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Regional Dimensions of Venture Capital in Sweden

An appraisal of regional innovation systems, venture capital and regional development in selected Swedish regions

by

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Sweden consistently ranks among the most innovative economies in the world. Further, Sweden displays the highest venture capital per capita investments in Europe. From the literature, it can be derived that venture capital is regionally clustered, and that innovation in Sweden occurs in regional innovation systems. However, previous research provides no evidence concerning the relation between regional innovation and venture capital in Sweden. Thus, this study explores the regional dimensions of venture capital and its relation to regional development in Scania, West-Sweden, and Stockholm. By creating a theoretical framework, this thesis follows a mixed method approach to explore the regional dynamics of venture capital. The first approach explores the characteristics of venture capital flows in Sweden. The results indicate that more than half of all venture capital flows towards the regions this study is concerned with. Most venture capital deals are observed in innovative business sectors. The second approach qualitatively investigates salient development paths concerning regions and sectors that secure most venture capital funding. Path upgrading and path diversification were found to be salient development paths in all regions, which relates to findings from step one where venture capital was identified to flow towards pre-existing innovation systems. This study concludes that venture capital is highly regional and supports regional development. However, the field requires further attention from scholars to investigate the relation between venture capital and regional innovation systems and its developments empirically.

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Abbreviations

RIS: Regional Innovation System

NIS: National innovation system

1 Introduction

Europe has a problem, depending on whom one asks an abounding amount of problems. But if one asks scholars from the fields of “entrepreneurial finance” or “economics of innovation”, one common denominator will be the “equity gap” or “innovation gap”. The elemental principle here is the gap between the USA and Europe, either in terms of potential innovation that is missed because capital is not provided (Cumming & Groh, 2018a), or the actual difference in innovation activities between the latter (Grilli & Murtinu, 2014).

As the savvy reader may realize, this problem cannot, and is not generalized. In Europe, one can observe considerable regional differences both in innovation and capital allocation aimed towards innovation, i.e. venture capital. It is somewhat common knowledge that northern Europe is performing reasonably better than its southern or eastern parts (Özbolat & Harrap, 2018). Especially Sweden is drawing considerable attention concerning innovation capabilities. The country ranks amongst the most innovative countries in the world (Buchenholz, 2020) and is the innovation leader in Europe (European Commission & Directorate-General for Internal Market, 2019a). Sweden has the second-highest number of venture capital-backed tech-unicorns, i.e. highly innovative firms that provide radical new concepts like Spotify or Oatly (Cherowbrier, 2020a; Darnell & Weinberg, 2019). This is also reflected in the venture capital investments per capita in Sweden which have been, from the first to the third quarter of 2019, the third-highest in the world with $264,8 per capita. This is roughly four times the amount other European innovators like Germany and France allocate per capita (Cherowbrier, 2020b).

Knowing this, the reader is somewhat ambushed to jump to conclusions regarding innovation in Sweden and its relation to venture capital. One must heed the call of academia and investigate what evidence there is between the connection of innovation and venture capital in Sweden. To the best of the author's knowledge, there is no satisfactory explanation for this phenomenon.

However, there is a considerable body of literature on innovation and its complex nature. Scandinavian scholars have championed the field of innovation research by introducing concepts like the “National Innovation Systems” and “Regional Innovation System” (Asheim, 1998; Lundvall, 1992; Sharif, 2006). Both represent a concept, which, in a simplified way, can

be understood as a complex interplay between actors and institutions in a spatial dimension either nation or region (or sector) (Edquist, 2006). Regional innovation systems are of particular interest as they allow for a more in-depth perspective and do not generalize processes within a nation. In Sweden (and other Nordic countries) one finds "regionally networked innovation systems," i.e. policies promote innovation and give the systems a more structured approach on a regional level (Asheim, 1998). However, Doloreux and Gomez (2017) stress: "…the RIS literature is nearly silent on the conditions that enable growth to accrue in regions where innovation occurs, often assuming that the conditions conducive to innovation will automatically lead to growth" (Doloreux & Gomez, 2017).

One body of literature that is not "nearly silent" on the conditions that enable innovation is the one concerning venture capital. Numerous studies have investigated the impact of venture capital on innovation (Cherif & Gazdar, 2011; Dessí & Yin, 2012; Geronikolaou & Papachristou, 2012), and came to mixed conclusions if venture capital creates innovation or if venture capital is attracted by innovation. The majority of scholars agrees that venture capital fosters innovation both on the firm level and beyond the firm level (Cumming & Dai, 2012; Samila, 2012). However, this assumption needs to be taken with a grain of salt, as most studies have been carried out in the US, primarily focussing on Silicon Valley. The literature provides no clear evidence for venture capitals effect on innovation beyond the firm level in European regions. This is also due to the fact that most European studies so far have been concerned with the national level and usually used patents as an innovation indicator (Cumming & Dai, 2012; Engberg, Tingvall & Halvarsson, 2019; Silver, Berggren & Fili, 2016).

What one can observe at hand is that both bodies of literature fail to acknowledge each other. "Economics of Innovation" and its spatial research concerned with regional innovation fails to consider enabling factors like venture capital. And in turn, the academic discussion around venture capital seems to generalize innovation by heavily focussing on the US and patenting activities, but not regional innovation systems and its complex dimension.

1.1 Aim and scope

Considering the brief exploration of the literature, the disparity of the two bodies is evident. The aim of this thesis is ambiguous to a certain extent. One aim is to spark the academic discussion in both bodies of literature to acknowledge each other. Evident overlaps in the thematic debates can be observed but, to the best of the author's knowledge, no study including both thematic areas has been conducted in the context of Sweden. Secondly, this study aims to take a first step towards understanding the regional dimensions of venture capital in Sweden and its relationship to regional development in Sweden.

The scope of this study is dedicated to the analysis of Swedish regional innovation systems. Sweden has received considerable attention from scholars in the field "economics of innovation", with many prominent scholars in the field conducting research at Scandinavian universities. Specifically, the focus of the analysis here lies on Sweden's three largest metropolitan areas. Metropolitan areas tend to have advantages to form regional innovation systems and perform and foster the latter in a superior way (Grillitsch, Martin & Srholec, 2017). South-Sweden i.e. Scania has strong regional innovation (Asheim, Coenen & Henning, 2003; Martin & Martin, 2016; Martin & Moodysson, 2013), one may think of famous university spin-off from Lund like Bluetooth or Oatly. The second region of concern is West-Sweden, where Gothenburg is located, the region is famous for its industrial sector and hosts large manufacturers like Volvo (Asheim, Coenen & Henning, 2003; Fogelberg & Thorpenberg, 2012). Lastly, Sweden's capital region is included in the analysis. Stockholm is considered a world renown innovation hub (Koschatzky & Sternberg, 2000). Besides Stockholm, Uppsala is included, as the latter has often received attention in combination due to the close spatial proximity of the cities.

From the literature it can be derived that venture capital has impacts on innovation beyond the firm level and can influence regional development (Florida & Mellander, 2016), studies so far have been heavily concerned with the US but studies concerning Europe are flourishing (Cumming & Groh, 2018a; Engberg, Tingvall & Halvarsson, 2019). To the best of the author's knowledge the regional dimensions of venture capital in Sweden are substantially under-researched. Yearly publications by Tillväxtanalys (Swedish agency for growth policy analysis) in collaboration with the SVCA (Swedish Private Equity & Venture Capital Association) address the current state of venture capital in Sweden, with a focus on venture capital investments on a national level (Kroksgård, 2018; Tillväxtanalys, 2020).

As the analytical goal of this study is to investigate the regional innovation dimensions of venture capital and its development, a fruitful relationship with Tillväxtanalys was initiated. Tillväxtanalys and SVCA generously provided access to a database which contained 7652 distinct venture capital deals that can be connected to different regions in Sweden. This unique availability of data makes this study possible. In the following paragraphs, the research questions, the underlying motivation, as well as potential outcomes of the study, will be outlined.

As this study is exploring a novel field with mixed methods, two analytical steps are pursued to understand the regional dimensions of venture capital. First, this study concerns itself with the research question:

1. What regional characteristics can be observed concerning venture capital in Sweden?

This research question allows for exploration of the phenomena of venture capital in Sweden and the respective regions of scope, in a descriptive method. Hence, the flows of venture capital per region, over the course of 11 years (2007-2018), can be examined. Subsequently, dynamics of venture capital in the three regions can be explored. Similar approaches have been used in the literature frequently to understand regional proximity of venture capital, but heavily focussed on the US and (rarely) China (Cheng, Hua & Tan, 2019; Diez, 2016; Geronikolaou & Papachristou, 2012; Hirukawa & Ueda, 2011). Using descriptive statistics to understand capital investment streams that have yet to be explored is particularly useful as it can deliver insightful results that spark an academic discussion that will ultimately overcome the limitations of a mere master thesis.

The second approach aims towards understanding the relationship between venture capital and regional development of innovation systems.

2. What are the salient characteristics of regional development concerning regional innovation systems that attract the majority of venture capital?

This research questions allows for a qualitative second step, that is created based on the results of the first research approach. The advantage of applying mixed methods in this case is that, venture capital in Sweden is a not sufficiently explored domain, and thus a preceding second step of analysis allows for a deeper understanding of the results from research question one. A qualitative discourse analysis will be based on codes and nodes from proceeding results and

deliver insightful results concerning theoretical advancements made by scholars concerning the development of regional innovation.

1.2 Structure of study

The following thesis first provides a detailed record of previous research in both “economics of innovation” and the field of “venture capital”. Literature gaps and the scope of the study are taken into consideration and will acquaint the reader about what has been done in the field so far. Following the literature review, a theoretical framework inspired by several recent advancements in the literature will be introduced, helping the reader understand the methodological approach of this study. The following method section, will enhance understanding about the reasons for applying both quantitative and qualitative methods. The last two chapters will present the results, both descriptive and qualitative, followed by a discussion. In the conclusion, the results will be summarized and a need for further studies will be discussed.

2 Literature review

2.1 Innovation

"The fundamental question for innovation research is how innovations occur" (Fagerberg, 2006, p.6)

2.1.1 The emergence of innovation in academia

In the academic discussion, the term "innovation" correlates with numerous disciplines. In the successive sub-chapter, a short but comprehensive overview of the term innovation will enlighten the reader how the academic body around "economics of innovation" evolved and in what direction it developed in recent decades.

Before embarking on the subject, it is crucial for the reader to recognize the difference between "invention" and "innovation" when considering the academic discussion in the field "economics of innovation". In some sectoral areas like "biotechnology", invention and innovation are closely connected. However, innovation is commonly referred to as the first commercialisation of the invention. The invention, can be understood as the outcome of the innovation process (Fagerberg, 2006).

One scholar that embarked and set the foundation for the development of economics of innovation is Joseph Schumpeter. What he describes as the "creative response" i.e. entrepreneurs seizing opportunities in response to changing circumstances like crisis or changes in the market environment, can be understood as an early definition of "innovative activity" (Malerba & Orsenigo, 1995; Schumpeter, 1934). In his later work Schumpeter empathized the role of larger companies and research and development, rather than new entrants like entrepreneurs (Schumpeter, 1942). The development of his argumentation from creative response towards more complex innovation activities carried out by firms are commonly referred to as Schumpeter I and Schumpeter II (Fagerberg, 2006; Malerba & Orsenigo, 1995).

According to Fagerberg (2006), Schumpeter's work sparked the academic discussion around innovation, which was long treated as an arbitrary phenomena researcher in social sciences could only observe, yet not fully grasp. Schumpeter's (1947) idea of the "creative response" is still prominent in prevailing research. In the field of economic history his ideas have ascendant influence over innovation studies (Schumpeter, 1947; Taalbi, 2017).

Of particular interest are the developments in the academic body around "economics of innovation" since the mid-1980s until the mid-1990s. In these curious times Lundvall (1985, 1992), Nelson (1993) and Freeman (1988) made remarkable contributions to the literature of innovation by introducing the concepts "Innovations Systems" and later "National/Regional Innovation Systems". These scholars were and still are preeminent in the field of innovation studies. It remains unclear who came up first with the concepts as they give each other credit for the development (Lundvall, 1985, 1992; Nelson, 1993; Sharif, 2006).

After considering the latter, copious questions may strike the reader: What are Innovations Systems? And why is the concept relevant for this study? The following sub-chapters intent to acquaint the reader with the knowledge necessary to grasp the complexity of innovation systems.

2.1.2 Conceptualization of innovation

Anterior to the development of innovation systems concepts, innovation was often understood in terms of sectoral classifications. Pavitt (1984) introduced a taxonomy to distinguish between innovation in different economy sectors:

1. Supplier dominated sectors (textiles, services): innovation through diffusion of technological approaches and learning-by-doing
2. Scale intensive sectors (automobile): innovation in processes, internal R&D, advantages through innovation are gained by patents
3. Specialized suppliers (equipment producers): performance innovation
4. Science based sectors: high rate of process and product innovations, science is source of innovation.

Sectoral classifications focus on three main dimensions: knowledge and technological domains, actors, networks and institutions (Pavitt, 1984). This work was later revisited and refined by

other scholars who concluded that the taxonomy can be of useful guidance when trying to understand technological developments in different sectors (Marsili, 2001). A more bounteous way to differentiate between sectors is: high R&D intensive and low R&D intensive (Malerba, 2006).

Analogous to sectoral systems, the innovation systems approach introduced in section 2.1.1 also acknowledges the complexity of innovation and innovation processes. Especially the interplay between knowledge domains, actors, networks and institutions can be found in both approaches (Edquist, 2006; Malerba, 2006).

Innovations systems are to a certain extend an antithesis towards neo-liberal economics. In innovation systems the interplay between actors is considered a complex social phenomenon and stands in contrast to static modes of analysis. Innovation, be it the outcome or process of innovation is considered non-linear as innovation systems have multiple feedback streams, in which different components influence each other (Lundvall, 2007; Sharif, 2006).

The divaricate nature of innovation and innovation systems has proven to be a challenging task for academics. Despite common analogies of definitions, there is no general definition. However, one common understanding of the innovation systems approach is brought forward by Edquist (2006): innovation systems concern "all important economic, social, political, organizational, institutional and other factors that influence the development, diffusion and use of innovations" (Edquist, 2006).

Successive to his description of what innovation systems concern he presents several advantages and disadvantages of the approach. Advantages include, that innovation is not considered as exogenous, the interdisciplinarity of the approach allows for different perspectives, innovation not only influences the components of the system but also their inter-relations and the broad focus beyond technical innovations and an emphasizes on the role of institutions (Edquist, 2006). Apparent to the advantages some direct disadvantages arise: similarly to innovation systems, institutions are a concept without common definition, interpreted differently among scholars and in it fluid nature innovation systems are rather a conceptual framework than a defined theory (Edquist, 2006).

In innovation systems there is a need for differentiation between the function and activities; the general function of an innovation system is to engage in innovation processes that foster, develop and diffuse innovations. The activities are those components and factors that influence

the process of innovation. Activities include for example the financing of the innovation process to enable commercialization of innovation (Edquist, 2006).

Innovation systems occur in different dimensions: sectoral, e.g. different industry networks or spatial, e.g. global, national, or regional. Two streams in the literature have emerged roughly at same time in the early 1990s: National Innovation Systems (hereafter as NIS) and Regional Innovation Systems (hereafter as RIS). The spatial dynamic here is that the NIS approach considers innovation systems on the national level, whereas the regional perspective acknowledges different innovation systems within nations. Freeman (2002) stresses the importance of the NIS approach to understand historical innovations, as national boundaries were of crucial importance in the 19th and 20th century and determined which nations forged ahead of others through innovation capabilities. In the 21st century, the approach of national systems seems too broad considering developments observable in regions like Silicon Valley (Cooke, 2001; Freeman, 2002).

Considering the scope of this study, regional innovation systems are of particular interest. Early scholars coining the term found that several RIS can evolve within one NIS, thus both concepts are not contradictory, but closely connected. Evidence here was provided by Saxenian (1994), who investigated regional innovation in the US by comparing Silicon Valley and Massachusetts (Saxenian, 1994). Her landmark study was among the first to use the geographical dimensions within one country concerning innovation systems. Later work by Cooke (1997, 2001) found compelling evidence that especially with the "New Economy" i.e. the interconnectedness through communication. Regional innovation and tacit knowledge are crucial factors for understanding innovation, which was illustrated using the example of Baden-Württemberg a highly innovative "Bundesland" in the federalist system of Germany which outperforms other regional innovation systems with similar structures (Cooke, 2001; Cooke, Gomez Uranga & Etxebarria, 1997).

After considering the past paragraphs, the reader may grasp that innovation is a highly complex and diverse body of literature. The discussion who came up first with concepts like NIS and RIS is very diverse and somewhat of a chicken-egg debate. However, the reader should understand the basic idea of innovation systems: non-linear networks of actors and activities that perform innovative processes. Knowing this, the following chapter will dive deeper into regional innovation systems and enlighten the reader on the necessity to further study the latter.

2.2 Regional Innovation systems

„Geography is fundamental not incidental, to the innovation process itself: That one simply cannot, understand innovation properly if one does not appreciate the central role of spatial proximity and concentration in this process" (Asheim & Gertler, 2006)

Studies on regional innovation systems, date back several decades. Early work on decentralized economic set-ups has investigated differences between regional innovation system from Italy, the UK and Portugal to understand why some regions innovate and others do not (Cooke & Pires, 1985; Piore & Sabel, 1987).

One landmark study by Asheim (1998) gave the RIS concept more depth and created categories for regional innovation systems. The three categories are:

1. Territorial embedded regional innovation systems: a primarily local learning process for synthetic knowledge bases i.e. not highly innovative but rather the adaption and extension of existing knowledge. One example is the North of Italy with territorial clustered shoe production.
2. Regionally networked innovation systems: also, primarily regionally, but policies aim to support the RIS and give it a more structured approach. This RIS is often considered the ideal RIS and can be found in Germany or the Nordics.
3. Regionalized national innovation system: clusters of science-parks for high-tech R&D and analytical knowledge. Examples are France and Japan.

Additionally, another by then yet not concretized RIS was introduced (due to the back then pre-mature nature) the entrepreneurial RIS / New Economy RIS, which is commonly found in Anglo Saxon countries. One may think of Silicon Valley here. These RIS tend to focus on radical innovations and do not suffer from sectorial lock-ins, yet do not have the same level of long term sustainability as the other three regional innovation systems (Asheim, 1998; Asheim & Gertler, 2006).

In more recent studies scholars have applied the fundamental question of "what drives innovation" on a regional scale. One can differentiate between two streams in the literature that are conjointly present in the academic discussion concerning the NIS. One stream of scholars

focusses on the importance or organizations and actors within innovation systems, regional and national, (Acs & Sanders, 2013; Nelson, 1993; Pavitt, 1984; Qian, Acs & Stough, 2013). The other stream concerns itself with a holistic approach to innovation systems and argues for knowledge bases, the learning economy, firm interactions and path-dependency through creative responses (Grillitsch, Martin & Srholec, 2017; Lundvall, 2007, 2016; Taalbi, 2017).

Obviously, it would be too elementary to cut the body of literature in two, as scholars explore different phenomena within the regional innovation systems. In a recent study Grillitsch et al. (2017) explore the importance of knowledge bases for regional innovation. Knowledge bases can be highly regional; one may think about cultural activities and symbolic industries. These symbolic industries may be highly relevant in the region of Scania in Sweden, yet completely irrelevant in China. Concerning innovation, scientific knowledge is a main driver, the latter is connected to analytical knowledge bases. However, as innovation can differ between knowledge bases these assumptions have to be taken with a grain of salt. For example; synthetic industries innovate around their supply chains rather than introducing radically new ideas. Thus, in the latter innovating through process improvements is the innovation outcome. (Grillitsch, Martin & Srholec, 2017).

A general assumption in the literature is that the more knowledge-intensive an industry or innovation system is, the more it tends to be regionally clustered (Asheim & Gertler, 2006). Several reasons may lie behind this, on the one hand, tacit thus complex knowledge tends to be codified and difficult to transfer over large distances. Even in times of universally available communication through the internet, this tends to be the case. Another reason for the regional concentration of innovation is that organizations that are closely located tend to co-operate more and knowledge transfer spillovers occur. Knowledge is somewhat cumulative in regional innovation systems. Grillitsch (2017) presents the latter as “the central argument for regional innovation is that the spatial and functional integration of innovation activities generates positive effects for co-located firms” (Asheim & Gertler, 2006; Grillitsch, Martin & Srholec, 2017; Malerba, 2006).

As mentioned previously, another stream in the literature puts a substantial focus on the firm/entrepreneur in the regional innovation process. Asheim (1998) did, in fact, present the newly emerging entrepreneurial regional innovation system. However, he did not exclusively put the focus on the entrepreneur as the sole innovator.

Qian et al. (2013) stress the importance of the role of new firms and entrepreneurial activity as the core of a regional innovation system. They argue that non-linear interactions between entrepreneurs are the core driver of innovation and the creation of knowledge spill overs (Acs & Sanders, 2013; Qian, Acs & Stough, 2013). In fact, there are such entrepreneurial innovation systems; most notably Silicon Valley, which, through knowledge spillovers and co-location of entrepreneurs became maybe the most famous regional innovation system by producing companies such as Apple. In recent years, the discussion around the role of entrepreneurship as a driver for regional innovation and development has accelerated. Conceptual studies concerning "entrepreneurial ecosystems" or "regional systems of entrepreneurship", have devoted their purpose to investigate what is often missed in the RIS literature: the enabling factors like financial capital for entrepreneurial activities and drivers of innovation, i.e. entrepreneurs. This stream of literature lays substantial focus on the role of entrepreneurship of regional innovation systems and its development (Ács, Autio & Szerb, 2014; Audretsch & Belitski, 2017; Cooke, 2001; Galindo & Méndez, 2014; Lafuente, Szerb & Acs, 2016).

