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Resilience after a large firm's closure: the role of place leadership, local resources, and social capital in the transformation of an Entrepreneurial Ecosystem

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Resilience after a large firm's closure: the role of place leadership, local resources, and social capital in the transformation of an Entrepreneurial Ecosystem

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Abstract

Studies have argued for the pivotal role of large firms in Entrepreneurial Ecosystems (EE). The sudden closure of large firms can be expected to have a substantial negative impact on an EE. This paper investigates the resilience of an EE in the aftermath of a large firm exit in the Lund region. A qualitative case study shows how agency and resources turned the local EE into a dynamic center for Life Sciences. Factors that contributed to the resilience of the EE in Lund were entrepreneurial place leadership, local resources, and social capital. The study provides a framework to understand the transformation of an EE after a crisis.

Keywords: entrepreneurial ecosystem, resilience, place leadership, social capital, entrepreneurship, closure of large firm

JEL-codes:
L26 Entrepreneurship
M21 Business Economics
O33 Technological change: choices and consequences, diffusion processes

1 Introduction

The Entrepreneurial Ecosystem (EE) literature has increased our understanding of the role of the context in which entrepreneurs operate. What has attracted less attention in the EE literature is the role of large firms. Large firms are often perceived to boost a region by attracting skilled employees and entrepreneurs to the region, acting as educators for technological and managerial skills of human capital (Garvin, 1983; Agrawal and Cockburn, 2003; Klepper and Sleeper, 2005), providing global business opportunity for local firms, and acting as a source for spin-off firms (Neck et al. 2004; Mason and Brown, 2014). In the EE literature, large firms are praised for their ability to provide new technology, connect different ecosystems globally, and create supportive programs for R&D collaborations with local start-ups (Malecki, 2011; Feld, 2012; Stam and Spigel, 2017).

The EE literature has still much to gain in understanding the role of large firms when an EE is confronted with a closure of a large firm. A closure of a major firm is often regarded as a negative shock to an EE (Holm et al., 2017), leading to negative multiplier effects (Tomaney et al., 1999). It can also lead to the destruction of skills, and have negative impacts on the regional community (Hudson and Sadler, 1985; Tomaney et al., 1999). However, a closure of a large firm may also have positive outcomes, as it might spur new entrepreneurship and bring new dynamics to a region (Buenstorf and Fornahl, 2008; Alvedalen and Boschma, 2017). The capacity of an EE to respond to a shock and its ability to re-employ displaced workers can differ between regions, depending on their resources (Herzog Jr. and Schlottmann, 1995; Hill and Markusen, 2000; Boschma 2015a; Diodato and Weterings 2015). However, there is still little understanding of what makes an EE more or less resilient to such shocks, and what factors may be held responsible for that. While battling a crisis, an EE is also transforming. The EE literature has yet drawn little attention to the evolution and dynamics of an EE (Mack

and Mayer, 2016; Alvedalen and Boschma, 2017; Shwetzer et al., 2019). Can an EE be expected to absorb the shock due to a closure in a resilient way and turn it into something positive? If so, what factors in an EE can contribute to its resilience?

The main objective of this paper is to identify and examine factors that might enhance the resilience of an EE when confronted with a closure of a large multinational firm. We present an empirical study of an EE in the university city of Lund in Sweden. In 2011, the large pharmaceutical firm AZ shut down its research and development (R&D) activities in Lund, resulting in the unemployment of hundreds of highly skilled employees. During those turbulent times, regional and national media were discussing if the Lund region and its Life Science industry would ever be able to recover from this shock. However, the actual outcome in Lund turned out to be positive in several respects. The empirical findings of this study show that place leadership, local resources and social capital in the region contributed to the resilience of the Life Science sector in the EE of Lund.

The paper is structured as follows. First, we discuss the EE literature and connect it to other literatures on resilience, place leadership, resources and social capital, to develop a comprehensive framework for understanding the resilience of EE in times of crisis. Secondly, we introduce the empirical study of Lund and explain which data have been collected and used. As the aim of the study is to develop a framework for the resilience of an EE, we use an abductive method. This means we start from data to recognize some initial patterns, and then go on theorizing through an iteration process with the data, the findings and the existing literature. The final part of the study will present and discuss the main conclusions.

2 Theoretical background

2.1 Large firms and Entrepreneurial Ecosystem

Since 2010, the Entrepreneurial Ecosystem literature has experienced a boom in publications (Isenberg, 2011; Feld, 2012; World Economic Forum, 2013; Acs et al., 2014; Stam, 2015; Alvedalen and Boschma, 2017; Spigel, 2018). An EE can be defined as "*a set of interdependent actors and factors coordinated in such a way that they enable productive entrepreneurship within a particular territory* (Stam and Spigel, 2017, p. 1). This concept is about creating resilient economies (Spigel and Harrison 2018; Roundy et al., 2017) and developing a supportive environment for new firms.

Despite its popularity, the EE concept has also been criticized. According to Spigel and Harrison (2018), EE is still undertheorized: it should focus on the different configurations of the elements through which resources to the overall entrepreneurial process are provided and that could not otherwise be accessed. Furthermore, there has been a tendency to focus on the separate elements, giving less attention to connections between them and to properties at the ecosystem-level, such as resilience (Motoyama and Watkins, 2014; Roundy et al., 2017; Spigel, 2017). The EE framework lacks a discussion of the consequences of missing components and the potential for interchangeability (Acs et al., 2014) which concerns the role of large firms in general, and any shocks they may cause in particular (Mason and Brown, 2014). Moreover, factors impacting dynamics and change in the EE have not yet been fully described (Mack and Mayer, 2016; Alvedalen and Boschma, 2017; Shwetzer et al., 2019).

