



Location choices of graduate entrepreneurs[☆]

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ABSTRACT

We review complementary theoretical perspectives on location choices of university graduate entrepreneurs derived from the individual-opportunity nexus and local embeddedness perspectives on entrepreneurship. Analysis of the full population of 215,388 graduates from Swedish institutions of higher education between 2002 and 2006 provides support for both location choice perspectives. Overall, 63% of graduate entrepreneurs start businesses locally in their region of graduation while 37% start businesses elsewhere. The likelihood of starting locally is substantially higher in metropolitan regions, if the graduate was born locally or has university peer entrepreneurs and entrepreneurial family members in the region of graduation. Implications for theory and public policy are discussed.

1. Introduction

The contributions of universities to entrepreneurial activities are wide-ranging, including both direct effects through the creation of ventures by faculty, students and recent graduates as well as indirect effects through graduates first seeking employment and later starting their own ventures (Boh et al., 2012; Wennberg et al., 2011; Wright et al., 2008). In terms of direct effects, the entrepreneurial activities of students and graduates appear to substantially outweigh those of university employees and thus constitute a particularly important mechanism for generating local economic activity and growth (Astebro et al., 2012; Bramwell and Wolfe, 2008; Etzkowitz et al., 2000; HESA, 2015). Evidence that faculty spin-offs are limited both in terms of numbers and returns (e.g. Wennberg et al., 2011), has led to an increased focus among both scholars and policy makers on student start-ups across several countries (e.g. Dahlstrand and Berggren, 2010; Fini et al., 2016; Hsu et al., 2007; Lazear, 2005; Lerner and Malmendier, 2013). However, many university students move locations after graduation and the extent to which they start businesses close to their place of graduation or elsewhere has not been studied.

The importance of formal human capital for successful entrepreneurship (Van Praag et al., 2013) and the importance of new business activity for regional growth (Fritsch, 2013) motivate an inquiry into the location choices of highly educated entrepreneurs. This paper seeks to advance the recent but growing strand of research on entrepreneurship among university graduates by examining both their likelihood of entrepreneurship and the location choices of those that engage in entrepreneurship. The limited studies examining localization choices indicate that graduates are more likely to start their ventures in the region where they complete their studies, even after controlling for birth region (Baltzopoulos and Broström, 2013). As our interest lies in elucidating this literature we focus on the locational choice element and begin by outlining a theoretical framework focused on this stage. The research question that we ask is: *What regional factors influence the probability that graduates who start firms do so in their region of graduation?* This question has direct research and policy implications concerning the localization of economic activity and the potential of utilizing universities to support local economic development. For example, local incubators will have little local impact if graduates eventually move away to start their businesses.

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From a theoretical viewpoint, studying the location choices of university graduates who engage in entrepreneurship is particularly interesting. Students graduating from university seeking to become entrepreneurs have invested extensively in human capital – investments they need to recover. They can either choose to work for somebody else to recover these investments or choose to engage in entrepreneurship. On graduation, sunk costs in specific careers, or family obligations, are likely minimal. University graduates are also at their most mobile life-stage, with a large proportion moving locations directly following graduation (Government Office for Science, 2016; Kodrzycki, 2001). Following graduation, university students who embark on an entrepreneurial journey are in a unique position to choose the locations of their businesses that provide the best opportunities for them. Later in life, such localization decisions are likely influenced by a wider range of other considerations (Dahl and Sorenson, 2009).

Two main theoretical arguments concerning localization choices of graduate entrepreneurs can be derived from the entrepreneurship literature. The individual-opportunity nexus view argues that businesses emerge at the intersection of entrepreneurial individuals and attractive opportunities (Eckhardt and Shane, 2003; Shane and Venkataraman, 2000). Business opportunities tend to be more abundant in urban agglomerations with strong demand and extensive purchasing power (Glaeser, 2007). Graduates in metropolitan regions thus face ample opportunities and should be more likely to act on these, *ceteris paribus*. Conversely, local embeddedness logic posits that proximity to supportive social networks and familiarity with local businesses constitute important drivers of localization decisions for entrepreneurs (Dahl and Sorenson, 2012; Ruef, 2010). According to this logic, we would expect university graduates to be more likely to remain in the locations in which they graduate. This behavior may be especially strong if they have family or university peers in the same region, or originally hail from the region.

We set out to explore the prevalence of university graduates' entrepreneurship and to test the extent to which the empirical patterns are consistent with these two theoretical perspectives. We do so by examining the full population of 215,388 individuals graduating from Swedish institutions of higher education between 2002 and 2006. Our results indicate that close to two-thirds (63%) of the graduates who start businesses do so in the region where they graduate, while 37% start their businesses elsewhere. We find ample support for both theoretical perspectives. Specifically, students living in metropolitan areas are more likely to engage in entrepreneurship, and also more likely to run a business in the local area after graduation, consistent with the individual-opportunity nexus view. Our results also highlight the importance of peer effects from other graduate entrepreneurs, supporting the local embeddedness perspective. When analyzing graduates' location choice with respect to starting their firms in the region of graduation, the metropolitan variables are strong predictors of local startups. Location choices are also influenced by local embeddedness relating to the presence of parent entrepreneurs and university peer entrepreneurs. Implications for theory and policy are discussed.

2. Theory and research on university entrepreneurship

Entrepreneurship is a central mechanism through which universities are believed to foster local economic development (Baptista et al., 2011; Fini et al., 2011; Grimaldi et al., 2011). Empirical research in this vein has focused primarily on entrepreneurship among university employees rather than among students or recent graduates (Rothaermel et al., 2007; Siegel and Wright, 2015b). One of the few studies on

location choices of former university employees examined the location of biotech firms spun out of US universities, finding that the location of the founders, other firms in the industry, and venture capitalists all influenced their location choice (Kolympiris et al., 2015). A more general study on the location choices of 35,000 entrepreneurs in Sweden – a third of them being university graduates – showed that graduates are significantly more likely to start ventures in the region where they complete their studies, even after controlling for birth region (Baltzopoulos and Broström, 2013).

In terms of economic impact, however, the predominant focus on university employees rather than students seems misplaced. Recently, Astebro et al. (2012) used data from the U.S. Scientists and Engineers Statistical Data System (SESTAT) to compare entrepreneurship in the 1995–2006 period among faculty and university graduates with at least a bachelor's degree in science or engineering. Based on population-weighted samples comparing entrepreneurship rates and individual earnings as entrepreneurs among recent graduates and faculty, their findings indicated that students are a far more important source of university entrepreneurship than current or former faculty, and student companies do not seem to be of lower quality than those of current or former university employees. Similarly, using Swedish data, Wennberg et al. (2011) found that startups by graduates who initially worked for private firms performed better than startups by those who initially worked for universities. Together, these findings suggest that to understand the wider economic impact of university-based entrepreneurship, a focus on university employees may be too narrow. University graduates constitute an important and understudied contribution to university-based entrepreneurship.

It is also important to acknowledge heterogeneity across universities regarding their ability to support and foster entrepreneurship. Universities differ substantially in terms of structure, resources, and commercial culture (Stuart and Ding, 2006). This means that there are likely important differences across universities in the magnitude and nature of entrepreneurial activities of their graduates. Research into this topic, however, is notably scarce and limited to comparative case studies of two or a few universities (Clark, 2004; Perkmann et al., 2013; Rothaermel et al., 2007). Some scholars propose that universities located in regions with concentrated financial and business communities are best positioned to foster entrepreneurship because of spatial proximity benefits (Martin et al., 2005). Elite universities in these regions may be at a particular advantage. In the UK, for example, some studies have pointed to the importance of the so-called 'Golden Triangle' of Cambridge, London and Oxford universities (Smith and Ho, 2006). In contrast, ventures emerging from universities outside such locations have been shown to attract funding by relying on quality signals relating to either the university or the founding entrepreneur (Mueller et al., 2012). In regions with more than one university, only the parent university appears to influence academic entrepreneurs' decisions to stay in the region (Heblich and Slavtchev, 2014).

Wright et al. (2008) distinguish between types of universities and the types of regions in which they are located, arguing that 'mid-range universities' are less likely to have critical masses of world-leading research than leading or elite universities. The distinction between 'mid-range regions' and 'urban regions' stem from the former being less likely to involve regions with extensive and deep corporate and financial infrastructures that generate entrepreneurial opportunities and mechanisms to fund and support them.

In sum, it appears that universities differ in their capacity to foster entrepreneurship. This likely influences the entrepreneurial activities of university employees and students as well as graduates, which is the focus of the present paper.