One major question scholars have devoted numerous studies towards is, how regional innovation systems develop and can be nurtured. Grillitsch et al. (2018) introduce numerous paths for RIS in a novel conceptual framework:

1. Path extension: innovation in firms which focus on the continuity of current industrial structures.
2. Path upgrading: e.g. new technologies that change the current production process
3. Path importation: a process of establishing industries that are novel to the region
4. Path branching: new industrial paths emerging out of existing ones
5. Path diversification; similar to path branching
6. Path creation: radical innovation creating new industries

These paths will, however, not only emerge naturally, they require supportive regional environments. Nurturing policies that are specifically designed for the particular characteristics of each regional innovation system are required for a sustainable development of RIS (Asheim & Coenen, 2005a; Grillitsch, Asheim & Trippl, 2018).

On a general note, it has to be addressed that regional innovation systems are not be confused with clusters. Clusters, i.e. densely concentrated industries or areas of business can emerge within regional innovation systems. This is one reason why the RIS approach somewhat outweighs the NIS approach. Regional innovation systems tend to occur in metropolitan areas

and have distinct advantages which cannot be generalized on a national level (Asheim & Coenen, 2005a; Grillitsch, Asheim & Trippl, 2018).

In the past paragraphs the reader has been presented with an overview on how innovation happens at a regional level. However, there are questions that remain. In the following section, a few considerable literature and research gaps will be addressed.

2.2.1 Gaps in the literature

One landmark study that reviewed the history of RIS research by Doloreux and Gomez (2017) stresses several gaps in the literature. Firstly, studies usually focus on a single already successful region. Thus, the transferability of those studies conducted is limited as each region brings different conditions to start with. Secondly, the general content of RIS studies is built around two major streams: organizations and how they interact with each other and the second stream concerning R&D and technological innovations. A third major gap in the literature is described as: "… the RIS literature is nearly silent on the conditions that enable growth to accrue in regions where innovation occurs, often assuming that the conditions conducive to innovation will automatically lead to growth."(Doloreux & Gomez, 2017). Other scholars have also acknowledged this gap with a specific focus on the interplay between financial enabling factors and entrepreneurial activity (Edquist, 2006; Malerba, 2006). In the literature, it is often assumed that innovation will just emerge, but the conditions that enable entrepreneurs or organizations to innovate like venture capital receive little to no attention in the field of regional innovation systems. How actors like venture capital funds or other general respond to existing regional innovation systems, and what opportunities are created through the latter is of particular interest. Studies that address these gaps have emerged in recent years. However, they have an increasing focus on Asia. One general pattern for regional innovation research is; it is almost exclusively qualitative in its nature (Cheng, Hua & Tan, 2019; Doloreux & Gomez, 2017).

2.2.2 Innovation in Sweden

In the following chapter, the reader will get a short but distinct overview of what is commonly perceived as natural, Swedish innovation performance.

Sweden was one of the first countries to recognize the connection between "innovation" and "systems of innovation". Through its governmental institution for innovation "VINNOVA" the country has not only given the concepts discussed in the previous paragraph legitimate status, but also acknowledge the importance of innovation for Sweden's development (Hall & Löfgren, 2017; Sharif, 2006).

In the literature, Sweden, not always solely but in context with other Nordic regions, has frequently been the topic of discussion in innovation research. Studies concerning the historical development of Sweden as a country (Taalbi, 2017) or studies concerning regional innovation in Sweden (Asheim & Coenen, 2005a; Asheim, Coenen & Henning, 2003; Asheim, 2019; Martin & Martin, 2016) have acknowledged the innovative capacity of Sweden both on a national and regional level. The ability to innovate is one of the main drivers that led to the development of Sweden being one of the poorest countries in Europe to becoming an innovation leader. This is not only echoed among the literate academics at Lund University but also acknowledged by the European Union.

According to the European Innovation Score Board, Sweden is the innovation leader of Europe. In the categorical analysis of the EU, Sweden scores very high in sectors like "Innovation-friendly environment", "Human Resources", "Attractive research systems" and "Intellectual Assets". Lower scores are only observed in sub-categories and include "venture capital expenditure" and "sales of new-to-market/firm innovations" (European Commission & Directorate-General for Internal Market, 2019a).

As this study is concerned with a regional scope, it has to be pointed out that in Sweden, regional innovation systems were acknowledged quite early, specifically the Region Stockholm/Uppsala (Cooke, 2001). In Sweden, similar to Germany and other Nordic countries, regional innovation takes place in "regionally networked innovation systems", as described previously, this is commonly regarded the "ideal type" of innovation systems (Asheim, 1998).

2.3 Venture capital

"Venture capital is reputed to be the most tailored financing mode the growth of high-tech entrepreneurial firms… (Grilli & Murtinu, 2014)"

In the following chapter, the reader will be provided with a brief description of the history of venture capital and its regional effects. It has to be noted that this is by no means a full review of all that is "out there" but rather a particular collection of literature that concern venture capital on a regional level and may lift some common assumptions the informed reader has about venture capital.

2.3.1 Venture capital

Venture capital is commonly known as an alternative way of investment in young start-ups/companies that tend to be active in highly innovative areas or are anticipated to produce radical innovations. Different from banks, venture capital firms usually invest in the latter, as the risk factor for them is somewhat part of the deal. In the US, venture capital is often considered one crucial factor of success for start-ups and offers potentially high returns. One may think about companies like Apple, Microsoft or Cisco, for whom venture capital was a crucial driver on their way to radical innovation (Cherif & Gazdar, 2011; Dessí & Yin, 2012; Geronikolaou & Papachristou, 2012).

Studies in the area of venture capital date back several decades and have produced mixed results concerning the relationship between venture capital and innovation. Scholars have different means of analysis and contrasting approaches towards venture capital and its impact. However, a common consensus is the impact of venture capital on the firm level. Several studies have found that venture capital investments can regularly be the crucial factor for a firm's ability to commercialize innovations (Engel & Keilbach, 2007; Hellmann & Puri, 2000; Pradhan et al., 2017). This relationship of VC to firms is repeatedly measured by using patents as a proxy for innovations, either as the number of patent applications or as patents granted. However, the literature stresses the difficulties in measuring the relationship between venture capital and innovation. If scholars measure one-way relationships, they tend to overinterpret biased results. This is due to the nature of venture capital and "success breeds success", firms that are already highly innovative tend to attract venture capitalists more than non-innovative firms.

Furthermore, technological shocks, like a radical new invention attract more venture capital in hindsight, thus after the innovation took place. The discussion in the literature is concerned with a bit of an "egg chicken" debate, and there is no evident collective agreement (Cherif & Gazdar, 2011; Dessí & Yin, 2012; Faria & Barbosa, 2014; Hirukawa & Ueda, 2011)

As this study is concerned with venture capital in regional innovation systems, the following sub-chapter will address what the literature has to say about the regional dimensions of venture capital and its dynamics beyond the firm level.

2.3.2 Venture capital and the regional impact

Studies concerning the regional impact and the spatial dimensions of venture capital date back several decades and came to partially mixed conclusions. Florida and Smith (1990) investigated regional structures of venture capital in the US and concluded that venture capital alone is not sufficient for high-tech development. In their previous work, they also stressed the fact that venture capital is regionally clustered in regions which are already innovative and are thus no singular driver of technological innovations (Florida & Kenney, 1988; Florida & Smith, 1990).

More recent studies have investigated regional dynamics of venture capital, and confirmed assumptions that venture capital operates (at least in the US) often in a "twenty-minute radius". Thus, the venture capitalist only invests if the firm is within a twenty-minute drive radius. This generalization has to be taken with a grain of salt. Nevertheless, several studies have found that regional venture capital tends to have impacts beyond the firm level and fosters regional development in dimensions of knowledge spillovers, employment and patenting. Young innovative firms tend to have positive effects on economic growth, and it is assumed that venture capital, through the firms they invested in, has a positive impact on the regions the start-up/firm is located in (Cumming & Dai, 2012; Samila, 2012).

Concerning the spread of venture capital among different regions, the literature commonly agrees that venture capital investments tend to be clustered in regions that seem promising for the venture capitalist, i.e. regions that already are innovative. Particularly regions that offer attractive baseline conditions for venture capitalists like a population with strong higher education backgrounds attract venture capitalist. In turn, these regions transform over time, where high numbers of venture capital investments are at large, entrepreneurs tend to relocate to those regions to increase their chances of receiving investments. Thus, venture capital is,

over time, also influencing the regional development. (Cumming & Dai, 2012; Florida & Mellander, 2016; Samila, 2012; Thompson, 1989).

However, there are considerable gaps in the literature that need to be addressed by future studies. The following sub-chapter will stress several gaps that will increase the understanding of the reader towards the purpose of this study.

2.3.3 Gaps in the literature

Until now, most studies concerning venture capital, both in general terms as well as regional dimensions of venture capital are conducted in the US, more particularly, in Silicon Valley. As these results are not universal, it is not possible to transfer these results to regions outside of the US. Furthermore, most studies consider the impact on the firm level, using patenting as a proxy for innovation. Thus, effects beyond the mere investment pose to be difficult to measure and are generally assumed to exist if investments were successful. (Cumming & Dai, 2012; Dessí & Yin, 2012; Hellmann & Puri, 2000; Park & LiPuma, 2020; Samila, 2012).

This gap in the literature reaches far beyond the mere academic spectrum. It receives increasing attention on a European level. It is commonly referred to as the "equity gap" or "innovation gap". Thus, the gap between potential innovation if capital is assigned accordingly and actual innovation (Cumming & Groh, 2018b; Grilli & Murtinu, 2014).

Scholars have started to address venture capital and its dimensions in Europe (Cherif & Gazdar, 2011; Engberg, Tingvall & Halvarsson, 2019; Faria & Barbosa, 2014; Silver, Berggren & Fili, 2016), but to the best of the authors' knowledge, regional innovation systems and venture capital are two bodies of literature that are yet to be combined. The lack of studies may be due to the fact that venture capital, thus a liberal approach to investments, is rather new in Europe and emerged in the past decades. Momentarily, venture capital is commonly considered a driver of innovation in Europe. However, generally assumed positive effects, are under-researched. Especially, factors that determine venture capital investments in the first place, like the innovation capacity of regions are in need of further investigation. Nevertheless, it can be expected that academia will rise up to this challenge considering that the EU pledged to support venture capital activities to stimulate innovation in the Union (Cumming & Groh, 2018b; Engberg, Tingvall & Halvarsson, 2019).

Geographical studies in combination with venture capital in Europe are needed to understand innovation from a different perspective. Recent evidence suggests that venture capital, through its investments, create realignment effects in regional innovation structures. Furthermore, enabling conditions in regions that determine where venture capital is invested, are heavily under researched in Europe (Florida & Mellander, 2016).

2.3.4 Setting the stage VC in Sweden

In Sweden, venture capital has a mixed history. Analogous to most other nation the concept of risky investments in young high-tech companies saw an upsurge during the dotcom boom. With the crash of the dotcom bubble, venture capital plummeted, and recovered until the next crash, the financial crisis. However, in recent years, Swedish venture capital activities have propelled and on a national level investments in ICT, life science and consumer goods seem to be drivers of venture capital investments (Silver, Berggren & Fili, 2016; Söderblom, 2012; Tillväxtanalys, 2020).

Concerning the previous literature chapter, the following chapter aims to create a theoretical framework based on recent advancements in the literature. The theoretical framework will set the boundaries for the succeeding analysis and potentially spark an academic discussion that concerns both bodies of literature.

3 Theoretical framework

"in theory, there is no difference between theory and practise. In practice, there is" (Yogi Berra)

In the following chapter, the reader will be presented with a conceptual framework that was inspired by recent contributions in the academic bodies. As the quote indicates, the conceptual framework has to be considered conscientiously. It is safe to assume that the regional dynamics of innovation and the interplay between its influencing factors is far too complex to be understood in one mere theoretical advance. However, the framework can deliver insightful results that help to understand regional innovation from a different perspective, and hopefully spark a new academic discussion concerning both venture capital and regional innovation systems.

To understand innovation, one must consider regional innovation systems. Knowledge bases and strong innovation systems tend to foster more innovation, and organizations within strong regional innovation systems create knowledge spill overs. There is also common agreement that strong regional innovation systems tend to be located in regions with a robust economic foundation (Acs & Sanders, 2013; Asheim, 1998; Doloreux & Gomez, 2017; Grillitsch, Martin & Srholec, 2017; Nelson, 1993).

In figure 1 the reader can observe a conceptual framework that is based upon recent advancements made by Grillitsch et al. (2018). In their framework broader categories of regional development were refined into six development paths. These paths (see below for detailed description) define the mechanism for regional development, and are in their framework sorted into the categories: specialisation, related variety and unrelated variety. Specialization can be understood if a region for example focuses on a singular industry or business sector, innovation happens through extension of this sector. Related variety concerns development paths that occur through interactions between different business sectors that are built upon the same knowledge base, like regions that are heavily concerned with the automobile sector but also have suppliers located around the area. Thus, different industries or sectors draw upon the same knowledge base. Unrelated variety is concerned with innovation

through knowledge spill-overs between unrelated sectors. Further, they differ between geographical space and economic space for development paths. (Grillitsch, Asheim & Trippl, 2018) .

Concerning the regional development paths a RIS can follow, Grillitsch et al. (2018) propose the following six categories which shall be explained hereafter:

Path extension: Occurs when firms innovate internally and create for example new products, one may think about a car producer introducing a new model with higher security standards or similar innovations. Essentially path extension, represents the use of already existing knowledge to further the development of industrial structures.

Path upgrading: Can be understood as the development or leapfrogging towards a new direction for regional industries. Three sub-categories can trigger the latter: *1. renewal* by introducing new technologies or organizational changes. One may think about new production methods like robotic automation that make factory workers nearly obsolete, or the shift from fuel-based cars towards battery/hydro based automobiles. *2. Climbing GPNs*, when industries climb up the value chain, one example could be former microchip producers that now manufacture the whole laptop instead of only one piece of the puzzle. *3.* Niche Development, concerns the integration of symbolic knowledge in the industry, one may think about tourism in Scania, when the slogan "Swedish Riviera" is utilized (Ferren, 2007).

Path importation: Can be understood as the establishment of existing industries, which are however novel to the region. Practical examples could be the establishment of so called "Gigafactory's" by Northvolt in North Sweden and Tesla in Brandenburg, Germany. Both industries or factory concepts or not new. However, they haven't been existing in the particular region before and thus have been "imported" (Enkhardt, 2020; European Commision, 2020).

Path branching: Is concerned with similar development paths like the "related variety", business sectors and industries develop by building upon existing knowledge and apply this knowledge in new context. Grillitsch et al. (2018) give the example of Fischer a producer of skiing materials which applied its competencies in a new context, the aviation industry (Grillitsch, Asheim & Trippl, 2018).

Path diversification: Like path branching, existing knowledge is utilized to innovate. However, in combination with knowledge that is novel to the industry or firm. One example could be milk

producers that apply new production structures and produce plant-based milk instead of traditional milk.

Path creation: Is the most radical form of development, where new paths are created from "scratch" or "by accident". However, in practise, new paths often emerge in environments that offer supportive structures. Strong economies with different knowledge bases are more likely to produce new paths and industries. Furthermore, spin-offs from existing industries and universities that create knowledge tend to produce new paths in practise.

Turning back to figure 1, the proposed theoretical framework for this thesis has some divergences from the initial framework by Grillitsch et al. (2018). The categorical classifications of specialisation, related variety, and unrelated variety as well economic space are not included. The reasoning behind this is, that this thesis is not concerned with all industries as a whole, but rather with the ones receiving most venture capital, on a regional level i.e. the geographical space.

Additionally, the relationship between venture capital and regional innovation systems, and the development of the latter is rather unexplored in the context of Sweden and Europe in general. The literature provides some general assumptions that need to be considered:

1. To understand innovation, one must also consider venture capital; in the literature, the relationship between innovation and venture capital has been investigated by numerous scholars. With a heavy focus on patents as an innovation indicator, they came to mixed results, yet in general, there seems to be a positive relationship between innovation and venture capital. Further, the literature has consensus on the regional dimension of venture capital i.e. venture capital is flows towards specific innovative regions. (Cumming & Dai, 2012; Cumming & Groh, 2018a; Engel & Keilbach, 2007; Florida & Kenney, 1988)
2. Ones does not know how venture capital flows are influenced by regional innovation systems and regional development in Europe. As the academic body is profoundly concerned with the US (and more recently China), there is little known about what factors attract venture capital in regional innovation systems, or which development paths are supported by venture capital. The literature on regional innovation is heavily concerned with the development of the regions, however, tends to consider enabling factors like financial capital as "given" (Cheng, Hua & Tan, 2019; Cumming & Dai, 2012; Doloreux & Gomez, 2017; Grillitsch, Asheim & Trippl, 2018).

Concerning venture capital in the proposed framework, the latter is treated as a supporting factor that can foster path development for regional innovation systems. As little is known about venture capital and its relation to regional innovation systems, the framework needs to be considered rather a "well informed assumption" than static fact. Until now it is unknown if venture capital in Sweden supports only supports developments directions like path creation i.e. radical new ideas, like it is hearsay from Silicon Valley where venture capitalists are considered drivers of radical innovation. Or if it also supports path extension and path upgrading within existing industries like the ICT innovation system in Silicon Valley which has transformed considerably over the past decades (Cherif & Gazdar, 2011; Dessí & Yin, 2012; Geronikolaou & Papachristou, 2012).

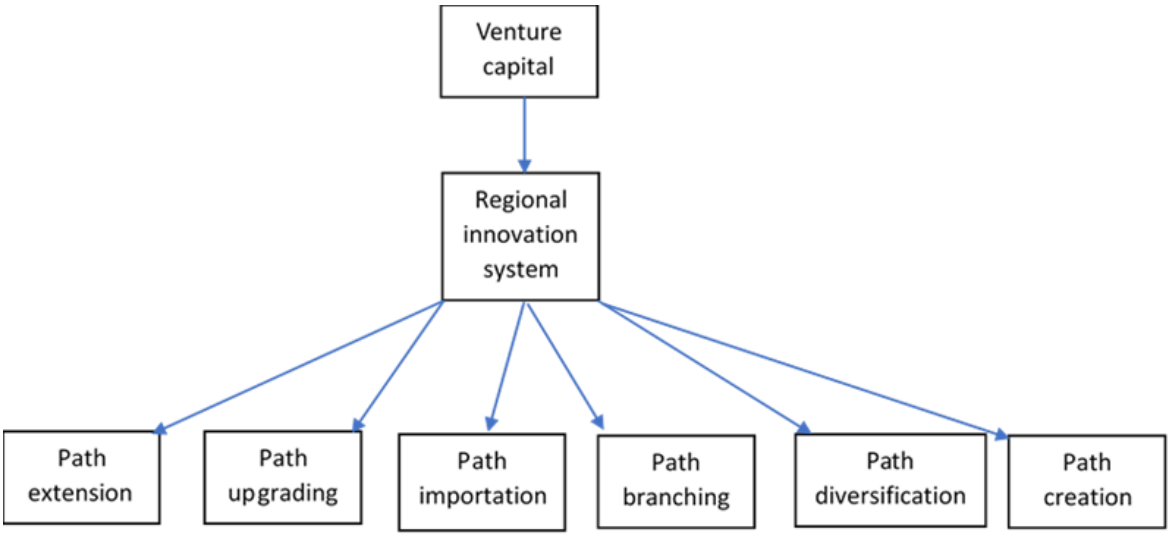

FIGURE 1 THEORETICAL FRAMEWORK

Concerning the theoretical assumptions of this framework, it is assumed that venture capital in a regional context, flows towards different business sectors or innovation systems. As these innovation systems or sectors, in theory, develop, it can be assumed that depending on the amount of venture capital, the latter plays some role in the regional development. So far it is unknown if venture capital in Sweden only provides support for regional development through certain development paths, all development paths or none at all.

Drawing upon practical examples from the US, the literature indicates that venture capitalists identify innovative regions, and invest in already innovative organizations and actors, thus

support the development of regional innovation (Cumming & Dai, 2012). In Silicon Valley, one may argue that path creation has taken place several times. However, most of the regional development and innovations fall into the related variety i.e. innovation occurs through the combination of related knowledge bases. One may think about Airbnb that combined existing knowledge about online platforms and tourism and branched a new path. Thus, in the US, in practise venture capital tends to flow towards already existing knowledge bases rather than creating radical new ones from scratch through path creation and importation.

As the theoretical framework of this thesis dictates the analytical approach that shall follow in later chapters, figure 2 delivers insightful information on how the analysis of regional development of innovation systems and venture capital in Sweden will take place. In a first step, the relationship between venture capital and the regional innovation system will be explored. This step will then offer insightful information for step two, where the development of the regional innovation systems will be investigated in more depth.