Mason and Brown (2014) suggested that the development of an EE starts with the region being attractive based on the presence of large firms with a strong technological base. Large firms can be important actors in EE for several reasons. They can act as a source of new

knowledge (Agrawal and Cockburn, 2003; Spigel and Harrison, 2018), a training environment for employees (Garvin, 1983; Agarwal et al. 2004; Klepper and Sleeper 2005), and a scaling-up mechanism for innovation when a large firm acquires small firms (Lindholm-Dahlstrand et al., 2019). Large firms can upgrade the managerial skills of local firms (Agrawal and Cockburn, 2003) and attract highly educated workforce and entrepreneurs to the EE (Huffman and Quigley, 2002; Mason and Brown, 2014). Furthermore, large firms can act as a source for spin-off firms (Neck et al., 2004; Klepper and Thompson, 2010; Huffman and Quigley, 2002). Spin-offs are key for the evolution of an EE because they renew and diversify the existing pool of knowledge and firms (Audretsch and Keilbach, 2004; Klepper and Thompson 2006; Boschma 2015b). Klepper and Thompson (2006) state that the more successful the large firm is, the higher the probability that it creates spin-offs that also perform better. Spin-off entrepreneurs also use the networks of their parents to connect to different EEs on an international scale and get access to global markets (Sternberg, 2007; Malecki, 2011).

A closure of a large firm may be a shock to a region and can lead to a steep decline of the local economy, at least in the short run, because it negatively impacts skills, competencies, and networks in a region (Hudson and Sadler, 1985; Herzog Jr. and Schlottmann, 1995; Tomaney et al., 1999). Knowledge and skills can be relocated or destroyed which can be very disruptive for a region, the spin-off process may come to an halt, and supportive local networks may fall apart. Having said that, scholars have also pointed out that specialized knowledge embodied in the displaced employees can suddenly be released and become available to other actors in the local system, which can instead lead to positive effects in the region (Holm et al., 2017; Almeida and Kogut, 1999; Song et al., 2003; Boschma et al., 2009; Hoetker and Agarwal, 2007; Malecki, 2010; Timmermans and Boschma, 2014). Moreover,

closure of a large firm may also spur new entrepreneurship and bring new economic dynamics to a region (Buenstorf and Fornahl, 2008; Boschma 2015a; Alvedalen and Boschma, 2017).

2.2 Resilience of an Entrepreneurial Ecosystem: place leadership, local resources, and social capital

The resilience literature explores how individuals, organizations and systems respond to shocks (Swanstrom et al., 2009). The so-called evolutionary perspective on regional resilience focuses on the long-term evolution of regions, and how regions try to respond and adapt to shocks (Garud et al., 2010; Simmie and Martin, 2010; Boschma 2015a). Some regions are highly resilient, while other regions are not, or only to a limited degree (Xiao et al. 2018). This evolutionary resilience literature explores which factors might be held responsible for that. In particular, they explore how local agents like economic and institutional entrepreneurs, and local resources and networks can make a difference (Boschma 2015a). Below, we discuss the role of place leadership, local resources and social capital.

2.2.1 Place leadership

Place leadership represents the institutional dimension of regional resilience and can play an important role in times of crises (Sotarauta and Beer, 2017). Place leadership literature offers important insights on how agency in terms of regional leaders and organizations contributes to the growth of regions and helps creating new growth paths (Halkier, 2013; Horlings and Padt, 2013; OECD, 2009). Regional leaders should be competent, influential and have strong leadership capabilities to impact key processes strategically (Horlings and Padt, 2013; Soebels et al., 2001). Place leadership coordinates actions and pools resources with vison-setting and consensus-building (Sotarauta and Beer, 2017). Governance processes connect different types

of actors and at different spatial scales (Morrison, 2007). Leaders lead beyond short-termism as they find solutions beyond the individual ambition and with a commitment to develop the region (Grillitsch and Sotarauta, 2019; Sotarauta and Beer, 2017). Place leadership is, hence, embedded in the social fabric of regions (Peters, 2012; Macneill & Steiner, 2010; Sotarauta, 2014). Place leadership is part of a holistic framework of transformative agency – the trinity of change agency that is at play in new path creation (Grillitsch and Sotarauta, 2019). The other two change agencies are Schumpeterian innovative entrepreneurship (source of path-breaking innovations) and institutional entrepreneurship (source of changes in institutions) (Grillitsch and Sotarauta, 2019). The role of agency is key to understand regional diversification and new path creation (Boschma 2017; Neffke et al. 2018).

2.2.2 Resources

Resources are a precondition for resilience. Resources can be defined as anything perceived by an individual to help attain a goal (Halbesleben et al., 2014). Resources embedded in the region can provide the basis for the actions of entrepreneurs, organizations and place leaders. As the supply of resources differs between regions, places also differ in terms of levels and intensity of entrepreneurial activity and the presence and quality of place leadership (Hidle and Normann, 2013; Blazek, et al. 2013; Stam, 2015).

Resources can be knowledge-based, skill-based and financial, and all will have an effect on the resilience of an EE when hit by a shock. Knowledge-based resources such as market and technological knowledge (e.g university research) can be especially important as they improve the firm's entrepreneurial ability, and increase new firm formation and performance (Wiklund and Shepherd, 2003; Deeds et al.,1997; Finkle, 1998; Bania et al., 1993). Skill-based resources are crucial as well. The local supply of skill-related resources is regarded as

an important shock absorber, as redundant workers may find more easily new employment in local activities that demand similar skills, and it will prevent high-skilled labor from leaving the region (Neffke and Henning 2013; Boschma 2015a; Diodato and Weterings 2015; Boschma 2017; Holm et al. 2017). Access to financial resources is also crucial, as it will affect how responsive an EE is to a crisis. The public sector might be a key actor, as private organizations like banks might be reluctant to invest in times of crisis (Boschma 2015a).

