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Spatial evolution of knowledge-intensive ICT services in Sweden: On the role of mobile entrepreneurs

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Abstract

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Spatial evolution of knowledge-intensive ICT services in Sweden: On the role of mobile entrepreneurs

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Abstract: The paper investigates the role of mobile entrepreneurs in spatial diffusion process of a rapidly expanding industry using the case of the knowledge-intensive ICT-services in Sweden over 1990-2010. The main contributions of this study are twofold. On the one hand, paper contributes to entrepreneurship research by showing that the spatial origin of an entrepreneur should be analysed not only in terms of local/non-local dichotomy but should more explicitly account for where she moves from. On the other hand, the paper demonstrates that mobile entrepreneurs are important drivers of spatial diffusion of an industry, which might be of an interest to economic geography scholars.

I. INTRODUCTION

The paper focuses on the spatial evolution of ICT-services in Sweden over 1990-2010. This sector is of an interest for several reasons. On the one hand, it became one of the main drivers of economic growth in the new, digital era (Lundquist et al. 2008) and experienced a remarkable growth in entry rates, number of firms, share of employment and value added. At the same time, relevance of ICT-services extends beyond their actual employment share as they are increasingly identified as key nodes in knowledge networks, 'bridges of innovation' fostering processes of knowledge creation and exchange (Muller and Zenker 2001; Miles 2005; Doloreux and Muller 2007) providing a platform for regional economic growth (Wood 2005). Importance for regional development coupled with explosive character of ICT-services' expansion calls for understanding particular mechanisms underlying their spatial evolution.

This paper focuses on one particular aspect of this evolution, that is, the role of mobile entrepreneurs[1]. The departing point for the analysis lies in acknowledging that processes of evolution of rapidly expanding industries are shaped by the dynamics of knowledge creation (Krafft et al. 2014), where entrepreneurship is seen as a crucial mechanism of generating a diversity of knowledge (Audretsch and Keilbach 2004), and, thus, industry evolution across space (Acs et al. 2009). Indeed, by diffusing activities from home to destination regions, mobile entrepreneurs may renew resource and knowledge bases of the latter, and, thus, facilitate industrial restructuring (Neffke et al. 2014).

As contribution of entrepreneurs to diffusion of industries across regions is dependent upon their ability to establish firms that will survive in the market and generate sustainable jobs, understanding factors behind firm growth and survival is of crucial importance. One of the most prominent roles in post-entry performance of new firms is attached to the human capital of firm founders: as new entries carry skills and routines embodied in their founders, entrepreneurs' characteristics have a relevant impact on firms' post-entry success (e.g., Colombo and Grilli 2005; Delmar and Shane 2006; Dahl and Reichstein 2007).

What has been left aside in most studies on the role of founders' human capital is a role that a spatial origin of an entrepreneur may play in a new firm growth and survival. Even when considered in the analysis, this aspect is often limited to distinguishing between local and non-local entrepreneurs. What might be of importance, however, is not *if* an entrepreneur relocated before starting a new firm, but rather *where* she moved from. Indeed, having a prior experience of employment in metropolitan areas (or dynamic regions in general) exposes an entrepreneur to superior knowledge bases allowing her to capitalise on that experience to establish more successful firms in a destination region. If true, this would imply that mobility of entrepreneurs would actually be an important channel through which ICT-services develop in regions outside the metropolitan areas. Following this reasoning, the research question is formulated in the following way: *are mobile entrepreneurs (particularly, those moving from the more dynamic regions) more successful in establishing ICT-firms in terms of their survival and post-entry employment growth?*

By using employer-employee linked data provided by Statistics Sweden, the paper describes patterns of spatial diffusion of the Swedish ICT-services between 1990 and 2010 and investigates whether mobility of entrepreneurs played any role in this diffusion.

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[1] Mobile entrepreneurs are understood as individuals switching the region of residence before starting a new firm

The main contributions of this study are twofold. On the one hand, paper contributes to entrepreneurship research by showing that the spatial origin of an entrepreneur should be analysed not only in terms of local/non-local dichotomy but should more explicitly account for where she moves from. On the other hand, the paper demonstrates that mobile entrepreneurs are important drivers of spatial diffusion of an industry, which might be of an interest to economic geography scholars.

The rest of the paper is organised as follows. Section II briefly summarises major patterns of ICT-services spatial evolution. In Section III a review of the previous literature is performed. Section IV provides a detailed discussion of data and procedures. In Section V effects of entrepreneurs' spatial background are estimated. Finally, Section VI discusses major conclusions and potential direction in which this research may develop.

II. EVOLUTION OF EMPLOYMENT IN ICT-SERVICES IN SWEDEN, 1990-2010

Over two decades between 1990 and 2010 ICT-services became one of the most dynamic sectors in the Swedish economy: total employment in these sectors increased from 30287 to 104059 employees, which corresponded to the tripling of the sectoral share in the national employment (0,68% to 2,37%). This expansion was, however, not equally distributed across Swedish regions as demonstrated in Figure II.1.[2]

Figure II.1. Employment in the knowledge-intensive ICT services, 1990-2010
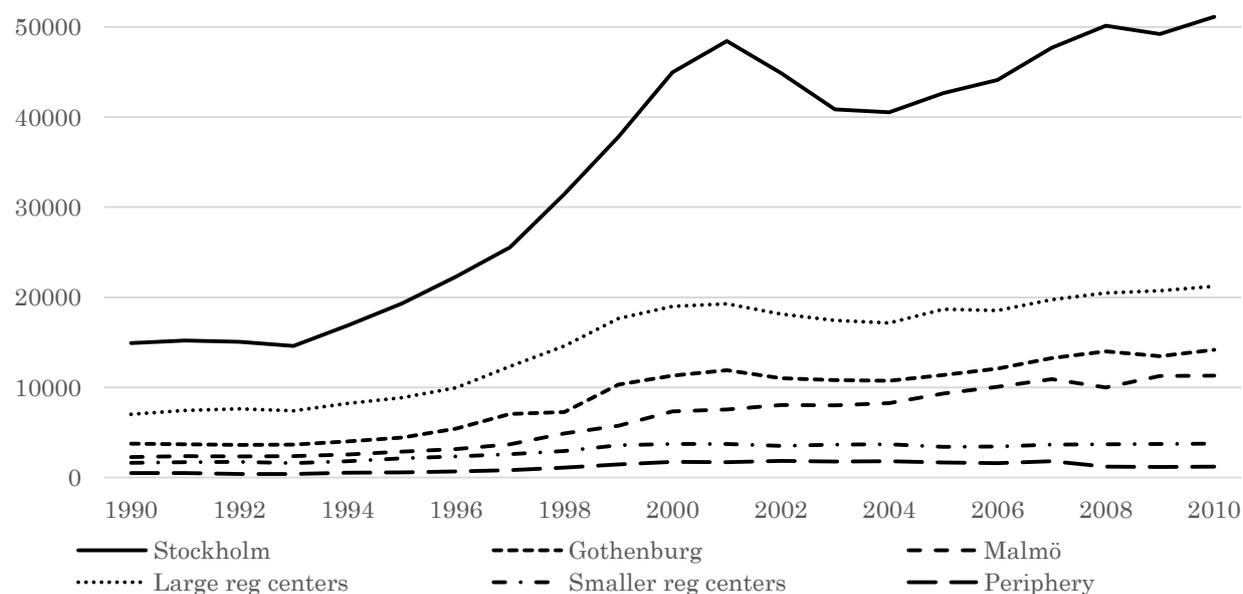
Employment growth, total over 1990-2010

Stockholm	Gothenburg	Malmö	Large regional centres	Smaller regional centres	Periphery	Total metro	Total non-metro
242,77%	277,49%	397,88%	202,38%	126,85%	132,57%	**265,81%**	**184,80%**

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[2] Six groups of regions are defined: (1) Stockholm; (2) Gothenburg; (3) Malmö; (4) large regional centres; (5) smaller regional centres; (6) peripheral regions. These regional groups (further named regional families) correspond to the layers of the Swedish regional hierarchy. Description of the procedure of allocating regions across hierarchy layers is found in Section III.1.