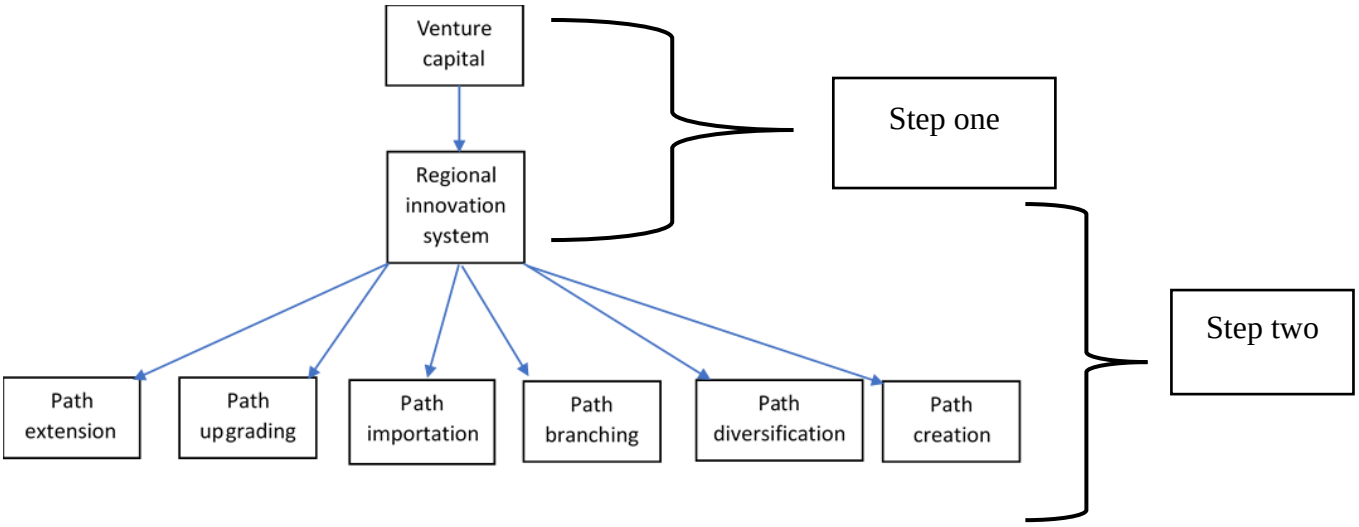

FIGURE 2 THEORETICAL FRAMEWORK; ANALYTICAL STEPS

This chapter introduced a simplified conceptual framework based on advancements by Grillitsch et al. (2018). Essentially it is designed to gain an initial understanding of where venture capital in Sweden flows, and what regional development paths in Sweden it supports. The two-step analytical approach will be presented in the following methodology chapter.

4 Methods

"Methodology is intuition reconstructed in tranquillity" Paul Lazarsfeld

The following chapter will give a detailed overview of the methods applied to help to understand the regional dimensions of venture capital, and to examine the development paths and its salient characteristics in relation to venture capital.

The approach will likely cause some controversy, depending on whom one asks. What is the right method for two fields that have a very different modus operandi? One the one side there is "economics of innovation" which is famous for its sophisticated application of qualitative measures (Asheim & Coenen, 2005a; Martin & Martin, 2016; Martin & Moodysson, 2011) and on the other side there is the field of "venture capital" that is quite naturally concerned with quantitative studies (Cumming & Dai, 2012; Florida & Kenney, 1988; Florida & Mellander, 2016; Geronikolaou & Papachristou, 2012; Samila, 2012).

As the readers are likely to be savvy researchers, they may suggest applying a mix of both methods. Hence, in the following section a methodological approach that aims to align with the two steps of the theoretical framework shall be presented.

Inspiration is drawn from scholars in the field of "economics of innovation" (Diez, 2016; Grillitsch, Martin & Srholec, 2017; Martin & Moodysson, 2011; Martin & Trippl, 2017) that apply descriptive statistics as a step towards understanding the foundations of regional innovation systems. Also among "venture capital" researchers, descriptive methods are quite prominent as they have proven to be insightful to understand the spatial dimensions of venture capital (Diez, 2016; Florida & Mellander, 2016; Silver, Berggren & Fili, 2016). A similar first approach will be followed and introduce descriptive results that concern both the regional innovation systems, as well as venture capital flows in the respective region.

In the second analytical step, qualitative methods will be applied based on research results from step one and the theoretical framework by Grillitsch et al. (2017). A directed content analysis will increase the understanding of salient characteristics of regional development in regions and sectors that have been identified in the previous step. By applying a content analysis and

respective coding, salient development paths can be identified and set into relation of venture capital flows both regional and sector wise.

4.1 Research questions

The two research questions concerning this study are:

1. What regional characteristics can be observed concerning venture capital in regional innovation systems in Sweden?

The first question concerns the general characteristics of venture capital in regional innovation systems in Sweden. By applying descriptive statistics, one will gain insights on the general development over time of venture capital in the respective regions. Concerning the theoretical framework that has been put forward in the previous chapter, the results of this research question will be particularly insightful. It allows for recognition of the flows of venture capital in different regions and if the capital is flowing towards sectors that are particularly important for the respective innovation system. This does not allow conclusions on the impact. However, it permits a general understanding of the structure of the theoretical framework and potential impacts.

2. What are the salient characteristics of regional development concerning regional innovation systems that attract the majority of venture capital?

This research questions allows for a qualitative second step, that is created based on the results of the first research approach. The advantage of applying mixed methods in this case is that, venture capital in Sweden is an not sufficiently explored domain, and thus a preceding second step of analysis allows for a deeper understanding of the results from research question one. A qualitative content analysis, will be based on codes and nodes from proceeding results and deliver insightful results concerning theoretical advancements made by scholars concerning the development of regional innovation.

4.2 General methodological consideration

In this study a mixed methods research approach will be applied. In economic research the combination of quantitative and qualitative data has been on the rise in several academic disciplines, amongst others the discipline concerned with the "economics of innovation". However, quantitative data is perceived by many as the gold standard of research. It is assumed that quantitative methods are more objective and representative than qualitative research, which is often connected with negative traits as being informal and subjective (Starr, 2014). Nevertheless, qualitative research has produced a considerable contribution to the study of innovation systems and is utilized by scholars in forms of interviews (Martin & Moodysson, 2011). Furthermore, both quantitative and qualitative research can carry flaws, an econometric analysis can be constructed subjective and biased and samples can be influenced by the researcher. Thus, a combination of both methods is in the case of this study deemed to be the most sufficient one as the unique availability of data and little previous research require qualitative explanations of quantitative results. For this study inspiration is drawn amongst others from Martin and Trippl (2017). The latter applied rigorous qualitative research, in combination with quantitative data on employment in sectors of interest for their study (Martin & Trippl, 2017).

As mixed method research opens an array of different combinations and research approaches in both qualitative and quantitative methods, in this study an "explanatory sequential mixed method" design will be applied. In sequential designs, research takes place in two stages where, in this case, a quantitative analysis precedes a qualitative analysis. It is particularly useful as the qualitative research will improve in terms of direction, as it is based upon findings from the quantitative analysis (Creswell, 2014, p.274). As the sequential mixed methods approach betides in two phase, researchers face several issues that are connected to this study design. As two research phases are carried out, time constraints can create issues for researchers and create boundaries in terms of which research approaches can be applied both quantitative and qualitative. Furthermore, researchers face the decision on which step to prioritize, in explanatory sequential designs usually the quantitative research step receives a higher priority than the qualitative research step, which is utilized for further understanding of quantitative results (Ivankova, Creswell & Stick, 2006). In figure 3, the theoretical method is illustrated. The mixing or merging of both methods takes place through the results of the quantitative

analysis, which will deliver direction for the qualitative analysis and the combined discussion of the results from both research approaches.

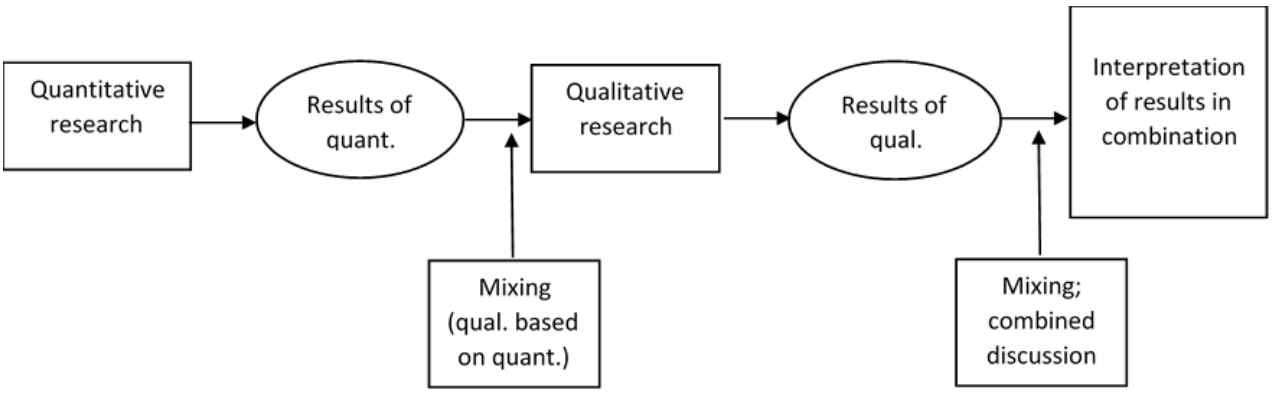

FIGURE 3 MIXED-METHOD APPROACH

4.3 Methodological application

Concerning the application of sequential mixed methods in this study, the process of analysis can be observed in figure 4. In this thesis, similar to the usual procedure in sequential explanatory methods, the priority lies upon the quantitative data. In the preceding qualitative section, the aim is to increase understanding and allow for contextual interpretation of the quantitative results i.e. the qualitative data is based on initial quantitative results and serves as a supportive function.

Inspiration is drawn from scholars in the field of "economics of innovation" (Diez, 2016; Grillitsch, Martin & Srholec, 2017; Martin & Moodysson, 2011; Martin & Trippl, 2017) that apply descriptive statistics as a step towards understanding the foundations of regional innovation systems. Also among "venture capital" researchers, descriptive methods are quite prominent as they have proven to be insightful to understand the spatial dimensions of venture capital (Diez, 2016; Florida & Mellander, 2016; Silver, Berggren & Fili, 2016). A similar first approach will be followed and introduce descriptive results that concern both the regional innovation systems, as well as venture capital flows in the respective region

The descriptive analysis will present results in four stages: in the first step, one will gain insight on the regional distribution of venture capital, by the amount of capital invested and the number of deals in Sweden. Further, sectoral distribution, i.e. what business sectors receive VC, yearly distribution, and the regional innovation indicators, will be presented. These illustrations will

help the reader understand the flows of venture capital in Sweden and the regions of interest: Scania, West-Sweden, and Stockholm/Uppsala. For each region, the same structure of presentation will be followed. This will allow for regional comparison concerning the flows of venture capital.

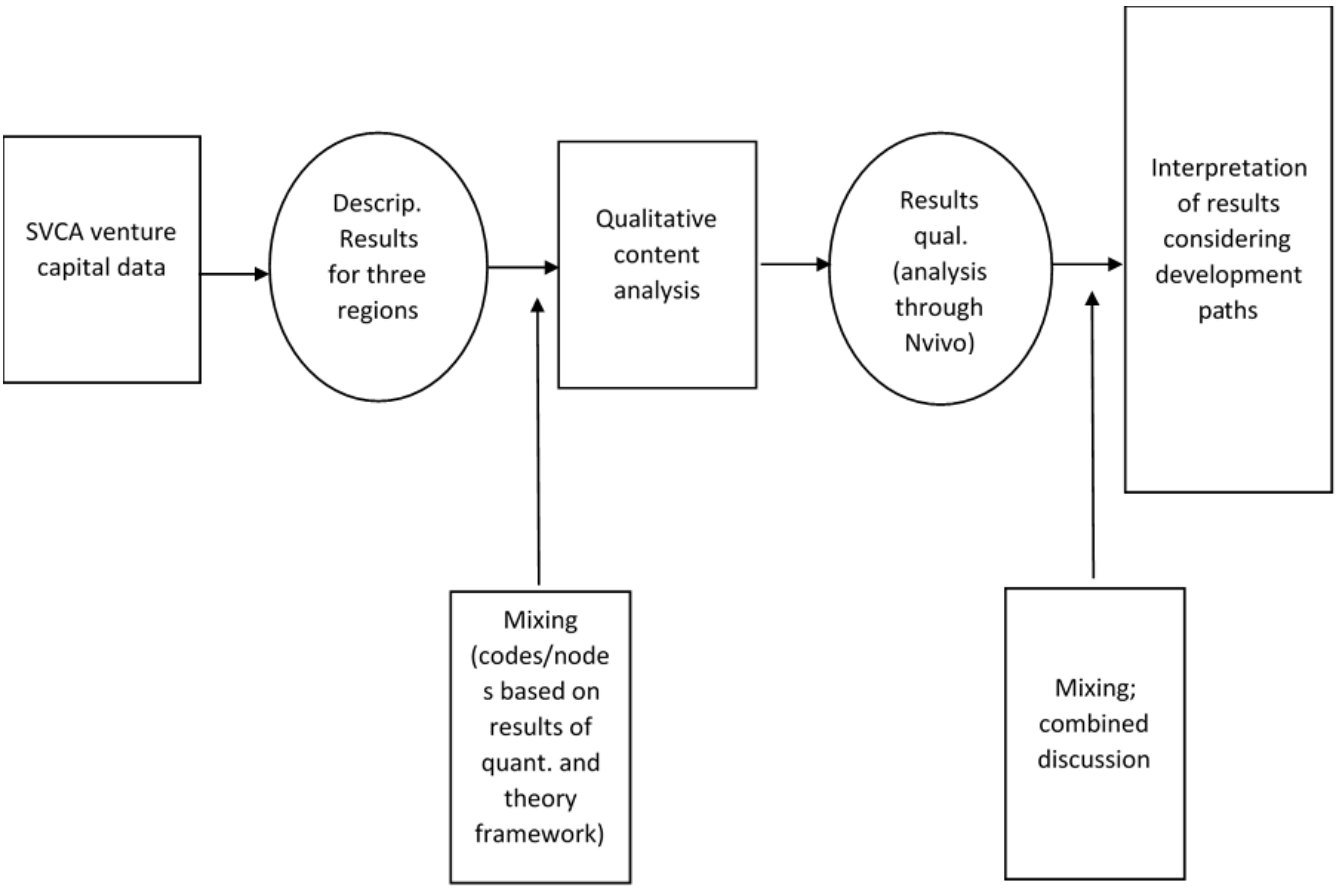

FIGURE 4 MIXED METHOD APPROACH APPLIED

In the preceding second step of analysis, this thesis will follow a rather unusual approach to qualitative methods. Qualitative research is famously associated with using interviews as a method to acquire data. In innovation research this method is well established and frequently applied. However, due to certain limitations, namely COVID-19 and the limited network of potential interview partners, the qualitative approach in this thesis will follow a rather unusual path in the domain of economics: a textual content analysis. The latter is often applied as a tool of analysing narratives as a somewhat linguistic method that aims to capture for example the change of words utilized in relation to topics of interest like “stock market crash”. Narrative analyst apply qualitative methods to gain understanding on how and when for example “stock market crash” is used to capture the development narratives (Shiller, 2017).

However, content analysis is a tool yet to be properly explored and utilized in the context of economic research, in which qualitative methods are underrepresented (Starr, 2014). In this thesis, a directed content analysis is applied to gain understanding about regional development paths. As a directed analysis, it is built upon previous research results and theories that direct the coding of the analysis. Content analysis is a tool frequently utilize by researchers to gain understanding about the "context" or the "message" of documents, it can be understood as an emerging method that became increasingly popular as the number of high quality documents available through the world wide web increased. In the case of this study, a directed content analysis is related to both the theoretical foundation by Grillitsch et al. (2017), as well as the research results from the first analytical step. Content analysis faces some concerns regarding its reliability and validity (see following section for detailed discussion). However, these can be overcome to an extend if, in this case, the findings of step one are used, to direct the data collection, and the six development dimensions by Grillitsch (2017) to guide the analysis. Coding is an essential part in analysing qualitative data, the codes in this directed content analysis are fixed, and represent the six development paths of the theoretical framework. The underlying strategy here is to analyse and construct meaning, as the goal of RQ2 is to identify salient structures concerning regional development paths (Bauer & Gaskell, 2000 p. 132; Hsieh & Shannon, 2005; Prior, 2014; Saldaña, 2014).

4.4 Data description and collection

4.4.1 Quantitative data

One decisive factor in this study is the unique availability of data. In the scope of the researcher's Master Program, a fruitful relationship with Tillväxtanalys was initiated. The agency works in close collaboration with SVCA. Both provided the researcher with a database with roughly 7652 observations from 2007 - 2018. Each observation represents one venture capital deal in Sweden. As the database is quite extensive, a considerable number of variables (roughly 140) was reviewed. However, since venture capital is a private market, no database can capture all market activities. This particular database is created by SVCA and constructed by submissions of deals by members of SVCA. Gaps are then filled in by collaboration with other organisations with similar purposes like "Invest Europe" or "France Invest". Further, public sources and commercial databases are applied. Thus, the database is a combination of various databases and captures venture capital in Sweden sufficiently for the scope of this study.

After exploration of the data and current issues in the literature, a set of variables was acquired that serve as the foundation of this study (see Appendix A). Furthermore, the author has collected extensive data from the "Regional Innovation Scoreboard", an innovation index created by the European Union to compare the innovative capabilities of European regions.

As this study is created based on data made available by Tillväxtanalys, a few things need to be taken into consideration to grasp the analysis fully. As the data is highly sensitive, an agreement between Tillväxtanalys and the author was drafted. Per this agreement, only aggregates and sums can be presented in the analysis and results section of this study. One may think about, singular observations in one sector, that would allow competitors to investigate how much money company X received in which year. For the sake of this study, extensive data manipulation methods were applied through SQL, Stata and Excel. The results of this "collapse" of the data can be found in the appendix B. Concerning the regional innovation data by the European Union, some years were not available as the study is not carried out every year. Thus, to fill the gaps, the means of both the preceding and succeeding year were calculated to fill the respective gap.

4.4.2 Qualitative data

In appendix A, an overview of the qualitative sample as well as the coding hierarchies and its respective references can be found.

In qualitative data concerning content analysis Bauer (2000) identifies three main sampling issues: representativeness, sample size and coding. Sampling in forms of analysis that concern the analysis of documents is particularly difficult as there is unlikely a full collection of documents which could be utilized for random sampling. In the case of this thesis, a sample of 21 publication was selected. The selected publications are 16 peer reviewed articles and 5 publications by agencies such as VINNOVA and the European Commission. The sample size is somewhat based on convenience sampling (Creswell, 2014), and deemed to be sufficient as this thesis follows a mixed methods approach. In mixed methods approaches triangulation and the discussion of results is not only based on one sample but in this case two: quantitative venture capital data and qualitative content. As the coding of the qualitative sample is based on theoretical advancements and research results from step one, the coherence of analysis is increased through the coding process. Furthermore, transparency is increased by providing lists of hierarchies and references in Appendix A.

During the data-collection, Bauer's (2000) concerns were taken into account. The collection strategy was based upon results of step one. ICT and Biotech/life science were identified as predominantly receiving venture capital in all three regions. Paired with other key words such as "regional innovation + Stockholm", online search tools such as google and google scholar were utilized. The data was considered for reliability in a first step of filtering the data, newspaper articles and publications by agencies as "Invest Skane" were deemed to have too much agency and bias in the first place. Only high-quality documents by either governmental institutions or publications in academic journals were deemed sufficient.

Concerning the transformation or manipulation of collected data; modern software techniques were utilized. Nvivo 12 is a software tool built for the analysis of qualitative data. In the case of this thesis, after the data collection the documents were imported to Nvivo and analysed. The following protocol indicates the steps taken during the analysis in Nvivo: 1. Import data into the Program, 2. Creating categoric cases based on regions, 3. Create codes and nodes for region and the six development paths as sub-categorical nodes, 4. Read each document individually and code regional information into case categories. 5. Review regional case categories, 6. Code per region, into the six development paths, 7. Export hierarchies and results in tables.

As the qualitative analysis of documents, involves a bias carried by the researcher, several things need to be taken into account. The researcher lives in Sweden in the concerned region Scania and is a student at Lund University in the field of "Innovation for Global Sustainable Development". The latter involves a bias as the researcher has pre-determined opinions about innovation is Sweden. These opinions may be "Sweden is very innovative", this bias is created through daily observations as well as courses during the time spend at Lund University. However, the researchers bias is considered and the analysis structured accordingly. As the analysis is built upon pre-determined categories, high quality data and quantitative results on which the researcher has little influence, the research bias is accounted for. However, it needs to be taken into account when reviewing the qualitative analysis at later stages.

In the following section, the results of a quantitative and qualitative analysis will be presented. As the chosen approach is sequential and rather extensive, the results will be presented in a form as concise as possible i.e. diagrams and tables rather than elaborative text. This leaves space for the preceding discussion section.

5 Empirical Results

"There is no smoke without fire."

In the following chapter, the reader will be presented with an extensive amount of illustrations. As this study is concerned with three regions, the results are thrice as a logical consequence. All quantitative illustrations are based on tables presented in appendix B. The structure of this chapter is as follows: General results for Sweden that are notably important will be presented. Afterwards, the three regions will be presented, including descriptive results that deliver insightful information on venture capital, followed by regional innovation indicators. In the second qualitative part, the results of the analysis will be presented in a brief tabular manner. Each region will be presented including the respective six development paths and the number of references found in the sample.

Note that all results are based on the available data, by Tillväxtanalys and represent by no means all general investments. Only venture capital investments available in the database are presented. Thus, if only the term "capital" is used, it still only refers to "venture capital". Furthermore, the qualitative results are by no means an empiric and definite description but rather a selection of high-quality sources that represent some information about the regional development paths.

5.1 Descriptive results

5.1.1 Sweden

In Sweden overall, one can observe 7652 venture capital deals with a total investment volume from 2007 – 2018 of tSEK290,649,979.9 for the international readers this is roughly the equivalent to €27,500,820,915.31 over the course of 11 years.

As figure 3 illustrates, one can observe the highest density of venture capital deals in Sweden, in the three regions, this study is concerned with. In numbers: 62% of all venture capital deals were made in Scania (9%), Stockholm/Uppsala (35% and 4%) and West-Sweden (14%).