2.2.3 Social Capital

Social capital might also be a crucial input for the resilience of an EE. Putnam (1993) defined social capital as 'features of social organization, such as trust, norms, and networks' (p. 167). Social capital is not a resource as such, but it is a mechanism in the network that provides access to and activates resources supporting new firm formation (Aldrich and Martinez, 2001; Anderson et al., 2007). Coleman (1990) makes a distinction between human capital which is a resource residing in the individual/network node on the one hand, and social capital which represents the links between the individuals/network nodes on the other hand.

Social capital is considered highly important for entrepreneurship, especially for high-tech firms. Entrepreneurs are a product of the social environment (Anderson and Miller, 2002). According to Anderson et al. (2007), social capital impacts entrepreneurship in four ways: it provides connectivity, credibility, and access to market opportunity, as well as network links that give access to resources. Besides a positive effect on entrepreneurship, social capital can also have a negative impact on entrepreneurship (Liao and Welsch, 2003; Davidsson and Honig 2003), by excluding actors from certain information that are outside of the network (Westlund and Adam, 2010; Westlund and Bolton, 2003; De Vaan et al. 2019). The bright side of social capital is often associated with its bridging quality in which "structural holes"

connect unconnected nodes (Burt, 2000, 2005), while the dark side of social capital often refers to its bonding quality, with a focus on strong and repeated ties (Coleman, 1988).

3 Methodology

A case study approach is essential for understanding mechanisms of regional resilience (Yamamoto, 2011). It is appropriate for the collection of in-depth, hard to obtain data, the development of frameworks (Yin, 2009), and the investigation of a phenomenon in its specific context (Eisenhardt and Graebner, 2007). For the theory building, we use the abductive case study approach (Peirce 1931; Kirkeby 1994) which systematically combines, matches and iterates between theories and the empirical data (Dubois and Gadde, 2002). The process was to compare an inductively derived initial framework (Miles et al., 2014) with suitable theories in an iterative process, going back and forth between theory and the empirical material, with the purpose of developing a framework that provided a good explanation of the phenomenon under study (Alvesson and Sköldberg, 2017; Dubois and Gadde, 2002). For example, the way place leadership (Sotarauta and Beer, 2017) worked seemed to be unique, and therefore, theory on entrepreneurial leadership (McGrath & MacMillan, 2000) was added to improve the framework.

The choice of the interviewees was based on snowballing sampling, using referrals to the particularly knowledgeable sources (Faugier and Sargeant, 1997; Stake, 1995). The semi-structured interviews (lasting from 50 minutes to 2 hours) were conducted in 2016 and 2019 with two sets of respondents. One group concerned founders and top managers of small firms (Table 1) that started before and after the closure. The other group represented other stakeholders - key organizational actors (Table 2). According to David (2018), the primary actors during the closure were FIRS - Research and Innovation Council of Skåne region,

Lund University, Mats Paulsson Foundation, Region Skåne, and former Astra Zeneca employees, most of which were covered by the interviews.

As typical for a case study, several sources of data were used which is useful for triangulation and validation of the results (Yin, 2009). However, the main use of multiple data sources was to discover new dimensions of the phenomenon rather than to verify findings (Dubois and Gadde, 2002). The documents used were firms' websites and yearly reports, and policy reports of Astra Zeneca's closure in Lund and the development of the Science park produced by Statistics Sweden and the national funding agency Vinnova. Another important source was a personal account by the former minister of finance, Allan Larsson, who was one of the key people involved.

Code	Source of the start-up	Roots	Number of Founders	Main products/ services	Year registered	Employment 2015	Sales 2016 MSEK
L1	CSO/Independent	Astra Zeneca	3	Services pre clinical/Own RnD	2011	4	5
L2	CSO/Independent	Astra Zeneca	7	Services pre clinical/Own RnD	2011	13	19
L3	CSO/Independent	Astra Zeneca	8	Product - Substance and device	2013	3	18
L4	CSO	Astra Zeneca	1	Services pre clinical/Education	2013	2	2
L5	USO	Lund University	3	Product - Cancer therapy	2000	23	59

Table 1: Overview of the interviewed firms. CSO – corporate spin-off, USO – university spin-off.

Code	Type of Stakeholder	Relation to the case/role
L6	Regional government (Region Skåne)	Regional expert in Life Science investments
L7	CEO Medicon Village Science Park	Kerstin Jakobsson – part of FIRS
L8 (2 interviews)	Lund University	Per Eriksson - Vice-Chancellor at the time, (initiator of FIRS)
L9	Medicon Village Science Park	Middle Management
L10	Lund University/Entrepreneur	Carl Borrebaeck - Deputy vice-chancellor of innovation at the time, professor and Portfolio Entrepreneur – part of FIRS. Main designer of the vison for MV.
L11	Regional Council (Region Skåne)	Pia Kinhult – part of FIRS

Table 2: Overview of the interviewed stakeholders other than firms.

