UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

The driving forces of Venture Capital funding in Sweden

A longitudinal study of the determinants and principal components of Venture Capital funding in Sweden from 2001 to 2020

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Abstract

This thesis analyses the driving forces of Venture Capital (VC) funding in Sweden over the years 2001 - 2020. The driving forces of VC funding is an essential piece in understanding how well the Swedish VC industry works and fulfills its purpose in the economy. This knowledge is missing in the literature. The main novelty of this research is the multifaceted investigation of the determinants, economic crises and overarching effects which might affect VC funding in Sweden. The dataset investigated consists of 10 different determinants in the form of economic variables from different institutional environments and four dependent variables in composite-source measures for each of the VC funding investment stages (Total, Seed, Startup and Expansion funding). This data is analyzed using OLS regression models and the dimensionality-reduction technique Principal Component Analysis (PCA); a novel application for investigating the Swedish VC industry. The results show that VC funding was affected positively by the positive development of the stock market, higher interest rates and larger spending on research and development (R&D) but negatively affected by more patent applications and a higher level of labor market rigidity. The regression results vary heavily between different investment stages and the effects of IPO activity and corporate tax rate could surprisingly not be established in any stage. It is also concluded that the economic crises of the period drastically harmed the amount of VC funding. From the PCA, the two components “Investor focus on VC and Innovation” and “State of the Financial Market” were significant in explaining VC funding which confirms the existence of cohesive effects in the economy capable of providing better ground for future research around the true drivers of VC funding in Sweden.

Keywords: Venture capital, funding, driving forces, Sweden, determinants, regression, OLS, stock market, interest, gdp growth, corporate tax, patent applications, innovation, labor market rigidity, principal component analysis, PCA

JEL: G24, C32, O43

Foreword

From the start of the thesis process, we thought that the Swedish VC industry had an exciting and unexplored aura around it. This aura culminated after reading an article about the ramping amounts of VC funding in the Swedish economy despite the continuous news about the drastic effects of the COVID-19 pandemic on the rest of the economy. This article encouraged us to understand how the Swedish VC industry tackled economic crises and made us hypothesize about its superior handling of them throughout the years. The first scope and purpose of the investigation were to perform a descriptive analysis of the economic crises starting with the Swedish real-estate crisis in the 1990s, followed by the dot-com bubble, the global financial crisis and the Euro crisis, to understand how the Swedish VC industry handled economic crises.

Additional dwelling into the subject quickly expanded the scope of the investigation after realizing that there essentially didn't exist a lot of literature on the crises or the determinants for the Swedish VC industry on which to base the descriptive analysis. By taking the "small" step of including a full-blown investigation of the determinants of VC funding to draw any reasonable conclusions about the crises, the study to be performed in the thesis had a new goal.

After investigating the literature even further and working for a while with this scope, another obstacle was stumbled upon that was harder to overcome: The inherent and inevitable collinearity of the determinant variables due to them being affected together by economic crises, booms, recessions or some other effects that were yet unexplained. Discussions led nowhere and the determinant literature provided little guidance other than pointing towards the need for a dimensionality reduction that may solve the problem. The problem became more prominent as we realized that the conclusions from the determinant regressions would probably be heavily misdirected at the same time as we discovered the Principal Component Analysis (PCA) technique from discussions with a friend that studied statistics. The solution to identifying the true drivers of VC funding became evident and the research question took its final form. The purpose of the investigation was set and the results became much more interesting than what was anticipated when we first read that article at the end of last year. The results proved fruitful from the determinant research and from the PCA, both providing an understanding of the Swedish VC industry over the last two decades about which has yet only been speculated.