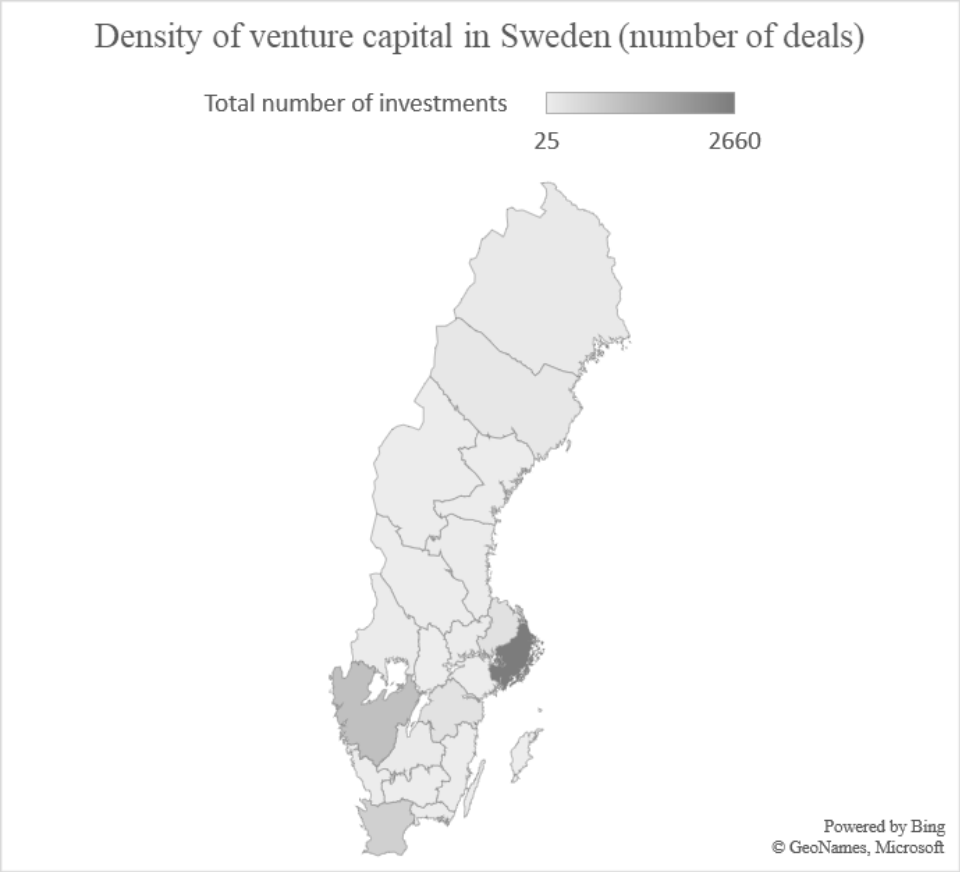

FIGURE 5 DENSITY OF VC INVESTMENTS

Concerning the total amounts of capital invested 77% of venture capital was invested in the latter: Scania (16%), Stockholm/Uppsala (50% and 4%) and West Sweden (7%).

The mean investment in these regions were Stockholm: tSEK52,572 (Uppsala: tSEK59,416), Scania tSEK63,944 and West-Sweden tSEK19,808.

Concerning the sectoral distribution of investments in Sweden overall one can observe, as figure 4 illustrates the following results: Four sectors account for 88% of all deals made and collect 79% of the total amount of venture capital invested.

1. Biotech and healthcare account for 25% of the number of VC investments made, 18% of the total amount of VC investments and show a mean tSEK27,637 invested per deal.
2. Business products and services: Account for 14% of the number of deals and 23% of the total amount of VC invested and showed a mean investment per deal of tSEK59,710
3. Consumer goods and services: Account for 9% of the number of deals number but 17% of the amount of VC invested and showed a mean investment per deal of tSEK67,780
4. ICT: Accounts for 37% of the number of investments made but 19% of total invested amount and show mean investment per deal of tSEK20,040

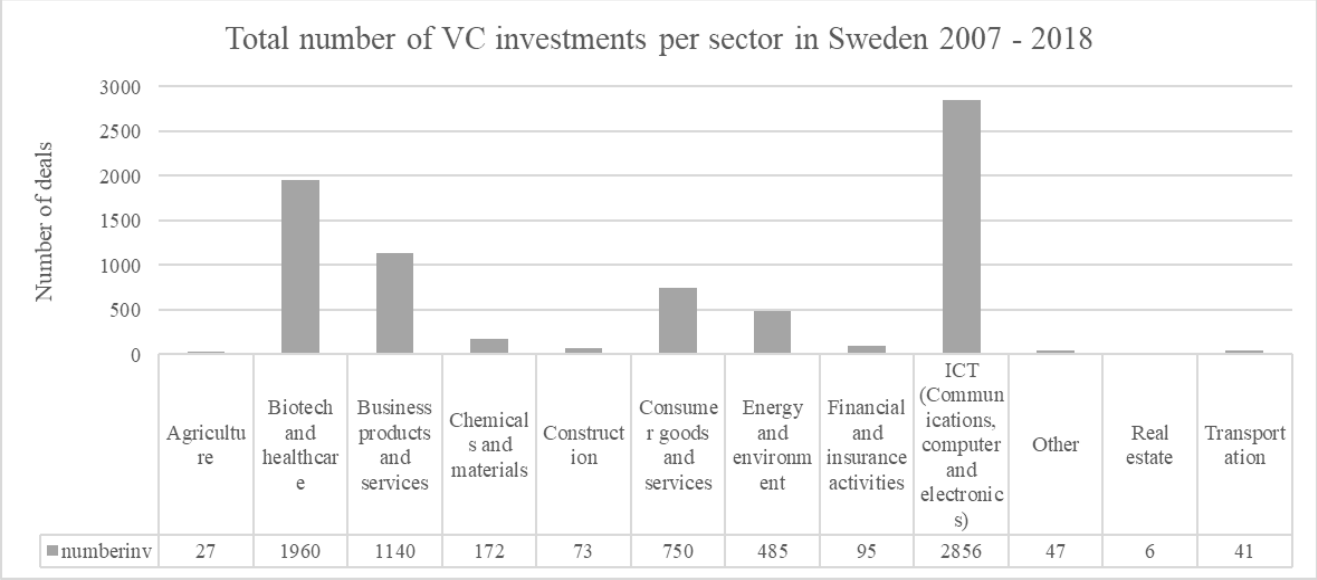

FIGURE 6 NUMBER OF VC INVESTMENTS PER SECTOR IN SWEDEN

In figure 5, one can observe the unstable nature of the venture capital market in Sweden. According to this sample, the amounts invested per year fluctuate heavily.

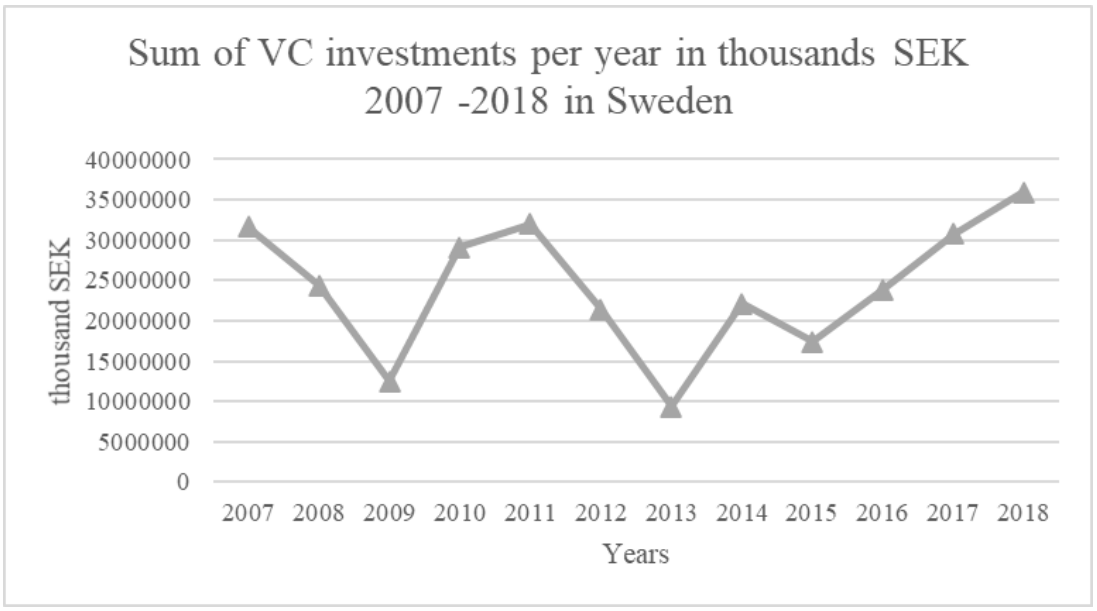

FIGURE 7 SUM OF VC INVESTMENTS PER YEAR IN SWEDEN

Somewhat surprisingly, in comparison to figure 5, figure 6 shows that the number of venture capital deals is rather stable, even if it is declining.

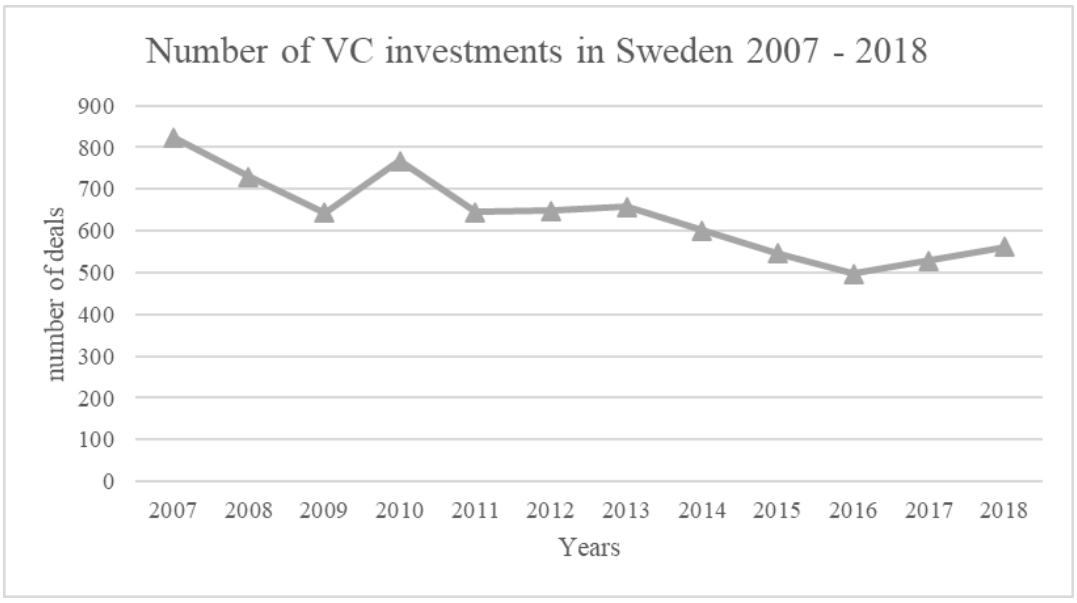

FIGURE 8 TOTAL NUMBER OF VC INVESTMENTS PER YEAR IN SWEDEN

Further, it was found as shown in table 14 in appendix B, that 82% of all deals are made in start-ups (including seed, later-stage ventures). Nevertheless, only 13% of the total amount of venture capital flows towards these young innovative organizations. Most capital is spent on buyouts, i.e. takeovers, where a total of 78% of the venture capital amounts from the sample is

invested. Further, somewhat surprisingly, in 36% of the number of deals, governmental agencies are the largest shareholder of the company receiving an investment.

5.1.2 Scania

In Scania, one can observe 706 venture capital deals between 2007 and 2018, with a mean investment per deal of tSEK63,944 and a total of tSEK45,145,112 invested.

Like Sweden overall, four sectors account for most of the venture capital investments. Notably, 87% of all deals were made in these sectors, and 92% of all venture capital invested in Scania went to these sectors.

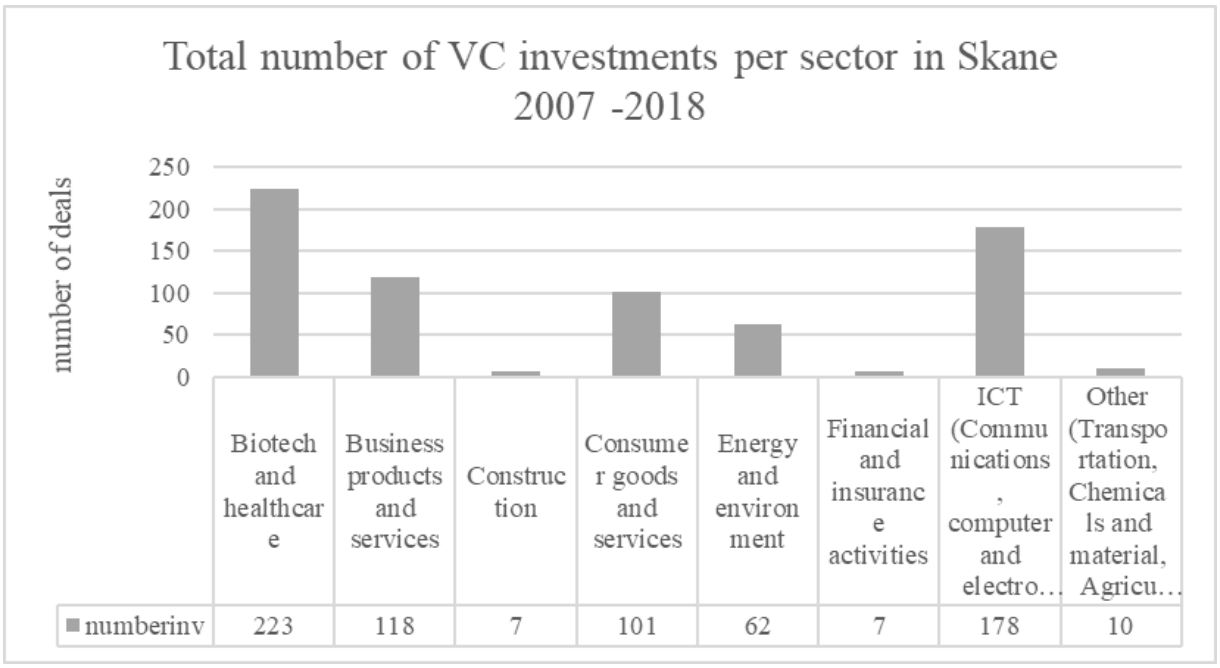

FIGURE 9 TOTAL NUMBER OF VC INVESTMENTS PER SECTOR SCANIA

1. Biotech and healthcare: Account for 31% of all venture capital deals and 14% of all venture capital invested in Scania. The mean invested amount per deal is tSEK28,145.

2. Business products and services: Account for 16% of all venture capital deals but collect 51% of all venture capital invested. The mean invested amount per deal is tSEK192,812.

3. Consumer goods and services: Account for 14% of all VC deals and 18% of the venture capital invested. The mean invested amount per deal is tSEK83,415.

4. ICT: Accounts for 25% of all deals made but only for 8% of the capital invested. The mean invested amount per deal is tSEK20,109.

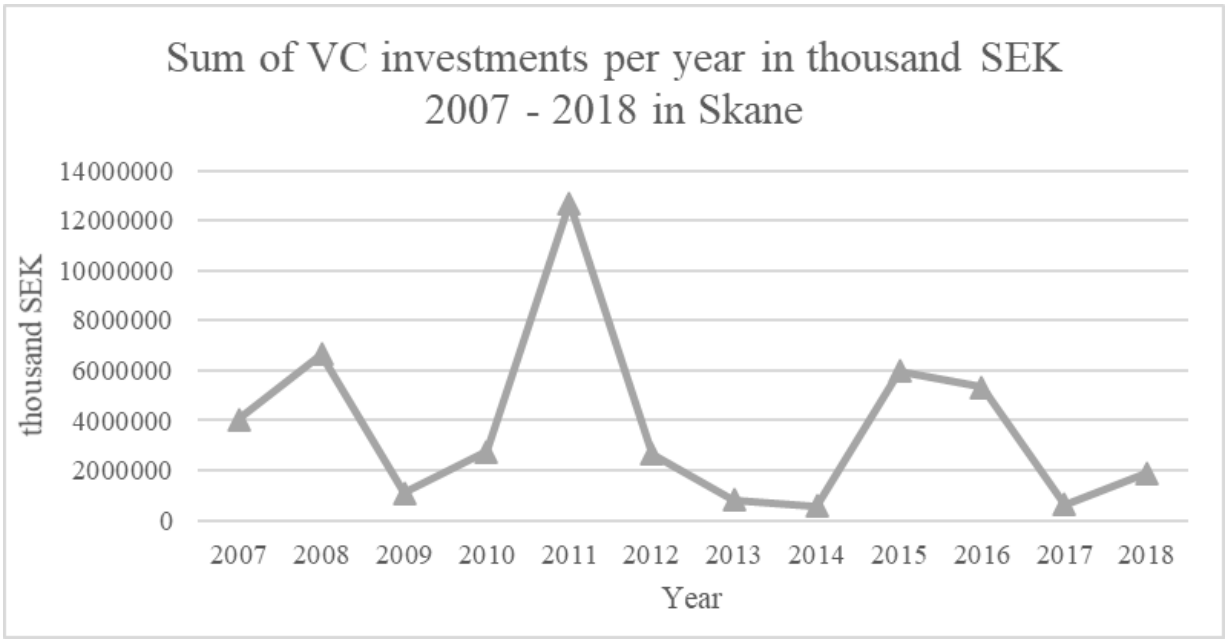

FIGURE 10 SUM OF VC INVESTMENTS PER YEAR SCANIA

In Scania, as shown in figure 8, venture capital investments fluctuate heavily per year, especially 2011, and the following collapse of venture capital investments are of interest.

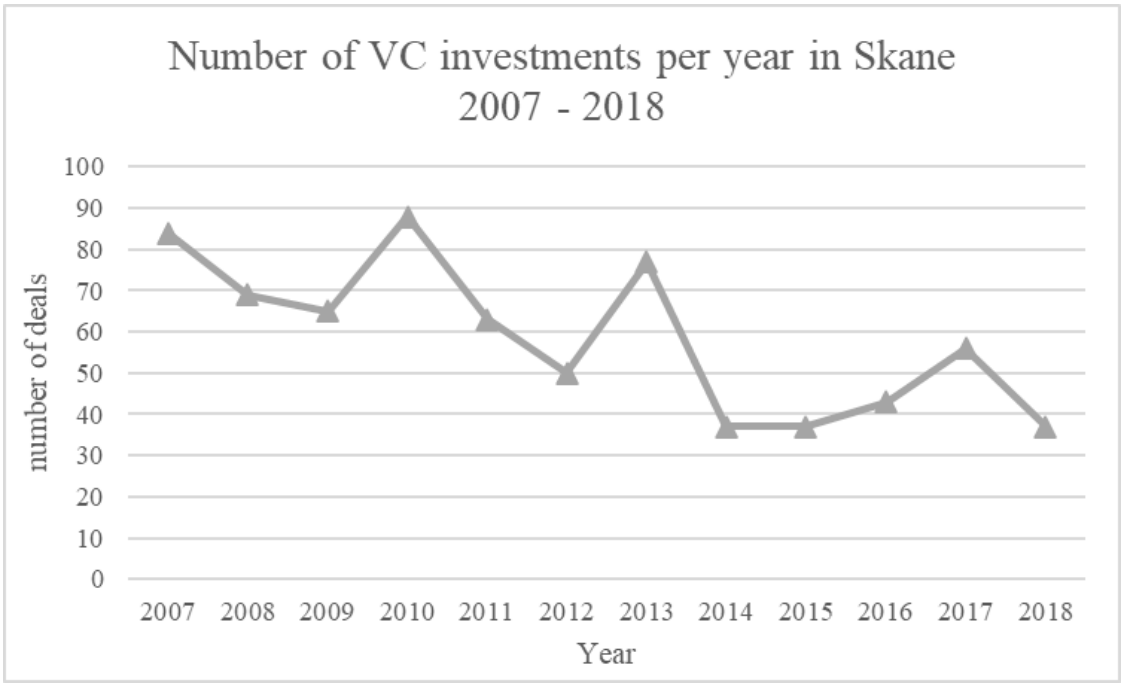

FIGURE 11 NUMBER OF VC INVESTMENTS PER YEAR IN SCANIA

Concerning the number of investments in figure 9, which is compared to figure 8 “steadily” declining, one can to a certain degree observe that the amount of VC invested per year is heavily influenced by either deals that are particularly high, or particularly low.

This is likely to be related to the fact that only 8% of all venture capital invested in Scania accounts for start-ups, yet 75% of the deals made can be allocated to the start-up phase. On the other hand, buyouts account for 87% of all capital invested, yet only for 12% of all deals made. This is also reflected in the mean invested amount in the latter; buyouts show a mean investment of tSEK434,666. And Start-ups only show a mean investment of tSEK7,712.

