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Entrepreneurial ecosystem (EE) is a popular concept in entrepreneurship studies that describes all actors and the interaction between actors in a specific geographical area. While studies have focused on a single case, this paper explores and compares the nature of five EEs in Life Sciences in Sweden and the US, based on own data collection in all five areas. The paper outlines commonalities and differences between how EEs operate and function in different territorial contexts. It also explores how national and local factors influence the rate and nature of entrepreneurship at the regional level. The paper shows how important it is to take a territorial perspective on EE, because EEs look different in distinct geographical and institutional contexts.

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1. Introduction

There is an expanding literature on Entrepreneurial Ecosystems (EE) (Stam 2015; Alvedalen and Boschma 2017; Spigel 2020). This literature has generated important insights with respect to factors that contribute to entrepreneurship. However, there is still debate concerning definitions and concepts that capture the essence of EE, and above all the empirical measurement of EEs (Stam 2018). For instance, it still is an empirical challenge in the EE

literature to develop appropriate metrics (e.g. Audretsch and Belitski 2017), and how to compare different EEs empirically (e.g. Harrington 2016).

There is increasing recognition that the territorial context in which EEs are embedded will have consequences for the nature and evolution of EEs. Empirical studies on EEs have adopted different approaches. One branch of empirical literature focuses on quantitative approaches that work with large datasets like Global Entrepreneurship Monitor, comparing entrepreneurship between many territories, often between countries (e.g. Xiumei and Haiyan 2018; Corrente et al. 2019), sometimes between regions (e.g. Hechavarria and Ingram 2014; Stam 2018). Another branch of empirical studies takes a qualitative approach, looking in detail at a single case (e.g. Neck et al. 2004; Cohen 2006; Mack and Mayer 2016). Both approaches have generated important insights but also have their limitations. Few studies exist that combine the strengths of both comparative and qualitative approaches that are based on own data collection. The few exceptions that exist focus their attention on the comparison between two regional cases at most, often within the same country (Spigel 2017). This has increased our understanding of differences in the nature and success of EEs in different territorial contexts, but there are no studies to date that investigate the combination of national and regional factors shaping entrepreneurship in regions. This study takes a first step in filling this gap in the literature.

This paper aims to explore and compare the nature of five EEs in Life Sciences in Sweden and the US, based on own data collection in all five areas. We outline commonalities and differences between how EEs operate and function in different territorial contexts. We explore how national and local factors have an impact on the rate and nature of entrepreneurship at the regional level. By doing so, we show the importance of taking a territorial and multi-scalar perspective on EE, as advocated recently in regional studies, and explore how EEs look differently in distinct geographical contexts.

The paper is structured as follows. Section 2 provides a brief literature review. Section 3 introduces the data and the five cases in Life Sciences. Section 4 makes the comparative analysis of the five EEs. Section 5 concludes and discusses implications for research.

2. Literature review

In recent years, the Entrepreneurial Ecosystem concept has attracted a lot of attention from researchers in entrepreneurship studies, policy makers and practitioners. Scholars like Feld (2012), Isenberg (2010), Acs et al (2014), Mason and Brown (2014), Stam (2015), Alvedalen and Boschma (2017) and Spigel (2017, 2020) have all been influential in defining, describing and discussing the concept of EE. Entrepreneurship being a heterogeneous phenomenon and regions possessing idiosyncratic resources have led to multiple definitions of EE. One popular definition is by Stam and Spigel (2017): 'a set of interdependent actors and factors coordinated in such a way that they enable productive entrepreneurship within a particular territory' (p. 1). Consequently, a key objective of the EE literature is to better understand how entrepreneurship is produced (Stam 2018) from a systemic perspective (Qian et al. 2013; Szerb, Aidis and Acs 2012; Acs, Autio and Szerb 2014).

From the very start, studies in EE focus on particular territories, taking an explicit or (more often) implicit geographical perspective. Doing so, it acknowledges the region-specificity of actors in EEs that act and interact in a local context. Specific focus is on high-growth entrepreneurial firms and their needs (Stam 2015), rather than on new venture creation or rates of self-employment per se (Autio et al. 2017). High-growth firms possess specific capabilities and resources and interact with the local environment more intensely at the start than other types of firms (Spigel and Vinodrai, 2020). Geography matters for entrepreneurship, as support structures like social networks and favorable institutions that help entrepreneurs get access to resources like knowledge, finance and human capital are geographically concentrated (Stuart and Sorenson, 2005; Boschma, 2015).

The EE literature has focused on elements and interactions and the self-reinforcement of the elements in an EE (Spigel 2017, Spigel and Vinodrai 2020). Isenberg (2011) argued that elements of an EE interact in specific ways that result in unique configurations of EEs. This has led to discussions which elements are considered crucial in an EE. Isenberg(2011) proposed six domains, namely: (1) public policies; (2) financial capital; (3) culture; (4) support institutions; (5) human resources; and (6) markets. Stam (2015) proposed to focus on networks of entrepreneurs, leadership, finance, talent, knowledge and support services. The crucial issue is the extent to which, and how these elements interact, and how strong these relationships are in an EE (Feld 2012; Motoyama and Watkins 2014; Spigel 2015). EE scholars have raised concerns in this respect. Stam (2015) asserts that "entrepreneurial

ecosystem factors do provide some focus, but they offer no consistent explanation of their coherence or their interdependent effects on entrepreneurship and, ultimately, on aggregate welfare" (p. 8). Stam and Spigel (2017) argue that the EE literature does not measure the relation between EE factors and entrepreneurship activity in a territory. Alvedalen and Boschma (2017) emphasize the lack of studies that explicitly link cause and effect in EEs.

There is recognition that institutional factors are tightly linked to entrepreneurial performance of countries (e.g. Busenitz et al., 2000; Spencer and Gomez, 2004; Chiles et al., 2007; Kshetri, 2007; Gupta et al., 2012). Institutions like social capital are regarded as crucial ingredients for entrepreneurial networks (Johannisson et al. 2002; Westland and Adam 2010). Institutions such as laws, norms and values enable, or not, interactions across individuals, firms and other organizations (Sine and David 2010; Huggins et al. 2012), and therefore have an impact on entrepreneurship in EEs. The EE literature has often been criticized because it does not fully capture the role of institutions, or it has failed to specify the exact nature of institutions (and their dynamics) that lead to entrepreneurial success (Alvedalen and Boschma 2017). Hall and Soskice (2001) explored the role of national institutions in their varieties of capitalism framework in which actions of economic actors and their interactions are regulated and coordinated by those institutions. These have an impact on how product, capital and labor markets function in countries, and therefore may also be considered crucial for entrepreneurship and innovation, not only in quantitative terms (how much entrepreneurship), but also in qualitative terms (what type of entrepreneurship). However, few studies on EE to date have adopted a comparative approach. Much of prior research on multi-country comparisons focuses on countries with relatively homogeneous institutions such as Asian countries (Wielemaker and Gedajlovic 2011), Western countries (Busenitz et al. 2000), CEE economies (Kshetri 2010), and post-socialist economies (Kshetri 2009).