2.1. Theoretical explanations for entrepreneurship among university graduates

Students graduating from university are at their most mobile life-stage and the majority of university graduates in many regions relocate geographically around the time of their graduation (Kodrzycki, 2001; Kodrzycki, 2001; Government Office for Science, 2016). University graduates often experience a relatively extensive period of job search after graduation, which can include unemployment or temporary jobs, before they settle into their careers (Oreopoulos et al., 2012). This also includes those that pursue an entrepreneurial career, who often engage in entrepreneurial activities for some time before this becomes their primary income source (Delmar and Davidsson, 2000). To a large extent, university graduates' location choices are driven by labor market opportunities, which tend to be more bountiful in metropolitan areas (Ahlin et al., 2014). The mobility pattern of graduates who choose to become entrepreneurs is however less clear (Plummer and Pe'er, 2010). Two complementary theoretical arguments help explain these choices. The first has its origin in an economic perspective on location and focuses on spatially distributed opportunities for entrepreneurship. The second is grounded in sociology and focuses on access to resources and role models provided by social ties originating in the person's vicinity. The two perspectives, while overlapping, thus differ in the relative emphasis they put on variables explaining these choices. We expand on these perspectives below.

2.2. Spatially distributed opportunities and university graduates' entrepreneurship

The individual-opportunity nexus view of entrepreneurship holds that businesses emerge at the intersection of entrepreneurial individuals and attractive opportunities (Eckhardt and Shane, 2003; Shane and Venkataraman, 2000). Thus, this perspective focuses primarily on access to and discovery of opportunities rather than their exploitation. Business opportunities tend to be more bountiful in urban areas with strong demand for various goods and services (Pe'er et al., 2006). Urban areas also provide access to strategic inputs through dense concentrations of consumers and other companies (Johnson and Parker, 1996). Further, due to the agglomeration of knowledge and the likelihood of knowledge spillovers, the identification of business opportunities is likely higher in urban areas (Acs and Armington, 2004). This logic is supported by evidence that startup rates are higher in areas with greater population density (e.g. Davidsson et al., 1994). The extent to which this is driven by people moving to these urban areas to start businesses or if it is a case of higher entrepreneurship rates among those already living there is largely unknown. However, in terms of location choices of university graduates, this logic would suggest that graduates benefit either from moving to or remaining in urban agglomerations to pursue entrepreneurial careers.

Geographical mobility may endow individuals with network resources and a cognitive base for identifying lucrative opportunities (Saxenian, 2007). A geographical shift may expose people to new and unexpected types of demand, which they may be able to accommodate through entrepreneurship (Williams, 2006). Movement may also enhance the possibility for bringing new skills and ideas into a context that may value such 'new' and different products or services (Davidsson, 2004). Newcomers into a region with access to a significant range of weak ties are also well positioned for information arbitrage that enables the discovery of entrepreneurial opportunities (Aldrich and Kim, 2007).

In sum, taking the individual-opportunity nexus perspective would lead us to expect university graduates to be, all else equal, more likely

to engage in entrepreneurship when located in an urban agglomeration, and more likely to move to urban agglomerations where opportunities are more abundant, unless already residing in such areas.

2.3. Local embeddedness and university graduates' entrepreneurship

The local embeddedness perspective on entrepreneurship offers different viewpoints. Local embeddedness is situated at the intersection of sociology and economic geography based on theory and evidence that individuals engaging in start-up processes are strongly affected by the economic and social environments surrounding them (Andersson and Larsson, 2016; McKeever et al., 2015; Minniti, 2005; Westlund et al., 2014). This line of reasoning holds that entrepreneurs are dependent on 'social embeddedness' created by regionally bounded personal interaction (Dahl and Sorenson, 2009). Social embeddedness involves a process of both drawing on and becoming engaged in local social structures (Jack and Anderson, 2002). People enjoy living close to family and friends, which offer valuable social bonds and affinity. For prospective entrepreneurs, such local ties can be highly valuable and converted into economic value in terms of providing access to resources, insights into local conditions for business, and facilitating effective economic activity (McKeever et al., 2015). Because of familiarity, locally embedded economic transactions are governed by trust rather than market mechanisms (Granovetter, 1985). Localized trust serves as an economic lubricant, replacing contracts, which reduces transaction costs and facilitates collaboration and resource exchange (Bird and Wennberg, 2014). Access to resources is typically a challenge for new ventures which face liabilities of newness (Stinchcombe, 1965). Friends, relatives, acquaintances and local networks can serve to overcome such liabilities and facilitate resource exchange (Hite, 2003). Such local networks can be particularly important for recent university graduates, who largely lack the networks established through a professional career. With its focus on access to resources and economic exchange, this perspective is chiefly concerned with opportunity exploitation rather than opportunity discovery.

A pioneering study by Pennings (1982) found that entrepreneurs often start their companies at their place of residence even if economic factors are more favorable elsewhere. Accumulating empirical support for the role of local embeddedness, a large-scale study by Dahl and Sorenson (2009) found that individuals rarely moved to start a business and that proximity to family is a strong determinant of entrepreneurs' location choice, net of economic effects. Bird and Wennberg (2014) found that local social norms and the number of small firms in the region strongly affected the number of new ventures created, net of economic agglomeration effects. Such behavior is challenging to explain from the viewpoint of the individual-opportunity nexus and hints at complementary explanations for graduates' location choice. The local embeddedness perspective suggests that entrepreneurs' location choice depends on proximity to social networks, family members, and prior familiarity with the local business environment (Dahl and Sorenson, 2012). This can provide advantages for prospective entrepreneurs, in particular for recent graduates that lack professional networks or other credentials that can otherwise help overcome liabilities of newness.

The local embeddedness perspective has been used more to explain the locational choices of prospective entrepreneurs rather than the choice to become an entrepreneur. Yet, local embeddedness changes the relative utility of employment vs. entrepreneurship. Because of embeddedness, resources needed for entrepreneurship can be accessed more easily and at lower cost. Thus, it changes the relative attractiveness of the two options.

In sum, the local embeddedness perspective would lead us to expect university graduates to be more likely to start businesses in areas where

they already live or where their family and friends live, controlling for the effects of urban agglomerations and metropolitan areas where opportunities are more abundant. To some extent, this conclusion is also derived from the tendency of social networks' roles as potential substitutes for agglomerations (Glaeser et al., 2000; Johansson et al., 2004).

2.4. Higher education in Sweden

Higher education in Sweden is predominantly controlled, financed and owned by the state. Universities are not allowed to charge tuition fees from EU residents, limiting private opportunities. Before 1965, there were only four universities in Sweden covering most academic fields. From the late 1960s onwards, higher education expanded considerably, particularly outside traditional university locations. This rise was fueled by the political ambition of offering higher education to everybody. Several new regional colleges were established until every county in Sweden was home to at least one university or college. In the early 1990s, 22% of Swedes aged 25–64 had completed a 3-year or longer university education. By 2014 this figure had grown to 40%. Recently, regional institutions of higher education have become important conduits for the government's regional growth policies, with the expectation that they will play an active and important role in furthering regional economic growth (e.g. Audretsch and Lehmann, 2005; Braunerhjelm and Borgman, 2004; Etzkowitz et al., 2000; Lindholm Dahlstrand, 2007).

Entrepreneurship has been suggested as a potentially important pathway to such growth (Jacob et al., 2003) and many Swedish universities have established entrepreneurship teaching and research commercialization departments (e.g. Henrekson and Rosenberg, 2001; Klostén and Jones-Evans, 2000). Prior studies of entrepreneurship among graduates in Sweden have generally been limited to perceptions and intentions among students (Autio et al., 2001; Yar Hamidi et al., 2008) or case studies of specific universities (Astebro et al., 2012; Johannisson, 1991). An important exception is Daghbashyan and Hårsman (2014) who examined the effects of various university degrees and graduating from an 'elite' institution on entry into entrepreneurship.

Our study instead explores the total population of students graduating from Swedish universities and their labor market activities during the three years subsequent to their graduation, focusing on those who engage in entrepreneurship. We analyze the total magnitude of their business ownership, avoiding problems with drawing inferences from a sample to a population; potential sampling biases; or censored observations. Also, we perform detailed analyses of the geographical dispersion of location of graduation linked to location of business startups. Our emphasis is on the effects of university and regional characteristics on graduates' likelihood of entrepreneurial entry, as well as on their location choices.