In figure 10 and 11, one can observe several innovation indicators for Scania, as the abbreviations of the variables were used in the legend for simplicity; a short recap of the variable names is of need:

1. RDPub: Research and Development Public sector,
2. RDBus: Research and Development Business sector
3. SMEInInH: SMEs innovation in house
4. SMEColO: SMEs collaborating with others
5. EPOApp: EPO patent applications
6. SMEProInn: SMEs introducing product or process innovation
7. SMEsMarOrIn: SMEs introducing marketing or organizational innovations
8. EmpInn: Employees in medium or high-tech sectors
9. SalesNewPro: Sales of new to market products

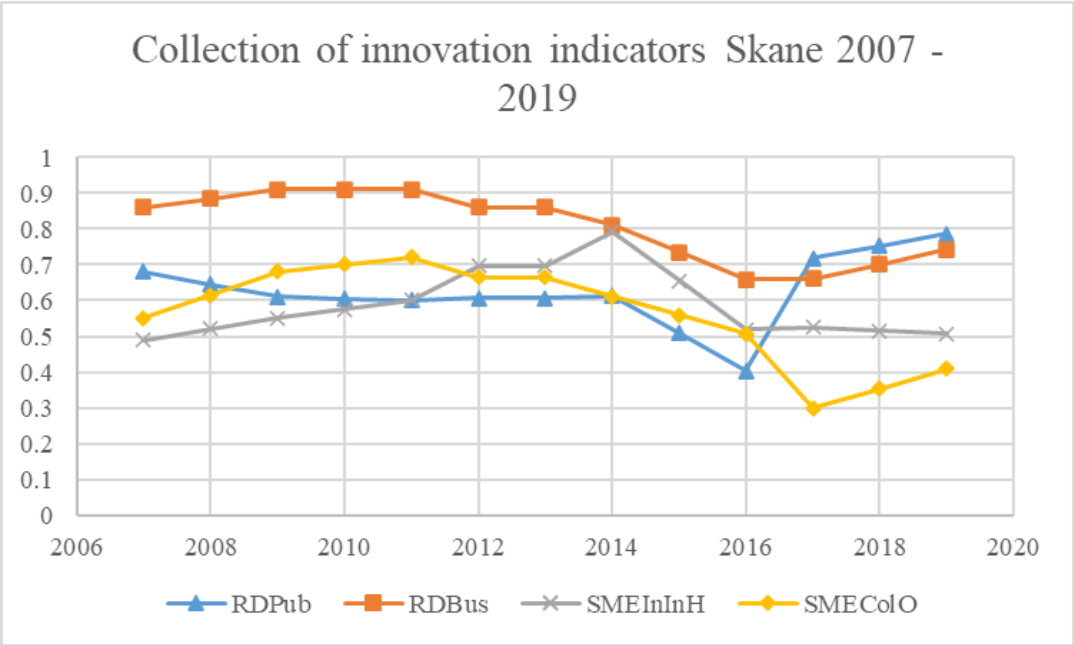

FIGURE 12 COLLECTION OF INNOVATION INDICATORS SCANIA 2007 – 2019

In Scania it is generally observed that the region is highly innovative, as 1 is the highest possible score on the scale, the region overall performs well. Especially, EPO Patenting scores perform consistently well, similar to RDBus and RDPub. However, one can also observe a somewhat declining tendency in most variables, especially SMEColO and SalesNewPro.

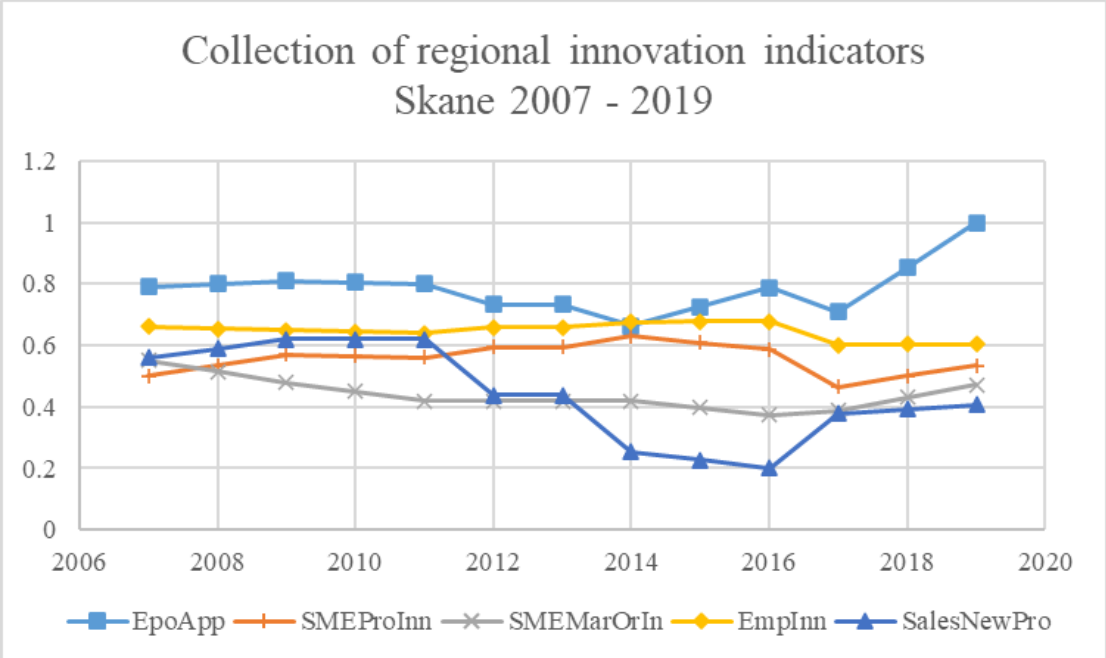

FIGURE 13 COLLECTION OF INNOVATION INDICATORS SCANIA 2007 - 2019 #2

5.1.3 West Sweden

In West-Sweden, one can observe a total of 1076 venture capital deals between 2007 and 2018 with a mean investment of tSEK19,808 per deal and a total invested amount of tSEK21,313,903.

In West-Sweden, the flow of venture capital is more diverse, considering the sectoral base: 5 sectors account for 91% of all deals made as well as 91% of all venture capital invested.

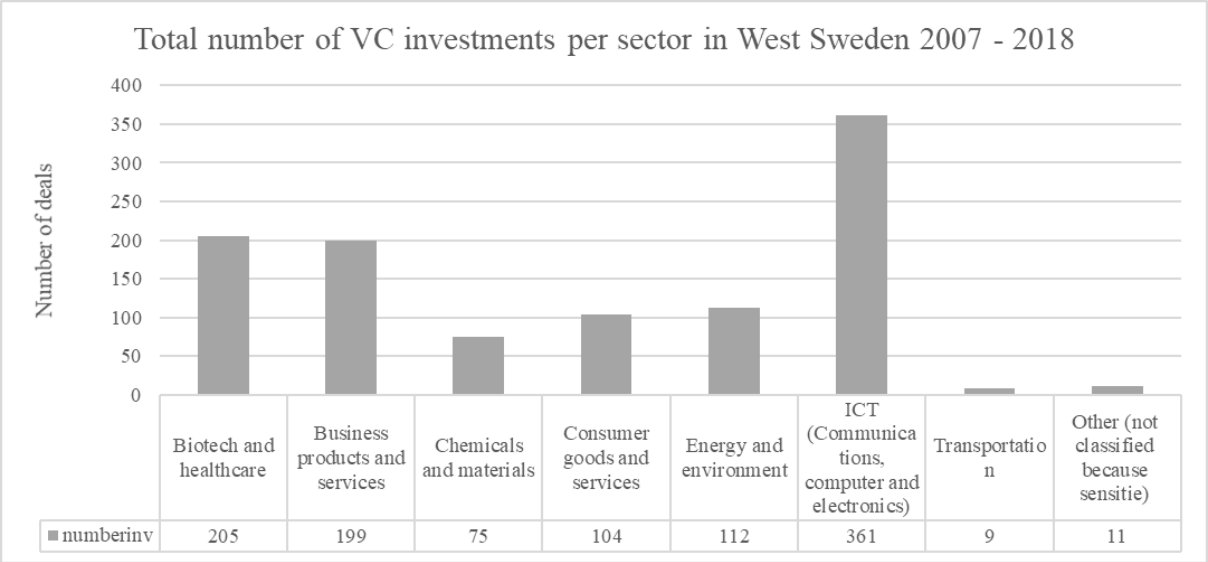

FIGURE 14 TOTAL NUMBER OF VC INVESTMENTS PER SECTOR WEST SWEDEN

1. Biotech and healthcare: Account for 19% of all deals made but only for 5% of the capital invested, with a mean investment of tSEK5,585.

2. Business products and services: Account for 18% of the deals made but collected 29% of the venture capital invested with a mean investment of tSEK31,473.

3. Consumer goods and services: Account for only 9% of the deals made but for 40% of the total venture capital invested with a mean investment per deal of tSEK83,730.

4. Energy and Environment: Account for 10% of all deals made and 4% of the venture capital invested with a mean investment of tSEK7,947.

5. ICT: Account for 33% of all venture capital deals made but only for 15% of the venture capital invested with a mean investment of tSEK9,395.

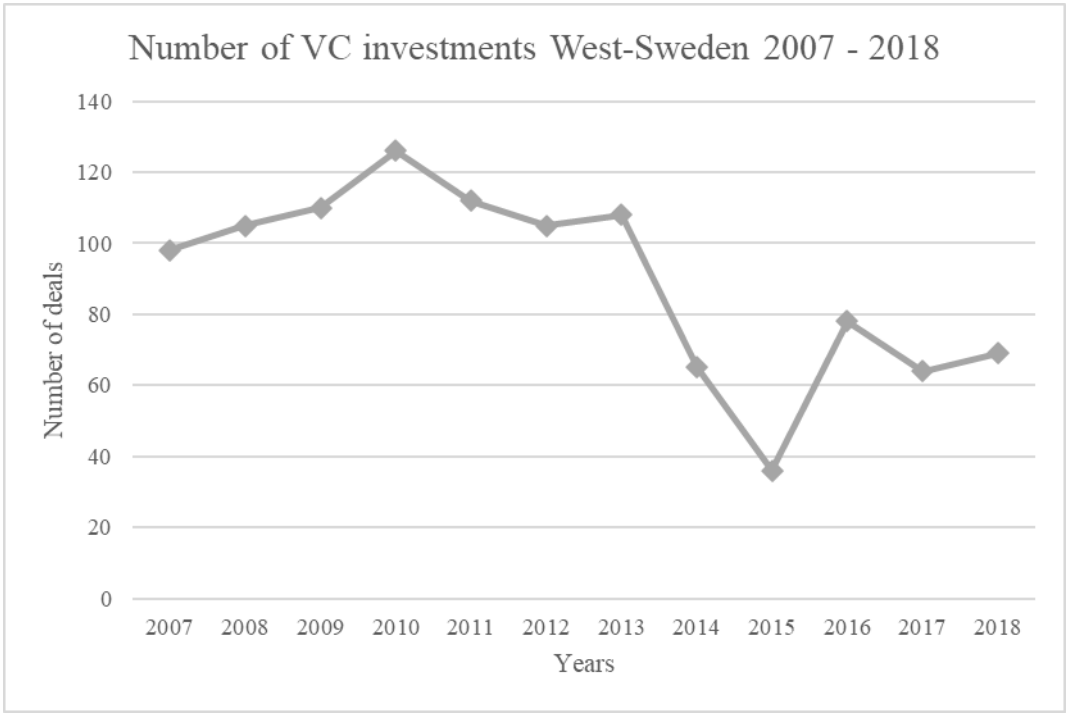

Figure 15 Number of VC investments per year West-Sweden

The number of VC investments in West Sweden has seen a sharp decline between 2013 and 2015 but is since then back on a relatively stable level between 60 and 80 deals per year. The amount invested is rather stable after a sharp drop from 2008 till 2011.

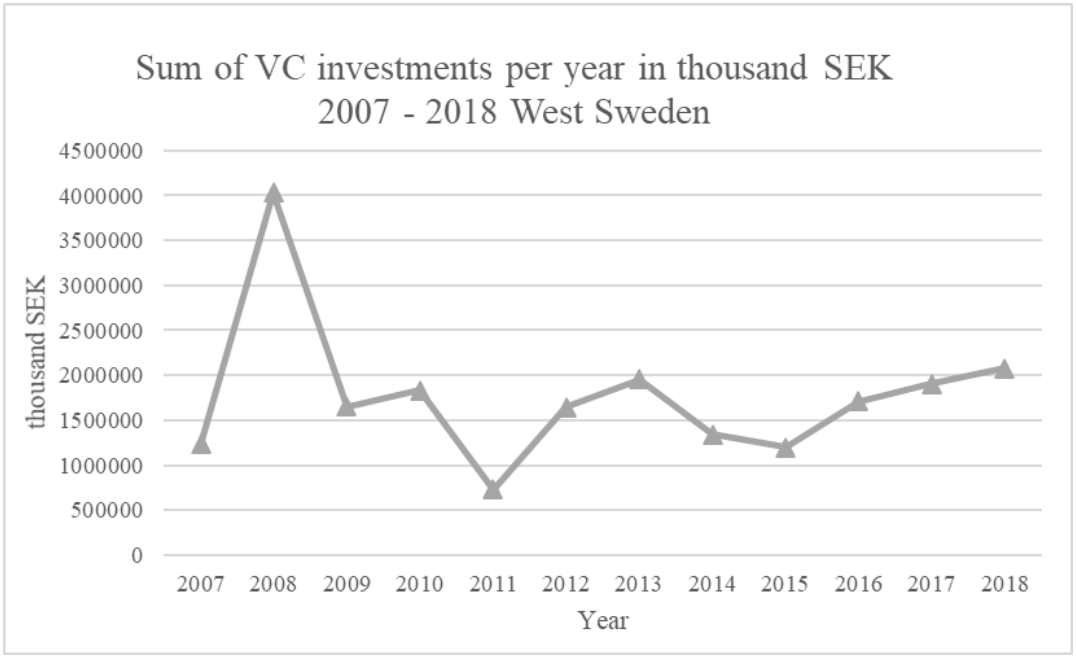

FIGURE 16 SUM OF VC INVESTMENTS 2007 - 2018 WEST SWEDEN

Concerning the last two figures, similarities to Scania are at hand. It is observed that 77% of all capital invested accounts for buyouts and only 7% of the deals made. Start-ups account for 87% of the venture capital deals made but only account for 15% of the capital invested.

It is also found that the deals made go in 35% of the cases to companies where governmental agencies are the largest shareholder.

The variables that are presented in figure 15 and 16 are the same ones used and described for figure 10 and 11, in the previous section.

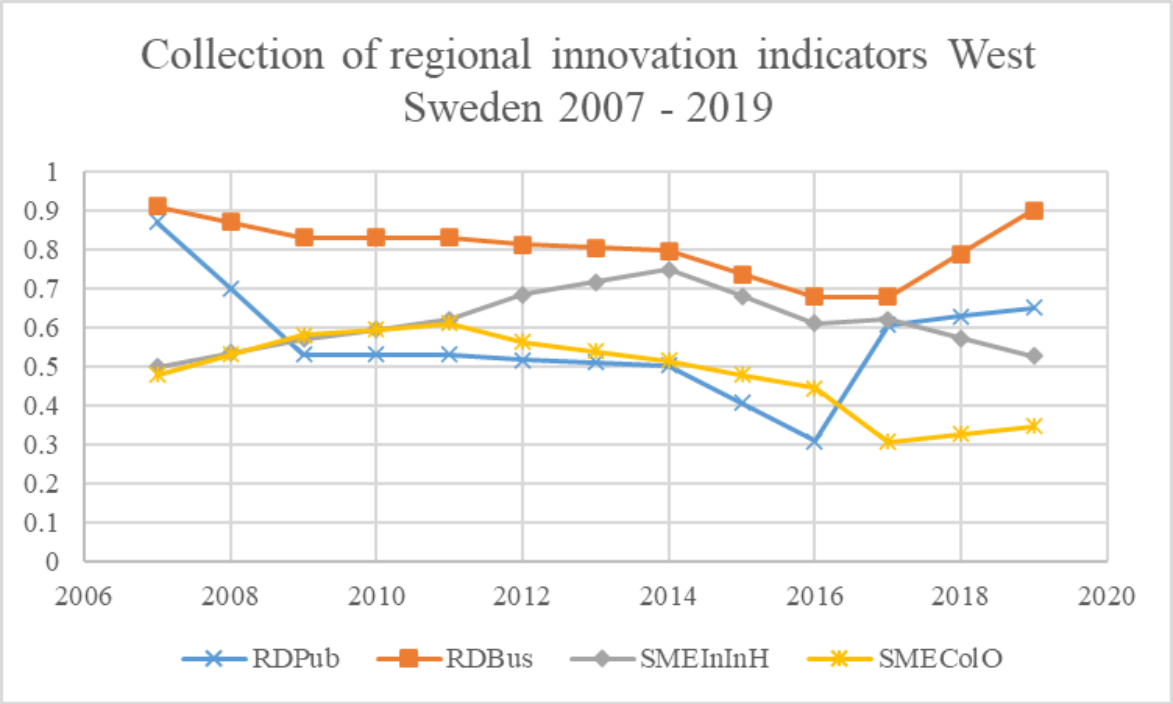

FIGURE 17 COLLECTION OF REGIONAL INNOVATION INDICATORS WEST SWEDEN 2007 - 2019

West-Sweden has a somewhat ambiguous development concerning its regional innovation indicators. SMEColO, seems to be on a steady decline, whereas SalesNewPro has increased drastically after being historically quite low. RDBus and EmpInn are rather stable and score particularly high.

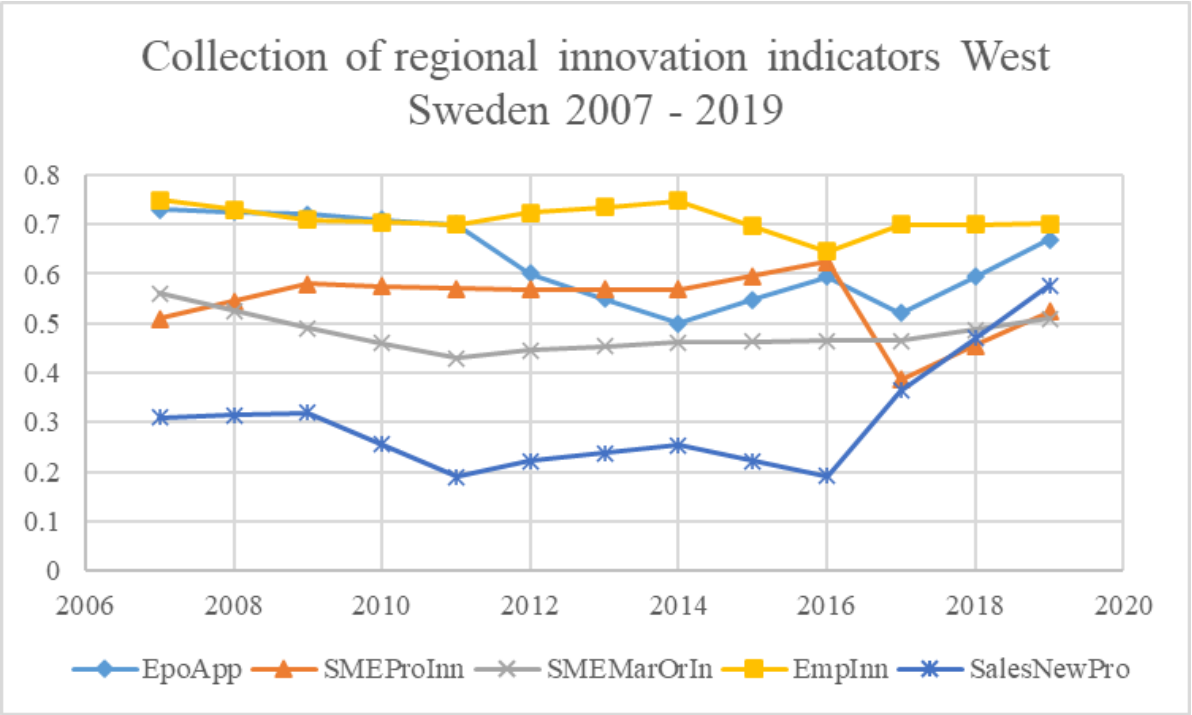

FIGURE 18 COLLECTION OF REGIONAL INNOVATION INDICATORS WEST SWEDEN 2007 - 2019 #2

5.1.4 Stockholm/Uppsala

In the following section, Stockholm and Uppsala are accounted for in combination. However, notable differences are that in Stockholm: 2613 venture capital deals were made with a mean investment of tSEK52,572 and a total invested amount between 2007 and 2018 of tSEK137,370,791. In Uppsala, there are 316 venture capital deals with a mean investment amount of tSEK59,416 and a total investment amount of tSEK18,775,598.

As figure 17 illustrates, strong sectoral distribution of venture capital investment is detected. The following four sectors account for 91% of all venture capital deals made and 74% of the amount of venture capital invested

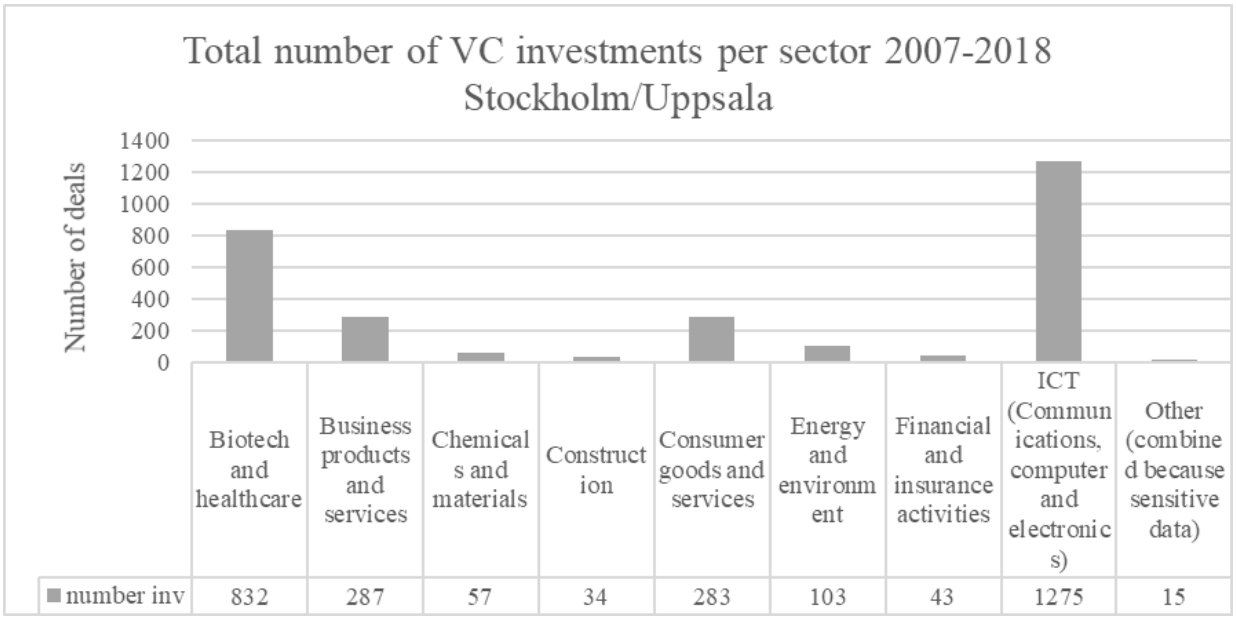

FIGURE 19 TOTAL NUMBER OF INVESTMENTS PER SECTOR STOCKHOLM/UPPSALA

1. Biotech and healthcare: Account for 28% of the number of VC deals made, and 22% of the total capital invested with a mean invested amount of tSEK41,521

2. Business products and services: Account for 10% of the number of deals made and 12% of the VC capital invested with a mean invested amount of tSEK67,680

3. Consumer goods and services: Account for 10% of the number of VC deals made and 15% of the total capital invested with a mean invested amount of tSEK86,787.