Another source of debate is how to measure EEs empirically, and how to compare them (Harrington 2016). This has been described by Audretsch and Belitski (2017) as a key challenge for the EE literature: "methodologically it is important to develop metrics in order to determine the strengths and weaknesses of a regional system of entrepreneurship and the relationship between each domain of the system, so that most relevant components can be assessed and targeted" (p. 1032). Empirical studies on EEs follow different approaches.

There are quantitative studies on EEs based on large datasets, comparing entrepreneurship between many countries and many regions. Xiumei and Haiyan (2018) used the Global Entrepreneurship Monitor (GEM) to compare the EE of China with other countries. Corrente et al. (2019) applied the SMAAS (Stochastic Multicriteria Acceptability Analysis) methodology to the performance of European countries in terms of EEs, taking as a proxy the number of growth-oriented start-ups and pointed out cultural norms, government programs, and internal market dynamics as important factors. Taich et al. (2016) compared 150 Metropolitan Statistical Areas in the US using the Stangler and Bell-Masterson framework, and found two dimensions crucial for EEs: Opportunity & Access, and Dense Dynamic Markets. Hechavarria and Ingram (2014) used GEM data for the US to examine the entrepreneurial ecosystem from 2001-2012 and more in detail at the entrepreneurial ecosystems of Seattle, Washington and Detroit, Michigan. Stam (2018) measured elements of EEs in 12 regions in the Netherlands: networks of entrepreneurs, leadership, finance, talent, knowledge, and support services.

Other studies on EEs are based on case studies of a single region. Neck et al. (2004) examined the region of Boulder (Colorado), Cohen (2006) investigated the EE of the Victoria region (British Columbia), and Mack and Mayer (2016) looked at the Phoenix region in Arizona. Part of the literature maintains that only qualitative research can understand entrepreneurship that is "… characterized by complex, dynamic and emergent processes, and the interplay between actors, processes, and contexts" (Karatas-Ozkan et al. 2014, p. 590). Similarly, Roundy et al. (2017) assert that 'count-based' metrics do not adequately capture the varying importance of actors and processes over time, and therefore favors narrative accounts of EEs instead, which is the approach of this paper.

Both types of approaches have generated important insights but also have their limitations. Few studies exist that combine the strengths of both comparative and qualitative approaches that are based on own data collection. Schwarzkopf (2016) compared the US and Germany and concluded that the US had a strong and more diverse entrepreneurial culture than Germany. Kshetri (2014) compared the EEs of Estonia and South Korea by looking at (1) regulatory framework; (2) values, culture and skills; and (3) access to and development of finance, market, R&D and technology. Kremer (2019) compared Germany, US and UK, based on the GEI index for EE with 14 pillars covering population (attitudes, abilities, and aspirations) and environmental features. Parracho (2017) compared the US, Germany and

Portugal on the basis of 25 factors. Spigel (2017) compared two regions in Canada (Waterloo, Ontario, and Calgary, Alberta) in which the EEs are composed of 10 cultural, social and material elements, and showed how the specific interaction between these elements creates a supportive regional environment.

These studies have increased our understanding of differences in the nature and success of EEs in different territorial contexts, but there are few or no studies that investigate the combination of both national and regional factors shaping entrepreneurship in regions. This study takes a first step in this direction by comparing five EEs across the US and Sweden. Also, there are few, if any, studies of cause and effect – the impact of entrepreneurial ecosystems on economic outcomes. While this study does not measure impact, our ambition is to move beyond statistical description and to look in greater detail than previous studies on the dynamics in different EEs and develop a new research agenda.

3. Methodology and data

We used inductive design for data collection and the analysis guided by the research question: What factors are at play in EEs in different regions and how do they impact the dynamics of innovative firms in the LS industry? Inductive pattern identification rather than theory-testing was more appropriate, due to a lack of research on EE in life sciences at the regional level (Eisenhardt et al., 2016). Inductive study provides an opportunity to understand the dynamics in EEs that involves complexity of actions of many local actors and the way a range of factors might have an impact on that. We utilize a comparative case study approach to understand the role of national and local factors on the dynamics of innovative LS firms in five different EEs. This study is taking a micro-perspective to the system by interviewing the firms, industry experts and supporting organizations. More specifically, we are looking at how new firms in LS sectors Pharmaceuticals (Pharma), Medical Technology(MedTech) and Bio Technology(BioTech) have emerged, how the environment has impacted them and what mechanisms have been responsible for certain outcomes.

We selected four regions that dominate LS in Sweden (Gothenburg, Lund, Stockholm and Uppsala) and one LS region in the US (Northeast Ohio). We conducted a total of 40 interviews in person or by phone during 2015-2019 with founders and top management of innovative LS firms. In order to obtain suitable candidates for the interviews, we obtained a list of start-up companies from local experts on the LS industry. We also interviewed regional

experts in LS such as national LS investigators, investment managers for the region, CEOs of Science Parks and Universities, and regional government management.

As shown in Table 1, twelve interviews were conducted in Lund, six in Gothenburg, nine in Stockholm, six in Uppsala, and seven in Northeast Ohio. The firms to be interviewed were selected on the basis of their location, year of registration (before and after Astra Zeneca and Pharmacia had major reorganizations and laid off large numbers of employees), activity in MedTech, BioTech and Pharma, and selling services and/or products. In order to gain perspectives from different stakeholders and examine activities, networks and components of the EEs, several types of archival data were used such as firm's registry online, annual reports, websites, industry reports and policy-related documents. This type of data was used to give detail to and triangulate the findings.

Data was coded and analyzed using methods inspired by grounded theory (Glaser and Strauss, 1967; Charmaz 2006; Gioia et al. 2013). An abductive approach (Dubois and Gadde, 2002) was used for strengthening the understanding of the initial findings at the analytical steps where data generated themes that were compared to the existing EE literature. The following analytical steps were adopted and adapted from Roundy (2019) for qualitative research of EEs: (1) Inductive focus - broad focus for the factors impacting EEs in LS across two countries; (2) First-order coding - initial concepts were identified and labeled by section-by-section coding of the transcribed interview material; (3) Second-order coding – initial codes were reduced/grouped according to similarities; (4) Theoretical aggregation – abstraction of codes into themes, iterating between the data and the EE literature; (5) Recursivity – tentative theoretical explanations on factors of influence were developed during the analysis, (6) Pattern identification triangulation – emerging themes and their explanations were subject to 'constant comparison and contrasting' within and across data sources; (7) Data organization – Atlas.ti, a qualitative data management program was used in the stages of the analysis.