3. Data and methods

Our main research question concerning the location choices of university graduate entrepreneurs places certain requirements on the data. First, we need comparable national data that are regionalized both in terms of place of study and place of labor market activity. Further, to investigate the effects of local embeddedness and selection we need longitudinal data that include students' pre-university history. To fulfill these goals, we constructed a longitudinal dataset through a combination of various registers made available to us through official registers at Statistics Sweden. Specifically, we use the LISA database which contains annual data about all Swedish inhabitants, including detailed information about place, type and time of education, place of residency, as well as employment data and family. Given our focus on university graduates, we limited our data to all individuals with a

completed 3-year or longer university degree in any subject during 2002–2006. If a person holds several university degrees (e.g., a BSc and an MSc degree from the same or different universities) we include their most recent university degree. Individuals that move abroad or die are excluded from LISA. In total, 215,388 individuals fulfill our data criteria.¹

We follow these individuals for up to three years after graduation or until they have entered entrepreneurship as a full-time activity by starting a new venture, after which our sample is right censored. Right censoring is generally not considered a problem if individuals 'being at risk' of entering entrepreneurship are uniformly sampled and followed for equal length of times (Yang and Aldrich, 2012), which is the case with these definitions.

3.1. Empirical strategy

Our model is based on full-time entrepreneurial entrants only. Our analytical procedure is divided into two steps: We first use a logit model to estimate the probability that an individual becomes an entrepreneur within 3 years after graduation (entrepreneurial entry). In a second step we estimate the likelihood that the entrepreneurs identified in step one launch their business in the region of graduation (graduate entrepreneurs' location choice). We use two different logit models to estimate probabilities that a graduate enter entrepreneurship. The difference between the two models lies in the use of university dummies in the second specification of each model. In our econometric framework, the probability that graduate i becomes an entrepreneur (E) at time t is defined as:

$$\Pr(E_{i,t} = 1 | \mathbf{x}_{i,t}) = \frac{1}{1 + \exp[-(\mathbf{x}'_{i,t}\Gamma)]}, \quad (1)$$

where $E_{i,t} = 1$ signifies graduate entrepreneurs who have become business owners within three years after taking their university degree. The matrix $\mathbf{x}_{i,t}$ contains the following information characterizing the individual (i), region (R), and university (j), respectively.

$$\mathbf{x}'_{i,t}\Gamma = \alpha + I'_{i,t}\beta + Z'_{R,t}\gamma + R'_{j,t}\sigma + \varepsilon_{i,t}, \quad (2)$$

The regional hierarchy is slightly complicated in this empirical framework. Counties are made up of a larger number of municipalities (except for Stockholm, which internalizes a labor market region larger than the county). Counties are administrative, rather than functional, regions, and are thus not integrated in terms of commuting flows. This issue has led researchers to also aggregate municipalities into labor market regions (e.g. Crampton, 1999; Johansson and Quigley, 2003). In total, Sweden has three levels of aggregation employed in our analysis: first, 21 counties, second, 81 labor market regions, and third, 290 municipalities. Our analysis contains variables on all three levels.

We employed county boundaries to define whether a student is in the same region as the university. This operation is motivated by students being substantially less distance-sensitive than employees in their location choices: students operate on tighter budgets and may be unable to choose place of residence freely, they may choose to continue residing with their parents and commute to university. We argue that a county is the proper 'interaction arena' with respect to students and universities.

However, counties are an improper level for the study of most regional interactions, since the majority of these are naturally constrained by the size of the labor market region, which motivates our second geographical aggregation. Theories of agglomeration economies almost universally emphasize this importance of functional regions, i.e. areas integrated by commuting flows (Combes et al., 2007; Duranton and

¹ Our usable sample comprises roughly 80% of the full population of Swedish University students during the observation period. We lack information on e.g., overseas students and students who move abroad or are deceased during the year in question. We also exclude students from the smallest universities.

Puga, 2004; Johansson et al., 2002). A Swedish county region contains on average about 4 functional regions, implying that the larger county is at best an indirect proxy for any one of its functional regions. Third, when variables are intended to proxy individuals' attributes, the best information is provided on the most disaggregated municipal level. This is the case for instance when we control for residential prices below.

The final part of Eq. (2), the $R_{i,t}$ matrix contains controls on the level of the university. In total, the model is estimated first excluding university dummies ("Baseline", below), and second, including such dummy variables ("University effects", below). The university dummies contained in $R_{i,t}$ will pick up time-invariant heterogeneity with respect to the university. As our time period is reasonably short such effects include student quality, access to infrastructure such as incubators or technology transfer offices, specific geographic effects as well as particular effects related to the density of university-networks and business opportunities that differ between the 30 universities in our dataset. Hence, some aspects of both local embeddedness and economic opportunities are controlled for in the second step. To some extent, we should also expect individual unobserved heterogeneity to be picked up by university dummies. This is because 'high-ability' students tend to self-select to certain universities or regions (Ahlin et al., 2014; Faggian and McCann, 2006).

This first step—the analysis of graduates' occupation choice—allows us to conduct an initial analysis of the relationship between regional factors and graduates' entrepreneurship after graduations. This step also provides a 'benchmark' for the subsequent location choice model. The approach allows us to discern differing effects of local embeddedness for graduates' occupation choice, relative to their location choice as entrepreneurs.

Next, a logit model similar to (1–2) is set up, where the underlying population is restricted to graduate entrepreneurs, and the new dependent variable indicates whether the business is located in the same county region as the university. We retain the practice of estimating the model with and without university dummies to control for time-invariant heterogeneity between universities such as their status among students. Time-invariant university heterogeneity includes university-specific factors affecting the likelihood that graduate entrepreneurs chose to locate proximate to the university or not, such as whether the university is situated close to another county, or the quality of its technology transfer facilities. These university controls would also pick up differences between the 30 universities in our dataset in the existence and quality of entrepreneurship education, and whether there are established networks with local businesses.

3.2. Dependent variables

3.2.1. Graduates' likelihood of entrepreneurial entry

Our first dependent variable is a traditional occupation choice indicator, measured as the transition to entrepreneurship as a full-time labor market activity (Folta et al., 2010).² We identify all individuals that enter entrepreneurship within three years of their graduation year.³ We use the three-year cutoff as university graduates often experience a relatively extensive period of job search on graduation, which can include unemployment or temporary jobs, before they settle into their careers (Oreopoulos et al., 2012). This also includes those that

² We study only full-time entrants since many students and workers alike establish part-time businesses in Sweden (Daghbashyan and Hårsman, 2014) and the predictors of part-time entrepreneurship are often quite different from full-time entrepreneurship (Folta et al., 2010).

³ We conducted robustness tests to check if the choice of a 3-year cutoff influenced our results. In alternative models, we instead used a 2-year cutoff. This decreased the sample of entrepreneurs from 5799 to 4428 (24%). Thus, relatively speaking, fewer graduates started their businesses during the third compared to the two first years following graduation. Estimating the same models as in Tables 2 and 3 with the 2-year cut-off shows substantially the same results, with statistical significance of our variables of interest remaining unchanged.

pursue an entrepreneurial career, who often engage in entrepreneurial activities for some time before this becomes their primary source of income (Delmar and Davidsson, 2000). Our dependent variable for occupational choice takes the value '1' for graduates entering entrepreneurship by starting their own full-time business in the year of graduation or any of the subsequent three years, and '0' otherwise.

3.2.2. Location choice as entrepreneurs (county level)

Our dependent variable for entrepreneurial location takes the value '1' for graduates entering entrepreneurship by starting their own full-time business in the same county as the university from which they graduated, and '0' if they start in another county.

3.3. Independent variables related to the individual-opportunity nexus

Indicators for the three large metropolitan areas in Sweden are our first important independent variables: *Region Stockholm*; *Region Gothenburg*; and *Region Malmö* (labor market region in occupation choice and county level in location choice). Start-up rates have often been showed to be significantly higher in large cities (Audretsch and Lehmann, 2005; Delgado et al., 2010; Stuart and Sorenson, 2003). The importance of large cities for entrepreneurship is often explained by cities providing richer entrepreneurial opportunities such as specialized market niches (Acs and Varga, 2005), access to relevant nearby markets and providers of resources such as financing (Stuart and Sorenson, 2003). The three indicator variables for the metropolitan areas variables are measured at the level of local labor markets in the first model of graduates' occupational choice to control for agglomeration effects.⁴ In the location choice model, this dummy variable is defined at the county level, since it must be assessed at the same geographical level as the dependent variable.

3.3.1. Proportion of public sector employees (municipal level)

A high proportion of public sector employees in the region may affect entrepreneurship by decreasing demand for new products and services (Braunerhjelm and Borgman, 2004). We account for this effect by measuring the relative ratio of employees in the public sector in proportion to the overall population in the labor market area.