4 The empirical context of the study

Lund is a university-dominated city and is the epicenter for Life Science research in Skåne county, Sweden (Medicon Valley Alliance, 2020). Several global firms like Baxter (former Gambro with its first artificial kidney), Tetra Pak, Ericsson, Sony Mobile Communications and Axis Communication have head offices and strategic R&D activities in Lund. Since the 1900s, the region has developed around Lund University which now has about 40,000 students and 8,000 employees and is globally ranked as a top 100 university. Ideon Science Park and world-class research facilities such as MAX IV and EES (European Spallation Source) aspire to connect research, innovation, and entrepreneurship in a Triple Helix manner (Lund Municipality, 2019; Invest in Skåne, 2019a). Skåne University hospital is one of the leading hospitals in the country with 12,000 employees and affiliations to Lund University and to Malmö University (Skånes Universitetssjukhus, 2019). Skåne County has about 13% of Sweden's total population and is part of the Öresund region (ca 4 million inhabitants) that stretches to the Danish side and the greater Copenhagen area. The Öresund region accounts for 26% of Swedish and Danish combined GDP (Invest in Skåne, 2019b). The Medicon Valley Alliance is a member-based organization managed by both Danish and Swedish authorities creating networking possibilities for Life Science firms in the international region.

The Life Science (LS) industry is one of the most dynamic and skill-intensive industries, and therefore, a good candidate to study the dynamics of its EE. Global shifts in knowledge base from chemical to biological and the increasing role of technology have been driving the life science industry and large firms to take drastic measures to stay in leadership positions (Carlsson et al., 2016). One of the largest players in the Swedish Life Science industry for the

last half of the twentieth century has been Astra Zeneca (AZ). The firm concentrated its global R&D in fewer scientific areas and in fewer locations which led to closures of several sites in different countries, which had a strong impact on the EEs for Life Sciences in the affected regions (Carlsson et al., 2016). After being present in Lund since 1950, the AZ R&D center closed in 2011, letting go of ca 900 high-educated employees. Parts of the operations were moved to one of the global R&D centers in Mölndal in the Gothenburg area. As shown in Figure 1, about 8% of the former employees started new firms in Skåne, while 23% changed their employment to AZ in Gothenburg (Sandström et al., 2011). About 85% of the employees chose to stay living in Skåne, some of whom were commuting to Denmark or Gothenburg (Andersson and Axelsson, 2018).

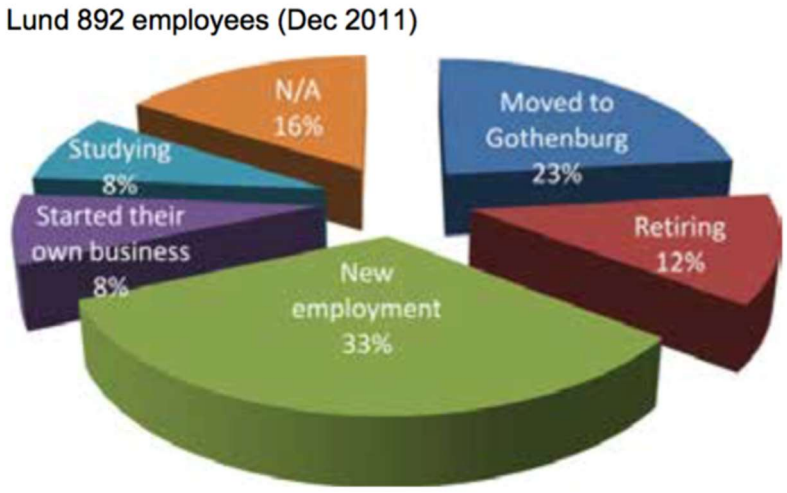

Figure 1. AZ's employees' employment status after closure (Sandström et al., 2011)

Former employment at AZ was greatly valued by the other actors in the EE as the large portion of the laid-off employees, mostly chemists and laboratory engineers, that stayed working in the same industry enjoyed higher average salaries than nationally. Those that chose to switch industry lost their advantage and had lower salaries (Andersson and Axelsson,

2018). AZ's closure was feared to become a "black hole" in the industry and was high on the agenda of Lund University and the Regional government (Larsson, 2019).

During many years, AZ had a good collaboration with Lund University concerning the employment of human capital AZ needed. Good collaborations had also been established with Region Skåne as responsible agent for regional health care, and with the municipality of Lund regarding the provision of infrastructure. These Triple Helix collaborations came to an end after the closure (Larsson, 2019). Interestingly, AZ had almost no research collaborations with local firms, and very few such collaborations existed with the university. Due to AZ's focus on in-house R&D, it only participated in a few courses, and it had some connections with selected scientists at Lund University.

What could have been a crisis in the EE of Lund following the closure was not. Scania region went from 16% of Sweden's total of Life Science employees in 2012 (VINNOVA, 2014) to 27% in 2016 (SwedenBio, 2020). A Science Park called Medicon Village (MV), with focus on the LS industry, was established in 2012. MV has since its inauguration developed and achieved most of its visionary plans. From the beginning of 2012 until the end of 2018, the whole facility has been rented out fully. New facilities were built, a new living area was under development, and new firms were started and developed according to the initial plan (Larsson, 2019). There are now 140 organizations and firms with one to 100 employees, giving employment to a total of 1,800 workers. This is almost double the number of people working in the facilities before the closure. Many of the new firms were spin-offs from the university or organizations at the MV. About 10 firms were started by former AZ employees. Around 20 firms have done IPO (Initial Public Offering), and firms have raised 3 billion SEK via new emissions since 2012. LU and Region Skåne are still the largest tenants, but SmiLe

Incubator hosts 20-30 firms and 80-100 workers. Firms move out of this incubator into the Science park after some years. There are 50 development firms (developing their products) where most have less than 10 employees with virtual organizations, acquiring competence on a contract basis. There are 70 service firms with knowledge from pre-clinical, clinical, business development to financing (Larsson, 2019; interviews). Other important knowledgeable tenants at MV are Regional Cancer Center South (Rcc Syd), the Palliative Development center, Region Skåne Biobank and CREATE Health – Cross-disciplinary cancer center where four faculties collaborate – medicine, technology, science, and social science**s.**

Closures of AZ facilities in other countries were not success stories like Lund. In Charnwood, UK, it was hard to find an actor that would use the facility for what it was built for and the result was a sale to a firm that was mostly interested in the land. Some buildings were used to create a Science Park, but only a few office spaces were rented out in 2018. Similarly, in Wilmington, Delaware, USA, the research activities in the region completely closed down or relocated. The AZ facilities were demolished and the land was sold for the construction of a hotel, housing and commercial facilities (Larsson, 2019).