Table 1 List of interviews. CSO – Corporate spin-off, USO – University spin-off, na – not applicable.

Code	Type	Source	Industry Sector/Expert role	Year registered
L1	CSO	Astra Zeneca	Pharma/Biotech	2011
L2	CSO	Astra Zeneca	Pharma	2011
L3	CSO	Astra Zeneca	Medtech	2013
L4	CSO	Astra Zeneca	Biotech	2013
L5	USO	Lund Uni	Biotech	2000
L6	Na	Regional government (Region Skåne)	Regional expert in Life Science	na

L7	Na	CEO Medicon Village Science Park	Top Management	na
L8 (2 interviews)	Na	Lund University	Top Management	na
L9	Na	Medicon Village Science Park	Middle Management	na
L10	Na	Lund University/Entrepreneur	University Management/Entrepreneur	na
L11	Na	Regional Council (Region Skåne)	Top management	na
S1	Na	Astra Zeneca/former Vinnova	National expert in Life Science	na
S2	Na	Biovation Science Park	Top Management	na
S3	CSO	Management buy out	Biotech	2009
S4	USO	KI and KTH	Biotech	2004
S5	USO	KI	Biotech	2008
S6	CSO	Astra Zeneca	Biotech	2012
S7	Na	KI Science Park	Top Management	na
S8	CSO	Pharmacia	Biotech	2003
S9	USO	KI and KTH	Medtech	2006
G1	Na	Na	Regional expert in Life Science	na
G2	CSO	Astra Zeneca	Pharma	2007
G3	USO	Chalmers	Medtech	2005
G4	USO	Uni of Gothenburg	Biotech	2010
G5	USO	Uppsala and Uni of Gothenburg	Biotech	2005
G6	CSO	Small firm	Biotech	2004
U1	USO	Lund Uni/Manchester	Medtech/Botech	1999
U2	USO	Uppsala Uni	Biotech	2013
U3	CSO	Pharmacia(Biovitrum)	Biotech/Pharma	2009
U4	Na	Uppsala Uni Innovation	Top Manager	na
U5	USO/CSO	Uppsala Uni (Financed by Pharmacia)	Medtech	2006
U6	CSO	Pharmacia	Medtech	2006
NEO 1	USO	CWRU	Medtech	2006
NEO 2	USO	CWRU	Biotech	2013
NEO 3	USO	UH/CWRU	Biotech	2010
NEO 4	USO	MS School of Medicine/CWRU	Pharma/Biotech	2013
NEO 5	CSO	Cleveland Clinic	Biotech	2007
NEO 6	USO	CWRU & UH	Medtech	2002
NEO 7	CSO	Cleveland Clinic	Medtech	2014

4. Results of the comparative analysis of 5 EEs

This section compares the five EEs in Life Sciences (LS). We first introduce each of the EEs briefly, starting with the overview of population, LS employment and number of LS establishments in the five regions in Table 2. Then, we compare them on nine factors that our analysis indicated as key features of EE in LS.

Table 2. LS industry in five regions. Swedish data shows year 2010 (Statistics Sweden) and Northeast Ohio data shows 2017 (BioOhio, 2019)

	Population	Number of employees in LS	Number of LS establishments
Lund (Malmö)	90.000 (300.000)	10.200	360
Gothenburg	600.000	7.800	350
Uppsala	170.000	3.500	140
Stockholm	1000.000	16.800	670
Northeast Ohio	4.500.000	22.500	1.300

Uppsala is a university city of ca 170, 000 inhabitants. It consists of over 100 LS firms and 3500 employees. The top five largest firms accounted for about 70% of the employees in 2016. Medical technology is the largest sector in terms of number of firms, followed by pharmaceuticals and biotechnology (Uppsala BIO). The EE is built around Uppsala University which acts as a source of LS innovations and technology transfer services and as a hub for connecting small and large firms. Another key actor is Pharmacia. Though this focal company disappeared in 2012, it had established a highly collaborative attitude in the region between universities and firms during several decades and boosted the rate of successful spin-offs. There are over 20 supporting organizations, such as innovation centers, holding companies and science parks.

The **Stockholm** area (including both the city of Stockholm and Södertälje[1]) is the epicenter of the LS industry in Sweden, with ca 50% (700 establishments) of Swedish LS firms residing there. The population is around 1.000.000 with 17.000 people having LS employment as displayed in table 2. There is a long tradition in LS, and large firms like Astra Zeneca and Pharmacia have made a big impact on the EE. Many global firms have their sales offices in

[1] Södertälje, 40 km southwest of Stockholm is where Astra's main research center was located before the merger with Zeneca in 1999. It is also where Astra Zeneca's main manufacturing plant is located, the world's largest pill-making facility.

Stockholm to monitor developments, but most innovative firms are small. Stockholm is well-endowed with important academic organizations such as Karolinska Institute, the Karolinska University Hospital, the Royal Institute of Technology, the University of Stockholm, and the Science for Life Laboratory. There are many Science Parks and support organizations in the EE, like the Karolinska Innovation Science Park, the Biovation Science Park and SwedenBio. Funding in Stockholm is available in many ways, like small stock markets, business angels, venture capitalists and some international funding organizations.

The EE for LS in **Gothenburg** covers an area with a population of around 600,000 people. There are about 350 LS establishments employing around 7,800 people. Historically, the EE has been shaped by large firms (Astra Zeneca, employing 2,500 people), hospitals (Sahlgrenska University Hospital) and universities (Sahlgrenska Academy, Chalmers and Gothenburg Universities). A strong ICT sector has led to a rapid growth in medical technologies. Other strong clusters are in pharmaceuticals and biotechnology (GBG region 2020). The EE hosts a range of network organizations, including science parks and incubators. Collaborative activities are relatively new. This can partly be explained by the closed approach of doing business by Astra Zeneca which set the culture in the EE for decades. Recently, Astra Zeneca changed its strategy, acting as investor in small firms and co-founder of large cluster projects.