3.3.2. Number of prior moves (municipal level)

To account for the potential that the discovery of entrepreneurial opportunities is correlated to regional mobility, for example by exposing individuals to new types of opportunities, with the possibility for bringing new skills and ideas into a novel context (Acs et al., 2009; Davidsson, 2004) we include a count variable measuring the number of different municipalities that an individual has previously resided in. In the location choice analysis, a history of frequent moving may also proxy for a lack of social networks at the most recent location.

3.4. Independent variables related to local embeddedness

3.4.1. Born in county of graduation

This is a dummy variable denoting whether an individual was born in their county of graduation, suggesting greater social embeddedness in that region in terms of established social networks based on 'strong ties' (Granovetter, 1983; Kenney and Goe, 2004). There may also be a general effect of inertia attached to where people stay in the same region and go to university where they were born, for no other particular reason.

Propensity to enter entrepreneurship may depend on university

⁴ In unreported models we also included the often used 'population density' variable as a predictor. This was strongly correlated to the metropolitan dummies and the control variable for residential prices, however the inclusion of population density did not alter the direction or significance levels for these two variables. In order not to over specify our models we therefore excluded population density.

peers previously entering (Kacperczyk, 2013). Peers' location choices are also likely to have an influence since proximity to other graduate entrepreneurs may expose a focal graduate to entrepreneurial role models (Andersson and Larsson, 2016; Kenney and Goe, 2004; Stuart and Sorenson, 2003). We measure such peer influences by two variables tracking the shares of entrepreneurs graduating from the same university and in the same year as a focal individual: *Peer entrepreneurs in county* is a variable describing the share of graduates from the same university and graduation year who are running local firms within 3 years after graduation. *Peer entrepreneurs in other counties* is identically defined but tracks the share of peers who are entrepreneurs in all other counties.

3.4.2. Parents living in county

To control for potential benefits for individuals preferring to locate close to kin, we include a dummy variable taking the value '1' if either of a focal person's parents are residing in the county of graduation (Dahl and Sorenson, 2009). Parents living in the county suggest greater local embeddedness since graduate entrepreneurs can draw upon support in terms of informal cash payments, and social support.

3.4.3. Parents entrepreneurs in county of graduation

To distinguish between the complementary effects of entrepreneurial role models and potential resources and support provided by nearby family members, we include a dummy variable taking the value '1' if any of a focal person's parents are currently engaged in business ownership while simultaneously residing in the same county as a focal person's university of graduation (Dahl and Sorenson, 2009). This variable is not represented in the occupation choice models, where parents' entrepreneurship (regardless of occupation) is included as a control variable.

3.5. Control variables

3.5.1. Parents are entrepreneurs

To account for intergenerational inheritance of entrepreneurship in the first model of graduates' occupation choice, we include a dummy variable taking the value '1' if any of a focal person's parents are currently a full-time entrepreneur (Sørensen, 2007). Entrepreneurial parents are likely to enhance graduates' entrepreneurial entry by them being able to draw upon entrepreneurial parents' business advice and support, in addition to the potential role model effect provided by entrepreneurial parents (Criaco et al., 2017). In the location choice model, where only entrepreneurs are represented, this variable is replaced by whether parents are *local* entrepreneurs in the county of graduation.

3.5.2. Living with parents

To control for graduates being more closely tied to family and region and potentially benefiting from lower costs of living as a resource, we include a dummy variable taking the value '1' if the graduate is living with his/her parents.

3.5.3. Individual age

We control for an individual's age as well as its squared term.

3.5.4. Gender

We control for an individual's gender by entering a dummy variable taking the value '1' for men and '0' for women.

3.5.5. Lagged wage (ln)

We control for graduates' yearly income (natural logarithm) in the year prior to potential entry (including employment during university

years) to proxy for the opportunity costs of entrepreneurship, compared to employment.

3.5.6. Residential prices (municipal level)

Residential prices (municipal level) have been shown to correlate with entrepreneurship since it may provide collateral for entrepreneurs or private investors supporting them in early stages (Hurst and Lusardi, 2004). Thus, where residential prices are higher, entrepreneurs may be better able to pursue resource demanding opportunities. We measure residential prices on the most fine-grained (municipality) level by including the mean price of single-family homes sold in the current year.

3.5.7. Years of education

Years of education signify general human capital, which may differ even among university graduates. Following earlier studies we measure years of education by a count variable (Colombo and Grilli, 2005).

3.5.8. Type of education

Individuals' types of higher education have also been shown to affect their likelihood of engaging in entrepreneurship (Gimmon and Levie, 2010). Similar to Daghbashyan and Hårsman (2014) we measure university graduates' types of education with 10 dummy variables.

3.5.9. Employment status

Categories aimed at controlling for graduate entrepreneurs' pre-entry labor market status: whether the person was employed in t-1, and whether they were unemployed but with wage receipts during the year. The base category is unemployed without wage receipts.

3.5.10. Year of graduation

We control for year of graduation by five dummy variables (2002–2006) to account for cohort effects.

3.5.11. Year dummies

We use year dummies to control for business cycle effects.

4. Results

4.1. Descriptive results

The Table A1 in Appendix A contains means, standard deviations, max and min values for the variables in the study. Notably, there is great variation in some regional-level variables such as residential prices. Houses in some areas cost on average more than 10 times the price of houses in other areas. Similarly, some indicators of local embeddedness (e.g., number of peers starting businesses in the same county) exhibit notable variability.

Table 1 lists all Swedish institutions of higher education that graduated 1000 or more graduations during the years 2002 through 2006. The second column displays the total number of graduates that fulfill our data requirements, the third column the total number of graduates that started a business within three years of graduation, and the final column lists the corresponding percentages. All Swedish institutions of higher education are listed from highest to lowest percentage of graduates starting businesses. Given that our sample is close to a whole country population, the study of these numbers is worthy of comment. A similar study examining the entrepreneurial activity of recent university graduates in the US by Astebro et al. (2015) included engineering students that had started businesses during their studies or within three years of graduation. Their definition is similar but not identical to ours, and their sample is more focused. The population estimates of entrepreneurship rates among recent science and engineering graduates in the US reported by Astebro et al. (2015)

Table 1
Swedish University Graduates 2002–2006.

University	Graduates 2002–2006	Graduates entrepreneurs	Share entrepreneurs
Stockholm School of Economics	1193	88	7,4%
Swedish University of Agricultural Sciences	2934	205	7,0%
Stockholm University	13311	680	5,1%
Royal Institute of Technology	8730	397	4,5%
Södertörn University	2283	97	4,2%
Chalmers University of Technology	6281	233	3,7%
University of Gävle	4285	131	3,1%
Göteborg University	19199	543	2,8%
Lund University	17636	498	2,8%
Luleå University of Technology	6215	168	2,7%
Blekinge Institute of Technology	2179	57	2,6%
Uppsala University	15287	398	2,6%
Mälardalen University	5831	150	2,6%
Karolinska Institutet	6934	178	2,6%
Linköping University	13811	342	2,5%
Malmö University	9068	207	2,3%
Halmstad University	3724	84	2,3%
Dalarna University	3979	85	2,1%
University West	3241	65	2,0%
Växjö University ¹	5450	109	2,0%
Karlstad University	6328	123	1,9%
Umeå University	13794	261	1,9%
Jönköping University	6251	117	1,9%
University of Borås	5030	88	1,7%
Skövde University	3096	53	1,7%
Mid Sweden University	6001	102	1,7%
Örebro University	7103	119	1,7%
University College of Kalmar ¹	3983	62	1,6%
Kristianstad University	3895	57	1,5%
Stockholm Institute of Education ^c	8336	102	1,2%
Total:	215 388	5 799	

Notes: All colleges with 1000 or fewer graduates excluded. 'Graduates entrepreneurs' are those entering entrepreneurship in the year of graduation or any three years following graduation.

¹ Today merged as Linneaus University.

^c Today part of Stockholm University.

amounted to 6.41%. This is higher than the entrepreneurship rates of 2.69% (5799/215,388) in the overall population of recent university graduates in Sweden that our data is based on, but still within the range of values in our study when looking at specific universities.⁵

Turning to specific universities listed in Table 1, we see that startup rates range from 1.2% to 7.2%, indicating great variation in the level of entrepreneurship across Swedish universities. For example, the entrepreneurship rate among recent graduates is almost six times higher for the Stockholm School of Economics compared to Stockholm Institute of Education. To some extent, Stockholm School of Economics and Swedish University of Agriculture are outliers in Table 1, with markedly higher rates, but also Royal Institute of Technology has a rate more than four times higher than Stockholm Institute of Education. Not surprisingly, the highest and lowest percentages are reported for specialized universities, indicating that the type of education chosen is

⁵ Inclusion of smaller universities such as art and craft schools increase the number of graduates by about 3% and also slightly increases the share of graduate entrepreneurs, presumably because graduates in the arts are more prone to enter self-employment due to lack of attractive employment opportunities.

intimately interlinked with entrepreneurial activity. However, numbers also vary greatly among universities offering a broad range of degrees, plausibly because the compositions or quality of degrees vary, because of differences in local entrepreneurial conditions, and because students self-select to different universities. These results are similar to those obtained when looking at the effects of various university degrees for entrepreneurial entry among adults in the labor force (Dagbhashyan and Hårsman, 2014).