5 Empirical findings

(i) Agency, policy and self-sustaining models

Vision-driven agency, acting on opportunities

It is clear from the data that the closure of AZ pushed the local actors to collaborate in a new way, with quick decisions at the highest possible level of power (David, 2018). More specifically, a few top-decision makers (governmental authorities and owners of private firms) have been instrumental for designing a vision, initiating and pushing the transition of the EE by recognizing the opportunity for a new type of Science Park after the closure and

accepting the risks. *"There were a few people in leading positions that dared to think in new ways and embrace changes, without them it would be very hard to make Medicon Village a reality"* - Carl Borrebaeck (the main architect of the vision). FIRS, a newly established coalition initiated by one of the leading actors, Per Eriksson – the vice-chancellor of Lund University at that time, was instructed to resolve the crisis situation and create something new. FIRS represented Lund University, Region Skåne, the Municipalities of Malmö and Lund, and the local business sector. It was the appropriate group of regional leaders that was capable to further develop and implement the vision for solving the crises by collaborating with many stakeholders at different levels. Besides the strategic leadership positions in the region, many members of FIRS also had previous or active and highly successful experiences in entrepreneurship and business development, not least in the Life Science industry. Per Eriksson made a point that it was important to engage local business leaders with long term commitment to the region. One of the key leaders who was essential for the funding of the vision, was a local philanthropic construction entrepreneur, Mats Paulsson. He was driven by a personal interest, due to the loss of one of his sons to cancer, and donated 100 MSEK in form of a trust fund. *"I like the concept with a center for cancer research, a science park and some smaller and larger firms. And I understand that you do not have a financier for buying the facility. I have decided and am ready to put in 100 million SEK of my own money into a trust fund which will have the mission to buy the AZ facility and to carry out the existing plan" – Mats Paulsson*, founder of PEAB (Larsson 2019, p. 228). Moreover, he was actively sharing his business knowledge and negotiating with AZ. Other financial actors (both private and public) were not able to invest due to high risks, or deficiency of financial resources.

To keep their brand in good light, AZ had an interest in finding the best possible solution for the region, rather than to maximize the profits by selling off the resources to the highest

bidder. No national monetary support was made available for the crisis, which also meant more freedom for decisions. The local knowledge of the involved actors made it possible to find a tailored solution for the EE during the crisis. FIRS had to work and adjust the solution during the process, like leaving initial ideas of buying and selling the AZ facilities for gaining value and embracing newly available resources like the philanthropic donation. *"We had to work with what was "on the table"… not having to follow national directives was key for a custom-made solution" – Pia Kinhult* (Regional Council). FIRS leaders were also taking political risks and followed their own beliefs taking decisions against votes in groups of advisors that were reporting to them. *"The leadership under me, deans, were against the solution with a majority of votes but I took the political risk to sign the contracts for Medicon Village following my conviction and my mandate. The decision was later supported by the University Board when they could have terminated my post if they disagreed" – Per Eriksson,* Vice-Chancellor Lund University.

Self-sustaining models for re-investments and expansion

To be successful, EE should be based on ideas of self-sustainability (Spigel and Harrison 2018). The solution for the crises was a new Medicon Village (MV) Science Park focused on LS, as an epicenter for the LS industry in the region. MV was growing organically with spin-offs and functioning fully free from governmental support, creating its own financial resources that were re-invested into research and developing the land in a business savvy way.

First, the combination of related scientific and entrepreneurial knowledge supported a fast spin-off process and growth of the Science Park. The solution to the crises was to acquire the AZ facility and land and create a world-leading LS center, MV, that would be able to support the "whole value chain" – from funding and facilities for the basic research to business

support and growth on one campus. More specifically, the vision was to combine the fragmented cancer research in Lund and Malmö region, the existing BioIncubator with a large portion of medical research and education, the innovation system of the LU (LUIS), and the existing small and medium firms in order to create a center for research and innovation that is unique in the whole of Scandinavia. *"What makes this center unique is the presence of world-leading research, firms in different stages of development, a wide innovation system and stable financing. New life-science firms get access to high-end laboratories and advanced equipment combined with the possibility to share critical pre-clinical and clinical knowledge. The goal is cost-effectiveness and high quality – success factors that today are hard to achieve for early development firms"* – Carl Borrebaeck, deputy vice-chancellor of innovation and the architect of the vision (Larsson, 2019, p. 214). MV was a response to the frustration over the fact that the development of a LS firm can take as long as 15 years. Spin-offs based on research, funded by profits from MV or from the university, and boosted by the support system of the MV, stayed in the Science Park. They were responsible for the expansion of the MV Science Park and keeping new knowledge in the EE. With time, new buildings have been built to support the growth. The founders of the AZ spin-off firms saw the creation of the new Science Park as an inspiration to start their firms and collaborate with each other. *"bring… companies together so you can draw on each other's ideas and you can really perform. I think that is one of the reasons why we dared to leave AZ, we saw this was happening" – Firm L1*

Second, the profit from the MV Science Park was reinvested back into its research and business/innovation activity. The solution was organized as a trust fund with three parties in a consortium/Triple Helix collaboration (Leydesdorff and Etzkowitz, 1996), with shared responsibility between Mats Paulsson Foundation, Region Skåne, and Lund University. The

latter two committed 20 MSEK per year for three years in rent payments as first tenants. ESS also moved into the facility and committed to paying rent. This is all different from a situation in which the revenue is kept by a private real estate firm that only rents out the facilities.