It might seem counterintuitive to be meta-critical to the investigation applied in this thesis, which it sometimes can seem like we are throughout the sections. Regressing VC funding on "independent" and "exogenous" economic and social variables to identify individual determinants is challenging. The conclusions quickly become bland and non-inspiring to the stakeholders of the knowledge brought forward from the investigation, as the variables are part of this larger and much more intricately working economic system. Developing the

determinants research almost became necessary to properly investigate the VC industry and to be able to draw the correct conclusions. The application of dimensionality reduction for investigating the VC industry in particular, is a novel way to provide deeper insights into aspects that are often hard to explain because of violations to the ceteris paribus principle. We have read reports and articles applying PCA to some other economic topics, but the most exciting is that we have seen its use increasing in the literature only in the last few years. The method itself is anything but intuitive, compared to regressions that are somewhat easily understood: X affects Y by coefficient Z. Still, its application and results provide ways to understand previously dim aspects of everyday life. We can talk for hours on end about the novel applications of PCA and its possibilities, but the point is that the results obtainable from performing a reduction of dimensions in social sciences inhibits an immense untapped potential. The VC industry is just a tiny subset of the vast economic and social system we all are a part of.

Looking back at the thesis process, it has been challenging and very demanding at times. Especially demanding was the work when we realized that the appropriate data was unavailable to us in our positions as university students. However, the process has been quite enjoyable and very rewarding, as the investigation provided us with the opportunity to dig deeper into a subject of our interest. We also learned a lot about the process of conducting a major study on a single topic, an experience that we will both bring with us for a long time. To round up, we should say that we are genuinely proud and happy to deliver the thesis that you are about to read to the School of Business, Economics and Law in Gothenburg (Handelshögskolan Göteborg).

Acknowledgments

The thesis process has been challenging but educational and has involved many hours and late nights of work. The outcome of the investigation in this thesis in its final form would not have been made possible without the support and valuable feedback from several sources and individuals. Therefore, a big thank you and acknowledgments to those who have contributed to its creation and quality.

First of all, we would like to express our most profound appreciation to our supervisor Evangelos Bourelos for providing us with guidance and support through the thesis process. We are thankful for your feedback, advice and for the confidence you have given us. We would also like to thank the members of our supervision group for the input and inspiring discussions in the supervision sessions. Thank you, Erik, Isak, Franklin, Lee and Daniel!

Secondly, we would like to express our thanks to Invest Europe, SVCA, Pitchbook and Crunchbase for answering questions by email to search for adequate data to use in the investigation. These answers have helped us pinpoint and find the sources that made the investigation thesis possible.

Thirdly, we would like to express our thanks to The School of Business, Economics and Law (Handelshögskolan Göteborg) for making this thesis possible and for help throughout the process. Thank you to our teachers Aineas Mallios, Marcin Zamojski, Mattias Sundén, Daniel Ljungberg and Ethan Gifford, for answering crucial questions throughout the process and providing us with valuable insights. On the note of insights: We would like to give a word of thanks to our friends Noel and Vilim, who gave us much-needed support and knowledge about statistics which has been incremental in the creation of the research method.

Lastly, we would like to thank the friends and family that have proofread the thesis and provided feedback in the final days and hours of the thesis process. Without this support, we would not have been nearly as confident in the grammatical, structural or informational content and confidently present the thesis on May 27th, 2021, for our peers.

Thank you all for the support and feedback!