Table 2 lists the same universities based on the location of firms started by recent university graduates from the largest to the smallest share of local startups. Again, there is great variation. For example, only 23% of entrepreneurs from Kristianstad University start their businesses outside the university county, whereas 58% of entrepreneurs from neighboring Blekinge Institute of Technology, located only 113 km from Kristianstad, run their businesses elsewhere. The highest proportion of firms started locally, in the county of the university from where they graduate, is noted among students graduating in metropolitan areas. On several occasions, over 80% of graduates start their businesses locally. The large variation across universities in different locations may be taken as an indication that localization choices of graduate entrepreneurs are linked to regional variation related to both employment opportunities and business opportunities. However, these results could also be driven by individual-specific factors such as demographics, as regional colleges and universities are known to attract older students (Blom, 2003). These descriptive results are likely driven by local labor market conditions as well as individual-specific and university-specific characteristics. Below we therefore move on to analyze graduates' occupation choices and location choices among those engaging in entrepreneurship.

Table A1 in Appendix A lists all variables and their mean values across the three groups of university graduates in our multivariate analyses (those that do not enter entrepreneurship in any of the three years subsequent to graduation, those that enter by starting a firm in their county of graduation, and those that enter by starting a firm in another county). Table B1 in Appendix B and Table B2 in Appendix B shows correlation matrices for all variables in the two sets of analyses.

4.2. Multivariate results

Table 3 displays logit models of graduates' likelihood of entrepreneurial entry among all 215,388 individuals graduating from Swedish institutes of higher education in the 2002–2006 period. Our models are based on yearly individual observations for the first three years post graduation (in total 834,526 individual-year observations).

Table 3 presents estimations with both 'baseline effects' in Column 1 and with university dummies in Column 2. These variables control for the large inter-university differences in entrepreneurship shown in the descriptive analysis. Table 3 presents exponentiated coefficients (Odds Ratios, OR, in the logit model). An OR of 0.9 (1.1) indicates that for each one-unit change in a predictor variable, the odds of entering entrepreneurship decreases (increases) by 10%. In Column 3 of Table 3 we also present x-standardized coefficients, based on the estimates of column 2. The odds change associated with a one-standard deviation change in the predictor variables are presented in order to (a) facilitate interpretation of non-integer variables as fractions, and (b) compare the relative importance of different predictor variables for university graduates entrepreneurial entry.

The top rows of Table 3 displays the theoretically motivated predictor variables and the bottom rows show our control variables. We first examine the effects of variables related to the individual-opportunity nexus view on entry into entrepreneurship by comparing the odds ratio in column 2 (University effects) of Table 3 with the standardized logit coefficient in column 3 of Table 3. Using the conventional cutoff of at least $p < 0.05$, we note positive associations between individuals' residence in the metropolitan area of Region Stockholm (1.364, $p < 0.01$). Thus, graduates residing in the

Table 2
Swedish University Graduates 2002–2006, starting firms in same or other county.

University	Graduates 2002–2006	Graduates entrepreneurs	Starting in same county as university	Starting elsewhere
Stockholm School of Economics	1193	88	90%	10%
Stockholm University	13311	680	89%	11%
Södertörns University	2283	97	89%	11%
University West	3241	65	88%	12%
Royal Institute of Technology	8730	397	85%	15%
Karolinska Institutet	6934	178	83%	17%
Chalmers University of Technology	6281	233	81%	19%
Kristianstad University	3895	57	77%	23%
Malmö University	9068	207	77%	23%
Stockholm Institute of Education ^c	8336	102	74%	26%
University of Borås	5030	88	73%	27%
Skövde University	3096	53	72%	28%
Göteborg University	19199	543	71%	29%
Lund University	17636	498	71%	29%
Dalarna University	3979	85	56%	44%
Karlstad University	6328	123	53%	47%
Luleå University of Technology	6215	168	52%	48%
Jönköping University	6251	117	51%	49%
Halmstad University	3724	84	51%	49%
University College of Kalmar ¹	3983	62	50%	50%
Linköping University	13811	342	46%	54%
Blekinge Institute of Technology	2179	57	42%	58%
Örebro University	7103	119	42%	58%
Gävle University	4285	131	42%	58%
Uppsala University	15287	398	39%	61%
Umeå University	13794	261	39%	61%
Mälardalen University	5831	150	39%	61%
Växjö University ¹	5450	109	31%	69%
Mid Sweden University	6001	102	25%	75%
Swedish University of Agricultural Sciences	2934	205	6%	94%
	215 388	5 799		

Notes: All colleges with 1000 or fewer graduates excluded. ‘Graduates entrepreneurs’ are those entering entrepreneurship in the year of graduation or any three years following graduation.

¹ Today merged as Linneaus University.

^c Today part of Stockholm University.

Stockholm region are substantially more likely to enter entrepreneurship, relative to the base category (non-metropolitan graduates). The corresponding effects for graduates from the Gothenburg and Malmö regions are close to 1, and statistically insignificant. The strong result for Stockholm—by far the largest agglomeration in Sweden—is consistent with substantial agglomeration effects in university graduates’ entrepreneurship (Audretsch et al., 2005). Agglomeration effects may also explain why universities in and close to Stockholm had the highest entrepreneurship entry rates in the descriptive results (Table 1). The coefficients in Table 3 suggests that higher ‘Residential prices’ in a focal municipality – indicating the availability of liquidity and consumer spending power (Hurst and Lusardi, 2004) – is slightly positively associated with graduates’ likelihood of entering entrepreneurship, but not statistically significant. ‘Percentage of public sector workers’, a common variable in regional analyses of entrepreneurship, does not show any significant relationship in Table 3. ‘Number of municipality moves’ is the final variable related to the individual-opportunity nexus. In contrast to what one would expect if entrepreneurial opportunities are correlated with regional mobility (Frederiksen et al., 2016), graduates who have moved several times across municipalities are less likely to enter entrepreneurship.

Turning to the proxies for variables related to local embeddedness in Table 3, we find several noteworthy effects. Individuals ‘born in county of graduation’ are about as likely to enter entrepreneurship as individuals born elsewhere. The variable describing ‘peer entrepreneurs in county’ is positively associated with a focal graduate’s likelihood of entering entrepreneurship (OR 2.635, $p < 0.01$). The x-standardized coefficient in column three indicates that a one standard deviation increase in the share of university peers that run a business in the region, is associated with a 35% increase in the odds of becoming an

entrepreneur, keeping university specific effects constant.⁶ The share of university peers who start businesses in *other* regions is also positive with a corresponding effect of 21%. Our findings lend support to prior studies of localized social interactions and entrepreneurship (Andersson and Larsson, 2016) and studies suggesting that knowledge spillovers between university students tend to breed entrepreneurship (Agarwal and Shah, 2014; Kacperczyk, 2013). This interpretation is further strengthened by the relatively larger effect of being close to *local* peer entrepreneurs.

The rightmost column in Table 3 displaying standardized logit coefficients allows us to compare the relative effect sizes of the different variables. A few variables stand out regarding their effect on the probability of entering entrepreneurship. Strong effects can be noticed for the Region Stockholm variable and the entrepreneurial peers variables. The Stockholm effect (OR 1.364, $p < 0.01$) suggests that all else equal, graduating from a university in the Stockholm region is associated with entrepreneurial entry. University dummies only explain a small portion of that effect. Further, the two variables ‘peer entrepreneurs in county’ (OR 2.635, $p < 0.01$) and ‘peer entrepreneurs in other counties’ (OR 2.448, $p < 0.01$) appear as important explanatory factors. These three variables are thus strong determinants of graduate entrepreneurship in our model, lending empirical support to both theoretical perspectives.

Turning to the control variables, we note that having at least one parent running their own firm is strongly associated with entry for a focal university graduate (OR 1.647, $p < 0.01$).

⁶ Predictably, the university dummies affect this estimated coefficient. The corresponding x-standardized “Baseline” effect is 17%.