A third and not a least important part of this self-sustaining model was that the philanthropist Mats Paulsson is a professional land developer with a large construction company. His knowledge has a positive impact on the future maintenance and development of the land of the MV and increased the value of the Foundation, which in turn reinvested money back into the MV Science Park and its activities.

(ii) Role of local human, financial and physical resources

Unique human resources released from AZ into the EE

Specific knowledge that was developed at AZ, e.g. regulatory and concerning clinical trials, was transferred to the EE through new employments and through AZ spin-offs. *"He was working at Astra Zeneca so he started [working for the small firm] in 2010 and that was really good, the key I would say for the company"* – Firm L5. The AZ spin-off firms made strategically important services, that were inaccessible before the closure, available to other actors in the EE. The AZ spin-off firms describe themselves as being placed at the center of their customers' strategic development, as their SME customers did not possess the type of knowledge typically acquired at a large firm. *"[customers] often have very senior scientists, professors and doctors and they can be as senior as you like, but if you never developed a drug... it is just a different discipline and you don't know what is required and when and how to do it. So that's really what we do, we work with scientists in small companies transforming their ideas into development projects basically"* - Firm L1. Not only firms but also various

academic groups, even in other regions bought e.g. educational services from the AZ spin-off firms. Hence, the firms and the researchers in the EE got a boost of new knowledge due to the closure of AZ.

Possibilities for new combinations were brought up as one important aspect by the interviewees. Human capital that moved into the MV represented different research fields, like groups of inhalation researchers formerly employed at AZ and groups of cancer researchers from the university. Co-location of different and overlapping knowledge and combination of research that was going on at different parts of the university and the region (e.g. a design firm collaborating with former AZ employees to create a Medtech firm) could move into the MV that had the necessary infrastructure. Additionally, policy played a role in upgrading the knowledge of the released workforce by establishing a targeted pharmacist education at LU.

Unique financial and physical resources – Smart Capital, Severance pay and Specialty Labs

There were two types of financial resources that were mentioned to be particularly important for the resilience of the EE. First, the capital donated by the entrepreneur Mats Paulsson. The donation was a "smart capital" which came with knowledge essential for the negotiations during acquisitions of the facilities and the organization of the self-sustaining model of MV. Another financial resource was directed directly towards the entrepreneurs - the severance pay from the large firm. Most of the firms were service providers that started their business based on an one year severance pay from Astra Zeneca. This led to a stable cash flow which allowed the entrepreneurs to not have to invest their own money, while keeping 100% of the ownership. These firms reported the severance pay as one of the most important factors to start their firm. *"There are two things that … were crucial reasons, essential. One is that we had time after we left AZ where we were paid with full salary and the other thing was the*

formation of the MV and that it was started so quickly after the closure" – Firm L2.

When it comes to physical resources, interviewees valued the high-end facilities that were kept after AZ, based on a model for sharing labs and equipment. The former AZ employees felt also comfortable working in the same buildings and specialty labs they knew well, still seeing their former colleagues but in new roles. *"Having labs and being able to rent fit for purpose labs where we knew the equipment, because most of it was from AZ so we knew not only about what type of equipment but actually that particular machine" - Firm L2.*

(iii) Role of Social Capital

Access to different networks have been important to overcome the crisis in the EE. Firstly, regional leaders relied on their overlapping and personal networks in involving other stakeholders. One of the key reasons for establishing MV Science Park in the way it was done, was to ensure geographical proximity and connections between actors. Hence, the goal was stronger social capital through formal and informal links and shared resources. *"There are studies saying that researchers should not even sit on different floors in the building. Here everything is close…university, firms, hospital, you can walk"* – Carl Borrebaeck, initial designer of the vision. MV users grouped themselves into smaller focused networks according to e.g. technologies within the Science Park. It is not just the connections but what is unlocked through them that had strong value for the development of the EE.

Secondly, AZ spin-off firms reported that it was mainly through the networks established during their former employment that they got new customers, employees, collaborators and merging partners. *"It was during my time at AZ, [I've met] people from the whole industry…Globally, I have personal contacts at senior management level and we are invited to come and present what we have"* – Firm L3. *"Even at the places we have not been to ourselves, there is of course quite high likelihood that somebody works there now, who we*

have worked with in the past. That is really how we have seen all of our businesses come"- Firm L1. The strong brand of AZ and the growing brand of MV Science Park had also an important signaling effect to access certain people and resources. Local networks were key for small firms. *"It would not have worked to start the firm in Stockholm or Gothenburg because the network is here in Lund"* - Firm L4 (service firm).

There is, however, a difference between the service and the product firms. Local social capital is important to the service firms' because their primary market is local, but product firms need local social capital for the research and development of their core products. *"Most important stuff [research on the core product] happens here in Lund"* - Firm L5 (product firm). Global social capital plays a more important role for product firms when it comes to acquiring global customers and collaborations with international universities for publishing. *"We will not have Swedish clients"* - Firm L3 (product firm). Service firms rely less on their global social capital. Hence, local service firms provide services to the product firms that in their turn have global customers. This makes firms interdependent in the EE but also linked to important international knowledge and market contacts.

Networks from former employments of the founders' also helped firms find their start up team and their new employees as they often hired former AZ colleagues as firms grew. Some former AZ employees worked as consultant brokers in terms of using their vast regional networks to help existing firms in the region to find human capital with a certain skill set, claiming to be able to find the right person in their network up to 95%. Another way the informal links played a role in the development of the s-o firms was to gain access to the hospital across the road. There were few formal connections to the hospital for the small firms and personal trust and networks were important for accessing certain medical doctors. Moreover, social capital played role in the way small product firms accessed investments.