4. ICT: Accounts for 43% of the deals made and 23% of the total invested VC capital with a mean invested amount of tSEK29,145.

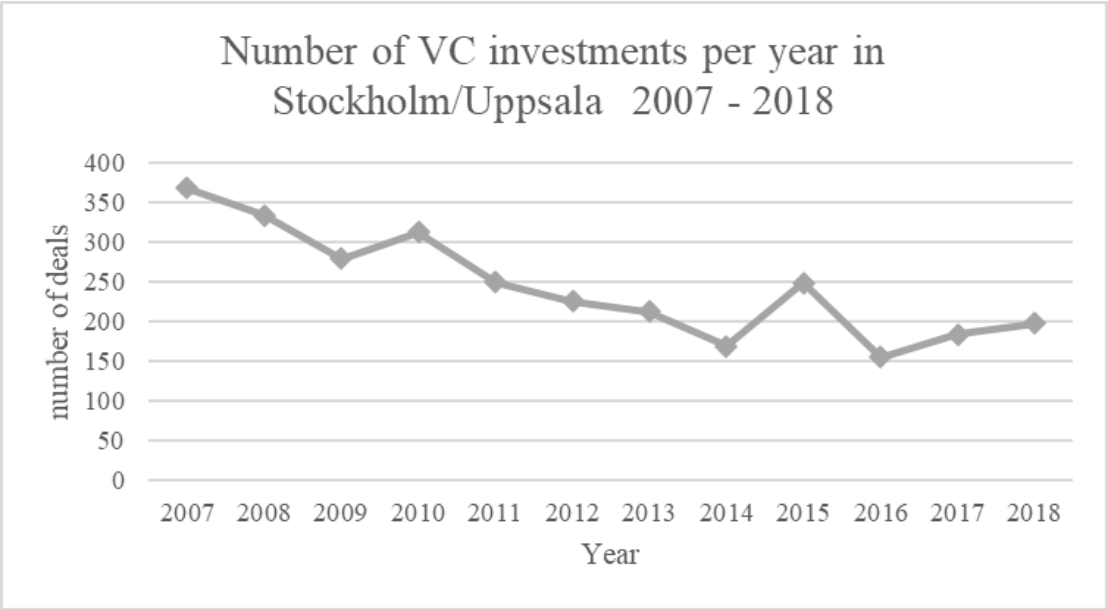

FIGURE 20 NUMBER OF VC INVESTMENTS PER YEAR STOCKHOLM /UPPSALA

In Stockholm/Uppsala as figure 18 indicates one recognizes a somewhat steady decline of the number of venture capital deals, compared to heavily fluctuating amounts of venture capital. However, since 2015 the total amount invested per year has increased drastically.

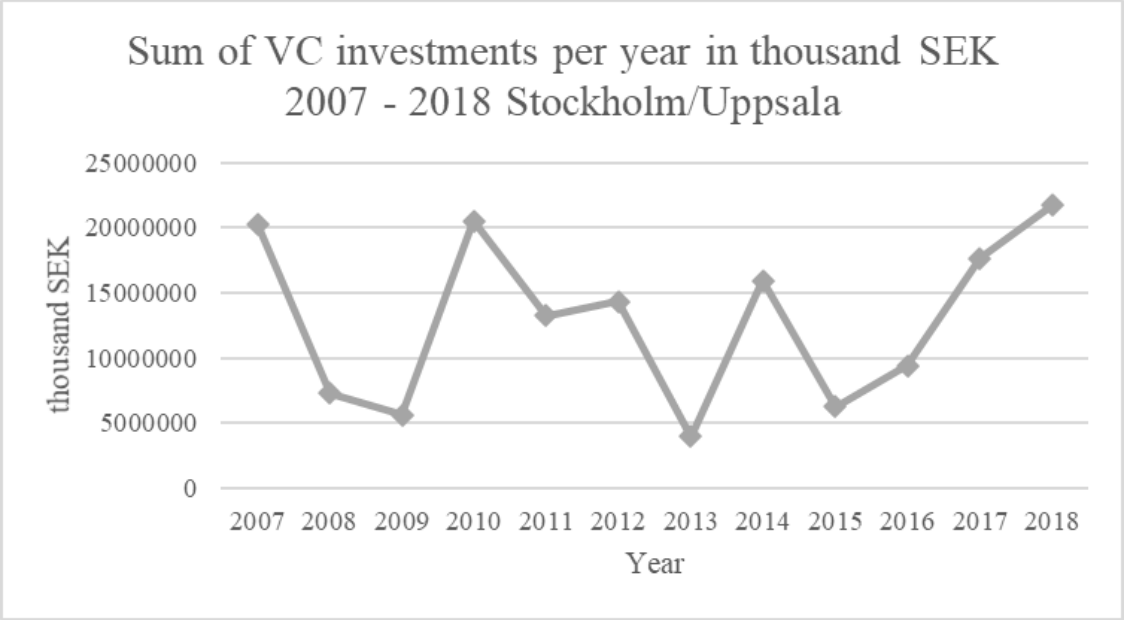

FIGURE 21 SUM OF VC INVESTMENTS PER YEAR STOCKHOLM/UPPSALA

This is likely to be related to the fact that 77% of all VC capital invested in Stockholm/Uppsala was concerned with buyouts, but the latter only accounted for 10% of the deals made. Start-ups received only 12% of all VC capital invested but accounted for 77% of the deals made.

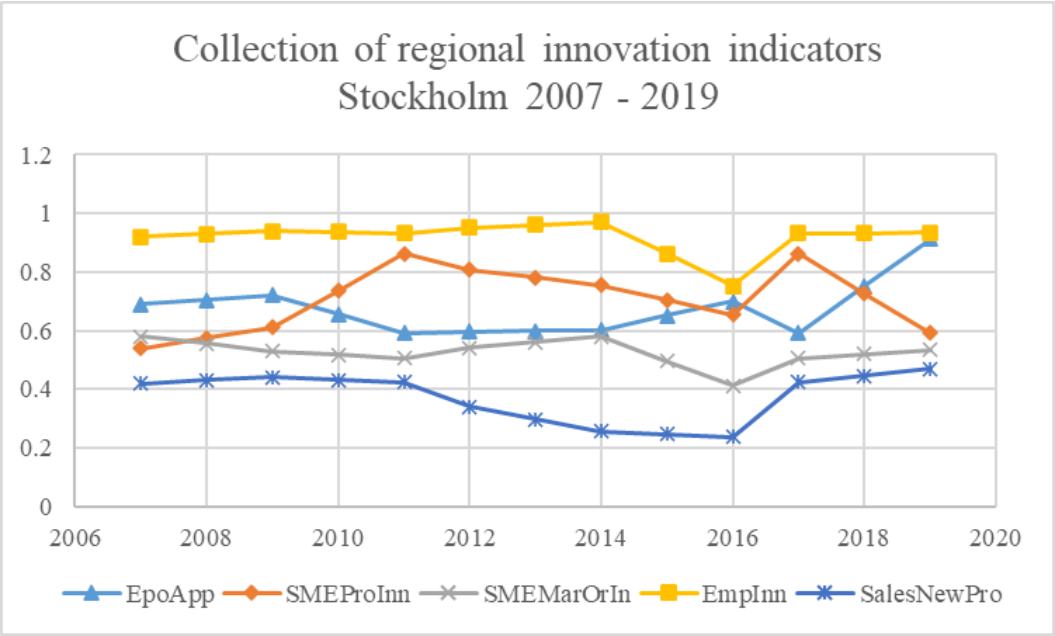

FIGURE 22 COLLECTION OF REGIONAL INNOVATION INDICATORS STOCKHOLM 2007 – 2019

Concerning the regional innovation indicators, (only available for Stockholm), generally very positive structures are in place. However, SalesNewPro, SMEColO and SMEMarOrIn seem to be performing lower than the other innovation indicators. Nevertheless, EmpInn, SMEInInH, EpoApp and RDBus are exceptionally high in Stockholm.

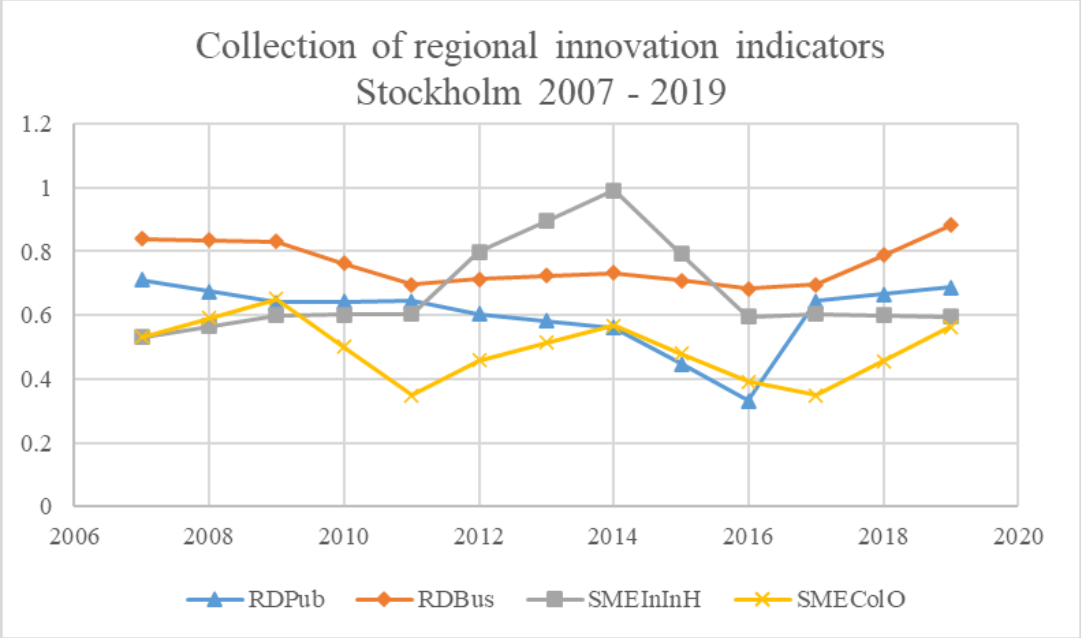

FIGURE 23 COLLECTION OF REGIONAL INNOVATION INDICATORS STOCKHOLM #2

5.2 Qualitative results

TABLE 1 SCANIA QUALITATIVE RESULTS

	Path branching	Path creation	Path diversification	Path extension	Path importation	Path upgrading
References	15	9	18	13	0	33
Percent	17.0	10.2	20.5	14.8	0.0	37.5
Scania	ICT; Moving media industry, old knowledge applied in new context	Oatly; university spin-off with connection to food sector	ICT; crises lead to the use of existing knowledge in combination with novel knowledge (moving media Malmö)	Biotech: organizations focus on research and produce internal innovations	No evidence could be identified in sample	Functional foods; SMEs are conducting research intensive activities
	General observed narrative; exiting knowledge in LiveScience/ICT is used to innovate	Historically venture capital and funding too low for radical innovation by small new firms	ICT; from hardware to software	Food sector is innovating slowly and rather extending that branching or upgrading		ICT; went through several periods of decline and renewed uprising
	"Growth Malmö" fund; used to support exiting businesses in development	High public and private investments (ESS and MAX IV) that potentially create new paths	Joint action "samhandling" campaigns aim to combine different regional knowledge bases like ICT and biotech	Exiting sectors like ICT and biotech receive considerable regional support to extend existing activates		General narrative; high resilience i.e. biotech / LifeScience and ICT re-invent themselves
	Food knowledge base is branching into functional foods		Medeon Science Park, Ideon Science park Medicon village aim to diversify and increase regional collaboration of knowledge bases			Regional initiatives support path-renewal and niche development
			Smart specialisation; strong narrative			Strong knowledge bases support RIS to develop and renew
						Large investments in e.g. ESS and MAX IV

TABLE 2 STOCKHOLM / UPPSALA QUALITATIVE RESULTS

	Path branching	Path creation	Path diversification	Path extension	Path importation	Path upgrading
References	6	3	14	8	0	23
Percent	11.1	5.6	25.9	14.8	0.0	42.6
Stockholm / Uppsala	ICT: Strong research centres like Kista enable RIS to apply knowledge in new context	Regional initiatives to promote entrepreneurship exists but in general a lack of agency	Kista; different knowledge bases like ICT and life science combine efforts for innovation	Large firms dominate Kista and follow pre-existing structures to develop	no evidence was found in the sample	Kista; supportive environment for path renewal. Strong collaboration between emerging pilot projects and market introduction of products/services
	Europe's leading industry in life sciences e.g. strong growth in new areas outside of drug development	Rather smart specialisation than new path creation	Close collaboration between research centres like universities and regional industries	Historically Stockholm's focusses on path extension, high dependency on ICT and life sciences		High share of innovative enterprises renew path development
			Kista ranked amongst best science parks in the world			Cooperation between industries leads to interlinked networks that promote niche development (e.g. Start-ups like Karma)
			ICT and life science work increasingly together and combine knowledge bases			Niche development supported by regional initiatives like "Creative Business Region Stockholm" (2009-2011)
			Initiatives to broaden and diversify ICT sector are in motion			Biotech mainly grew in new drug development and biotech tools. Growing number of SMEs with new technologies
			Environmental technologies are rising			

TABLE 3 WEST SWEDEN QUALITATIVE RESULTS

	Path branching	Path creation	Path diversification	Path extension	Path importation	Path upgrading
References	8	22	20	15	0	34
Percent	8.1	22.2	20.2	15.2	0.0	34.3
West-Sweden	Thick industrial structure knowledge is utilized in new context like smart mobility	University and large firm spin-offs create new development paths	General narrative: industry combines traditional knowledge with ICT and other formerly novel sectors	Industrial tradition in West-Sweden shows historic focus on path extension	no evidence found in the sample	"Industrial heart" of Sweden re-news paths e.g. "Drive me" initiative for autonomous driving
	Formerly unrelated fields branch like ICT and automotive sectors	Automotive sector supports start-ups "Mobility X-Lab"	Mobility and transport sectors work towards self-driving cars with Volvo	Areas outside of Göteborg are still focused on industrial production i.e. path extension		Geely, through Volvo works for new paths in the automotive industry
	Joint connectivity initiatives from 2000 onwards; "Microwave Road Initiative" among others	Seed funding and Venture Capital initiatives by large corporations	Geely invested considerably to diversify the automotive knowledge base	Despite increasing focus on entrepreneurship extension and continuation of old industrial paths carries on		Biotechnology upgrades paths like textile industries (Smart textiles)
		Chalmers University aims to be Sweden's lead idea investor and business developer	Smart specialisation; diversified knowledge bases like Smart textiles			Large number of tech-based companies emerged in from existing knowledge bases powered by seed capital
		Incubators and accelerators both private and public support creation of new ideas and concepts	Regional agenda to bring regional industries closer together to create diversification			Structural change forces companies into path-renewal
			Göteborg BIO Program ran from 2004 - 2014, biotech development and collaboration			Smart specialisation - focus on core industries and upgrading of the latter

5.3 Discussion

In the successive section, the empirical results will be set in relation to previous research by scholars in both fields, economics of innovation as well as venture capital. Further, the consanguinity of the theoretical framework and the results will be revealed.

General observations that can be made by following the results are that venture capital is regionally clustered in Sweden's metropolitan areas. The findings confirm common assumptions and previous studies that have been conducted in different spatial setting (Cumming & Dai, 2012; Samila, 2012). In the respective regions, venture capital tends to flow, towards pre-existing innovative sectors. Especially ICT and biotech companies in regional innovation systems tend to secure venture capital funding. In general, substantial fluctuations in the invested total capital, on a national and regional basis indicate that venture capitalists tend to respond to specific signals. As venture capitalists are especially known for identifying promising innovations, the reasons for fluctuations may be connected to VC actors, responding to technological shocks or similar developments.

Revisiting the work by previous scholars and comparing their advancements to the results presented in the previous section, several commonalities can be found. However, as this study is somewhat explorativ, the connections cannot account for every meticulous detail. Concerning the work by Pavitt (1984) on sectoral innovation, clear patterns can be recognized. Especially science-based sector where product and process innovation based on scientific research are prominent seems to secure the largest number of venture capital deals.

Following Asheim's (1998) advancements in the conceptualization of innovation networks, one can observe that regionally networked innovation systems in Sweden attract the overall largest share of venture capital which flows towards highly innovative sectors within the innovation systems. Coupled with these observations, it can be assumed that venture capital is a nurturing factor for existing industries and sectors within the innovation system. As the literature displays evident research gaps on enabling factors for regional innovation systems to develop and sustain, the degree to which venture capital is responsible for the latter cannot be fully accounted for (Doloreux & Gomez, 2017; Malerba, 2006).

However, it is known that RIS need nurturing factors to develop, considering that the invested capital only leaves slight impacts it is still a supporting function for the RIS and can be

connected to previous research (Asheim & Coenen, 2005b; Grillitsch, Asheim & Trippl, 2018). Especially the different paths RIS can follow are of interest. Concerning the work by Grillitsch et al. (2017); regional innovation system can follow different directions. Especially, path extension, path upgrading, path branching, and path creation are of peculiar interest considering venture capital. In the result section, one can clearly observe that venture capital flows towards famously innovative sectors and industries within the RIS. Thus, path extension, path upgrading, and path branching are especially supported by venture capital investments are venture capital seems to follow steady patterns in terms of sectoral investments. Further, venture capital is prominently connected to high-risk high-reward investments. Thus, path creation through new VC backed innovations is a possible impact of venture capital.

As the body of "economics of innovation" is still premature to venture capital, the discussion has to be considered with a healthy amount of scepticism and not be considered as static facts. Nevertheless, analogous results were observed to advancement made by Cumming and Dai (2012), Samila (2012), Thompson (1989), Florida (2016), as most venture capital in Sweden is regionally clustered in metropolitan areas, that are regional innovation systems. Recent advancements by Florida (2016) indicate that venture capital transforms the regions, which attract venture capital in the first place. This leads back to the theoretical framework that was introduced previously.

As venture capital in Swedish regions is mainly concerned with Biotech and healthcare, business products and services, consumer goods and services and ICT, these four streams represent the majority of the investments. The descriptive analysis found that venture capital flows almost exclusively towards regional innovation systems. This ties into advancements by Cherif & Gazdar (2011), Dessi & Yin (2012), Faria & Barbosa (2014) and Hirukawa & Ueda (2011), that venture capital follows a "success breeds success" approach.

As the second research question concerns salient development characteristics, the following discussion will concern the two most referenced development paths for each region. Results from the quantitative approach, have shown that in general biotech/life science and the ICT secure most venture capital.

In the qualitative analysis, strong evidence was found that all three regions are heavily concerned with "smart specialisation" i.e. the resilient development of existing sectors by combining different knowledge bases. The latter is observed to be an overarching narrative that concerns the regional development is all three regions. This is also reflected in the quantitative

analysis as already existing industry sectors secure most venture capital funding. However, on a general note, in the qualitative sample it became evident that especially Gothenburg is offering nurturing ground for start-ups, the typical recipient of venture capital funding. In Scania, the lack of venture capital has been identified as problem for the development of independent start-ups. Even if structures like incubators exists, the lack of capital appears to be problematic. This echoes also in the quantitative findings concerning Scania, where the number of venture capital deals per year is quite low considering that the region has a strong knowledge base in several regional innovation systems. Furthermore, Stockholm, which attracts most venture capital overall, has shown a lack of agency concerning entrepreneurial activities, according to the qualitative sample. The region seems to follow a "never change a winning team" approach. Thus, large corporations that dominate science parks like Kista, invest heavily in research. However, small new entrants that do not have support by some of these larger corporation's face challenges of securing funding. However, as the sample carries a bias to a certain extent, this does not necessarily reflect the reality today as things might have changed in recent years or simply were not picked up by the sample.

Concerning research question two for Scania, both path upgrading and path diversification have been referenced most frequently, closely followed by path branching.

Path upgrading in Scania takes place through the renewal of existing industry paths. In the sample examples from the overarching biotech/life science area were observed. Even if organizations like Tetra-Pak decreased their presence and the employment in agriculture is declining, the sector re-invents itself by focusing on research and development. In the ICT sector, over the past decades several periods of decline and renewed upriser have been observed. Strong connections to local universities made is possible to develop niches like the media cluster in Malmö. Large investments in research facilities like ESS and MAX IV aim to increase to collaboration between actors to create new paths and "upgrade" existing knowledge bases.