Table 3
Logit models on university graduates' likelihood of entrepreneurial entry.

Variables	Baseline (Odds Ratios)	University effects (Odds Ratios)	X-standardized logit coeff.
<i>Regional-level variables</i>			
Labor market region: Stockholm	1.326** (0.076)	1.364** (0.082)	1.14
Labor market region: Gothenburg	1.050 (0.055)	0.987 (0.061)	1.00
Labor market region: Malmö	0.992 (0.055)	0.957 (0.065)	0.99
% municipal public sector employees	0.991 (0.005)	0.991 (0.006)	0.98
Number of municipality moves	0.901** (0.033)	0.900** (0.033)	0.96
Born in county of county of graduation	0.994 (0.028)	0.999 (0.029)	1.00
Peer entrepreneurs in county of graduation	1.675** (0.073)	2.635** (0.336)	1.35
Peer entrepreneurs in other counties	2.162** (0.146)	2.448** (0.372)	1.21
<i>Control variables</i>			
Parents are entrepreneurs	1.644** (0.056)	1.647** (0.056)	1.18
Living with parents	1.159** (0.061)	1.158** (0.061)	1.03
Age	1.149** (0.017)	1.150** (0.017)	2.95
Age squared	0.999** (0.000)	0.999** (0.000)	0.47
Gender (male = 1)	1.957** (0.057)	1.958** (0.057)	1.38
Lagged wage (ln)	0.658** (0.009)	0.657** (0.009)	0.43
Residential prices (municipal level)	1.000* (0.000)	1.000 (0.000)	1.05
Years of education	0.875** (0.018)	0.880** (0.018)	0.91
Constant	0.002** (0.001)	0.001** (0.001)	
Individual-year Observations	834,526	834,526	
Unique individuals	215,388	215,388	
Pseudo R2 (MacFadden's)	0.08	0.08	

Notes: ** $p < 0.01$, * $p < 0.05$. Columns 1 and 2 show Odds Ratios with standard errors clustered by individuals. Column 3 shows x-standardized logit coefficients from the second column (adjusted for the right hand side variables' respective standard deviations). All models also include dummies for year, employment status (employed, unemployed but with wage during the year, unemployed), education degree, and year of graduation.

Individuals' age is positively (OR 1.150, $p < 0.01$) associated with entrepreneurial entry among recent university graduates, but at a decreasing rate as indicated by 'age squared' (OR 0.999, $p < 0.01$)—similar to random-population samples of entrepreneurs (Delmar and Davidsson, 2000). Male graduates much more frequently enter entrepreneurship (OR 1.958, $p < 0.01$) and opportunity costs as measured by 'lagged wage' has the expected negative effect (OR 0.657, $p < 0.01$). We also find that years of education is negatively associated with entry (OR 0.880, $p < 0.01$). As all graduates have at least a bachelor degree, the negative effect emanates from graduate students

Table 4
Logit models on the likelihood of graduate entrepreneurs starting their venture in the region of graduation.

Variables	Baseline (Odds Ratios)	University effects (Odds Ratios)	X-standardized logit coeff.
<i>Regional-level variables</i>			
County of graduation: Stockholm	2.073** (0.441)	3.710* (1.913)	1.79
County of graduation: Gothenburg	1.741** (0.246)	3.418** (1.580)	1.59
County of graduation: Malmö	1.746** (0.240)	3.662** (0.999)	1.55
% municipal public sector employees	0.998 (0.014)	0.997 (0.015)	0.99
Number of municipality moves	0.296** (0.033)	0.293** (0.032)	0.62
Born in county of graduation	3.466** (0.339)	3.521** (0.349)	1.85
Peer entrepreneurs in county of graduation	3.621** (0.802)	3.300** (1.220)	1.62
Peer entrepreneurs in other counties	0.136** (0.053)	0.077** (0.040)	0.45
Parents living in county of graduation	4.784** (0.546)	5.065** (0.589)	2.19
Parents entrepreneurs in county of graduation	1.705* (0.371)	1.725* (0.381)	1.18
<i>Control variables</i>			
Living with parents	0.300** (0.036)	0.291** (0.035)	0.71
Age	0.995 (0.035)	1.006 (0.036)	1.04
Age squared	1.000 (0.000)	1.000 (0.000)	1.07
Gender (male = 1)	1.046 (0.082)	1.049 (0.083)	1.02
Residential prices (municipal level)	1.000 (0.000)	1.000 (0.000)	0.95
Years of education	1.281** (0.059)	1.314** (0.064)	1.26
Constant	0.028** (0.028)	0.015** (0.016)	
Unique individuals (entrepreneurs)	5799	5799	
Pseudo R2 (MacFadden's)	0.36	0.37	

Notes: ** $p < 0.01$, * $p < 0.05$. Columns 1 and 2 show Odds Ratios with standard errors clustered by individuals. Column 3 shows x-standardized logit coefficients from the second column (adjusted for the right hand side variables' respective standard deviations). All models also include dummies for year, employment status (employed, unemployed but with wage during the year, unemployed), education degree, and year of graduation.

being relatively less likely to enter entrepreneurship within our time frame, keeping all other observable characteristics constant.⁷

Having established factors relating to graduates' occupation choice, we next examine the factors that determine the localization choices of those who do enter entrepreneurship in Table 4. We estimate a logit model where

⁷ Model 3 also include controls for education specialization (all columns) as well as university of graduation (columns 2 and 3), suppressed to save space. The results for university of graduation (available upon request) mirror the bivariate patterns shown in Table 1.

the dependent variable takes the value 1 for entrepreneurs starting a new venture in the county from where they graduate and 0 otherwise. Similar to Table 3, we first estimated ‘baseline effects’ in Column 1 followed by a model including university dummies in Column 2 (used to interpret the results). Column 3 displays the x-standardized coefficients from column 2.

In terms of variables conceptually related to the individual-opportunity nexus, the metropolitan dummy variables (defined at the county of graduation) are strongly positively associated with the decision to run a local firm. Consistent with the individual-opportunity nexus view, this result indicates that graduating in a metropolitan region is strongly associated with running local startups. The percentage of local public sector workers has a negligible association with the likelihood of starting in one’s region of graduation. The effect of having a history of moving between municipalities is strongly negatively associated with starting in one’s region of graduation. The x-standardized effect in column three indicates that a one standard deviation increase in this variable decreases the probability of running a local startup by 38%.

In terms of variables primarily related to local embeddedness, being ‘born in county of graduation’ has a large influence on graduate entrepreneurs’ location choices. The odds ratio (OR 3.521, $p < 0.01$) suggests that entrepreneurs born in their county of graduation are substantially more likely to start a business in that region.

Table 4 also reveals a positive effect of ‘peer entrepreneurs in county of graduation’ (OR 3.300, $p < 0.01$) and a negative effect of the number of ‘peer entrepreneurs in other counties’ (OR 0.077, $p < 0.01$) on graduate entrepreneurs’ likelihood of starting their business in the county of graduation.⁸ While the share of university peers running a local firm may also be correlated with localized opportunities, this effect is theoretically more strongly linked with graduates’ location choice being affected by local embeddedness (Dahl and Sorenson, 2009). We further note a positive coefficient of ‘parents living in county’ (OR 5.065, $p < 0.01$). Keeping the effect of parents living in county’ constant, the additional effect on starting local businesses of ‘parents entrepreneurs in county of graduation’ is still strong (OR 1.725, $p < 0.01$) and the x-standardized coefficient of 1.18 further confirms that if a graduate’s parents run a firm in the county of graduation, the graduate is substantially more likely to run a local business, relative to other graduate entrepreneurs.⁹ From the standardized logit coefficients in column 3 of Table 4, the effects of graduating in metropolitan regions, and also four coefficients related to local embeddedness are large: the latter variables are ‘born in county of residence’, ‘parents living in county of graduation’, ‘parents entrepreneurs in county of residence’ and ‘peer entrepreneurs in county’. All four variables are strongly associated with graduate entrepreneurs’ decisions to start their businesses in the county of graduation.

Taken together, the variables approximating local embeddedness are not only associated with the propensity to start a business as we saw in the previous analyses, but are also strongly associated with location of the startup. In light of the strong metropolitan effects, we also find support for the individual-opportunity nexus view for graduate entrepreneurs location choices.