Metropolitan areas (Stockholm, Gothenburg, and Malmö) appear to be the most attractive locations for ICT-services as these regions not only concentrate most of employment but also outperform lower layers of the regional hierarchy in terms of aggregate employment growth (266% vs. 185%). These developments go in line with discussion in the literature underlining that the role of knowledge-intensive business services (which ICT-services are a part of) is particularly pronounced in the most dynamic regions at the top of the regional hierarchy (Chadwick et al. 2008; Simmie and Strambach 2006).

Three intertwined factors contribute to that (Keeble & Nachum, 2002; Freel, 2006; Koch & Stahlecker, 2006; Cook et al., 2007; Sokol et al., 2008; Delgado-Márquez and Garćia-Velasco 2013). First, knowledge-intensive services benefit from scale economies offered by metropolitan areas. Second, firms operating in these sectors require access to specialised knowledge and are, thus, attracted to areas with a great availability of human capital. Third, provided that much of this knowledge is tacit, proximity to clients, suppliers, competitors, and experts, suppliers as well as government institutions plays an important role. In that respect, large, dense regions offer special advantages in terms of knowledge flows and knowledge spillovers, since they combine the localisation of clusters in specific industries with industrial diversity (Karlsson et al. 2010).

Besides, as conditions favouring structural change towards the knowledge-based economy are cumulative, growth in knowledge-intensive services is likely to strengthen differences across regions in favour of major metropolitan areas (Wood 2005; Corrocher and Cusmano 2014). This trend is pronounced in the Swedish economy as the latter are diverging further from non-metropolitan regions.

Within metropolitan areas group Malmö is a growth champion with almost five times increase in ICT-services employment over 20 years. What is peculiar here, Malmö has not been successful in terms of developing ICT-manufacturing branches (Lundquist and Olander 2009); neither was it the first mover into ICT-services: explosive growth in these industries started 3-4 years after they had taken off in Stockholm and Gothenburg. Nevertheless, Malmö managed to leapfrog the initial stages of expansion and became the most dynamic region in the 2000s. It was the only region unaffected by the dotcoms' crisis of the early 2000s. This allows talking about some convergence among at least the top layers of the regional hierarchy.

As differences in total employment numbers are subject to scale effects, it is also interesting to look at ICT-services employment numbers relative to the regional employment mix (Figure II.2.). Two important observations appear here.

First, until around 1997 employment in all regions developed around the same growth trajectory. After that, however, trajectories diverge. Surprisingly, it was the most peripheral regions where the share of ICT-services in a regional employment mix increased the most initially. Possible reasons for that include a lower base effect and/or weak employment developments in other industries. At the same time, peripheral regions suffered the most from the burst of the dotcoms' bubble in the early 2000s as well as the financial crisis of 2007-2008. As in the case with the total employment, Malmö managed to use the opportunities of ICT expansion the most enjoying continuous growth interrupted only by the financial crisis of 2007-2008.

Figure II.2. ICT-services in the regional employment mix, 1990-2010 (index, 1990=100)
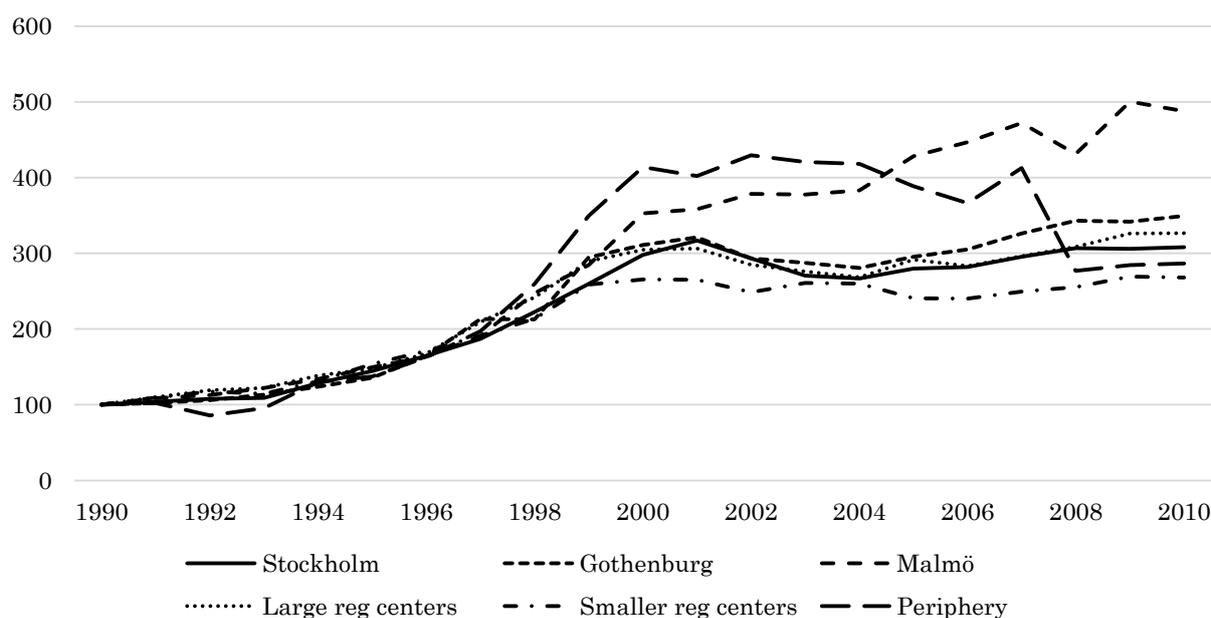
*ICT-services share in total regional employment, total growth over 1990-2010*

Stockholm	Gothenburg	Malmö	Large regional centres	Smaller regional centres	Periphery	Total metro	Total non-metro
207,89%	249,35%	387,75%	226,56%	167,81%	186,62%	**237,16%**	**219,58%**

Second, when controlling for regional labour markets' employment mix, ICT-services growth is more equal across metropolitan and non-metropolitan areas (237% vs. 220%). Given client-oriented nature of ICT-services a faster total employment growth in metropolitan areas might be a manifestation of a higher concentration of client industries. In other words, faster ICT-services expansion in metropolitan areas might have taken place not due to factors internal to the industry but rather was a result of a more dynamic expansion in client sectors.

As sources of regional employment growth might be internal (labour redistribution across sectors, new labour market entrants, etc.) and external (reallocation of labour across regional labour markets), it is important to look at inter-regional worker flows. Patterns of net worker reallocation in ICT-services (Figure II.3.) suggest that regions might be divided into receivers of workers (metropolitan areas) and suppliers of workers (non-metropolitan areas).

It may be concluded now that metropolitan areas were more successful in employment growth as they managed to combine internal sources of growth with attracting workers from the lower levels of the regional hierarchy. At the same time, notwithstanding the net outflow of workers from more peripheral regions, ICT-services' labour markets in the latter were dynamic enough to not only compensate for workers leaving the region but also to ensure the continuous increase in ICT-services employment, which points again to a huge demand for ICT labour at all layers of the regional hierarchy.