Because the funding was rather hard to obtain at a certain stage and there were few venture capital firms in the region, business angels were the popular source for funding and those people are most often reached through informal links.

Entrepreneurs have actively contributed to the transformation of EE by leveraging their former AZ links and forming Medicon Valley Inhalation Consortium (MVIC) one year after the closure of the anchor firm. The Consortium brought together expert firms that could take on larger global projects and gain more visibility in the industry. Because of the collaborative initiative, the starting environment for new firms was described as safer and encouraging and attracted firms from different parts of the region to Lund. *"I brought AZ firms together and they formed the MVIC and landed orders for totally 20 MSEK… There are 22 firms, many of them from AZ - whole development chain in inhalation products. MVIC can now negotiate with larger firms, this is really good"* - Firm L3. *"We saw the possibility with networks between different firms and scientists with everybody focusing on their own area"* - Firm L1.

6 Conclusion and Discussion

This paper has examined the effect of the closure of a major R&D center of Astra Zeneca in the Lund region on the resilience of its EE in Life Sciences. While closure of large firms can lead to a collapse of clusters and damage regional economies, this case study showed, instead, a remarkable resilience of the EE and overall positive outcomes. This begs the question which factors could be held responsible for this transformation of an EE.

The Entrepreneurial Ecosystem (EE) literature has yet paid little attention to the dynamics and evolution of EE, and their resilience in particular (Mason and Brown 2014; Alvedalen and Boschma 2017; Roundy 2017). Because the EE literature provided few clues, we borrowed

theoretical concepts from neighboring literatures, such as literature on regional resilience, place leadership (PL) and social capital. The case study showed that a particular type of PL is required for successfully handling a major closure - Entrepreneurial Place Leadership (EPL). Overall, the case study showed that three factors contributed to the successful transformation of the EE: (i) a new type of governance of EE in crises – Entrepreneurial Place Leadership (EPL), (ii) the role of related local resources, and (iii) social capital in terms of ties among place leaders and between former employees. Our study also showed that EPL, local resources and social capital are important parts that are closely intertwined. This study has resulted in a new framework on the resilience of an EE, as outlined in Figure 2.

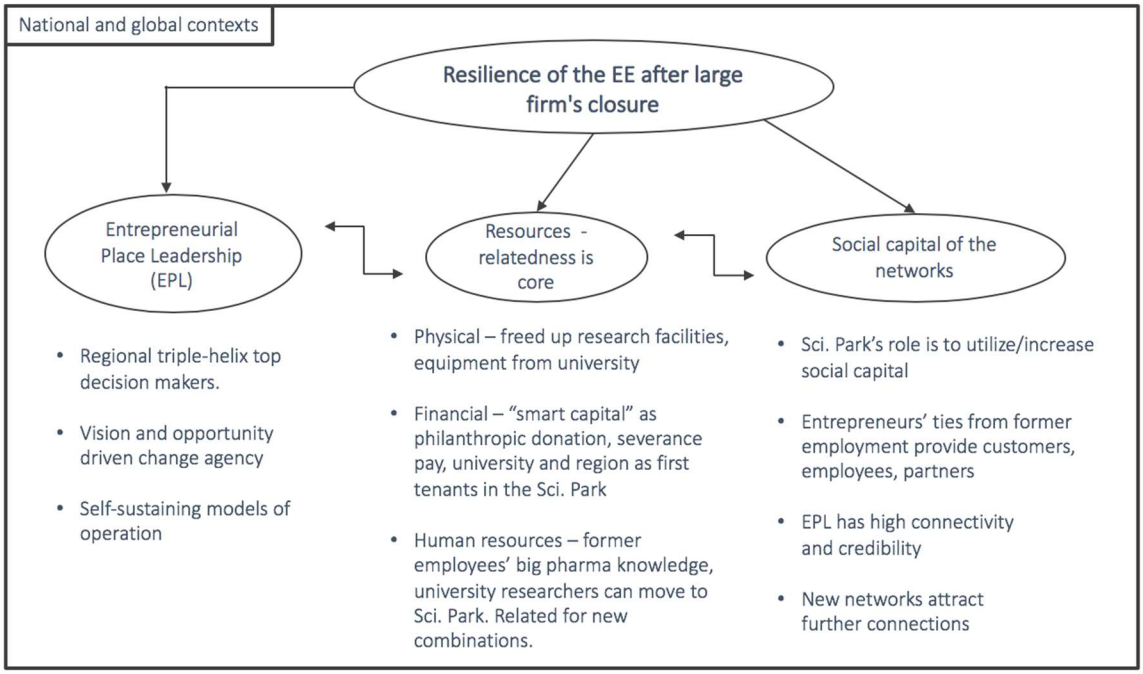

Figure 2. Framework of resilience of an EE in crisis

PL was evidently important and embedded in the social fabric of the region (Peters 2012; Macneill and Steiner, 2010). PL was represented by influential regional leaders that worked collaboratively through vison-setting and consensus-building (Soebels et al., 2001; Horlings

and Padt, 2013; Sotarauta and Beer, 2017). They acted as a driving force for designing, igniting and implementing the transformation of the EE. These leaders held top positions in academia or were influential life science entrepreneurs that gave legitimacy to the vision towards other stakeholders and in negotiations with the closing firm. Being entrepreneurs themselves, they represented Schumpeterian innovative entrepreneurship – one type of the trinity of change agency required for transformation in regions (Grillitsch and Sotarauta, 2019). The establishment of FIRS was key to bring the leaders together. Other key policy decisions were the allocation of activities of Lund University and Region Skåne to the new facilities, and to build a strategic responsibility for keeping collaboration for the future development of the MV and the EE.