Path diversification e.g. the combination of existing knowledge bases with novel ones, is similar to path upgrading, closely connected to the regional resilience. In the sample it became evident that Scania's strong knowledge base enables it to re-combine existing paths. The moving media network is an example for path upgrading but also diversification as existing knowledge bases were combined i.e. ICT and the media industry in Scania and Blekinge in 2008.

Both path upgrading and path diversification (as well as path branching) are closely connected and developments of regional innovation systems cannot simple be classified as being one but

not the other. The general narrative that can be observed is that Scania, as the two other regions, concerns itself with "smart specialisation" where innovation systems and knowledge bases are recombined to counteract potential regional lock-in's. Especially the moving media industry which benefited from existing IT infrastructures in Lund and symbolic innovation systems i.e. creative sectors in Malmö can be one example that overlaps from path diversification to path upgrading. Furthermore, as this thesis is being written Oatly, a Lund University spin-off that produced functional food resembling dairy products based on oats, received a $200M investment by Blackstone a large private equity company from Wallstreet. This is another example of path upgrading and diversification as Oatly, builds upon the existing knowledge base of functional food and applies biotechnical advancements to upgrade existing paths. One may even say that this is an example for path creation, if development continues as rapidly as it does now.

In West-Sweden, the results need to be taken with a grain of salt as most identified developments were concerned with Gothenburg or the area surrounding the city. Nevertheless, it can be observed from the qualitative sample that the area of West-Sweden is dependent on industrial production, even if the latter is in decline. Path extension has been and still is a development path which is often observed. However, the most salient ones are, path upgrading and path diversification. Even if path creation was referenced more frequently, it does not represent the accurate salient path developments as the number of references does not automatically correspond to the most salient development path. Like other Swedish regions, West-Sweden aims to follow the path of smart specialisation. Different knowledge bases like ICT and biotech do not only secure most venture capital funding according to the quantitative sample, but also support the regional development heavily according to the qualitative sample.

Path upgrading, in West-Sweden is part of the overarching narrative of smart-specialisation. Novel initiatives that support industrial development like self-driving cars upgrade the traditional paths of industrial production. As the region was also heavily concerned with textile production, existing knowledge bases created new technologies like smart textiles that support industries that formerly faced lock-in challenges. Industrial renewal is also supported by large amounts of seed capital and incubators that support the creation of new technologies in the sectors of biotechnology and ICT.

As the industrial heart of Sweden, path diversification comes somewhat naturally, in the qualitative sample evidence was found that collaboration between formerly unrelated

knowledge bases is supported and on the regional agenda for development. One example that ties both into path upgrading and path diversification is the textile industry, which combined existing knowledge with the biotechnological knowledge base to create smart textiles.

Concerning path creation, the qualitative results somewhat echo what can be observed in the quantitative section. Venture capital flows dominantly towards ICT and biotech (closely followed by business products and services), and the number of deals and amount invested is considerably higher than in for example Scania. This can be related to qualitative findings that indicate that especially in Gothenburg, the support of start-ups through incubators and seed capital is considered important for the regional development. Chalmers University is a key player in the commercialisation of scientific advancements, and even acts as an investing organization to support university spin-offs. With regards to the sample, West-Sweden was found to have the most supportive environment for start-ups, and it creates supporting structures in different knowledge bases throughout the region.

Concerning Stockholm/Uppsala, the sample offered some interesting results that somewhat increase understanding for the overwhelming majority of venture capital investments in biotech/life science and ICT. In both cities large numbers of people are employed in the both sectors and global corporations have strong ties in science and business parks like Kista. Not surprisingly, smart specialisation is the apparent goal in Stockholm. However, as mentioned previously, in the qualitative sample evidence was found that in the first decade of the new millennia, Stockholm lacked agency and regional coordination concerning the development of regional innovation systems. The ICT sector has been developing fast and has shown high levels of resilience during the dotcom burst and the financial crisis. However, concerning the sample, the regions is profoundly focused on IT, thus; it could face lock-in challenges.

One advantage that the heavy focus on ICT carries for the region is concerned with path upgrading. The presence of large corporations that invest heavily in research and create shared knowledge hubs with local universities, enable the continued upgrading of existing technologies. Kista, aims to become the world's leading science park and is consistently ranked amongst the most renowned science parks already. Stockholm has a flourishing start-up scene that develops new technologies that upgrade existing paths but also diversify paths by combining existing knowledge bases, one may think about Klarna, Karma and the Norrsken Foundation.

Concerning Kista, it has to be noted that the latter is also closely connected to path diversification as several innovation systems or clusters i.e. ICT and biotech are located in the science park. Furthermore, strong collaboration with universities like the KTH, enable regional innovation systems to diversify and combine exiting knowledge bases with new knowledge through research and collaboration initiatives.

6 Contributions and limitations

Concerning the results section and the preceded discussion, the contributions of this study are multivocal. As the overarching aim was to accelerate the discussion concerning both venture capital and regional innovation systems in combination, this contribution is upon future scholars to fulfil. However, what has been contributed in this thesis is the clear connection between venture capital and regional development especially concerning path diversification and path upgrading.

A more practical contribution of this study may be that potential readers are entrepreneurs or venture capitalists. Thus, the latter would now have a clearer picture of the dynamics of venture capital in Swedish regions and act accordingly. If one entrepreneur seeks to gain investments in ICT, he or she may be advised to seek investments in Stockholm. If one venture capitalists seeks to invest in biotech or healthcare, the investor now knows that attention should be given to Scania instead of other Swedish regions. However, this contribution is rather a hopeful assumption by the author.

In the previous sections, some limitations were already stressed. However, before the conclusion is presented, some general limitations need to be addressed. First and foremost, this study faces the limitations of only applying descriptive approaches. These may help to understand unexplored areas like venture capital in Sweden, however, do not allow for empirical conclusions. Furthermore, the second analytical step and its qualitative nature bear the limitation of sampling, a rather small sample cannot fully explain all complex developments in regional innovation systems. It only allows for a narrow perspective that help to understand the quantitative findings.

7 Conclusion

"In economic theory the conclusions are sometimes less interesting than the route by which they are reached" Piero Sraffa

The ambiguous aim of this study was to spark the academic discussion between the two bodies of literature: "economics of innovation" and "venture capital". By presenting an extensive background of both academic bodies, clear gaps in the literature were identified. Both academic bodies evidently fail to acknowledge each other. Regional innovation studies do not sufficiently account for enabling factors of innovation, and in turn, venture capital studies oversimply innovation and dominantly focus on the US.

Based on recent work of Grillitsch et al. (2018), a theoretical framework was drafted that illustrates the dynamics of venture capital and regional innovation systems. Due to the novel nature of this study, only certain parts of the inter-relation between regional innovation and venture capital can be explored. As the theoretical framework dictates, the flow of venture capital into the regional innovation system is explored in a first advance. The second step aimed to identify the salient structures of development in regional innovation systems.

By applying a mixed methods, the overarching theoretical framework was followed accordingly. In the first step, descriptive tools were applied to investigate the regional dynamics of venture capital. In the second step a qualitative analysis was applied to increase understanding about salient development structures in regional innovation systems that secure most venture capital in Sweden.

The results delivered insightful information that can answer the first research question fully. Venture capital in Sweden follows clear regional patterns; the regions of scope secure the majority of venture capital investments in Sweden. In the respective regions, especially biotech and healthcare as well as ICT secure most of the venture capital deals. However, general regional characteristic that were quite striking indicate that start-ups only secure most of the venture capital deals. Most capital, in general, flows towards buyouts/takeover deals.

Concerning the second research question, the answer is more ambiguous. The qualitative sample delivered insightful information about development paths in Swedish regions and sectors that secured most venture capital. In all regions path diversification and path upgrading was found to be of considerable importance. The general narrative in all regions follows a smart specialisation approach where existing knowledge bases are in the focus of policy agendas. Venture capital seems to be closely connected to path diversification, upgrading and creation as venture capital flows predominantly towards existing innovation systems.

This study contributes to the academic discussion by delivering insights on regional dynamics of venture capital. As per this study, it is now clear that venture capital is highly regional and follows different sectoral streams in Swedish regions. Thus, it is hoped that an academic discussion will evolve around venture capital and its relation to regional innovation systems.

Future research

Admittedly, this thesis creates more questions than it answers. By indicating that venture capital is indeed regionally clustered in Sweden and flows towards highly innovative sectors, future research should venture into several directions. Economics of innovation and the emerging academic body around the "entrepreneurial ecosystem" or "regional system of entrepreneurship" need to concern themselves with the role of venture capital. Future studies should especially focus on the impacts of venture capital on the firm level in different regions to assess what entrepreneurs gain from venture capital investments beyond monetary factors. Furthermore, future research should combine more advanced qualitative and quantitative methods. Thus, interview actors like venture capitalists and entrepreneurs to understand their motives and what role the regional dimension plays in their decision-making process. Furthermore, the database by Tillväxtanalys and respectively SVCA, offers a foundation for future research on more detailed regional factors of venture capital and thus, should be explored accordingly.

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Appendix A

TABLE 4 OVERVIEW OF QUALITATIVE SAMPLE

Reference used in result section	Category of document	Title	Year	Reference list source
Publication 1	Publication of the European Union	Regional Innovation Monitor Plus; Regional Innovation Report (South Sweden)	2014	(Johnson & Olson, 2014)
Publication 2	Publication of the European Union	Regional Innovation Monitor; Regional Innovation Report (Stockholm)	2011	(Lindqvist & Baltzopoulos, 2011)
Publication 3	Publication of the European Union	Regional Innovation Monitor Plus Regional Innovation Report (West Sweden)	2015	(Johnson & Fredricsson, 2014)
Publication 4	Article published by Vinnova	Global trends with local effects	2014	(Sandström & VINNOVA, 2014)
Publication 5	Publication of the European Union	Place-Based Innovation Ecosystems: Volvo companies in Gothenburg (Sweden)	2019	(Sorvik, Zingmark & Ardenfors, 2019)
Article 1	Paper published in academic journal	Nordic SMEs and Regional Innovation Systems	2003	(Asheim, Coenen & Henning, 2003)
Article 2	Paper published in academic journal	Knowledge bases and regional innovation systems: Comparing Nordic clusters	2005	(Asheim & Coenen, 2005b)
Article 3	Paper published in academic journal	The Geography of Innovation: Regional Innovation Systems	2006	(Asheim & Gertler, 2006)

Article 4	Paper published in academic journal	Comparing knowledge bases: on the geography and organization of knowledge sourcing in the regional innovation system of Scania, Sweden	2013	(Martin & Moodysson, 2013)
Article 5	Paper published in academic journal	Metropolitan Innovation Systems: A Comparison between Barcelona, Stockholm, and Vienna:	2016	(Diez, 2016)
Article 6	Paper published in academic journal	Policy capacities for new regional industrial path development – The case of new media and biogas in southern Sweden:	2016	(Martin & Martin, 2016)
Article 7	Paper published in academic journal	Multiple paths of development: knowledge bases and institutional characteristics of the Swedish food sector	2016	(Zukauskaite & Moodysson, 2016)
Article 8	Paper published in academic journal	Knowledge Base Combinations and Innovation Performance in Swedish Regions	2017	(Grillitsch, Martin & Srholec, 2017)
Article 9	Paper published in academic journal	Innovation Policy as Performativity—the Case of Sweden	2017	(Hall & Löfgren, 2017)
Article 10	Paper published in academic journal	The evolution of the ICT cluster in southern Sweden – regional innovation systems, knowledge bases and policy actions	2017	(Martin & Trippl, 2017)
Article 11	Paper published in academic journal	Place-based innovation policy for industrial diversification in regions	2018	(Grillitsch & Asheim, 2018)
Article 12	Paper published in academic journal	Innovation Policies and New Regional Growth Paths: A place-based system failure framework	2018	(Grillitsch & Trippl, 2018)
Article 13	Paper published in academic journal	Smart specialisation, innovation policy and regional innovation systems: what about new path development in less innovative regions?	2019	(Asheim, 2019)
Article 14	Paper published in academic journal	Innovation policy for system-wide transformation: The case of strategic innovation programmes (SIPs) in Sweden	2019	(Grillitsch et al., 2019)

Article 15	Paper published in academic journal	Roles of intermediaries in supporting eco-innovation	2018	(Kanda et al., 2018)
Article 16	Paper published in academic journal	Embracing the future: path transformation and system reconfiguration for self-driving cars in West Sweden	2019	(Miörner & Trippl, 2019)

TABLE 5 REFRENCES AND CODES IN SAMPLE

	Codes	References
Publication 1	7	126
Publication 2	7	72
Publication 3	7	198
Publication 4	14	55
Publication 5	4	15
Article 1	14	29
Article 2	4	7
Article 3	0	0
Article 4	6	36
Article 5	6	29
Article 6	4	10
Article 7	5	16
Article 8	9	12
Article 9	7	18
Article 10	5	31

Article 11	0	0
Article 12	0	0
Article 13	4	5
Article 14	0	0
Article 15	5	13
Article 16	6	23

TABLE 6 REFRENCES PER FILE PER REGION AND CODE

Code	Files	Reference
Scania	11	88
Path branching	5	15
Path creation	4	9
Path diversification	6	18
Path extension	5	13
Path importation	0	0
Path upgrading	9	33
Stockholm Uppsala	6	54
Path branching	4	6
Path creation	1	3

Path diversification	4	14
Path extension	3	8
Path importation	0	0
Path upgrading	6	23
West-Sweden	7	99
Path branching	4	8
Path creation	5	22
Path diversification	3	20
Path extension	3	15
Path importation	0	0
Path upgrading	4	34

TABLE 7 DESCRIPTION OF QUANTIATIVE VARIABLES

Variable	Variable shortcut in analysis	Description	Scale	Source
R&D expenditure Public sector	RDPub	R&D expenditure in the public sector as per cent of regional GDP. Found to be particularly important for innovation in knowledge-based economies	Per cent, 0-1, where zero is the lowest possible score and one the highest possible score	(Es-Sadki et al., 2017; European Commission & Directorate-General for Internal Market, 2016, 2019b; European Commission & Enterprise and Industry Directorate-General, 2009, 2012, 2014)
R&D Expenditure business sector	RDBus	R&D expenditure in business sector as per cent of regional GDP. Indicates the formal creation of new knowledge within firms. Particularly important for science-based sectors	same as above	Same as above
Non-Innovative R&D expenditure	NonInExp	Measures factors like organizations acquiring new machinery, patents and similar activities.	same as above	Same as above

SMEs innovating in house	SMEInInH	SMEs that introduced novel or improved innovative products and services that have been developed "in-house" in SMEs	same as above	Same as above
Innovative SMEs collaborating with others	SMEColO	Co-operation of SMEs with other firms and public research institutions. Measures the flow of knowledge between the latter. Indicator for complex regional knowledge networks	same as above	Same as above
EPO Patent Applications	EpoApp	Measures European patent applications, patents are often used as an innovation indicator in comparison with the GDP.	same as above	Same as above
SMEs introducing product or process innovations	SMEProInn	Technological innovations measured by introduction of new products (goods or services) and processes. High levels should indicate higher regional innovation activity	same as above	Same as above

SMEs introducing marketing or organizational innovation	SMEMarOrIn	Non-technical innovations especially important in service sectors.	same as above	Same as above
Employment in medium/high tech manufacturing and knowledge intensive services	EmpInn	Manufacturing and service employees that are involved in innovative processes and creation of new products/services.	same as above	Same as above
Sales of new to market products and services	SalesNewPro	Measures both creation of technologies as well as the diffusion of the latter, i.e. when other firms adopt new technologies	same as above	Same as above
Regional GDP mining, quarrying and manufacturing industry (B05 -C33)	LNRGDPMinQuManuInd	regional GDP for each respective region, the rationale behind using split up regional GDP is to measure impacts on an as micro level as possible	reported in Million SEK from 2007 - 2017 , in analysis ln for each respective year is generated and used in the regression	(SCB, 2018)

Regional GDP Information and communication (D35 - E39)	LNRGDPICT	same as above	same as above	(SCB, 2018)
Regional GDP financial services and insurance activities (K64 – K66)	LNRGDPFinIns	same as above	same as above	(SCB, 2018)
Regional GDP Professional, Scientific, technical and admin activities (M65 -M82)	LNRDGPProSciTech	same as above	same as above	(SCB, 2018)
Electricity, gas, steam and air conditioning, water supply, waste (D35-E39)	LNRGDPElectricWaWat	Same as above	Same as above	(SCB, 2018)
Year of Investment	YearInv	Year of investment deal	2007 - 2018	Tillväxtanalys and respectively SVCA

Business sector of company receiving investment	RepProMainBusSec	Business sectors include sectorial categories like: Biotech, healthcare, ICT, business services etc.	categorical	Tillväxtanalys and respectively SVCA
Fund Stage focus	FundStaFoc	Focus of the fund: Early Stage, Start-ups, buyouts etc.	categorical	Tillväxtanalys and respectively SVCA
Investment stage of company receiving investment	InvStaReco	Stage of the company receiving the investment: Start-up, buyout, early venture, seed round	categorical	Tillväxtanalys and respectively SVCA
Type of Largest Shareholder	LarShaTypeFirm	Variable indicating the type of largest shareholder. Not universally available. Indicate shareholder like: private individuals or government agency	categorical	Tillväxtanalys and respectively SVCA
Investment amount	sumofinv	Amount invested in particular deal	Thousands in SEK	Tillväxtanalys and respectively SVCA

Appendix B

SWEDEN

TABLE 8 DESCRIPTIVE STATISTICS INVESTMENTS PER BUSINESS SECTOR SWEDEN

Descrpitive statistics Business sector							
RepProMainBusSec	mininvest	meaninvest	maxinvest	numberinv	sumofinv	percentinv	percent of amount
Agriculture	250	413824.42	6951240.5	27	11173259	0.35284893	3.844231824
Biotech and healthcare	0.4495	27637.78	5237613.2	1960	54170048	25.614219	18.6375544
Business products and services	0.0961	59710.083	5072918	1140	68069495	14.898066	23.41974879
Chemicals and materials	10	24503.745	1624470	172	4214644.1	2.2477784	1.450075486
Construction	51.28	83212.313	2547353	73	6074498.9	0.95399895	2.089970526
Consumer goods and services	0.0961	67780.202	3514950	750	50835151	9.8013591	17.49016158
Energy and environment	0.2	21909.764	3391558.8	485	10626235	6.3382122	3.656024689
Financial and insurance activities	100	211386.64	3846876.8	95	20081730	1.2415055	6.909248729
ICT (Communications, computer and electronics)	0.0961	20040.842	4393750	2856	57236644	37.323576	19.69263653
Other	28.652	13391.904	145166.8	47	629419.46	0.6142185	0.216555825
Real estate	476.38	64066.655	374400	6	384399.93	0.07841087	0.132255275
Transportation	100	174498.9	4955500	41	7154454.9	0.53580763	2.461536353

TABLE 9 DESCRIPTIVE STATISTICS FUND STAGE FOCUS SWEDEN

Descriptive statistics Fund Stage focus						
FundStaFoc	mininvest	meaninvest	maxinvest	numberinv	sumofinv	percentinv
Buyout	14.88	346784.76	6951240.5	639	221595460.2	8.350758
Corporate venture	1650	47477.692	814550.85	25	1186942.3	0.32671197
Early stage venture	0.936	5332.2579	122186.9	1679	8952861	21.941976
Generalist	4.13	28414.623	802560	712	20231211	9.3047569
Growth capital	171.759	43794.784	583200	189	8277214.3	2.4699425
Later stage venture	0.7	2527.5077	200000	1395	3525873.2	18.230528
Mezzanine	2464.8	92615.521	413140	45	4167698.5	0.58808155
(other not classsified because sensible)	4294.44	4294.44	4294.44	1	4294.44	0.01306848
Venture (all stages)	0.0961	7653.6654	655244.24	2967	22708425	38.774177

TABLE 10 DESCRIPTIVE STATISTICS REGIONAL VC INVESTMENTS SWEDEN

Descriptive statistics State Region of company invested in							
PorComSta	mininvest	meaninvest	maxinvest	numberinv	sumofinv	percentinv	percent amount
	9.51	5391.5101	97500	48	258792.48	0.62728698	0.089039221
Blekinge	16.269	21462.88	301036	47	1008755.4	0.6142185	0.347068798
Dalarna	80	43659.799	364049	44	1921031.2	0.57501307	0.660943168
Gotland	3.069	3957.8353	44458.927	25	98945.882	0.32671197	0.034042969
Gävleborg	50	27137.508	412474.62	67	1818213.1	0.87558808	0.625567938
Halland	300.72	40066.049	525250	50	2003302.4	0.65342394	0.689249105
Jämtland	29	3741.3267	26100	51	190807.66	0.66649242	0.065648605
Jönköping	100	34656.196	1000000	97	3361651	1.2676424	1.156597697
Kalmar	10	25100.34	344666.5	56	1405619.1	0.73183481	0.483612312
Kronoberg	125	30137.87	340400	35	1054825.5	0.45739676	0.362919513
Norrbotten	4.6176	9551.5405	168356.48	117	1117530.2	1.529012	0.384493469
Other	46	53614.984	3248347.5	207	11098302	2.7051751	3.818442346
Skåne	33.33	63944.917	5072918	706	45145112	9.2263461	15.5324668