Figure II.3. Net worker flows across regional families, 1990-2010 (3-year moving average)
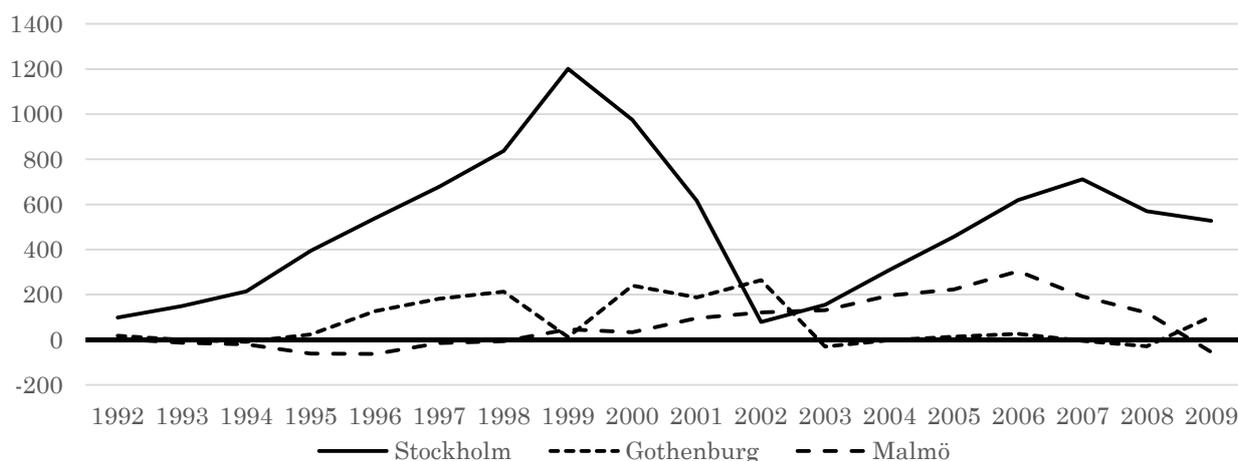

(a) metropolitan areas
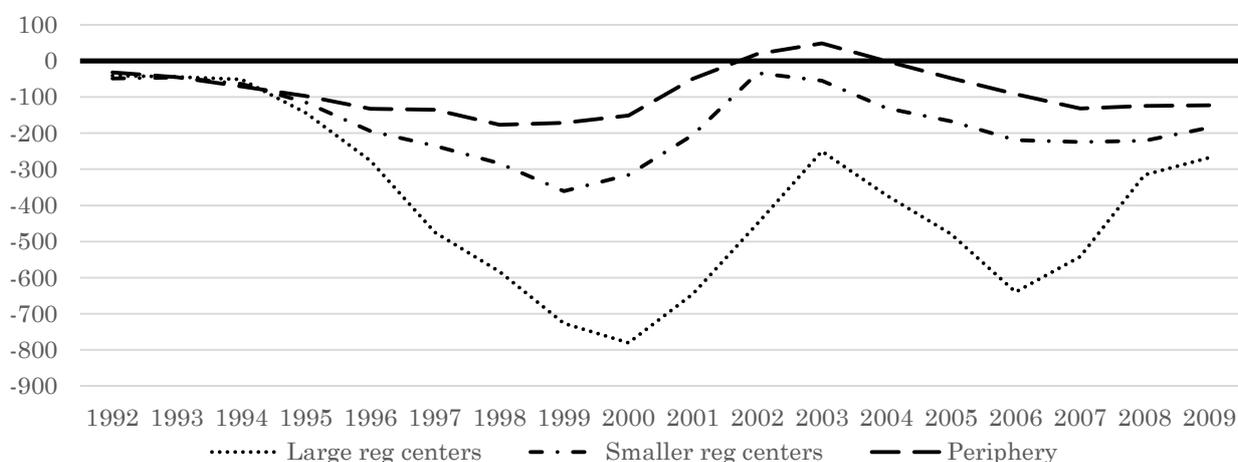
(b) non-metropolitan areas

Note: In these figures, only flows of labour across regional families are considered. For example, a positive net flow for Stockholm indicates that there were more workers coming to Stockholm from other regional families than leaving Stockholm for other regional families.

As net flows mask lots of labour market dynamics (Davis and Haltiwanger 1995; Dunne and Merrell 2001; Essletzbichler 2007), it is important to look at the gross worker reallocation patterns across the layers of the regional hierarchy (Figure II.4.). It may be noticed that even though moves down the regional hierarchy are less frequent, they are still comparable in magnitude with the upward moves. The dynamics of worker reallocation in ICT-services extends, therefore, beyond pure concentration of labour in the most dynamics regions at the top of the regional hierarchy.

Here, in the 1990s, the period of the most explosive employment growth in ICT-services, the number of upward and downward moves demonstrated the same ascendant trend peaking in year 2000. Collapse of the dotcoms' bubble led to the dramatic decrease in the intensity of spatial reallocation (particularly pronounced for the upward moves). In times of recovery from the crisis patterns of upward and downward moves diverged: while the former ones increased relatively fast, the latter ones stabilised around the same level.

Figure II.4. Moves up and down the regional hierarchy, 1991-2010
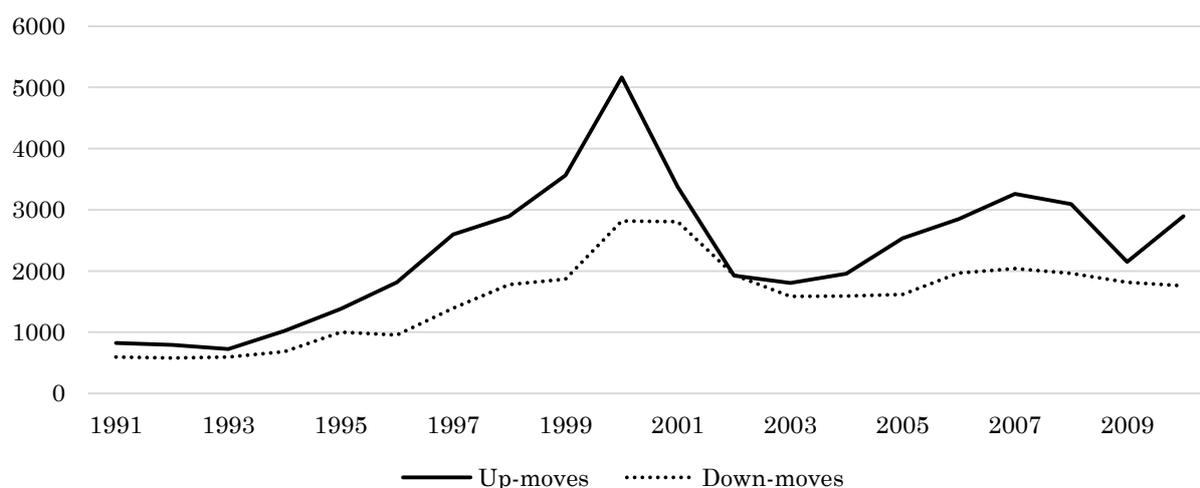
This result is fully in line with the previous research performed in a different context: Champion (2004) and Findlay et al. (2009) demonstrated that outward worker flows from London to more peripheral regions of Great Britain are remarkably high and go above initial expectations. Thus, substantial amount of workers moving down the regional hierarchy is not a phenomenon confined to ICT-services or Sweden. Moves from central regions to periphery are, in that respect, an important component of inter-regional labour reallocation.