Lund is a university-dominated city of about 92,000 inhabitants in southern Sweden (Skåne county), next to a larger city of Malmö. Lund/Malmö are hosting ca 350 LS establishments and ca 10.000 employees. Lund is part of Medicon Valley with 40.000 LS employees, which is a large LS cluster that stretches across border to Denmark and the Copenhagen area (Medicon Valley Alliance, 2020). Lund is one of the most dynamic EEs in LS in Sweden, with many new firms that started after the closure of Astra Zeneca's research facility in 2011. The number of LS employees in Skåne county has grown recently from 16 to 27% of Sweden's total LS employees (VINNOVA, 2014; SwedenBio, 2020). Focus among the new firms is in biotechnology and pharmaceuticals. The establishment of the Medicon Village (MV) Science Park in 2012 has boosted new firm formation and strong collaborations between researchers, Lund University, support organizations, businesses and governmental agencies.

Northeast Ohio is a region in the US state of Ohio with about 4,5M inhabitants. The region hosted 1,313 LS establishments with a total employment of 22,509 in 2017. Medical device and equipment employed the largest number (BioOhio 2019). The Cleveland Health-Tech Corridor is a prime location for the 170+ life science firms in close proximity to world leading health organizations, business incubators and academic centers. The EE is centered around Case Western Reserve University (CWRU) with University Hospitals and the Cleveland Clinic Foundation (CCF). They are among the largest LS research organizations in the US and act as both clients and collaborators to the firms. The Cleveland Clinic, the 4th largest research hospital organization in the US with 45,000 employees in NE Ohio and 67,000 worldwide, has three research centers with over $300 million in research funding. Both CCF and UH have effective internal organizations for technology transfer as well as seed funding. Two-thirds of all LS start-ups in Northeast Ohio originate in these organizations. The primary role of the university in the EE is to support faculty research that results in intellectual property that can be commercialized.

Below, we compare the five EEs more closely on nine factors that were derived from the abductive approach and selected as key dimensions of EEs in LS: University-Industry links, Large Firms, Entrepreneurial Support Infrastructure, Funding, Global Links, Institutions and IP, role of Local/National Links, Entrepreneurial Management, and the role of Hospitals.

University-Industry (U-I) links

The U-I links in North-East Ohio are much stronger and have a different nature than in Sweden. Case Western Reserve University (CWRU) and the Cleveland Clinic Foundation (CCF) – both private organizations - are the main sources of new LS spin-offs and have had strong industry links from the start. They provide networks, and tangible and intangible resources to the local LS industry. CWRU and CCF both have a strong scientific reputation which spills over to their spin-offs, boosting their legitimacy for further collaborations. Both organizations own the IP that is produced and support research with the goal of commercialization.

U-I links differ very much across the EEs in Sweden. Uppsala has very strong U-I links with Uppsala University as the focal point of the EE. Informal and highly trusted networks provide small and large firms with resources like equipment and human capital and new collaborative projects. In the much larger EE of Stockholm, U-I collaborations are also strong and well

networked where it is easy to find key people to collaborate with. Stockholm EE provides a rich academic environment with many local universities such as KTH, KI and Stockholm University. The story is very different in Lund and Gothenburg which had historically weak U-I links in LS. One of the reasons for this is the research culture of AZ that is discussed in the section on the role of large firms. However, this is now changing. U-I collaborations in Lund have been low for many years for non-USOs (University Spin-Offs) but have been developing fast since the closure of Astra Zeneca and the establishment of the Medicon Village Science park (MVSP). MVSP was designed to support research and its commercialization in the region and to stimulate networking among actors in the EE. Lund University acts as provider of researchers, equipment, and human capital to small firms, business advice through TTO and to a lower degree as customer. In Gothenburg, which has a larger EE than Lund, research links between Corporate Spin-Offs (CSOs) and the universities – Gothenburg and Chalmers Universities – are still weak and even described as "impossible" now and then, as illustrated by slow responses to requests for collaborations. Links to international universities are highlighted as very important instead. University Spin-Offs (USOs), on the other hand, have strong connections to their key research groups but not to the commercialization side of the universities. This situation is changing in recent years due to more collaborative projects and large firms starting to invest in stronger and more open links.

Role of large firms

There are striking differences with respect to the role of large firms in the different EEs. Northeast Ohio has no large pharmaceutical firms based in the region. However, the Cleveland Clinic has multiple collaborations with large pharmaceutical firms and medical equipment suppliers around the world. It also has its own TTO (The Global Cardiovascular Innovation Center, GCIC), which plays an important role not only as a major center for research, innovation, and new business ventures in life science in the region but also as a major partner with local and state agencies in promoting regional economic growth.

The role of large firms in the EEs in Sweden is very different. Astra Zeneca (AZ) and Pharmacia are two giant companies that had contrasting impacts on the nature and quality of firms in the EEs and how EEs in different regions in Sweden operate. Astra Zeneca had its strongest presence in Stockholm, Gothenburg, and Lund and had historically generated few spin-offs. AZ had very few local collaborations with the university and local firms; it was mainly absorbing or insourcing research human capital. The departure of AZ in 2011 in Lund

had a positive impact on the EE in LS. After closure, the large R&D facility became a Science Park that transformed Lund into a growing and dynamic EE. When AZ left Lund, it was part of a move to consolidate research in fewer locations and fewer areas of research. Some of AZ's inhalation research was moved to Gothenburg, leaving behind many researchers with less developed IP. As a result, the spin-offs started by former AZ employees were generally in services and early stages of product development with few products to sell. In Gothenburg, AZ still is the largest employer and has one of its global strategic R&D sites there. There has been a change in the dynamics of the EE due to the changing strategy of AZ in more recent years. AZ has started to collaborate in research projects no matter the type of actor, and it invests directly in small firms. AZ has also established an incubator (BioVentureHub) that gives small firms access to knowledge and equipment of AZ.

Throughout its history, Pharmacia operated in all three sectors of the life science industry (pharmaceuticals, biotechnology, and medical technology). The priorities shifted over time, constantly changing the configuration of the company. There was an open and permissive innovation climate within the company that made it possible to conduct high-risk projects outside core business areas and to collaborate with academic scientists (mostly in Uppsala and Stockholm). The company was an early entrant into biochemical products and was constantly spinning off units. Pharmacia went through numerous mergers, acquisitions, and spin-offs. Several of these changes involved large international pharmaceutical firms such as Upjohn, Amersham, Monsanto, Pfizer, and GE Healthcare. When Pharmacia gradually phased out its activities in Sweden, it was largely through spin-offs. Entire business units were sold or spun-off, not closed; they stayed in Uppsala and became either independent companies or subsidiaries of other companies. In addition, many new companies have been started by former employees in the Pharmacia group. As a result, the number of companies and employees in the EE in Uppsala continued to grow even after Pharmacia as a corporate entity disappeared (Sandström et al., 2011).