Since we allow for graduates to enter entrepreneurship in up to three years after graduation, we recognize that for those that take a job and shortly thereafter enter entrepreneurship, employer characteristics may play a role for their likelihood of entering entrepreneurship. Some graduates may for example take a job in a small firm to “train” for

entrepreneurship (Parker, 2009) which could affect our results regarding university graduates’ entrepreneurial propensity and their location choices. We therefore ran a series of robustness tests including employer characteristics known to influence entrepreneurship among employees (log of employer size, and a dummy for public vs private sector employment (Sørensen, 2007; Özcan and Reichstein, 2009)). While these two variables were negatively associated with entrepreneurial entry (OR: 0.765 and 0.631 respectively, both at $p < 0.01$), inclusion of these additional control variables for those that held a job subsequent to graduation did not markedly affect any of our theoretical variables of interest. Since these analyses only include the subset of our sample which held a job during or right after graduation (82.2% of individual-year observations and 74.5% of all graduate entrepreneurs) we do not include them in the main analyses. It should be noted that our main analyses include the natural log of wages from employment, which will be naturally 0 for graduates without an employer, and high for well-matched or particularly productive graduates. This suggests that graduates opportunity costs in terms of a potentially good match with an employer shortly after graduation is effectively controlled for in the analyses.

5. Discussion

This paper focuses on the entrepreneurial activities of recent university graduates and their location choices. This group is interesting for several reasons. University graduates have been shown to be far more important in generating startups than university employees (Astebro et al., 2012). Yet, most studies to date examine entrepreneurship among university researchers, omitting university graduates. From a localization viewpoint, graduates are particularly interesting as, in contrast to university faculty, they are at their most mobile life-stage.

We explored theoretical arguments concerning localization choices of university graduate entrepreneurs derived from the individual-opportunity nexus and the local embeddedness perspectives on entrepreneurship. Our results provide support for both perspectives, while much research has focused on the former perspective.

We found large variation across universities in terms of graduates’ propensities to enter entrepreneurship, consistent with earlier studies seeking to identify characteristics of ‘entrepreneurial universities’ (e.g. Daghbashyan and Hårsman, 2014; Jacob et al., 2003). When including all institutions of higher education in Sweden graduating 1000 students or more during the studied period, those that are specialized and localized close to Stockholm are the most prone to generate a high share of entrepreneurs among recent graduates, and generally also the most prone to generating local entrepreneurs.¹⁰

In the multivariate analyses, we examined the relative importance of a large number of variables approximating for both economic and social factors, revealing interesting but differential effects of these variables for entrepreneurial entry and location choice. We found that graduating from the Stockholm region was a particularly important predictor of entering entrepreneurship among recent university graduates, even after controlling for their university of graduation. Thus, this result seems to originate from the localization as such, rather than from the quality of Stockholm education institutions. Sweden is a highly centralized country with headquarters of national and international companies, public offices, wealthy individuals, and population heavily agglomerated to and around Stockholm. Our results are consistent with such agglomerations exerting a strong influence on recent university graduates to prefer an entrepreneurial career over wage work. This provides some credence for agglomeration affecting the likelihood of entrepreneurial entry among university graduates.

⁸ We find similar results when ‘peer entrepreneurs in county’ and ‘peer entrepreneurs in other counties’ are included separately. The x-standardized effects are lower when estimated without university effects, hence we refrain from interpreting these.

⁹ To examine the potential of multicollinearity problems between ‘parents living in county’ and ‘Parents running local firm’ we excluded ‘Parents running local firm’ but results remained substantially the same. The pairwise correlation between the two variables is 0.43.

¹⁰ We also conducted analyses not presented here that included the very smallest institutions, which supported this observation.

However exactly how urban agglomeration influences entrepreneurship is beyond the focus of this paper. It should be noted that in strongly agglomerated areas, not only opportunities for entrepreneurship but also employment opportunities are more extensive, and wages tend to be higher (Andersson et al., 2014). Thus, it is not theoretically clear-cut that agglomeration per se should lead to higher entrepreneurship rates. We did not find similarly large effects of the other metropolitan areas, Malmö and Gothenburg. This can possibly be explained by Sweden being extremely centralized, with Stockholm accounting for approximately 40% of GDP – a share that keeps growing. The corresponding numbers for Malmö and Gothenburg are below 15% and 10% respectively. The results are consistent with strong agglomeration effects in Stockholm, supplemented by quantitatively important peer effects shaping entrepreneurial entry, as indicated by the positive effects of peer entrepreneurs. Our paper further explores regional factors that affect the decision among entrepreneurs to run their business in their region of graduation. Strong effects are found in whether the individual was born in the region of graduation, whether the graduation region is a metropolitan area, and the presence of local peer entrepreneurs. Future entrepreneurs who stay in a region to pursue their degrees also tend to stay after graduation to pursue their entrepreneurship, particularly if other students make similar choices and if the region is a metropolitan area. This finding is interesting not only for Sweden but for all countries where universities are spread out across the country. While some universities primarily recruit students regionally, other universities attract students from all over the country. Our analyses indicate that such geographical differences in recruitment may spill over into the localization of subsequent entrepreneurial activities of graduates. The share of university peers starting businesses in the county where a focal individual graduates, and whether parents living nearby are present, particularly if they are entrepreneurs rather than wage-based, exerted strong positive effects on graduates' location choice. Finally, graduating from a metropolitan region is strongly associated with running a startup in the region of graduation, providing some support for the importance of business opportunities in choice of location.

5.1. Limitations and future research

Notwithstanding these contributions, our findings have a number of limitations, which also offer implications for future research. First, although we were able to use population data to provide generality to university graduates' occupation and location choices, our research design is not causal in nature. To fully assess the causal patterns of university graduates' likelihood of starting ventures in proximity to the universities from where they graduate, experimental designs such as randomized acceptance to specific university programs are likely needed. Further studies may also contrast our population-wide findings from Sweden with evidence from countries with different university and entrepreneurial contexts since different university ecosystems may influence the role of entrepreneurial mobility (Ács et al., 2014), including the relative importance of local embeddedness and individual-opportunity nexus explanations for graduate entrepreneurs' occupational and location choices. Second, our focus has been on whether graduates move to a different region within the same country. Other research has examined the behavior of entrepreneurs returning to their home country to create businesses (Filatotchev et al., 2011; Kenney et al., 2013) and further research might explicitly compare graduates with an ethnic origin who remain in the country where they graduate to start a venture with graduates who return to their home country to do so. Third, to account for selection and sorting into the labor market which could obfuscate drawing inferences between universities and their graduates' entrepreneurship and venture location choices, we examined only graduates who started a venture within three years of graduation. This choice however limits the potential to study the performance of ventures started since it may take longer than a few years

to establish a profitable and growing venture, particularly if graduates seek to acquire commercial skills and financial capital from being employed in a corporation before starting a venture (Wennberg et al., 2011). Our contribution stems from investigating opportunity-related factors and local embeddedness-related factors for graduates' location choice of their ventures, not in assigning causality to any specific mechanism within these theoretical perspectives. Fourth, it is difficult to conduct country-wide population studies and at the same time provide fine-grained assessments. For example, it would be interesting to know if certain locations are more attractive depending on fields of study and/or industry chosen for the startup, or if performance, survival and growth differ between those that start businesses where they reside vs. those that move. There may also be differences between solo startups and firms started by teams. We also limit our study to those entrepreneurs that are present at the actual startup of the business. Others may join soon thereafter, and these 'joiners' may exhibit different mobility patterns than those who initially started the firm. These are certainly interesting questions that deserve attention in future studies.¹¹ Fifth, although we have considered the influence of peers, individuals may be more strongly influenced by peers operating in certain industries, in particular those that may be growing. Further research exploring this issue may need to adopt a qualitative approach in order to address the challenges for quantitative analysis arising from startups changing industry code in their early years of operation (Reynolds and Curtin, 2009) and to probe the potentially differing effects of peer entrepreneurship in various industry segments. Sixth, startups may change their location when growing. While this was beyond the scope of our study, further research can obtain interesting insights by examining the growth of graduate entrepreneurs' firms shifting location compared with those that do not. Finally, it should be highlighted that universities play a larger role for entrepreneurship and local economic development beyond the core mechanisms of graduate entrepreneurship and their location choices investigated here.

5.2. Policy implications

Our findings have implications for university policies to support start-ups by graduates. The high proportion of graduates not shifting their region to start a business, compared to those who move, suggests that universities outside metropolitan areas may benefit from developing new strategies to maintain graduate entrepreneurs not born in the vicinity who may be lacking the local ties evidenced to enhance their location choice in the region. Policy efforts could include mentoring programs by peer entrepreneurs and incubator spaces seeking to facilitate start-ups by students prior to graduation (Amezcu et al., 2013; Falck et al., 2012; Siegel and Wright, 2015a). Non-metropolitan universities may find increasing returns in facilitating local start-ups since these in turn may induce additional graduates to run their firms in the region of graduation. While graduate start-ups in local universities potentially provide important glue for regional economic development, policy development may need to be fine-grained since policy conditions depend on whether universities are located in metropolitan areas or not, and whether graduates stay or not. As such, policies need also to consider the extent to which universities differ in social embeddedness among graduates, such as the ratio of in-region versus out-region graduates and the relative rates of peer entrepreneurship in the university in question.