In Figure II.5. a distribution of movers' age with respect to the direction of the move is presented suggesting that the average age of an average upward mover is consistently lower than that of a downward mover.

Figure II.5. Average age of hierarchy movers, 1991-2010
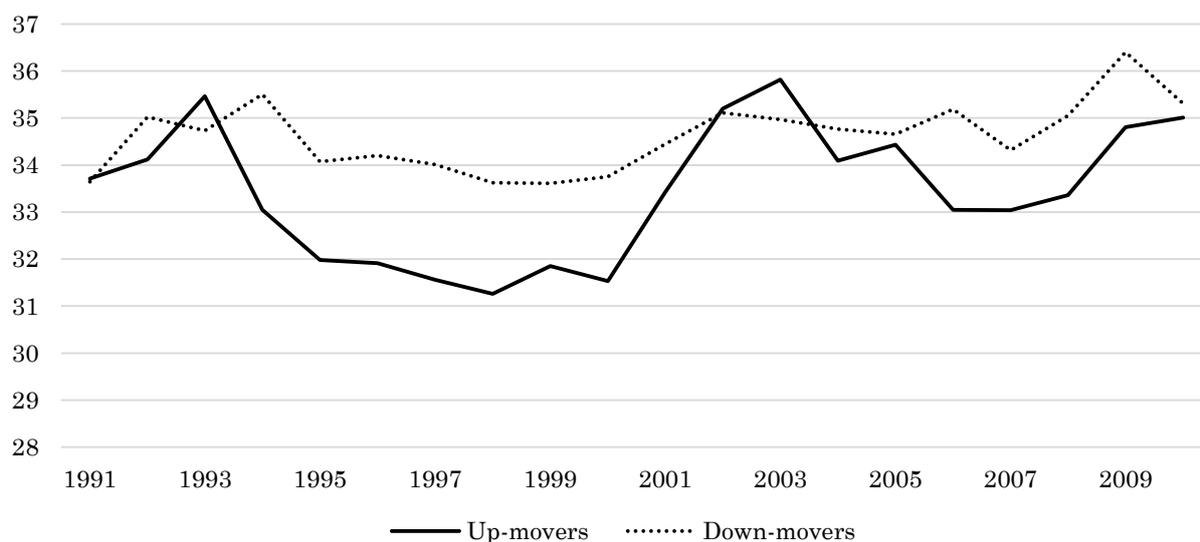
The relation between the age and direction of a move comes as no surprise as large, dynamic regions are more attractive for younger individuals (Fielding 1992; Tervo 2000; Lindgren 2003; Bjerke 2012). This relationship holds also for a sub-group of direct job-to-job switchers, implying that the age difference among up- and downward movers is not (primarily) driven by young, inexperienced workers in the stage of 'career shopping' moving to metropolitan areas to

find their first employment, but also takes place in case of experienced individuals. Thinking of an age as a proxy for individuals' accumulated skills and knowledge makes it possible to speculate that individuals moving downward in the regional hierarchy are more likely to contribute to the knowledge diffusion beyond core regions.

Finally, individuals moving down the regional hierarchy are more likely to become entrepreneurs compared to individuals moving in the opposite direction (Figure II.6.). Actually, it is observed that for most years downward entrepreneurial entries are more frequent even in absolute terms. It goes against the conventional wisdom of individuals moving to big cities to start their businesses.

Figure II.6. Shares of individuals entering as entrepreneurs, 1991-2010
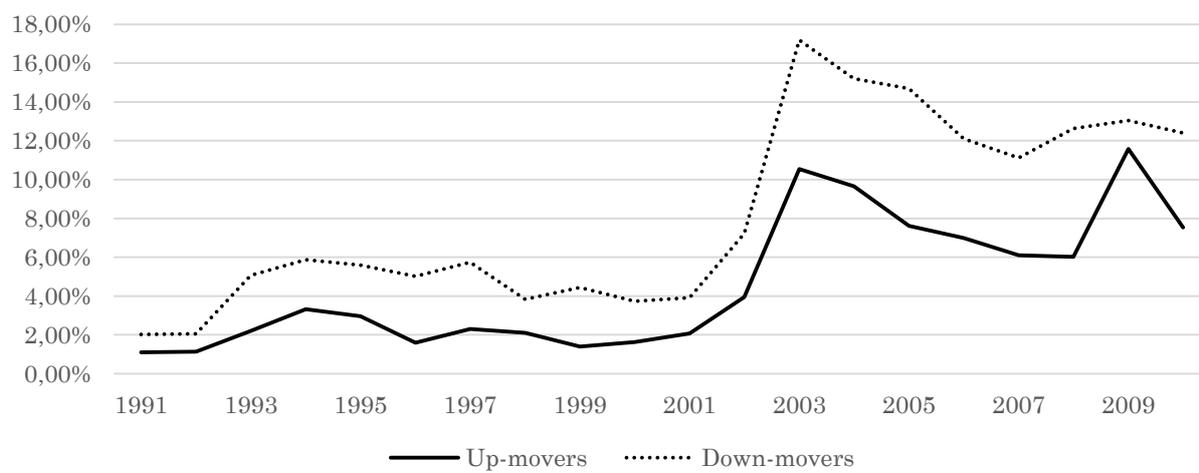
Given the high share (of up to 17%) of downward moves associated with entrepreneurial entries, it is interesting to see if mobile entrepreneurs are performing any better than local ones provided that they are able to capitalise on their prior experience of employment in the more dynamic areas, where they could acquire knowledge and skills superior to the regions where they establish their start-ups. This is an issue for investigation in the remainder of the paper.

III. THEORETICAL FRAMEWORK

III.1. Entrepreneurs as agents of rapidly expanding industries diffusion

Understanding the processes of evolution of rapidly expanding industries requires acknowledging that they are strongly shaped by dynamics of knowledge creation in geographic and technological space (Krafft et al. 2014). Several driving forces are involved, including the creation of new innovative firms, mobility of skilled labour enabling knowledge transfer and exploitation in new contexts.

Entry of new firms into an industry has for a while been considered as a key determinant of industry evolution (Schumpeter, 1934). Entrepreneurial opportunities exist since certain individuals exhibit beliefs not shared by others regarding how their knowledge and skills can be combined with other resources in creating new value (Shane and Venkataraman 2000; Colombo and Grilli 2005). Therefore, when existing firms do not commercially exploit generated knowledge, other economic agents do by becoming entrepreneurs that contribute to

a diversification of existing knowledge base. Entrepreneurship is, therefore, an important mechanism of generating a diversity of knowledge (Audretsch and Keilbach 2004).

At a regional level, it has been shown that entrepreneurs are conduits for bringing new knowledge into a region (Acs et al. 2009). Evolution of an industry in a region is conditional upon entrepreneurial activities that are the initial sparks for subsequent anchoring of the industry (Fredin 2014). In the context of emerging/rapidly expanding industries it has been claimed that entrepreneurship is one of the key indicators of regional branching, whereas other knowledge diffusion processes (e.g. labour mobility, knowledge sharing through networks) may or may not initiate it (Tanner 2014). Neffke et al. (2014) has shown that regional structural change is enhanced by entrepreneurs transferring new activities to the region.

Noseleit (2013) finds that regional industrial change induced by entrepreneurs is positively associated to regional growth relating to the ability of entrepreneurs to efficiently re-allocate resources across regional sectors. Consequently, the performance of new organisations is important for economic development and growth.