The EE in Stockholm has many large national and international firms with R&D, production or sales offices. Interestingly, it is mostly large Swedish firms, also by creating industry networks, and not the presence of many international ones in Stockholm that have had most impact on the EE. Initiatives taken by large firms in Stockholm influenced both the region and the country as a whole. The largest national LS business network (SwedenBio) was started by seven large Swedish firms. Before its departure, Pharmacia also supported many spin-offs and

diverse collaborations with researchers (mostly in Uppsala and Stockholm). AZ is still present in the EE. It closed down its R&D facility in Södertälje but that did not spur EE dynamics like it did in Lund. One reason can be that the closed culture and no local tradition of resource sharing and spin-offs around AZ was, in this case, not well-mitigated by the other actors of the EE. Spin-offs from AZ after closure are few and many are service firms.

Entrepreneurial Support Infrastructure

The Entrepreneurial Support infrastructure ranges from being strong and knowledgeable in the EE in Northeast Ohio, to being weak and inward-looking at times in the EE of LS in Gothenburg. Many regional and national support actors in Sweden have been criticized for a lack of LS entrepreneurial skills. However, regional actors in the EE of Uppsala have been praised for being complementary. Support infrastructures, like access to funding, seem to have more resources and impact the closer they are to Stockholm, which accentuates the role of geographical proximity to the epicenter of power.

Northeast Ohio has a strong entrepreneurial support infrastructure in life sciences. The CWRU School of Medicine and the Cleveland Clinic, both private organizations, are major centers for medical research globally, with hundreds of millions of dollars of annual research funding (much of it from the National Institutes of Health). They have well-staffed and competent TTOs and provide pre-seed venture capital to new start-ups. They are the source of two-thirds of the life science startups in the region. The Cleveland Clinic plays an active role in local and regional organizations, both private and public, promoting entrepreneurship and economic growth in life sciences (BioEnterprise and BioMotiv) as well as generally (TeamNEO and Jumpstart). The state of Ohio also provides entrepreneurial support, mainly through its Third Frontier program. The state and regional organizations complement each other and work well together. There is also local expertise available for intellectual property protection and navigation of the approval process for drugs and medical devices.

In Sweden, support infrastructure is most often not as networked, and nationwide organizations are criticized for shallow support and high burden of reporting. There are also notable differences across Swedish EEs.

Uppsala's support infrastructure is strongest, with key organizations located in the same building. Informal meetings are held and insights into each other's activities are shared which

is helpful to direct entrepreneurs to the right people. Uppsala Innovation Center (UIC) is ranked as the world's 5th best incubator 2019/20 (UBI Global 2020). There are also strong links to support organizations in Stockholm. Some national organizations are perceived as providing better support in knowledge and funding than in other regions. Being close to the national government means better access to resources and supporting policies. However, what also concerns all regions in Sweden, many actors in the support infrastructure are perceived to have overlapping objectives and absorb funding which should be going directly to the entrepreneurs. Stockholm has many strong support organizations like KI Science Park but is lacking the complementarity of Uppsala.

In Lund and Gothenburg, support infrastructure for LS firms seems weaker. Lund is developing in many ways. Prior to and at the start of MV Science Park, the local and national support organizations dealing with funding and business support were weakly connected and had little knowledge of LS entrepreneurship specifically. The entrepreneurial support was perceived to be good only for the initial steps of registering a firm. Costly reporting for getting support was mentioned as problematic. After the establishment of MVSP and the Smile Incubator, the university support system was better used and connected. However, regional and national actors are still criticized for inefficiency.

Gothenburg's support infrastructure was described as weak, specifically for the LS firms, despite the local presence of world-leading incubators like Chalmers Ventures (world's best in 2019/2020 according to UBI Global 2020) and BioVentureHub inside AZ. It was generally criticized for lacking entrepreneurial experience and being too path-dependent. Specifically, international sales experience and benchmarking were lacking in the support organizations, except for a few highly engaged people. The support organizations and Technology transfer offices at universities had few to no full-time employees and weak commercialization support. Furthermore, clear links among the support actors were felt missing, as well as a commercialization strategy for the industry/region. Firms mentioned there is a need to separate entrepreneurial support between the different LS sectors (pharmaceuticals, medical technology and biotechnology) due to highly different requirements in regulations and funding.

Funding

There are big differences between Northeast Ohio and the Swedish regions as far as the level and nature of funding in the EEs in LS are concerned. The main difference is in terms of the number and variety of sources, both public and private, as well as the amount of funding available. In Ohio, research funding is available through federal agencies such as the National Institutes of Health and the National Science Foundation. The U.S. Small Business Administration provides both loans and grants through its Small Business Innovation Research (SBIR) program. The Ohio Third Frontier program offers similar support for new start-ups at the state level. Seed funding is available from a variety of sources including CWRU and the Cleveland Clinic, business angels, as well as federal and state agencies. Venture capital is available primarily from VC firms in other U.S. regions but also from local VC firms.

The availability of funding was about 10 times larger in Northeast Ohio than in the Swedish EEs. For example, during the Valley of Death (when firms have the greatest difficulty acquiring funding after the initial stages of development), funding ranged from ca 2M EUR to 20M EUR in the US region, and from 200.000 EUR to 1M EUR in the Swedish regions. Some Ohio firms were able to acquire ca 30-45M EUR during later stages of their development regionally. Even more capital can be sourced from other more VC intensive parts of the US like New York and Boston.

In Sweden, by contrast, most funding for entrepreneurial activity in the life sciences comes from national public agencies and is oriented toward physical infrastructure like labs and buildings rather than more risky investments in individuals and firms.

All regions in Sweden experienced funding as deficient and suffered from a lack of international investments. Public funding, covering initial steps in seed funding, from e.g. Almi and Vinnova was seen as signaling legitimacy but was seen as risk averse. Most funding options come from business angels that are accessed through private networks, and from small stock markets like Spotlight and First North that are perceived as highly risky. Stockholm has more funding actors than other EEs in Sweden, both public and private. There are also a few strong international investors like the Alzheimer's Association and the Bill and Melina Gates Foundation. Bengt Ågerup, a famous LS entrepreneur was mentioned as one key source of investments and knowledge. He has invested in firms in Uppsala, Gothenburg

and Stockholm but not in Lund which is geographically more distant from the capital. Some LS firms have established subsidiaries abroad to apply for international funds which seemed to be easier than at home. Lund has many consultant and service firms that have grown organically; there are also many small product firms in the pre-clinical trial phase that do not yet require large VC investments. Several firms complained about the heavy burden of reporting and drip-feeding of available seed capital in the region. Business angels from personal networks and local serial entrepreneurs are more concentrated in the Stockholm EE and were key to the success of some product firms. Due to lack of personal networks, funding is not readily available to entrepreneurs, especially foreign ones.