Gothenburg, Sweden
6th of June, 2021

Ludvig Streng

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Table of Contents

List of Tables

List of Figures

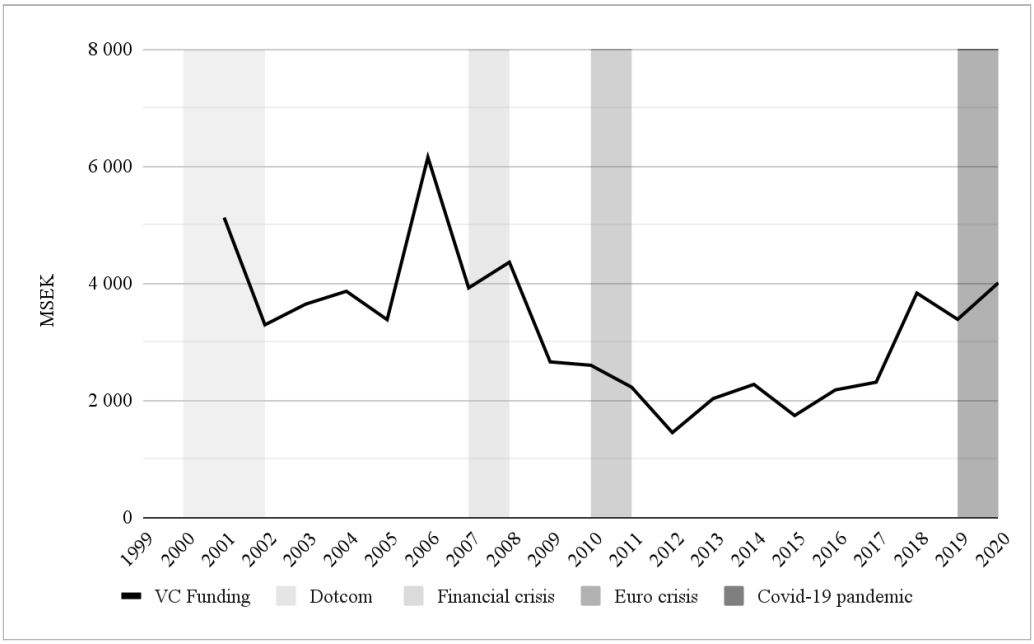
List of Formulas

1. Introduction

The Venture Capital (VC) industry is one of the more secluded and mysterious industries in the modern economy. The investment activities by its agents, venture capitalists (VC:s), are despite this shrouded aura an incremental part of any economy in terms of economic development, business-climate development, job-creation, GDP growth and innovation in general (Gompers & Lerner, 2000; Isaksson, 2006; Block & Sandner, 2009). Through the screening of ventures, entrepreneurs and ideas, VC:s identify promising investment opportunities and provide capital, knowledge and networks to enhance their development into fully-fledged, well-functioning businesses (Metrick & Yasuda, 2011; Howell et al. 2020). These businesses provide innovative solutions to the citizens of a country, thus capturing previously untapped market potential and lead to a continuous development that can be seen in the collective productivity growth and replacement of outdated technologies and processes. The immense importance of not having a stationary but rather a continuous development of society is indisputable. In the modern economy, VC:s are essential agents in supporting and driving this development (Zider, 1998; Samila & Sorenson, 2011; Pradhan et al. 2019).

Almost all countries have a VC industry to some extent, but with different outputs and compositions. A great example of a country that has established an excellent working VC industry is Sweden: It has one of the best performing VC industries globally despite having a relatively small population size. In the last five years alone, it has invested more capital in ventures and produced more unicorns (companies with a valuation of more than 8.5 bnSEK approx.) per capita than any other European country (Daly, 2021; Atomico, 2021). Many of these unicorns are innovative and international companies, with examples such as Spotify, iZettle, Klarna and Mojang, to name a few. The Swedish economy benefits considerably from this well-functioning VC industry. Its GDP is increased by 1% annually because of the activities in the VC ecosystem, with an increase of almost 5% by the entire private equity industry (Copenhagen Economics, 2019). A VC industry like the one in Sweden consists of strategic VC investors, competent entrepreneurs, well-equipped incubators and large amounts of VC investments into innovative ventures (VC funding) that contribute to the continuous testing and development of new ideas in the economy. It has not always been this way in Sweden and the development of its VC industry has been anything but a straight road since it was started in the early 1970s (Isaksson, 2006). It has experienced more than a few troublesome but molding moments, with some of the most critical moments occurring over the last two decades alone (Figure 1).