II.2. Mobile individuals and inter-regional knowledge transfer

Labour mobility is frequently considered as a key factor behind constructing and sustaining competitive advantage for firms and regions (Almeida and Kogut 1999; Gertler 2003; Bathelt et al. 2004; Power and Lundmark 2004; Agrawal et al. 2006; Breschi and Lissoni 2009; Maliranta et al. 2009). As knowledge is embodied in individuals, labour mobility is a mechanism of the cross-fertilization of previously unconnected ideas, enhancing firms' and individuals' innovation rates (Saxenian 1994; Almeida and Kogut 1999; Rosenkopf and Almeida 2003). While skilled workers take their knowledge with them, at the same time they acquire new knowledge from their new colleagues, establish new links and social networks, thus, promoting new combinations of ideas (Laudel 2003; Trippl and Maier 2010).

Just as labour mobility is a principal mechanism of knowledge transfer across firms, movements of skilled individuals across regions act as on of the main channels through which knowledge is transferred throughout the space (Coe and Bunnell 2003; Fratesi and Senn 2009; Breschi et al. 2010). Recent empirical works have extensively documented the influence of non-local knowledge sources on firms' innovative performance and knowledge acquisition (Owen-Smith and Powell 2004; Gittelman 2007; Gertler and Levite 2005; Rosenkopf and Almeida 2003; Simonen and McCann 2008; Boschma et al. 2009).

In that respect, the role of entrepreneurs as conduits for knowledge diffusion is particularly pronounced for new entrants originating from outside a region as they may be less likely to rely on existing social networks, social conformity, norms, and so on, most of which are bounded at the local level (Breschi and Lissoni, 2005). Non-local entrepreneurs by diffusing activities from their home regions renew the resource base of a destination region implying that mobile entrepreneurs may induce significantly more structural change than local ones (Neffke et al. 2014).

II.3. Background of entrepreneurs and post-entry performance of new firms

Contribution of entrepreneurs to diffusion of industries across regions is dependent upon their ability to establish firms which would not only survive over particular period of time but

would generate sufficient employment growth. In that respect, factors of post-entry survival and growth of newly established firms are of a crucial interest.

New firms suffer from liability of newness (Carrol and Hannan 2000). Vast variety of factors (including industry characteristics, entry timing, barriers of entry, etc.) helping to overcome it has been studied over time (Delmar and Shane 2006). Particularly much attention is directed to the human capital of founders or founding teams of new firms (Bates 1990; Cooper et al. 1994; Bosma et al. 2004; Colombo and Grilli 2005; Delmar and Shane 2006; Dahl and Reichstein 2007).

The key to understanding the interest in background characteristics of founders lies in the competence-based theories claiming that capabilities of founders, as reflected in their human capital characteristics, are important determinants of post-entry success of new firms (Colombo and Grilli 2005). Indeed, as all entrepreneurs bring to their firms knowledge and skills acquired through their previous work and education experience, new firm entries carry skills and routines embodied in their founders (Dahl and Reichstein 2007).

The literature in the field distinguishes between *general* (e.g., education and experience) and *specific* (e.g., work experience in the same or related industry) human capital. When it comes to general human capital, post-entry performance of new firms is positively related to age, education and work experience of founders (Bates 1990; Brüderl et al. 1992; Almus et al. 1999). It has been shown, however, that specific human capital of founders is more important when it comes to survival and employment growth of new ventures (Stam et al. 2008; Gimmon and Levie 2010).

In particular, accumulation of the industry-specific human capital positively contributes to the post-entry firm performance through several channels. First, a founder or founding team with experience in an industry has a better understanding of how to satisfy customer demand in that industry because such information is often only available through industry participation (Delmar and Shane 2006). In that respect, routines employed by founders in developing entry strategy and making relevant steps to achieve necessary outcomes will be better shaped (Dahl and Reichstein 2007). Second, industry experience allows transferring acquired competences including an in-depth knowledge about technology, production processes, existing products and services which can only be learned through employment in an industry (Klepper 2001). Third, founders starting new firms in the same industry as they have been working in can make use of social networks developed from their prior settings. All in all, this allows saying that prior experience in the same industry is inherited in the process of new firm establishment (Buenstorf and Klepper 2009).

To sum up, previous literature provides an extensive overview of effects of entrepreneur background on the post-entry performance of a new firm. This paper adds up to this debate by looking more carefully at the spatial origin of founders, particularly, if coming from a region at a higher level in the regional hierarchy plays any role.

III.4. Putting it all together: Hypothesising on the role of mobile entrepreneurs

Based on the review of the literature it is possible to formulate three stylised facts:

(1) evolution of rapidly expanding industries is shaped by the process of knowledge creation in which entrepreneurs are the prominent actors;

(2) the role of entrepreneurs as conduits for knowledge diffusion is particularly pronounced for new entrants originating from outside a region as they are less embedded in existing regional networks and are able to renew the knowledge base of a destination region;

(3) contribution of entrepreneurs to diffusion of industries (in terms of establishing a firm generating employment growth) across regions is dependent upon their prior experience which is inherited in the process of new firm establishment.

All in all, the spatial diffusion of an industry might be a story in which entrepreneurs played an important role.

In that respect, it is interesting that even though some studies look at a spatial origin of an entrepreneur as a factor of a new firm survival and growth, this analysis is often limited to distinguishing between local and non-local entrepreneurs. However, mobile entrepreneurs originating from the core regions at the top of the regional hierarchy, could be important actors in the process of diffusion beyond these regions as they are transferring new knowledge from technologically superior areas to more peripheral ones. Indeed, it is the dynamic urban context together with concentration of capabilities in the knowledge-intensive industries in regions at the top of the regional hierarchy that provides access to opportunities for acquiring tacit knowledge (Gordon 2013). Therefore, prior employment at a higher level of the regional hierarchy makes it possible for entrepreneurs to capitalise on the previous experience in order to develop successful firms in the region of entry. In that respect, just as prior experience of an entrepreneur in an industry is inherited by a new firm (Klepper 2001; Buenstorf and Klepper 2009), prior experience in more dynamic region might be inherited in terms of superior knowledge embedded in a founder of a new establishment.

It is, therefore, hypothesised that *performing an entrepreneurial entry associated with a downward move in the regional hierarchy has a positive impact on post-entry performance of a new firm.*

IV. DATA AND METHODOLOGY

IV.1. General information

Data used in this paper comes from the linked employer-employee dataset – Longitudinal Integration Database for Health Insurance and Labour Market Studies (LISA) – provided by Statistics Sweden. These records contain yearly information on individuals' workplaces and incomes for the country's entire population. Individuals are linked to the establishments of their main job for which location and industry affiliation are known.

According to the Swedish industry classification system there are seven 5-digit industries in the ICT-services group: (1) hardware consulting (SNI92/02 72100); (2) data consulting (SNI92/02 72201/72220); (3) software development (SNI92/02 72202/72210); (4) data processing (SNI92/02 72300); (5) database management (SNI92/02 72400); (6) maintenance and reparation of office and accounting equipment (SNI92/02 72500); (7) other ICT-services (SNI92/02 72600). Of these, only the former five are considered knowledge-intensive and are, thus, included into the analysis in the paper.