Global links

The role of international links is stronger for the Swedish EEs than for Northeast Ohio, but Northeast Ohio LS firms have direct access to a large national market. Global research links are common for firms in Sweden but less so when it comes to market relationships. The support infrastructures in Uppsala and Stockholm have played a role in helping LS firms to develop global links. The non-entrepreneurial attitude and national focus of the support infrastructure tend to hold firms back in Gothenburg and Lund.

All EEs in Sweden have strong global research links, especially in product firms. When it comes to international connections with customers, Stockholm and Uppsala are in the lead. In those EEs, customers are almost exclusively global, also for service firms (Contract Research Organizations - CROs). Collaborations with global customers are used as learning mechanisms on how to further develop products. Science Parks are taking part in international networks to support Swedish firms that want to go abroad and give them a "soft landing". However, across all regions there is a tendency of entrepreneurs-researchers that are still working on the technology to prefer selling to the national market. The issue seems to be the lack in confidence and knowledge about international markets and how to navigate them. On the other hand, successful firms also complain that they had difficulty selling their innovations in Sweden.

Firms do need to focus on their direct survival but those that are not having any international strategies from the start are missing out on developing their capabilities further. Missing out to acquire knowledge about the variety of potential applications for their technology and hence can be at lower stages of development than the 'born-globals'. Born-globals are also

receiving larger investments. Service firms in Lund have few international customer connections and focus instead on catering to local product firms. By building a consortium together, however, they have been able to attract larger international clients.

Institutions

One key difference between Sweden and the US is that the invention belongs to the organization (e.g. university and hospital) where it was originated in US, and to the inventor in Sweden. This makes its registration and commercialization in Sweden person-dependent from the start and less available for others to use. Another key difference is the entrepreneurial culture. In Northeast Ohio, it is highly dynamic and largely focused on growth. In Sweden, the entrepreneurial culture varies greatly between EEs, with a large impact of dominant large firms. Pharmacia instilled an experimental, informal and collaborative culture in Uppsala and Stockholm, while this is less so in Gothenburg and Lund, due to AZ's more secretive approach to research.

Registered patents are key in LS for making collaborations possible and to signal legitimacy. In Sweden, by law, IP rights belong to the inventor. This implies that organizations in the EE cannot take control of the IP and they need to provide support that inventors can trust and use. A large part of the EE is, hence, entrepreneur-dependent and relies on the interest and resources of researchers to register patents. A hurdle that was mentioned by firms both in the US and in Sweden was obtaining regulatory approval for their products. It has become stricter and harder for small firms to manage that which requires better entrepreneurial and regulatory experience in the management team.

Informal institutions like the experimental culture of entrepreneurs in Sweden have been strongly impacted by the culture of the two global firms Pharmacia and AZ. The firms dominated different regions and followed different strategies when it comes to openness to experimentation, informal trust and network density among the EE actors. In Uppsala and Stockholm, Pharmacia had instilled a highly collaborative and networked way of working where informal connections could be used for establishing new collaborations or hiring new employees. A spin-off culture with resource support from Pharmacia was also a positive outcome. This effect is more pronounced in the smaller EE of Uppsala. Stockholm also hosts AZ. AZ was known for a closed and protective attitude towards other actors in the EE, with very few spin-offs as the result. AZ has been dominant in Lund where, in fact, the culture has

become more collaborative after the site of AZ closed down in 2011. AZ is still operating in Gothenburg and Stockholm but has changed its attitude in recent years. Hence, cultures in Lund and Gothenburg instilled in former employees are still displaying skepticism towards collaborations but this is changing.

Culture in Northeast Ohio is highly dynamic, open to networking, and shows a strong focus on growth. The university and hospitals dictate commercialization agreements for their spin-offs, and these are at times perceived to be too restrictive.

Role of Local/National Links

Northeast Ohio LS firms can use local funding resources. They can also collaborate with the mother research organizations as well as with customers outside the region. As soon as they require large VC investments and more skilled labor, relocation to another more resourceful region is sometimes seen as a necessity. Alternatively, researchers, management personnel, and other resources can be attracted from outside the region. Service firms in Uppsala and Lund mention that they could not have started in another region. By building local networks, firms have tried to mitigate the liability of smallness and address the non-collaborative environment in Lund and Gothenburg. In general, Swedish firms are reluctant to relocate and source as much as possible in the region, or they attract international resources through local/national conferences.

Local and national links play an important role for research, the start-up process and for markets of the service firms in Lund and Uppsala. Firms need to be well connected locally to the different actors in the EE but only to certain networks of other small firms that are not customers. In Lund, the Medicon Village Inhalation Consortium (MVIC) allows small firms to attract larger customers. Also in Gothenburg where local connections are weakly developed, some entrepreneurs have taken the initiative to organize networks for sourcing of knowledge and to help each other with customers. This is done to mitigate the general skepticism for collaborations among firms in the region. Stockholm has lots of local resources. Conferences are arranged in Sweden to attract global investors because Swedish firms don't seem to move themselves much. KI Science Park has arranged possibilities for visiting firms in their incubator.

Entrepreneurial Management

In the start-up phase, the main problem is typically to commercialize the intellectual property. In the life science industry, this requires approval by the relevant national or international agency. Such approval may be obtained after successful completion of three stages of clinical trials. Since each stage requires more participants than the previous one, the trials become increasingly expensive. The primary management task is to manage this process – recruiting participants and trial sites as well as securing the necessary funding. This involves networking, presentations at academic conferences, keeping abreast of developments in the field, keeping in touch with the regulatory agency, and drawing the attention of potential investors while also managing the business "at home." Few inventors are equipped to manage this on their own - but they may not have sufficient cash flow to hire the necessary manager. The larger the initial funding, the higher is the probability of a successful product launch. This is where LS firms in Northeast Ohio have an advantage over Swedish firms that typically have less initial funding. Being located in a large metropolitan area with a long history of LS entrepreneurship, they can recruit locally, but they can also go outside the region (such as Boston and New York). Local support agencies such as BioEnterprise, Jumpstart, Team NEO, and BioMotiv[2] are helpful in making business connections. Venture capitalists often provide similar connections. It is not uncommon for managers to split their time between NE Ohio and firms in other regions. LS startups also get support from technology transfer offices at CWRU or CCF who have full time employees to support the business side of new start-ups.