Figure 1 - Total VC investments in Sweden 2001 - 2020



(Source: See method-section)

The most notable examples of the uneven development of the Swedish VC industry are the economic crises since the year 2000. The first economic crisis started when the dot-com bubble burst in the year 2000, followed by the global financial crisis (GFC, or mortgage crisis) in 2008, the Euro-crisis in 2011 and most recently, the COVID-19 pandemic in 2020. These crises have had huge impacts on the overall economy and probably on the VC industry in Sweden but their exact effects are hard to establish as the effects on the VC industry do not stop until long after they break out (Sundqvist, 2014). The most recent economic crisis has raised more than a few questions about the state of the Swedish economy in general and the Swedish VC industry in particular. The Swedish economy was affected negatively by the COVID-19 pandemic, with unemployment spiking at 9.1 % of the total workforce and the GDP experiencing its largest-ever quarterly decrease of 7.6 % in the second quarter of 2020 (SCB, 2021a; SCB, 2021b). Sweden did not impose any lockdowns during the pandemic, as opposed to much of Europe, but has kept the economy running by instead imposing strict and mandatory restrictions on social gatherings and business operations. This unique strategy has raised a heated debate about the best way to handle the pandemic, both in terms of the citizen's safety and the health of the economy. One can speculate for hours on end about this subject, but the fascinating matter is the development of the Swedish investment climate during this pandemic. The OMXSPI-index, which is the composite index of all companies on the Swedish stock market, decreased by almost 35 % from February to March in 2020, only to recover at a 10 % increase over the entire year as if the pandemic never happened (NASDAQ OMX Nordic, 2021). The Swedish VC industry also experienced a similar development during the pandemic, where VC funding first drastically decreased in the second quarter of 2020 but surprisingly increased in total over the entire year compared to the already high levels of VC funding in 2019 (Figure 1). This is a very counterintuitive

unfolding of the effects of the pandemic and, on the larger scale, raises an essential question about the fundamental aspects of the Swedish VC industry: If a global pandemic with widespread effects on the economy does not decrease VC funding in one of the best performing VC industries in the world, then what affects VC funding in Sweden?

1.1 Research question

When the amount of VC funding in the economy diminishes or the general performance of the VC industry is diminishing, Swedish ventures receive less financial support. Therefore, they might find it harder to develop their business ideas as many ideas depend on the financial support of VC:s. There are often a lot more ventures seeking financial support than the amount of VC funding. Reducing the total amount of VC funding in the economy reduces the financial support of an already limited number of funded ventures that will be able to test and develop their business ideas in the economy. Overall, a reduction in VC funding reduces the ability of VC:s to act as the agents of a continuously developing force in the economy. Understanding the driving forces of VC funding in Sweden is, therefore, somewhat burdened by the larger purpose of understanding how well the VC industry is working and fulfilling its purpose in the modern economy. However, this empirical knowledge about the Swedish VC industry is minimal and what drives the VC funding in the Swedish economy can not directly nor concretely be answered. Some research has been carried out over the last 20 years and new articles are published at an increasing rate, but the knowledge is still limited and needs to be expanded. This lack of understanding of the drivers of VC funding is not a problem during good times, or like the case of Sweden when the VC industry is performing well nonetheless, but it quickly becomes problematic if the industry's good performance is diminishing. The actions taken to restore the industry, or achieve an even better working VC industry, can readily become misguided with arguments based on faulty grounds or not based on research at all. Such misdirections quickly become deeply problematic as the means used for the support often consist of governmental funds and actions (Grilli, Latifi & Mrkajic, 2019).

Understanding what drives VC funding in Sweden is a crucial piece in keeping up the performance of the already well-performing VC industry in Sweden and hedging the risk of misguiding efforts, should it not perform as well in the future. One of the most interesting and important concepts that have yet to be shed light upon are the real drivers of VC funding in the Swedish economy as they reflect the willingness of VC:s to supply capital to innovative ventures. The understanding of VC funding in Sweden is the aim of this thesis; therefore, to contribute to the literature on the drivers of VC funding in the Swedish VC industry, the following research question is asked:

What are the driving forces of VC funding, both in total amount and divided into the three investment stages Seed, Startup and Expansion, in Sweden over the years 2001 - 2020?