Layers of the Swedish regional hierarchy are identified according to the following procedure. First, 290 Swedish municipalities are aggregated into 90 local labour markets (as of year 2000) as suggested by Statistics Sweden. Second, based on a method developed by Swedish Agency for Economic and Regional Growth (NUTEK 2004)[3], local labour markets are further aggregated into six regional families, corresponding to the layers of the Swedish regional hierarchy, namely: (1) Stockholm; (2) Gothenburg; (3) Malmö; (4) large regional centres; (5) smaller regional centres; (6) peripheral regions.

IV.2. Identifying entrepreneurial entries. Dependent variables

Identification of entrepreneurial entries and their founders is performed in three steps.

First, for each year between 1990 and 2010 the sample of establishments and firms (all establishments belonging to the same parent firm are linked through a shared firm identifier) operating in the knowledge-intensive ICT-services is derived. Second, selection of new entries at year *t* is performed. Here, an establishment is defined as an entry if two conditions are satisfied: (1) an establishment exists at year *t* but not year *t-1*; (2) identifier of a firm to which an establishment is linked exists for year *t* but not year *t-1*. The second condition ensures that establishments entering through the incumbent firms' expansion are excluded from the analysis[4]. Third, based on the income information distinguishing between incomes derived from wages and from a private business founders behind each firm are identified.

For each of identified new firms, two dependent variables are constructed in order to capture their post-entry performance, namely, survival and employment growth. In order to distinguish between medium- and long-term aspects of post-entry development of a new firm, these variables are constructed over five- and ten-year horizons.

Assuming that an establishment is founded at year *t*, its survival is modelled as a binary variable, where:

$$\text{Survival}_{t+5(t+10)} = \begin{cases} 1, \text{if an establisment still exists at time t} + 5 \ (t+10) \\ 0, \text{if an establishment doesn't exist anymore at t} + 5 \ (t+10) \end{cases}$$

Provided that an establishment survives over five- and ten-year horizon employment growth variable is constructed:

$$\Delta\text{Employment}_{t+5(t+10)} = \ln\big(\text{Employment}_{t+5(t+10)}\big) - \ln(\text{Employment}_t)$$

Only full time employees in the working age are counted as employed here. This implies the following restrictions on the sample: (1) only individuals aged 16-64 are considered; and, (2) to be counted as employed, an individual should have an official 'gainfully employed' (*förvärvsarbetande*) status, that is, being employed at the moment of data collection for employment registers.

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[3] Criteria involved include population size and density, business dynamics, share of individuals with higher education as well as access to higher education institutions.

[4] To deal with multiple entrances of the same establishment (e.g., when it stops operations for one or more years and reopens again), all establishments which are identified as entering more than one time are excluded (531 establishments, around two per cent of all entries).

IV.3. Independent variables

After identifying new entries, founders behind them, and defining dependent variables, several characteristics of founders are derived as suggested by the framework of this paper and findings in the previous research.

First, two variables operationalising spatial origin of an entrepreneur are constructed. Here, an entrepreneur's regional move is observed when (1) an individual starts a new firm at time *t*; and, (2) a region where the firm is founded at time *t* is different from a region of residence (for previously unemployed) or employment (for previously employed) at time *t-1*.

One variable addresses local/non-local dimension of founders' origin and is constructed as a categorical variable:

$$\text{Regional move} = \begin{cases} 1, \text{if all founders originate from the same region, where a firm is founded} \\ 2, \text{if some of the founders originate from another region} \\ 3, \text{if all founders originate from another region} \end{cases}$$

Here, a regional move is defined at the level of a labour market region. In cases when a firm is started by an individual entrepreneur, this variable, obviously, becomes binary with only two possible values (1 or 3).

Second variable reflects on a level of the regional hierarchy from which an entrepreneur comes from. As I am most interested in the spread of knowledge from higher levels of regional hierarchy it is modelled as a binary variable:

$$\text{Move down} = \begin{cases} 1, \text{if at least one of the founders originates from a region at a higher hierarchy level} \\ 0, \text{if all founders originate from regions at the same or lower hierarchy levels} \end{cases}$$

As previous literature suggests that post-entry performance of a firm is dependent upon founders' prior experience which is inherited in the process of new firm establishment, a mode of entry into entrepreneurship is included as an explanatory factor. Three general modes of entry are distinguished:

- *entry from non-participation* takes place when an individual starting a firm at time *t* was not connected to any firm at *{t-1; t-2; t-3}* and/or was below an official working age at *t-1*;
- *entry from employment* implies that an individual starting a firm at time *t* was gainfully employed (at the time of a register employment record) at *t-1*;
- all other entries are identified as *entries from unemployment*.

Entries from unemployment and previous employment are also divided into:

- *related entries*, that is, entries from within ICT-services two-digit industry group;
- *unrelated entries* that are entries from all other industries.

This is done as it has been shown that related entry of individuals positively contributes to a firm performance as opposed to other forms of entry, and inter-regional mobility is beneficial when it is related (Boschma et al. 2009; Timmermans and Boschma 2014). This implies that there are five possible entry modes: (1) entry from non-participation; (2) entry from related unemployment; (3) entry from unrelated unemployment; (4) entry from related employment; and, (5) entry from unrelated employment.

Based on this, two categorical variables are constructed:

$$\text{Related entry} = \begin{cases} 1, \text{if no founders had related experience} \\ 2, \text{if some founders had related experience} \\ 3, \text{if all founders had related experience} \end{cases}$$

$$\text{Direct switch} = \begin{cases} 1, \text{if no founders start a firm directly after being employed} \\ 2, \text{if some founders were employed in a year previous to starting a firm} \\ 3, \text{if all founders start a firm directly after being employed} \end{cases}$$

In the same vein, variables for education and sex of founders are defined:

$$\text{Higher education} = \begin{cases} 1, \text{if no founders have higher education} \\ 2, \text{if some founders have higher education} \\ 3, \text{if all founders have higher education} \end{cases}$$

$$\text{Sex of founders} = \begin{cases} 1, \text{if all founders are women} \\ 2, \text{if a founding team is mixed} \\ 3, \text{if all founders are men} \end{cases}$$

Besides, for each new entry (average) age of founders, whether it was founded by an individual or a group of individuals, industry (at a five-digit level), year of founding as well as location (a layer of the regional hierarchy) are recorded.

IV.4. Empirical models

First, probability of survival and post-entry employment growth are estimated within pooled logistic regression and pooled OLS framework respectively. However, an important issue arises here.

A relevant problem in new firm growth studies is the possibility of selection bias, given that selection is a function of the firms' efficiency in competition with other similar firms (Delmar et al. 2013). Indeed, the most efficient firms normally survive and grow, while less viable firms (which typically correspond to smaller and more slowly growing firms) are systematically selected out of the market (Nelson and Winter 1982). As entries' growth rates are only observed for the subset of surviving firms, pooled OLS estimation results may be inconsistent if firm exit and employment growth are not independent phenomena.

Therefore, following some recent studies on new firms survival and growth (Czarnitski and Delanote 2012; Delmar et al. 2013; Huber et al. 2014) a Heckman-type model is specified in order to correct for selection bias on new firms survival. Formally, this model includes an outcome (growth) equation and a selection (survival) equation, as follows:

$$\Delta Emp_i = \begin{cases} \beta_o F_i + \beta_1 C_i + \varepsilon_i, & \text{if } y_i^* > 0 \\ \text{not identified}, & \text{if } y_i^* \le 0 \end{cases}$$

$$Survival_i = \begin{cases} 1, & \text{if } y_i^* > 0 \\ 0, & \text{if } y_i^* \le 0 \end{cases}$$

where F_i – vector of founders' characteristics, C_i – vector of control variables, $y_i^* = \beta_o F_i + \beta_1 C_i + \theta_i$ represents a latent variable measuring the differential in new firms' utility between remaining active or exiting the market. By allowing the error terms ε_i and θ_i to be correlated, it is possible to correct for non-randomness of the selected sample of new firms.

