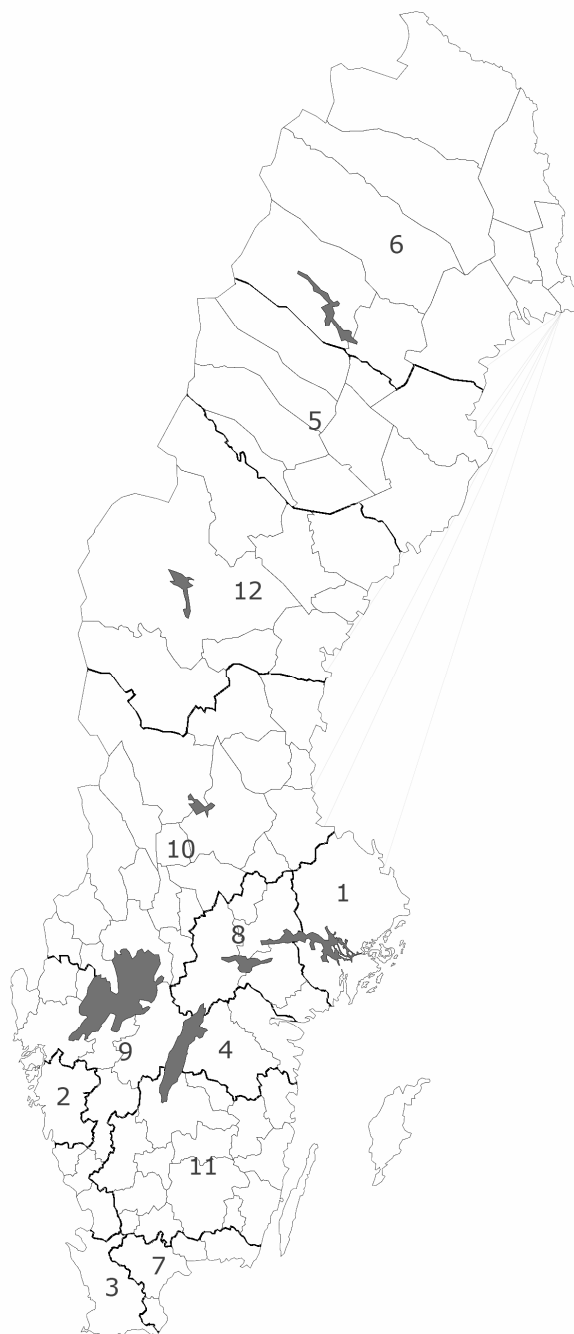
Additional controls	Full set of regional dummies	Full set of regional dummies	Full set of regional dummies	Full set of regional dummies	Full set of regional dummies	Full set of regional dummies
Pseudo R^2	0.64	0.78	0.79	0.79	0.79	0.78
Log-likelihood	-58383.07	-34543.82	-34436.41	-33960.52	-34386.20	-34221.51

Number of cases: 35 187; Number of observations: 2 850 147 (=35 187 x 81)

Standard errors in brackets

*Significance levels: *: 10%, **: 5%, ***: 1%*

Figure 1. The 81 functional regions of Sweden and an aggregated set of 12 regions.



Legend: Numbers refer to the numbers assigned to regions in Table 1.

Appendix – Alternative Specific Multinomial Probit Model (ASMPM)

The usual approach in discrete choice modelling is to implement a multinomial logit or probit model when the explanatory variables of interest are case-specific (describe the individuals and their environment). The conditional logit model allows the explanatory variables to be alternative specific (describe the characteristics of the different alternatives in relation to the individual making the choice). Both of these types of models depend on the IIA assumption (uncorrelated errors among alternatives). Long and Feese (2006) discuss an extension of these models that allows to incorporate alternative-specific along with case-specific data, but also relax the assumption that the errors are uncorrelated, the alternative-specific multinomial probit model (hereafter referred to as ASMPM). The ASMPM requires the computation of multidimensional normal integrals. The development of methods of maximum simulated likelihood that became feasible with the advances in computational power helped alleviate this problem (McFadden, 1989; Train, 2003; Cameron and Trivedi, 2005).

Our analysis aims at testing how varying individual ties with some of the alternative regions can affect the competition among regions for attracting entrepreneurial talents. To give an example, we expect the Stockholm-Uppsala region to be the most attractive region for all potential entrepreneurs. We are interested however in testing if an individual from e.g. Gothenburg that studied in a third region will exhibit an increased propensity to set up in his place of studies despite the pull effect his home region and Stockholm will exert on him. Similarly we expect all regions to exert a stronger or weaker pull. We don't want to assume any alternative as irrelevant. We are therefore reluctant to dismiss the IIA assumption as irrelevant that easily. Lastly, the ASMP model allows conditioning the discrete choices on case-specific controls, in other words characteristics of the individual rather than of the region.

Analytically, we let u_{im} stand for the utility individual i receives from alternative m . Then,

$$u_{im} = x_{im}\beta + z_i\gamma_m + \varepsilon_{im}, m = 1, \dots, J, \gamma_1 = 0, J = 12 \quad (7)$$

where \mathbf{x}_{im} contains the values of the alternative-specific variables for alternative m and case i , β contains the effects of the alternative-specific variables, \mathbf{z}_i contains case-specific independent variables for case i , and γ_m contains coefficients for the effects on alternative m relative to the base alternative. ε_{im} is a random, normally distributed error term. Finally, the probability of choosing alternative m from among J different alternatives is:

$$\begin{aligned}\Pr(y_i = m) &= \Pr(u_{im} > u_{ij}, \forall j \neq m) = \\ &= \Pr(\mathbf{x}_{im}\beta + z_i\gamma_m + \varepsilon_{im} > \mathbf{x}_{ij}\beta + z_i\gamma_j + \varepsilon_{ij}, \forall j \neq m), \quad j = 1, \dots, J\end{aligned}\quad (8)$$

Where

$$\mathbf{x}'_{im} = [\textit{Born} \quad \textit{Studied} \quad \textit{Worked} \quad \textit{Born} \times \textit{Studied} \quad \textit{PSindex}] \quad (9)$$

Turning to the case specific controls, we expect younger, male entrepreneurs to be more mobile, and therefore more likely to be attracted by the opportunities offered by the three ‘metropolitan’ regions of Sweden. The latter part of this expectations is based on the observation that differences exist between males and females in the way they relate to their family while establishing a firm (Greve and Salaff 2003). We therefore include a *Male* dummy and the *Age* of the entrepreneur. The case-specific variables vector thus is:

$$\mathbf{z}'_i = [1 \quad \textit{Age} \quad \textit{Male}] \quad (10)$$

The first element of \mathbf{z}_i equalling 1 captures the base utility of each one of the 12 regions that is the same for all individuals and relates to the characteristics of the local entrepreneurial environment discussed above. Among factors that we thus model as equally important for all types of entrepreneurs are, as discussed in section 2, heterogeneous incentives structures for entrepreneurship across regions, characteristics of the local population and institutional factors characterising the regional economic milieu. It is worth noting that the localisation economies do not fall under this category since from the point of view of the entrepreneur they vary across both industry branches and regions and not just across regions.