1.2 Working hypotheses

The research question is somewhat broad; Not that it is poorly specified, but rather that it can be answered in many ways due to the vast number of potential explanatory factors in the economy. Because of the inherent lack of direction as to how the research question should be answered, exploratory research has to be conducted in order to provide some direction for the investigation in this thesis. One way to make the research question easier to handle is to dissect it into smaller pieces based on the areas of possible driving forces of VC funding. Some of these can be identified in the areas within the literature that influential researchers have investigated and some in the hypothetical areas that have only been hinted at in the literature. These areas are stated as working hypotheses that can be more concretely tested and either accepted or rejected after performing the investigation in this thesis. Working hypotheses are a bit harder to test as they are vaguer than hypotheses, but they are better for investigating concepts that are not completely established and still in the works, which is suitable due to the nature of the investigation (exploratory) of the Swedish VC industry (Stebbins, 2001; Casula, Rangarajan & Shields, 2020). The statements that compose these working hypotheses take off in the overarching research question and outline the three main topics of discussion that can be prolific and almost necessary in discussing and investigating what drives VC funding in Sweden.

Firstly, much research implies that there have been widespread effects and fundamental shifts in the VC industry due to the economic crises (Strömberg, 2005; Blommé & Prytz, 2013; Sundqvist, 2014; Carlson & Henrikson, 2020). The same multitude of research does not exist for the Swedish VC industry, but the widespread and adverse effects of the crises can still be assumed to have affected the Swedish VC industry. The first working hypothesis is stated as follow:

Working Hypothesis 1: There is a negative effect of the larger economic crises on VC funding in Sweden during the period 2001 - 2020.

Secondly, many researchers have investigated VC funding by looking at different economic variables that can explain some aspects of the VC industry. Such economic variables can be reflecting a country's formal (laws, politics, finance), informal (social attitudes, cultural norms) and contextual (macro, technological development) institutional environments. These measures are commonly referred to as determinants of VC activity (Gompers & Lerner, 2000; Jeng & Wells, 2000; Lerner & Tåg, 2013; Grilli, Latifi & Mrkajic, 2019) and on the subject, the most highly cited and influential article (+1 400 citations) found that Initial Public Offerings (IPO:s) are the main driving force behind the cyclical swings in VC activity and later stage VC:s being more highly affected by high IPO activity (Jeng and Wells, 2000). Other factors brought up as influential are accounting standards, labor market rigidities and GDP growth. Further, it is argued that the legal and tax structure are essential drivers of VC

activity, even though they could not be fully captured in their model. Another very influential article (+1 200 citations) on the drivers of VC fundraising in the US economy from 1972 to 1994 (Gompers & Lerner, 2000). The researchers found, much like Jeng and Wells (2000), that GDP growth, IPO activity and tax structure heavily affect VC activity. An interesting finding is that VC activity increases with increased amounts of R&D spending by the government and policy changes that make it more beneficial and desirable to become an entrepreneur. In a more direct approach to applying the determinants in the Swedish setting, Lerner and Tåg (2013) compare the US VC industry to the Swedish VC industry. They show that institutional differences led to the later development of the Swedish VC industry by pointing at higher tax rates for entrepreneurs and the later development of the financial market in Sweden as hampering factors. They do not perform an extensive statistical analysis but still show that the legal environment, the tax system, labor market regulations and public R&D expenditure drive VC funding.

The specific determinants of VC funding in Sweden are fully established and need much further investigation. Sweden has been included in investigations with this specific purpose by very influential researchers (Gompers & Lerner, 2000; Jeng & Wells, 2000; Romain & van Pottelsberghe, 2004; Félix, Piles & Gulamhussen, 2013), but often through cross-sectional studies and compared to other VC industries; Other results from the literature on determinants are discussed further in section *2.4 Venture Capital Determinants*. Due to the lack of knowledge around the determinants of the Swedish VC industry and the specific industry being distinguishably different from its neighboring VC industries, it is interesting for an investigation to focus solely on the determinants of VC funding in the Swedish VC industry. A second working hypothesis can be made about the ability of determinants to explain the driving forces VC funding in Sweden.