Interestingly, in this case place leadership has also shown entrepreneurial aspects that are different to the traditional description of PL. First, the FIRS group had the ability not only to focus on the recovery and continuity of the EE, but also to see how newly available and existing undervalued resources created an opportunity for something new (Shane and Venkataraman, 2000). Second, the FIRS members acted like entrepreneurial leaders and achieved shared perception in a pragmatic way by expanding actors involved. These are examples of entrepreneurial leadership in firms that are often termed 'building commitment', 'defining gravity' and 'framing the challenge' (Gupta et al., 2004; McGrath & MacMillan, 2000). Working in the face of uncertainty required entrepreneurial leaders in a firm to "absorb uncertainty", as they take responsibility for the future insecure outcomes and "absorb" its paralyzing effect, allowing others to continue working with the vision (Gupta et al., 2004; McGrath & MacMillan, 2000). This was demonstrated in our case when actors took personal risks while following their conviction and acted as institutional entrepreneurs, which is another type of the trinity of change agency (Grillitsch and Sotarauta, 2019). During the process, FIRS had to rely on the knowledge, resources and networks as they appeared, instead

of following a defined plan. For example, they left behind dead-end opportunities, like buying and selling the AZ facilities to gain value, and embraced new means as they arose, like the philanthropic donation. These actions describe the entrepreneurial process of effectuation (Sarasvathy, 2001). The mutual interest in finding a beneficial solution for FIRS and AZ was another contributing aspect to the successful outcome (Holm et al., 2017).

A new and unique part of the EPL concerns the making of the EE as self-sustaining (Spigel, 2017) after the shock. The financial model of reinvesting the revenue back into research and entrepreneurial support, and local and international networking facilitated the creation of spin-offs and the organic growth of the EE. Moreover, the ability to increase the value of the land of the MV through the Mats Paulsson Foundation increased that revenue, making the well-being of the EE less reliant on governmental monetary support. Consequently, EPL here is defined as visionary and opportunity driven that focuses on self-sustaining mechanisms to support resilience in an EE. EPL has been instrumental in governing the EE in times of crisis. EPL is dependent on the institutions and types of resources available in a region, which leads to diverse types of PL and outcomes in different regions (Sotarauta and Beer 2017; David, 2018, Hidle and Normann 2013; Blazek et al., 2013). As actors may come and leave, collective EE memory and structures in place become important stabilizers (Bengtsson and Lind, 2004). There is a strong need to understand better why that seems to work in some place, and why not in other places. Comparing both cases of failures and success in EE would bring important new insights in the resilience of EE in times of crisis.

Local resources such as financial, human and physical resources are also considered important for the resilience of an EE. Our case showed that absence of national financial support did not hinder a positive outcome, and it even contributed to a tailor-made solution

organized at the regional level. Without doubt the Lund region was a resource-rich area, but it still required strong PL to mobilize and activate local financial and other resources.

Human resources played a key role because former AZ employees with unique training in big pharma became available to other actors in the EE after the closure. The local presence of skill-related activities made it easier to absorb the laid-off AZ personnel (Boschma 2015a, 2017; Holm et al. 2017). Hence, there was a window of opportunity for small firms in the EE to harness the knowledge and boost their development. Complementary research and skills were shared and combined through support organizations at MV, responding to technological and managerial needs of new high-tech ventures (Aldrich, 1999; Oakey, 2003).

The presence of local resources appeared to be crucial. In such a context, there is less need for major policy interventions to prevent a major closure. Strong local structures make it easier for entrepreneurial agency to succeed. But this potential also needs to be activated after a closure, like continuing commitment from the closing firm, and support to the local firms and organizations to use the released expertise. Other actions required are the provision of severance packages for firms, and the upgrading of skills of former employees with specifically designed education at the local university. This would help industry-specific human capital to stay in the region and limit its devaluation (Buenstorf, 2007b).

Access to social capital also proved to be important for resilience of EE (Boschma, 2015). Place leaders had high connectivity and credibility (Anderson et al., 2007; David, 2018). Close geographical proximity of the key actors, from researchers to hospital, contributed to the formation and exploitation of social capital in the Science park informally. This is in line with the entrepreneurship literature on the role of geographical proximity for high-tech firms and their strong reliance on the informal networks (Fukuyama, 1995).

New spin-off firms exploited network ties that had been created during their employment at AZ. These local networks enabled them to find new customers, employees, collaborators and merging partners (Harrison et al. 2004 ; Andersson et al., 2007). Furthermore, credibility of the AZ spin-offs supported access to new links due to the strong brand of AZ and the growing reputation of the MV Science Park where they held office. Similar to spin-offs in the IT sector (Buenstorf and Fornahl, 2008), entrepreneurs actively contributed to the transformation of the EE, by building on their former AZ bonds and the formation of Medicon Valley Inhalation Consortium (MVIC) among small firms. Geographical proximity facilitated the formation and working of networks but also made possible serendipitous connections through boundary spanners like support organizations and consultants (Burt, 2005).

The overall conclusion is that a closure of a large firm, when handled properly, can lead to a positive transformation of an EE, with long-term effects that outweigh the negative effects. The study on Lund showed that resilience of an EE depended on factors that are strongly interlinked and depend on each other. Without EPL, the positive transformation of the EE would not have started in the first place. However, it would not have continued if the local resources and social capital had not been in place and utilized. Future studies should examine other cases of resilience of EE and assess whether similar factors (and possibly other factors) made a difference. Comparing such cases in different contexts (like for other types of industries, other types of regions, other types of shocks, et cetera) would contribute to a better understanding of resilience of EE's, and the dynamics and evolution of EE more in general.

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