Swedish EEs lack regulatory and business knowledge in their firms, unless the entrepreneur (often also the researcher) is experienced and has strong networks to acquire resources and advice needed. In Gothenburg, firms were most critical of the lack of managerial knowledge in the EE. Business experience comes in through smart capital from business angels, like Bengt Ågerup in Uppsala/Stockholm/Gothenburg and Carl Borrebaeck in Lund. They actively mentor the firms they are investing in. But such LS savvy entrepreneurs and investors are few in Sweden. Interestingly, entrepreneurial management skills in LS, especially with an international dimension, are lacking in the support infrastructure. The technology transfer office and the investment company of Gothenburg University are not seen as very active: they

[2] *BioEnterprise* is a business formation, recruitment, and acceleration initiative designed to grow healthcare companies and commercialize bioscience technologies, *Jumpstart* is a partnership between public and private entities supporting growth of an entrepreneurial ecosystem and high-growth firms, *Team NEO* assists employers in attracting and retaining talent in the region, and *BioMotiv* is a mission-driven investment company with focus on medicine.

are criticized for owning 2/3 of the firm but not contributing to the leadership of the firm – silent owners. Technology transfer offices did not seem to have full time employees to fulfill this role. This was strongly pronounced in Gothenburg and somewhat in Lund. Letting entrepreneurship master students lead new LS companies was seen as a bad idea too, due their inexperience in both management and technology. Uppsala and Stockholm seemed to have slightly better access to local entrepreneurial mentors through incubators. In Lund, the business knowledge in the support organizations was not viewed as entrepreneurial and people were not rotating and gaining knowledge but were rather employed for decades and often lacking LS experience too.

Role of Hospitals

There are many hospitals and several hospital systems, both public and private, in Northeast Ohio. Health care in the region is dominated by two large private hospital systems, the Cleveland Clinic Foundation and University Hospitals of CWRU, each with multiple locations in the area. As already indicated, both UH and CCF act as primary sources of academic research and life science spin-offs while also serving as investors, lead customers for healthcare products, and places of clinical trials. These organizations are well connected regionally, nationally, and globally.

In Stockholm/Uppsala/Gothenburg firms are smaller in general than in Northeast Ohio. Hospitals are used for doing small scale tests. Large scale clinical trials are more often done at international hospitals in order to be in the right market and obtain the right regulations. In Lund, firms are too young to have developed products ready for clinical trials, and access to health care goes often through personal networks. Small firms are seen by hospitals as being too unstable to be considered as suppliers. In Gothenburg, the role of hospitals was at the lowest level. The main hospital was heavily criticized for poor management of resources and for not being interested in collaboration with small firms. Both in Gothenburg and in Stockholm EEs, large infrastructural investments that connect health care, universities, and firms are being planned.

In Table 2, we have summarized all previous findings for all five EEs in LS.

Table 2. Comparison of five EEs in LS in US and Sweden across nine dimensions

	LUND	GOTHENBURG	UPPSALA	STOCKHOLM	OHIO
University-industry links	**Increasing in the Science Park.** CSOs - weak, USOs - strong. Personal network based. Uni can't own IP.	**Weak to Increasing.** U-I links are weakly developed but are in transformation. Unis start to focus more on LS, large firms collaborate more.	**Strong.** Informal and highly trusted. Uppsala university is key.	**Strong. Networked.** Easy to collaborate with key people, world leading universities.	**Strong**. Uni owns and license out IP, commercialization of research is goal.
Role of Large firms	**Weak.** No U-I collaborations with AZ, no spin offs. closure and released resources had positive impact and MVSP. Large employer gone.	**Increasing.** Change from no collaboration to new large investments and knowledge sharing in EE by AZ.	**Strong.** Many spin-offs with supportive resources, informal links, easy labor movement.	**Strong. Many.** Large presence but often sales offices. Many spin-offs. Investments in infrastructure, employers. Largest LS business network (SwedenBio) started by 7 swedish large firms.	**Non.** Problem for scale up and accessing skills.
Support infrastructure TTOs, Sci Parks etc)	**Increasing.** Weakly connected, low LS knowledge, shallow support, high administrative burden, much better with MVSP but TTO is weak.	**Weak. Person specific success.** Inward looking, shallow entrepreneurial knowledge. Weak TTO, too much administration.	**Strong. Complementary.** Closely connected to Stockholm EE.	**Patchy. Many actors.** not complementary, confusing. Many national support organizations are Sthlm focused.	**Strongest. Networked.** Private and Public org. Co-location in a cluster. Strong focus on large funding and commercialization strategies. Strong TTO.
Funding	**Weak.** Firms too young for VC. Public - risk averse. BAs in personal networks and IPO are key.	**Weak/increasing.** Too few VCs. AZ invests directly. Lack of global investments. LS BA are key (Ågerup). Valley of death. Risky IPOs.	**Weak.** Few VCs. Large firms invested. Lack of global investments. LS BA are key (e.g. Ågerup).	**Weak (Best in Sweden).** Some international investors. Local LS BA are key (e.g. Ågerup). Valley of death. Risky IPOs.	**Strongest.** 10x swedish EE from regional and national government, Uni and the hospitals, networked actors**.**
Global links	**Strong research,** few for market.	**Strong research links** and few born-globals. Lack global market skills.	**Strong research and customer** links with service and product firms.	**Increasing.** Some born-globals. Lack global market skills. Sci Parks in international network.	**Weak.** First at late stages of development.
Institutions (entrepreneurial culture, policy) and IP	**Developing** protexctionist AZ culture with MVSP**.** Non-experimental culture in public support. Anti-employment culture. IP is key for collaboration and legitimacy.	**Changing.** Protectionist AZ culture opens up. Non-experimental culture in public support, focus on infrastructure.	**Open collaboartive culture.** IP is key for collaboration and legitimacy. Pharmacia's experimental culture stayed.	**Mixed level of openness.** Pharmacia's experimental culture stayed and AZ's closed culture is present too. Firms don't look for experimental collaborations. Policy focus on infrastructure and networking.	**Strong culture and government as large investor.** University and Hospitals own IP and focus on commercialization .