Working Hypothesis 2: Formal (laws, politics, finance), informal (social attitudes, cultural norms) and contextual (macro, technological development) institutional environments in the Swedish economy can be used as causal explanations (determinants) of VC funding in Sweden.

Investigating the individual determinants is a good way to identify the effects that certain aspects of the economy might have on VC funding. It is, however, somewhat problematic to distinguish between the individual determinants and their combined effects. The individual effects are identified by applying the ceteris paribus (all other equal) principle, which means that one of the economic variables are changed whilst the others are kept constant to distinguish the individual effect. The validity in this principle is violated due to the inherent collinearity of the variables, as they are all existing in the same economic system. Changing one of the variables often leads to a change in some other variable in the economy. This is because an economic system is affected by many things like market forces, consumer behavior and governmental policy, which are all intricately connected. A problem with reducing the explanation of what drives VC funding to a few determinants is that the

overarching effects easily become overlooked, favoring the individual explanations as they are much easier to grasp. This problem is sometimes reasoned around in the literature but merely outlined and never fully pinned down.

The problems with collinearity opens a venue for further developing the investigation of the driving forces of VC funding. Due to this interrelatedness of the determinants, there might be some overarching effects or at least common factors that can be explained at a larger scale than the determinants themselves. These overarching effects could represent changes in the economy, thus possibly being cohesive explanations of the drivers of VC funding. Analyzing such effects could provide a more nuanced explanation of the drivers of VC funding wherefore it could be useful to embrace, rather than disregard, the collinearity of individual determinants. A third working hypothesis is stated:

Working Hypothesis 3: There are overarching and cohesive effects in the determinants that can be used to explain VC funding in Sweden.

Answering the research question is in no manner an easy feat, as both the temporal scope and the purpose of the investigation pose interesting methodological challenges that are developed far too little in similar literature. However, identifying the true drivers of VC funding in Sweden is an essential part of understanding how the VC industry works and providing guidance to its stakeholders in developing it moving forward.

2. Theoretical framework

The theoretical framework for investigating the research question consists, in this thesis, of three distinct sections of literature. These sections reflect and show the relevant literature to ensure a general understanding of the subject and provide a theoretical background for investigating each of the working hypotheses.

Firstly, a background on the investigated industry is brought up. Understanding how actors within the Swedish VC industry are working, organizing and making investment decisions is important as the outcome of these are reflected in the amount of VC funding. The processes can become heavily affected and sometimes even deserted when the actors experience heavy exogenous shocks such as an economic crisis or a drastic change in some part of the economy. The understanding of how these processes work creates a better ground for analyzing the output of the industry.

The second section of the theoretical framework sheds some light on the backgrounds of the prior economic crises and brings forth some literature about how they have affected the economy and the VC industry. The working hypothesis about how the economic crises have affected the Swedish VC industry relies heavily on findings from other literature. This research cannot investigate the full effects of the crises on its own, which points to the theoretical framework as an essential part of the discussion around the crises. The crises brought up start with a brief description of the Swedish real-estate crisis of the 1990s, even though this period is not included in the research. It is brought up as a background to the following crises and their molding effects on the Swedish VC industry moving forward (Isaksson, 2006). Further, the background and the effects of the dot-com bubble are brought up as the first economic crisis within the temporal scope of the investigation. The financial crisis is then brought up in the same manner, but an extensive literature base is not provided for the following Euro-crisis as it does not exist. The last part of this section brings forth the background and the yet very scarce literature surrounding the COVID-19 pandemic.