V. MOBILE ENTREPRENEURS AS DRIVERS OF SPATIAL DIFFUSION

V.1. Descriptive statistics for the sample of new firms

Table V.1. presents descriptive statistics for the variables included in the empirical analysis.

Table V.1. Descriptive statistics

	N	Mean	St.dev.	Min	Max
Survival, 5 years	16299	0,28	0,45	0	1
Survival, 10 years	6932	0,15	0,36	0	1
Employment growth, 5 years	4477	0,19	0,68	-3,93	8,97
Employment growth, 10 years	1023	0,21	0,69	-2,30	4,09
Move down	28083	0,08	0,27	0	1
Group	28083	0,07	0,25	0	1
(Average) Age	28083	38,66	12,22	16	82
	None		**Some**	**All**	
Regional move	85,75%		1,74%	12,51%	
Higher education	62,21%		2,19%	35,60%	
Related entry	67,32%		1,50%	31,18%	
Direct switch	30,70%		1,08%	68,22%	
	All women		**Mixed**	**All men**	
Founders' sex	12,18%		2,68%	85,14%	

As it follows from the table, around 28 per cent of firms survive over five years and only 15 per cent survive over ten years. Most employment growth on average takes place within first five years after a firm is founded as may be seen by comparing five- and ten-year employment growth averages.

With respect to the spatial origin of firm founders only 14 per cent new entries have a non-local founder (alone or as a part of a founding team). Of these, more than a half (8 per cent) have at least one founder coming from a region at a higher level of the regional hierarchy. This again demonstrates that entrepreneurial entries associated with the downward move in the regional hierarchy are quite frequent.

As for other characteristics of founders, 7 per cent of new entries are founded by a team of entrepreneurs. Majority of entries are founded by individuals/teams with no higher education (62 percent) and no related experience (67 per cent). At the same time, most firms are founded by individuals switching directly from previous employment (68 per cent). Finally, men are dominating as entrepreneurs (85 per cent), which in general reflects the gender structure of employment in ICT-services.

V.2. Post-entry performance of new firms and founders' characteristics

Results of estimating pooled logistic and pooled OLS regression models are presented in the Table V.1. Five-year models include entries between 1991 and 2005, while ten-year models are specified for entries between 1991 and 2000. For each of dependent variables, two regressions are estimated: (1) including only spatial origin of founders; and, (2) including all other founder(s) characteristics. All models include the constant, industry, region and year dummies, which are not reported in the table. Firm-cluster robust standard errors are employed[5].

Starting with five-year survival models we can observe that spatial origin of firm founders in ICT-services does indeed have an effect on the probability of survival. In the model with only spatial characteristics being included (column I) it is demonstrated that having a mixed team of founders (*Regional move* variable), where some of the founders are local and some come from another region, has a positive impact on the probability of survival, while in the case of all founders being non-local, chances of survival decrease compared with a situation when the firm is founded by local entrepreneurs. Besides, having an infusion of knowledge from a region at a higher layer in the regional hierarchy (*Move down the hierarchy*) has a positive impact on the survival probability.

Including other characteristics of entrepreneurs (column II) changes the picture in some way. While there is no more observed significant difference between local and mixed founding teams (*Regional move*), coefficients for extra-local founders and having an input from the higher hierarchy level (*Move down*) remain of the same sign, but lose somewhat in the magnitude and significance. A couple of other interesting observations can be made here. First, starting a firm as a team (*Group*) has a very strong positive significant effect on the probability of survival. Having related work experience (*Related entry*) increases the probability of plant survival as does a direct switch from previous employment (*Direct switch*). Somewhat surprisingly, having higher education does not contribute to the probability of survival (*Higher education*) unless a founding team has individuals both with and without higher education. New entries founded by men tend to survive more (*Sex*).

While looking at ten-year survival models, the first striking feature is that almost the half of coefficients for entrepreneurs' background characteristics become insignificant, including the coefficients for the spatial origin of firm founders. Explanation to this fact might be that over a longer time period, characteristics of founders become less important when compared to other factors: characteristics of employees, behaviour of an entrepreneur, external shocks, etc. Alternatively, with time entrepreneurs become embedded into local networks and capitalise on local sources of knowledge, which might make their previous background less relevant to the survival of the entry. Therefore, decreased significance of coefficients should not come as a huge surprise. Nevertheless, starting as a team, having related experience and performing direct switch from previous employment both have a positive impact on the probability of a long-term survival with coefficients having bigger size than in the five-year model. This suggests that characteristics of founders are still important, while effect of coming from another region is mediated by inclusion into local networks.

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[5] The models presented in Table V.1. are for all regions, including Stockholm for which *Move down* variable has no sense. However, as excluding Stockholm has no effect on the signs and significance of coefficients, it was decided to leave the models as they are because of more generalizable results.

<div align="center">**Table V.1. Survival and employment growth regressions**</div>

Dependent variable	Survival, 5 years		Survival, 10 years		Employment growth, 5 years		Employment growth, 10 years	
Regional move (reference: no)								
– some movers	0,8087***	-0,0312	0,8926	0,3496	0,3679**	0,4450**	0,7277*	0,9344**
– all movers	-0,3049***	-0,1590*	-0,2478	-0,1221	0,0681	0,0454	-0,1911**	-0,1993**
Move down the hierarchy	0,2966***	0,1916*	0,2960	0,1794	-0,4071**	-0,4194*	0,2727*	0,2671*
Group		1,0731***		1,2084***		0,1632*		0,3101**
Higher education (reference: no)								
– some of the founders		0,3549***		-0,1460		0,0207		-0,0592
– all of the founders		-0,0092		0,0412		0,0431**		0,0751
Related experience (reference: no)								
– some founders		0,0158		0,3429		-0,0442		0,1654
– all founders		0,2828***		0,3112***		-0,0050		-0,0231
Direct switch (reference: no)								
– some founders		-0,0266		0,0111		-0,0565		-0,1686
– all founders		0,5192***		0,7013***		0,0464**		0,0333
(Average) Founder age		0,0130***		0,0094***		-0,0066***		-0,0108***
Sex (reference: all women)								
– mixed		-0,0632		-0,4216*		-0,5253***		-0,9028***
– all men		0,1650***		0,0996		-0,0360		-0,0518
N	16299	16299	6932	6932	4477	4477	1023	1023
(Pseudo-)R^2	0,0082	0,0401	0,0110	0,0421	0,0300	0,0595	0,0377	0,1105

Industry, region and founding year dummies as well as the constant are included in the model but not reported. Estimation performed with firm-cluster robust standard errors. ***(**,*) – significance at 1% (5%,10%) level.

Turning to employment models it should be noted that just as in the case with survival models having a mixed team of founders with respect to the spatial origin has a positive impact on the growth of employment over both five- and ten-year horizon. At the same time, having only non-local founders slows down the employment growth.