Local/National	**Strong local.** Key for start of service firms. Customers, resorces and collaborations.	**Developing local and national.** Firms oganize themselves into networks.	**Strong local.** Local network for research, customers and resources is key.	**Strong national** for research and resources, arranging conferences. Sci park push and has visiting firms from other regions. Small firms don't collaborate much.	**Strong national.** Research collaborations and customers are national. Most customers are in other regions however.
Entrepreneurial Management	**Weak.** Business and regulatory knowledge essential but not common in the team or support organizations.	**Weak** in firms and support org. Master students are bad CEOs. Phase dependent management skills needed.	**Weak.** 2/3 of the ownership is inactive fr TTO. Firms need more business experience. Researchers cant be CEOs too.	**Weak. in support org.** And in firms. Phase dependent management skills needed.	**Strong.** Employ skilled managers at start.
Role of Hospitals	**Low.** Firms too young. Access mostly through personal networks. As suppliers small firms are disadvantaged.	**Small scale**. **Strong with international hospitals.** Sahlgrenska does not work with SMEs. Hospital is heavily criticized for poor management or resources.	**Small scale.** Firms too young. Test beds at akademiska, also use Stockholm hospitals.	**Small scale. Strong with international** hospitals. As customer - too careful and slow in decisions.	**Very strong.** Source of most spin-offs. Strong Investments and managerial competence and technical support. Client and collaborator.

5. Conclusion

This paper has conducted a case study approach comparing five EEs in LS in two countries. We investigated national and regional factors in order to get a detailed understanding of factors impacting the evolution and nature of EEs in different territorial contexts. We combine the strengths of both comparative and qualitative approaches based on own data collection through interviews. The abductive approach produced nine dimensions in which the EEs were compared: University-Industry links, role of Large Firms, Entrepreneurial Support infrastructure, Funding, Global links, Institutions and IP, Local/National links, Entrepreneurial Management, and the role of Hospitals.

Our study shows how crucial it is to take a territorial perspective on EE that compare different regions, as EEs look differently in distinct geographical contexts. The key difference between the EEs was between Northeast Ohio on the one hand, and the Swedish regions on the other hand, reflecting the influence of the national dimension. There are large institutional differences between NE Ohio and Sweden that govern the networks and actions of different

actors. In NE Ohio, the involvement of regulatory agencies and the government at different levels is much stronger and the incentives for large actors are more entrepreneurial and growth-oriented than in Swedish EEs. The Hospitals and the Universities have drastically different roles. In NE Ohio, they are private entities that are active actors in regional economic development aligning actions of other actors. In Sweden, they are more detached from the growth strategy of the EEs and take more the role of a service supplier.
This is not to say that there were no differences between the Swedish EEs. On the contrary, the importance of regional factors had a large impact on how EEs in LS function and operate. The strongest differences across the Swedish regions were seen in how University-Industry links are shaped, what roles large firms play in EEs, how institutions like culture impact interaction patterns in EEs, the importance of different support infrastructures, and the specific involvement of hospitals in the EEs. Many of these dimensions are also interdependent. For instance, the local culture of openness or closeness to collaboration was impacted heavily by large dominant firms that resulted in weaker or stronger spin-offs in EEs. Also the level of development of firms in different EEs had consequences for how much hospitals played a role, and how much funding was needed by firms.

Less variation across Swedish EEs was found in the availability of funding, global and local links, and the entrepreneurial management. Public funding was perceived to be more risk adverse. Where funding was seen as deficient, EEs differed in how accessible private investors were. Being closer to Stockholm and its higher concentration of privately connected money and power did have positive impact on the availability of investments, also international investments. However, private networks run the risk to exclude new and not so well-connected entrepreneurs. Hence, there is a possibility for policy to address the lack of systemically accessible capital for firms during their seed and growth stages.
Global links were strong for research, while there seemed to be a lack of general confidence and knowledge about the international markets and how to navigate them. Born-globals tapped faster into the global value chains of the EEs and not only received larger amounts of national (business angels) and international funding (funding agencies abroad) but also developed unique capabilities (new applications for their products, fit to an international market) that could be attractive to further foreign direct investments (FDI) (e.g. Melinda and Gates Foundation). Policy could support new firms to take part in the global value chains to a larger extent and attract FDI at the same time.

High-growth firms have specific and strong connections to the actors in the EE of their origin. Hence, local links were key to the start-up process but in different ways in different EEs, and Swedish firms did not seem interested in relocating to other regions. In all Swedish regions, firms were lacking regulatory and business knowledge in their teams but also in the support organizations.

Support organizations should be better connected and be better at supplying the firms with entrepreneurial life science knowledge/skills suited for different stages of development and specific life science sectors. Business savvy full time employees should further rotate between private and public employment and have more understanding of international markets.

The overall conclusion is that there is more available funding, entrepreneurial managerial experience, and stronger networks and more structured links to hospitals (closer to customer needs) in Northeast Ohio than in Sweden. The role of government is also different: the government in Northeast Ohio acts as direct investor in firms, while the government in the Swedish EEs is active as investor in infrastructure and acts as a risk-adverse investor in firms. The Swedish EEs experienced big changes and followed distinct development patterns in LS, due to the way a few large firms acted historically, impacting the strength and nature of collaborations and flows of resources in the EEs. Weaker dimensions like entrepreneurial managerial experience and support infrastructure resulted in firms with high-quality innovations that grow slowly.

Comparing EEs turned out to shed light how EEs operate in different territorial contexts. However, it also raised some questions that need to be taken up in future research. First, there is a need to develop more understanding of how an EE makes international connections. What does it mean to internationalize, and what is required to make that happen in an EE. This has been studied extensively in the International Business literature (Oviatt and McDougall, 1994, 2005) but is still relatively unexplored in the EE literature. Second, this paper compared EEs in different territorial contexts and has highlighted the peculiarities of each EE. This needs to be supplemented by a multi-scalar approach that is more specific at what spatial scales the different dimensions (like funding) operate. This would also throw light on the national dimension that was only touched upon in this paper. There is a need to be more specific about differences between countries (like the US and Sweden) and how institutional and cultural dimensions at the national scale have their impact on entrepreneurship (Chowdhury et al. 2015; Dilli et al. 2018) and on how EEs function at the regional scale. Third, this study looked

at the Life Science sector where we found factors in the EEs specific to that sector. Hence, the EEs are not only region-specific but also sector-specific. The paper highlighted that different sub-sectors (Medtech, Pharmaceuticals and Biotech) within LSs use the factors differently. This calls for further studies that go into the specificity of sectors that might influence the nature and evolution of the EEs. This goes beyond EE research that "has remained largely industry agnostic" (Spigel and Harrison, 2018, p. 156) ignoring the sectoral dimension. Fourth, the paper lacks to some extent a dynamic perspective, because the way the different dimensions have an impact on EE might depend on the stage of development of the EE (Mack and Mayer 2016; Alvedalen and Boschma, 2017). This calls for a more systematic understanding of what are the important factors as EEs evolve over time.

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