Stockholm	0.0961	52572.059	6951240.5	2613	137370791.1	34.762154	49.80727595
Södermanland	196.63	64952.107	814550.85	47	3052749.1	0.6142185	1.050318007
Unknown	0.52	21898.634	2881323.5	1347	29497460	17.603241	10.14879126
Uppsala	0.7	59416.448	5237613.2	316	18775598	3.9205436	3.971780391
Värmland	11	23407.662	270354.24	62	1451275.1	0.81024569	0.499320553
Västerbotten	2.85	12162.182	888765	173	2104057.6	2.2608468	0.723914581
Västernorrland	100	7191.9556	153307.33	56	402749.51	0.73183481	0.138568565
Västmanland	6	15900.591	238830.39	72	1144842.5	0.94093048	0.393890442
Västra Götaland	0.4495	19808.46	2573120	1076	21313903	14.061683	7.333185723
Örebro	19	58401.855	542520	27	1576850.1	0.35284893	0.542525442
Östergötland	3.744	11753.155	624204	282	3314389.7	3.685311	1.140337142

TABLE 11 DESCRIPTIVE STATISTICS INVESTMENT STAGE REPORTING COMPANY SWEDEN

Investment stage Reporting company							
InvStaReco	mininvest	meaninvest	maxinvest	numberinv	sumofinv	percentinv	percent amount
Buyout	35.93044	314780.44	6951240.5	723	227586260.7	9.4485102	78.30252051
Growth capital	0.0961	35064.844	814550.85	557	19531118	7.2791427	6.719807089
Later stage venture	5	9999.2311	600669.57	1783	17828629	23.301098	6.13405477
Replacement capital	100	84228.055	955711.86	57	4800999.2	0.74490329	1.651814733
Rescue/Turnaround	73	12874.289	240000	49	630840.14	0.64035546	0.217044618
Seed	0.52	1641.6564	57210.43	883	1449582.6	11.539467	0.498738241
Start-up	0.2	5228.4864	210104	3600	18822551	47.046524	6.476020044

TABLE 12 DESCRIPTIVE STATISTICS LARGEST SHAREHOLDER SWEDEN

Largest Shareholder Firm type investment							
LarShaTypeFirm	mininvest	meaninvest	maxinvest	numberinv	sumofinv	percentinv	
Academic institution	7.16	6071.5785	87400	214	1299317.8	2.7966545	0.447038667
Bank	90	8232.438	80480	162	1333655	2.1170936	0.458852602
Capital markets	8.5	38386.558	1072000	328	12590791	4.2864611	4.33194283
Corporate investor	9.51	9652.9499	221280	430	4150768.4	5.6194459	1.428098632
Family office	111.41	25029.273	329192.5	78	1952283.3	1.0193413	0.671695658
Foundation	250	66950.709	1774272.8	68	4552648.2	0.88865656	1.566367969
Fund of funds	3	793.8222	13005	192	152413.86	2.5091479	0.052438971
Government agency	0.2	3685.1343	583200	2797	10307321	36.552535	3.546300252
Insurance company	40.67	14545.579	814550.85	70	1018190.6	0.91479352	0.350315041
None	0.0961	110187.82	6951240.5	1848	203627086.2	24.150549	70.059212
Other	2.823	45146.794	1960855	178	8036129.3	2.3261892	2.764882103
Other asset manager	20	5012.3887	90175.439	196	982428.19	2.5614219	0.338010754
Private individuals	1.2866	39871.992	2573120	776	30940666	10.14114	10.64533565
Private pension fund	1500	86082.313	553500	59	5078856.5	0.77104025	1.747413328
Public pension fund	4.13	18075.881	525250	256	4627425.4	3.3455306	1.592095547

TABLE 13 DESCRIPTIVE STATISTICS INVESTMENTS PER YEAR SWEDEN

Investments by year						
YearInv	mininvest	meaninvest	maxinvest	numberinv	sumofinv	percentinv
2007	7.16	38405.604	3617644.5	824	31646217	10.768427
2008	2.823	33425.268	5072918	730	24400445	9.5399895
2009	1.023	19485.877	1202880	644	12548905	8.4161004
2010	0.0961	37978.849	3391558.8	767	29129777	10.023523
2011	0.4495	49617.809	4955500	645	32003487	8.4291688
2012	0.2	33083.531	4213250	648	21438128	8.4683743
2013	2	14296.24	1079820	658	9406925.9	8.5990591
2014	1.2866	36812.016	6951240.5	601	22124021	7.8541558
2015	1	31852.047	4168141.6	546	17391217	7.1353894
2016	1.4	47945.515	3248347.5	498	23876867	6.5081025
2017	0.52	58097.858	3846876.8	529	30733767	6.9132253
2018	0.73	63968.369	5237613.2	562	35950223	7.3444851

SCANIA

TABLE 14 DESCRIPTIVE STATISTICS SCANIA

Region Total inv						
PorComSta	mininvest	meaninvest	maxinvest	numberinv	sumofinv	percentinv
Skåne	33.33	63944.917	5072918	706	45145112	100

TABLE 15 DESCRIPTIVE STATISTICS VC INVESTMENTS PER YEAR SCANIA

Descriptive investment per year						
YearInv	mininvest	meaninvest	maxinvest	numberinv	sumofinv	percentinv
2007	60	48214.354	2325000	84	4050005.7	11.898017
2008	68.468606	96566.494	5072918	69	6663088.1	9.7733711
2009	53.523656	16894.259	400000	65	1098126.9	9.2067989
2010	147	31398.876	651229.6	88	2763101.1	12.464589
2011	171.75904	201731.19	4474552.5	63	12709065	8.9235127
2012	90	53081.281	1096472.4	50	2654064.1	7.082153
2013	61	10652.308	170000	77	820227.69	10.906516
2014	400	15571.959	180384.16	37	576162.47	5.2407932
2015	1000	161103.88	4168141.6	37	5960843.6	5.2407932
2016	100	123708.51	1903352	43	5319466.1	6.0906516
2017	33.33	11425.513	218645.78	56	639828.76	7.9320113
2018	166.66	51111.679	814770.45	37	1891132.1	5.2407932

TABLE 16 DESCRIPTIVE STATISTICS INVESTMENTS PER BUSINESS SECTOR SCANIA

Sectoral investment descriptive stat							
RepProMainBusSec	mininvest	meaninvest	maxinvest	numberinv	sumofinv	percentinv	percent of total inv
Biotech and healthcare	90	28145.428	1903352	223	6276430.4	31.586402	14.0827199
Business products and services	60	192812.09	5072918	118	22751826	16.713881	51.04933414
Construction	2809	136734.22	400000	7	957139.53	0.9915014	2.147578647
Consumer goods and services	53.523656	83415.152	2325000	101	8424930.3	14.305949	18.90340942
Energy and environment	33.33	11493.296	284900	62	712584.36	8.7818697	1.598858795
Financial and insurance activities	600	266570.66	1096472.4	7	1865994.6	0.9915014	4.186819196
ICT (Communications, computer and electronics)	100	20109.021	814770.45	178	3579405.8	25.212465	8.031279895
Other (Transportation, Chemicals and material, Agriculture)	not available	not available	not available	10	576800.34	1.41643	1.29419385

TABLE 17 DESCRIPTIVE STATISTICS FUND STAGE FOCUS SCANIA

Fund stage focus descriptive							
FundStaFoc	mininvest	meaninvest	maxinvest	numberinv	sumofinv	percentinv	percent of total inv
Buyout	61	443899.62	5072918	86	38175367	12.181303	84.56146339
Early stage venture	60	5058.4445	59532.33	212	1072390.2	30.028329	2.375429282
Generalist	53.523656	22970.25	329192.5	74	1699798.5	10.481586	3.76518839
Growth capital	171.75904	24588.317	180000	26	639296.24	3.6827195	1.416091837
Later stage venture	250	5856.347	72750	33	193259.45	4.674221	0.428084998
Venture (all stages)	33.33	8427.0366	195088.92	265	2233164.7	37.535411	4.946636794
Other (Mezzanine, Corporate Venture)	not available	not available	not available	10	1131835.49	1.41643	2.507105311

TABLE 18 DESCRIPTIVE STATISTICS INVESTMENT STAGE REPORTING COMPANY SCANIA

Investment stage reporting company							
InvStaReco	mininvest	meaninvest	maxinvest	numberinv	sumofinv	percentinv	percent of total inv
Buyout	111.41	434666.12	5072918	91	39554617	12.889518	87.61661181
Growth capital	53.523656	15888.455	400000	72	1143968.7	10.1983	2.533981343
Later stage venture	68.468606	7244.9275	44201	155	1122963.8	21.954674	2.487453825
Seed	200	2361.0838	17599.86	61	144026.11	8.6402266	0.319029249
Start-up	33.33	7714.9398	195088.92	319	2461065.8	45.184136	5.451455815
Other (Replacement, Rescue)	not available	not available	not available	8	718469.98	1.133144	1.591467953

TABLE 19 DESCRIPTIVE STATISITCS LARGEST SHAREHOLDER SCANIA

largest shareholder descriptive							
LarShaTypeFirm	mininvest	meaninvest	maxinvest	numberinv	sumofinv	percentinv	percent of total inv
Bank	90	5490.7542	15000	28	153741.12	3.9660057	0.347618537
Capital markets	53.523656	37651.192	400000	62	2334373.9	8.7818697	5.278169165
Corporate investor	816.93	17316.552	89294.789	31	536813.12	4.3909348	1.213768907
Family office	111.41	25108.845	329192.5	34	853700.75	4.815864	1.930272171
Foundation	250	6166.088	38808	17	104823.5	2.407932	0.237012659
Government agency	33.33	5086.0153	51800	184	935826.81	26.062323	2.115964462
None	68.468606	192825.1	5072918	177	34130042	25.070822	77.1702148
Other	100	213730.36	1903352	10	2137303.6	1.4164306	4.832580573
Other asset manager	60	2202.3164	17308	36	79283.39	5.0991501	0.179264832
Private individuals	100	25552.865	478000	109	2785262.3	15.439093	6.297656767
Public pension fund	2232	17579.206	99216	10	175792.06	1.4164306	0.397477127
Other (academic institution, insurance company, private pension fund)	not available	not available	not available	8	918149	1.133144	2.075993799

West Sweden

TABLE 20 DESCRIPTIVE STATISTICS WEST SWEDEN

Total investments descriptive statistics						
PorComSta	mininvest	meaninvest	maxinvest	numberinv	sumofinv	percentinv
Västra Götaland	0.4495	19808.46	2573120	1076	21313903	100

TABLE 21 DESCRIPTIVE STATISTICS INVESTMENTS PER BUSINESS SECTOR WEST SWEDEN

Investment descriptive per sector							
RepProMainBusSec	mininvest	meaninvest	maxinvest	numberinv	sumofinv	percentinv	percent of total investment
Biotech and healthcare	0.4495	5585.9383	136000	205	1145117.4	19.052045	5.372631223
Business products and services	1.4	31473.849	2573120	199	6263295.9	18.494424	29.38596437
Chemicals and materials	10	2111.6559	16531.614	75	158374.19	6.9702602	0.743055793
Consumer goods and services	27.47	83730.243	1079820	104	8707945.2	9.6654275	40.85570464
Energy and environment	25	7947.6488	184374.68	112	890136.67	10.408922	4.176319447
ICT (Communications, computer and electronics)	0.936	9395.0763	811311.88	361	3391622.6	33.550186	15.9127243
Transportation	400	4363.7778	19000	9	39274	0.83643123	0.184264704
Other (not classified because sensitive)	not available	not available	not available	11	718136.9	1.02230483	3.369335521

TABLE 22 DESCRIPTIVE STATISTICS YEAR OF INVESTMENT WEST SWEDEN

Year of investment descriptive statistics							
YearInv	mininvest	meaninvest	maxinvest	numberinv	sumofinv	percentinv	percent of total investment
2007	11	12580.169	354330	98	1232856.5	9.1078067	5.784283221
2008	12.47	38363.261	2573120	105	4028142.4	9.7583643	18.899131
2009	1.023	15043.679	360000	110	1654804.7	10.223048	7.763968524
2010	0.936	14551.639	423467.54	126	1833506.5	11.710037	8.60239686
2011	0.4495	6547.828	210816.61	112	733356.74	10.408922	3.440743579
2012	1.1817	15652.877	629351.1	105	1643552.1	9.7583643	7.711173876
2013	2	18135.305	1079820	108	1958613	10.037175	9.189368197
2014	25	20629.382	655244.24	65	1340909.8	6.0408922	6.29124481
2015	10	33278.185	495000	36	1198014.7	3.3457249	5.620813394
2016	1.4	21923.141	929414.06	78	1710005	7.2490706	8.022955818
2017	5	29712.912	564084.6	64	1901626.3	5.9479554	8.921999519
2018	95	30123.406	811311.88	69	2078515	6.4126394	9.751921201

TABLE 23 DESCRIPTIVE STATISTICS FUND STAGE FOCUS WEST SWEDEN

Fund stage focus descriptive statistics							
FundStaFoc	mininvest	meaninvest	maxinvest	numberinv	sumofinv	percentinv	percent of total investment
Buyout	157.197	228596.9	2573120	61	13944411	5.669145	65.42401575
Early stage venture	0.936	2258.1925	122186.9	385	869404.11	35.780669	4.079047023
Generalist	27.47	30425.232	629351.1	98	2981672.7	9.1078067	13.98933248
Growth capital	1000	55129.24	155400	14	771809.36	1.3011152	3.621154577
Later stage venture	2	2219.0973	52061.52	133	295139.94	12.360595	1.384729702
Venture (all stages)	0.4495	4897.9058	655244.24	377	1846510.5	35.037175	8.663408733
Other (not classified because sensible data)	not available	not available	not available	8	604955	0.74349442	2.83831174

TABLE 24 DESCRIPTIVE STATISTICS INVESTMENT STAGE REPORTING COMPANY WEST SWEDEN

Investment stage reporting company							
InvStaReco	mininvest	meaninvest	maxinvest	numberinv	sumofinv	percentinv	percent of total investment
Buyout	157.197	198095.48	2573120	83	16441925	7.7137546	77.14178563
Growth capital	95	22724.796	153100	39	886267.04	3.6245353	4.158164084
Later stage venture	5	8353.9965	136000	202	1687507.3	18.773234	7.917401788
Seed	1.4	681.79494	11135.6	150	102269.24	13.94052	0.479824095
Start-up	0.4495	2638.8952	78422.078	594	1567503.7	55.204461	7.354372095
Other (not classified because sensible data)	not available	not available	not available	8	628430.25	0.74349442	2.948452303

TABLE 25 DESCRIPTIVE STATISTICS LARGEST SHAREHOLDER WEST SWEDEN

Largest shareholder descriptive statistics							
LarShaTypeFirm	mininvest	meaninvest	maxinvest	numberinv	sumofinv	percentinv	percent of total investment
Academic institution	94	1012.4047	10500	70	70868.33	6.5055762	0.332498134
Bank	200	3667.0317	15000	23	84341.73	2.1375465	0.395712271
Capital markets	120	70928.225	360000	17	1205779.8	1.5799257	5.657245393
Corporate investor	25	6677.757	74586.561	79	527542.8	7.3420074	2.475111189
Fund of funds	3	762.49298	8500	162	123523.86	15.055762	0.57954594
Government agency	0.4495	3506.8736	74971	382	1339625.7	35.501859	6.285220005
None	1.4	47268.209	1079820	218	10304470	20.260223	48.34623655
Private individuals	270	79469.911	2573120	76	6039713.2	7.063197	28.33696474
Public pension fund	27.47	17618.69	85215	37	651891.52	3.4386617	3.058527186
Other (family office, foundation, private pension fund, other asset manager, other)	not available	not available	not available	12	966146.138	1.11524164	4.532938592

Stockholm / Uppsala

TABLE 26 DESCRIPTIVE STATISTICS STOCKHOLM/UPPSALA

Region descriptive stat						
RepProSta	mininvest	meaninvest	maxinvest	numberinv	sumofinv	percentinv
Stockholm	0.0961	52572.059	6951240.5	2613	137370791.1	89.211335
Uppsala	0.7	59416.448	5237613.2	316	18775598	10.788665

TABLE 27 DESCRIPTIVE STATISTICS INVESTMENT YEAR STOCKHOLM/UPPSALA

Year investment descriptive						
YearInv	mininvest	meaninvest	maxinvest	numberinv	sumofinv	percentinv
2007	7.16	55263.738	3617644.5	367	20281792	12.529874
2008	2.823	21848.417	472016.16	333	7275523	11.369068
2009	8.5	20076.022	523500	279	5601210.1	9.5254353
2010	0.0961	65761.468	3391558.8	312	20517578	10.6521
2011	25.8912	53205.359	4955500	249	13248134	8.5011949
2012	0.2	63611.279	4213250	225	14312538	7.6818027
2013	4	18639.374	912900	212	3951547.2	7.2379652
2014	1.2866	94179.196	6951240.5	169	15916284	5.7698873
2015	1	25188.554	1279185.6	248	6246761.3	8.4670536
2016	2.77	60716.055	1451436	155	9410988.5	5.2919085
2017	0.7	96418.471	3846876.8	183	17644580	6.2478662
2018	0.73	110352.55	5237613.2	197	21739452	6.725845

TABLE 28 DESCRIPTIVE STATISTICS BUSINESS SECTOR STOCKHOLM/UPPSALA

Business sector descriptive stat							
RepProMainBusSec	mininvest	meaninvest	maxinvest	numberinv	sumofinv	percentinv	amount inv perc
Biotech and healthcare	0.7	41521.947	5237613.2	832	34546260	28.405599	22.12427717
Business products and services	0.0961	67680.623	4213250	287	19424339	9.7985661	12.4398259
Chemicals and materials	25.839	44936.155	1624470	57	2561360.8	1.9460567	1.640358646
Construction	57.195122	98297.663	2547353	34	3342120.5	1.1608057	2.14037642
Consumer goods and services	0.0961	86787.217	3514950	283	24560783	9.6620007	15.72933136
Energy and environment	0.2	70559.923	3391558.8	103	7267672	3.5165586	4.654396445
Financial and insurance activities	300	313517	3846876.8	43	13481231	1.4680778	8.63371292
ICT (Communications, computer and electronics)	0.0961	29145.255	4393750	1275	37160200	43.530215	23.79830884
Other (combined because sensitive data)	not availabke	not available	nit availabel	15	13802423.15	0.5121208	8.839412297

TABLE 29 DESCRIPTIVE STATISTICS FUND STAGE FOCUS STOCKHOLM/UPPSALA

Fund Stage Focus descriptive							
FundStaFoc	mininvest	meaninvest	maxinvest	numberinv	sumofinv	percentinv	amount inv perc
Buyout	14.88	404155.41	6951240.5	300	121246622.6	10.242404	77.64932905
Early stage venture	1.2866	7725.0086	90175.439	683	5276180.9	23.318539	3.378996446
Generalist	4.13	31983.096	802560	337	10778303	11.505633	6.902691212
Growth capital	300	44846.094	583200	93	4170686.7	3.1751451	2.671010681
Later stage venture	0.7	4448.2346	106992.9	342	1521296.2	11.67634	0.974275627
Mezzanine	22494	108027.07	413140	12	1296324.9	0.4096961	0.830198455
Venture (all stages)	0.0961	10244.988	192907.68	1154	11822716	39.399112	7.57155907
other (no classification as sensible data)	not available	not available	not available	8	34257.681	0.2731308	0.021939464

TABLE 30 DESCRIPTIVE STATISTICS INVESTMENT STAGE REPORTING COMPANY STOCKHOLM/UPPSALA

Investment stage reporting company descriptive							
InvStaReco	mininvest	meaninvest	maxinvest	numberinv	sumofinv	percentinv	amount inv perc
Buyout	35.930441	383674.75	6951240.5	316	121241221.5	10.788665	77.64586959
Growth capital	0.0961	42384.32	802560	305	12927218	10.41311	8.278909355
Later stage venture	7	11631.381	600669.57	827	9619152.5	28.234892	6.16034259
Replacement capital	800	95287.288	955711.86	23	2191607.6	0.7852509	1.40355958
Rescue/Turnaround	73	4842.8014	37282.23	17	82327.623	0.5804029	0.052724641
Seed	0.7	2384.5213	36651.62	187	445905.48	6.3844315	0.285568871
Start-up	0.2	7686.5679	210104	1254	9638956.2	42.813247	6.173025369

TABLE 31 DESCRIPTIVE STATISTICS LARGEST SHAREHOLDER STOCKHOLM/UPPSALA

Larges shareholder descriptive							
LarShaTypeFirm	mininvest	meaninvest	maxinvest	numberinv	sumofinv	percentinv	amount inv perc
Academic institution	7.16	9421.6357	87400	123	1158861.2	4.1993855	0.742163306
Bank	99	10451.362	68950	78	815206.21	2.6630249	0.522078171
Capital markets	8.5	36934.602	1072000	175	6463555.4	5.9747354	4.139420361
Corporate investor	150	10597.578	175000	152	1610831.9	5.1894845	1.031616495
Family office	1529.55	27846.006	279300	25	696150.15	0.8535336	0.445831733
Foundation	347	94037.779	1774272.8	39	3667473.4	1.3315125	2.348740457
Fund of funds	6	1016.8571	13005	28	28472	0.9559577	0.018234171
Government agency	0.2	6263.0465	583200	734	4597076.2	25.059747	2.944081028
Insurance company	40.67	2566.3748	37391.88	51	130885.12	1.7412086	0.08382206
None	0.0961	149204.85	6951240.5	794	118468647.8	27.108228	75.87024514
Other	2.823	21364.797	1960855	120	2563775.6	4.0969614	1.641905153
Other asset manager	200	20638.892	90175.439	28	577888.99	0.9559577	0.370094368
Private individuals	1.2866	28276.001	949248	390	11027640	13.315125	7.062372754

Private pension fund	1500	46386.813	553500	37	1716312.1	1.2632298	1.099168617
Public pension fund	4.13	16926.532	348000	155	2623612.5	5.2919085	1.680226181