An interesting observation can be made, however, by looking at the effect of an entrepreneur coming from a region at a higher layer in the regional hierarchy. While this effect is positive in a ten-year model, it is negative for a shorter time horizon. This switch in the signs might be interpreted in the following way. It is quite possible that many of entrepreneurs are moving to more peripheral regions to work in some form of freelancing, where they individually undertake consultancy projects without having to employ other workers. In that respect, they are turning into some kind of 'lifestyle entrepreneurs', which might lead to a negative effect on the employment growth. At the same time, surviving over a long time-span (ten years, in this case) might be an indication of an original motivation of an entrepreneur to start a firm which would be expanding over time. This would result in a positive impact on employment growth in a long run.

As for other employment growth determinants, there seems to be a positive effect of founders having higher education in the mid-term, but this effect disappears in the long run. Having related experience is shown to have no significant effect on employment growth, while performing a direct switch from previous employment only affects growth in the five-year model. Starting a firm as a group positively influenced employment growth, which is more pronounced in the ten-year model.

All and all, there is some evidence in the models that spatial background of founders, and, particularly, coming from a region at a higher layer of the regional hierarchy has an effect on the post-entry firm survival and growth.

Given the problem with selection bias, discussed in Section IV.4., Heckman-type model was estimated (Table V.2.). Just as in the case with pooled logistic and OLS models, five-year models include entries between 1991 and 2005, while ten-year models are specified for entries between 1991 and 2000. Only models including all other founder(s) characteristics are estimated. All models include the constant, industry, region and year dummies, which are not reported in the table. Firm-cluster robust standard errors are employed.

Findings reported in Table V.2. in general confirm results discussed before. That is, spatial origin of founders matters, and more so in the long run. What is interesting, estimating probability of survival and employment growth simultaneously increases both size and significance of coefficients for spatial origin variables in the ten-year model. Starting as a group, having related experience, and performing direct switch all have a positive effect on probability of survival and employment growth in both medium and long run. The estimated correlation between the errors of output (growth) and selection (survival) equations are positive and significantly different from zero in both five- and ten-year models suggesting that results of simultaneous estimations are, indeed, valid and should be preferred over unconditional models reported in Table V.1.

VI. DISCUSSION AND CONCLUSION

The paper aimed at describing the patterns of the spatial evolution of knowledge-intensive ICT-services across the layers of the Swedish regional hierarchy as well as discussing the role of mobile entrepreneurs in the diffusion process of these industries. All in all, results of the analysis presented in the paper suggest two sets of conclusions.

Table V.2. Heckman selection equation for survival and employment growth

Dependent variable	5 years		10 years	
	Employment growth	Survival	Employment growth	Survival
Regional move (reference: no)				
– some movers	0,3587	0,0808	1,2896***	0,1176
– all movers	-0,0469	-0,0901**	-0,2534**	-0,1071
Move down the hierarchy	0,0516	0,0854	0,3211**	0,1001
Group	0,4635***	0,8902	0,6822***	0,8961***
Higher education (reference: no)				
– some of the founders	0,1397	0,2831**	-0,2193	-0,0508
– all of the founders	0,0151	0,0088	0,0600	0,0306
Related experience (reference: no)				
– some founders	-0,1167	0,1032	0,3725	0,2593
– all founders	0,1501***	0,1478***	0,1315**	0,1765***
Direct switch (reference: no)				
– some founders	-0,0714	-0,1313	-0,4270	-0,0174
– all founders	0,2523***	0,3021***	0,3720***	0,3672***
(Average) Founder age	0,0009	0,0039***	-0,0053**	0,0019
Sex (reference: all women)				
– mixed	-0,4122***	-0,2661***	-0,9234***	-0,4618***
– all men	0,0533	0,0716**	0,0060	0,0329
N	16164	16164	6892	6892
N censored	11687	11687	5869	5869
N uncensored	4477	4477	1023	1023

Industry, region and founding year dummies as well as the constant are included in the model but not reported. Estimation performed with firm-cluster robust standard errors. ***(**,*) – significance at 1% (5%,10%) level. The estimated correlation between the errors of employment growth and firm survival are positive and significantly different from zero in both 5- and 10-year models suggesting that these equations should be estimated simultaneously

It has been demonstrated that employment growth in ICT-services strengthened differences across regions in favour of major metropolitan areas as they managed to combine internal sources of growth with attracting workers from the lower levels of the regional hierarchy. At the same time, numbers of gross worker reallocation imply that dynamics of worker reallocation in ICT-services extended beyond pure concentration of labour in the metropolitan areas. Here, the high share of moves from central to peripheral regions associated with entrepreneurial entries suggested that mobile entrepreneurs could be an important channel of ICT-services diffusion through the Swedish regional system. Building upon the latter claim, the paper focused on the mobile entrepreneurs and demonstrated that their previous experience is an important predictor of new firms' post-entry performance. The most important conclusions are summarised below.

Having an infusion of non-local knowledge tends to have a generally positive impact on the probability of a medium-term survival of a new firm, unless there is too much knowledge coming from outside the region (that is, when all founders are non-local). This goes in line with observations made by Boschma et al. (2009) that individuals moving from other regions might lack a needed degree of proximity to local knowledge bases, thus, making it difficult for them to operate successfully in a new context. However, a mix of local and external knowledge is expected to have a positive impact on a firm. If at least one of the founders of the firm is coming from a region at a higher level of the regional hierarchy, that has a further positive impact on the survival probability. This effect, however, disappears in a long run. When it comes to the employment growth there is a positive impact in medium and long run from having a mix of local and non-local entrepreneurs, which is in a long-run complemented by a positive effect of entrepreneurs originating in a region at a higher level of the regional hierarchy.

These results suggest that it's not only the industrial experience of a founder that is being inherited by a new firm (Klepper 2001; Buenstorf and Klepper 2009), but also prior experience in a more dynamic region providing access to opportunities for acquiring superior knowledge (Gordon 2013). Entrepreneurs originating from the most dynamic regions can, therefore, contribute to renewal of a regional knowledge base in more peripheral ones by diffusing activities from their home regions in the vein of findings of Acs et al. (2009) and Neffke et al. (2014).

In line with the previous literature on the effects of entrepreneurs' background on the post-entry performance of a new firm, the paper also demonstrates that the previous experience and the mode of entry into entrepreneurship (in terms of having industry experience, starting a firm directly from employment without any long spell of unemployment) tend to positively affect survival chances and employment growth of new establishments.

All in all, by showing that the entrepreneurial entries are expected to be more successful in case when individuals with non-local origin (particularly, the ones coming from more dynamic regions than a region where the entry is performed) are involved in founding the firm, paper makes two major contributions. On the one hand, paper contributes to entrepreneurship research by showing that the spatial origin of an entrepreneur should be analysed not only in terms of local/non-local dichotomy but should more explicitly account for where she moves from. On the other hand, the paper demonstrates that mobile entrepreneurs are important drivers of spatial diffusion of a rapidly expanding industry, which might be of an interest to economic geography scholars.

Although the results contribute to filling the gap in the existing literature, there is a substantial need for additional research. An interesting aspect for future work is to look not only at the founders' origin but also to analyse initial human capital endowments more broadly, that is, to take into consideration all employees which are employed at a new firm from the moment of its

foundation. Such focus is important as initial workforce has a substantial influence on the quality and quantity of a new firm's early growth (Koch et al. 2013). More profound survival analysis might be performed where the possible impact of founders' background on the duration of post-entry survival is examined. Besides, time component might be taken into consideration more explicitly as ICT-services over considered time period have moved along industry life cycle from the stage of rapid expansion to the stage of mature industry, which could imply different effects of founders' background on the post-entry firm performance. Finally, it may be interesting to investigate if infusion of knowledge from other regions plays the same role at different layers of the regional hierarchy.

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