¹¹ We thank one of the anonymous reviewers for drawing our attention to these interesting questions.

Appendix A

Table A1
Variable Descriptives.

	Graduates not starting new business				Graduates starting new business in other county				Graduates starting new business in same county			
	(n = 828,727)				(n = 2169)				(n = 3630)			
	Mean	Std.dev.	Min	Max	Mean	Std.dev.	Min	Max	Mean	Std.dev.	Min	Max
Regional-level variables												
Labor market region: Stockholm	0.25	0.43	0	1	0.34	0.47	0	1	0.37	0.48	0	1
Labor market region: Gothenburg	0.13	0.33	0	1	0.08	0.27	0	1	0.16	0.36	0	1
Labor market region: Malmö	0.10	0.29	0	1	0.06	0.24	0	1	0.12	0.32	0	1
County of graduation: Stockholm	0.19	0.39	0	1	0.10	0.30	0	1	0.37	0.48	0	1
County of graduation: Gothenburg	0.17	0.38	0	1	0.11	0.32	0	1	0.20	0.40	0	1
County of graduation: Malmö	0.14	0.35	0	1	0.10	0.29	0	1	0.15	0.36	0	1
% public sector employees (municipality)	7.83	2.68	1.33	27.92	7.90	2.85	1.33	23.69	7.96	2.41	1.33	23.69
Number of municipality moves	0.15	0.40	0	6	0.23	0.48	0	4	0.08	0.30	0	3
Born in county of graduation (1 = yes)	0.53	0.50	0	1	0.11	0.31	0	1	0.56	0.50	0	1
Peer entrepreneurs in county	0.43	0.31	0	2.31	0.10	0.50	0	2.31	0.66	0.42	0.04	2.31
Peer entrepreneurs in other counties	0.26	0.21	0	2.25	0.36	0.29	0.03	2.25	0.22	0.14	0	2.25
Parents living in county (1 = yes)	0.39	0.49	0	1	0.09	0.29	0	1	0.53	0.50	0	1
Parents entrepreneurs in county of graduation (1 = yes)	0.06	0.25	0	1	0.02	0.14	0	1	0.14	0.35	0	1
Control variables												
Parent(s) entrepreneurs (1 = yes)	0.13	0.34	0	1	0.21	0.41	0	1	0.19	0.40	0	1
Living with parents ((1 = yes)	0.05	0.22	0	1	0.12	0.32	0	1	0.06	0.25	0	1
Age	32.52	7.72	20	64	32.58	7.45	21	63	33.68	7.85	22	64
Gender (male = 1)	0.34	0.47	0	1	0.54	0.50	0	1	0.55	0.50	0	1
Lagged wage (ln)	6.78	1.99	0	11.82	6.04	2.52	0	9	5.77	2.72	0	9
Residential prices (municipality)	2100	1112	216	6528	2176	1241	243	6528	2490	1126	237	6528
Years of Education	15.48	0.74	12	21	15.39	0.87	12	21	15.52	0.84	12	21
Education dummy: humanities and theology	0.05	0.23	0	1	0.09	0.29	0	1	0.11	0.32	0	1
Education dummy: law and social science (incl. business)	0.29	0.45	0	1	0.36	0.48	0	1	0.37	0.48	0	1
Education dummy: teaching	0.20	0.40	0	1	0.06	0.23	0	1	0.06	0.24	0	1
Education dummy: natural sciences	0.05	0.21	0	1	0.03	0.18	0	1	0.04	0.19	0	1
Education dummy: engineering	0.19	0.39	0	1	0.24	0.42	0	1	0.27	0.44	0	1
Education dummy: agriculture and forestry	0.01	0.09	0	1	0.06	0.24	0	1	0.00	0.05	0	1
Education dummy: medicine	0.03	0.18	0	1	0.04	0.21	0	1	0.03	0.18	0	1
Education dummy: nursing & care	0.18	0.38	0	1	0.06	0.23	0	1	0.07	0.26	0	1
Education dummy: arts	0.01	0.08	0	1	0.06	0.23	0	1	0.04	0.19	0	1
Education dummy: others	0.00	0.03	0	1	0.00	0.04	0	1	0.00	0.05	0	1
Employed in t-1	0.93	0.25	0	1	0.89	0.31	0	1	0.86	0.34	0	1

Appendix B

Table B1

Correlation matrix: Graduates' likelihood of entrepreneurial entry.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Occupation Choice															
2 Labor market region: Stockholm	0,02														
3 Labor market region: Gothenburg	0,00	−0,22													
4 Labor market region: Malmö	0,00	−0,19	−0,12												
5 % public sector employees (municipality)	0,00	0,18	−0,17	−0,11											
6 Number of municipality moves	0,00	0,05	−0,01	0,00	−0,01										
7 Born in county (=1 if born in county)	0,00	−0,01	0,05	0,06	−0,05	−0,08									
8 Peer entrepreneurs in county	0,02	0,30	0,15	0,13	0,01	−0,01	0,10								
9 Peer entrepreneurs in other counties	0,00	−0,11	0,03	0,02	0,04	0,04	−0,15	0,24							
10 Parent(s) entrepreneurs	0,02	0,01	0,00	0,00	−0,01	0,01	0,02	0,01	0,01						
11 Living with parents (dummy)	0,01	−0,01	−0,01	0,00	−0,05	0,03	0,01	0,02	0,00	0,05					
12 Age	0,01	−0,04	−0,03	−0,04	−0,06	−0,19	0,02	−0,02	−0,05	−0,07	−0,16				
13 Gender (male = 1)	0,03	0,04	0,02	0,02	0,04	0,05	−0,03	0,06	0,02	0,00	0,08	−0,13			
14 Lagged wage (ln)	−0,04	0,03	0,00	−0,05	−0,01	−0,08	0,04	−0,04	−0,02	0,03	−0,17	0,13	−0,01		
15 Residential house prices (municipality)	0,02	0,67	0,16	0,11	0,11	0,02	−0,01	0,41	0,02	0,02	−0,05	−0,09	0,08	0,06	
16 Years of education	0,00	0,08	0,02	0,02	0,05	0,01	−0,06	0,16	0,18	0,01	−0,02	0,02	0,10	0,07	0,16

Note: LMA = Labor Market Area: N = 834,526 (individual-year observations).

Table B2

Correlation matrix: Graduate entrepreneurs' likelihood of starting their venture in the region of graduation

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Location Choice															
2 County: Stockholm	0.30														
3 County: Gothenburg	0.11	−0.27													
4 County: Malmö	0.08	−0.23	−0.18												
5 % public sector employees (municipality)	0.01	0.16	−0.15	−0.12											
6 Number of municipality moves	−0.19	−0.03	−0.03	0.00	−0.01										
7 Born in region of graduation	0.45	0.16	0.07	0.07	−0.01	−0.08									
8 Peer entrepreneurs in county	0.29	0.55	0.09	0.13	0.05	−0.01	0.16								
9 Peer entrepreneurs in other counties	−0.22	−0.39	−0.04	0.06	0.01	0.02	−0.18	0.09							
10 Parents living in county of graduation	0.44	0.12	0.08	0.07	−0.02	−0.07	0.66	0.14	−0.15						
11 Parents entrepreneurs in county of graduation	0.20	0.04	0.03	0.04	−0.02	−0.03	0.30	0.05	−0.05	0.43					
12 Age	0.07	0.05	0.00	−0.01	−0.02	−0.17	−0.01	0.04	−0.02	−0.07	−0.09				
13 Gender (1 = male)	0.01	0.00	−0.01	0.01	0.05	0.04	0.03	−0.01	−0.01	0.03	0.00	−0.21			
14 Residential house prices (municipality)	0.13	0.44	−0.03	−0.02	0.12	0.00	0.06	0.40	−0.06	0.05	0.02	−0.06	0.05		
15 Living with parents (dummy)	−0.09	−0.01	−0.03	0.00	−0.07	0.06	0.00	−0.02	0.03	0.07	0.06	−0.20	0.12	−0.10	
16 Years of education	0.08	0.07	0.03	0.00	0.04	−0.01	−0.01	0.15	0.13	0.01	0.00	0.05	0.04	0.14	−0.03

Note: LMA = Labor Market Area: N = 5799.

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