The last part of the theoretical framework utilized in this thesis sheds some light on the literature regarding VC determinants in the economy. Such determinants have been investigated by many researchers in different countries, different settings and with different scopes. They are brought up as a background to the second working hypothesis around the determinants of the Swedish VC industry, but their connection to the actual Swedish VC industry is vague. Some research investigates the Swedish VC industry but often does so in cross-sectional research. For some form of reliability in the literature regarding the Swedish VC industry, only the most prominent and uncontroversial determinants are brought up and discussed. This section further builds into the method section, as many of the discussed determinants will be utilized in the method.

A comment must be made on the lack of literature regarding the third working hypothesis, which seeks to investigate the overarching and cohesive effects as drivers of VC funding. The principal component analysis (PCA) utilized for this inductive research cannot be based on any literature from similar utilization, except some brief comments about the need for a dimensionality-reduction in some of the articles on determinants. This is unfortunate, as the discussion around the findings from the PCA becomes one-sided and poorly nuanced. However, the application of the PCA method for analyzing the VC industry is novel and the outcome of the investigation becomes a start to a literature base for researchers that seek to apply PCA for investigating the VC industry.

2.1 Literature selection, availability and quality

Literature on the Swedish VC industry is somewhat challenging to come by. The research field is young and undeveloped but has increasingly captured the interest of more researchers and research papers since 2010. Isaksson (2006) argues that the composition of the industry itself makes research about it hard, as data on the Swedish VC industry is generally difficult to come by. This has induced a theoretical gap in the literature and an inadequate understanding of the Swedish VC industry.

This theoretical gap can somewhat be filled by utilizing research conducted on other (larger) VC industries in Germany, the UK, and the US. Researchers have investigated the VC industries in these countries more than the Swedish industry has been investigated, most likely due to the larger size of the country's population. The findings from this literature, foremost from research conducted on VC industries in economies with similar structures, are a good base for creating the research method and analyzing the outcome of the investigation on determinants of VC funding in Sweden. However, the unique position of the Swedish VC industry does require a bit of a distance to the direct applications of conclusions from other settings, as the Swedish setting most certainly will differ in many aspects.

In order to create an as nuanced picture as possible about the state of VC research, several sources such as online libraries and databases have to be examined. The most important source from the perspective of this thesis is Supersök at Göteborgs Universitetsbibliotek, which encapsulates a large portion of all research literature. Supersök has articles from most journals, websites, and other libraries (such as the influential source Business Source Premier) and can search for citations and citings of specific articles, which has been crucial in finding additional literature. Supersök does, however, lack in showing articles from smaller journals and is more focused on European literature, so in order to not miss any notable literature, Google Scholar was examined as well. On top of these two sources, Google Search was used as an extension to almost every article subject to acquire literature that is not visible on the research databases from different organizations relevant to the VC industry. These might not always be included in online libraries, such as reports from the Swedish Venture Capital Association (SVCA), Organization for Economic Co-operation and Development

(OECD) and Invest Europe (former European Venture Capital Organization / EVCA), to name a few. By investigating the literature this way, the risk of missing influential articles is reduced drastically; A risk that could tip the entire thesis in the wrong direction through misdirected grounds for the investigation, method selection and discussion around the findings.

With the appropriate sources in place, the focus of the literature selection shifts to the reasoning behind actually selecting the relevant literature for this research. This thesis only uses subjects about analyzing determinants, the state of the VC industry and the development of the VC industry, as these are the areas most relevant to the research question. The selection process of literature on these subjects is based on selection-criteria as it is imperative to be precise in order to achieve a systematic and time-effective search for literature (Bell, Bryman & Harley, 2018). The selection criteria is divided into which delimitation criteria has to be fulfilled for the article to be included and then into which keywords had to be included in the article abstract, headline or topic in order for it to be relevant to the investigation. The criteria are used as strict delimitations to which articles are included or excluded, while the keywords are used as mere guidelines to which included articles are actually relevant for the research question and the working hypotheses. For example, all articles used in this thesis fulfill the criteria, but not all articles contain the keywords, as reasoning outside of the main subject has sometimes been necessary to strengthen and nuance the arguments throughout the thesis.

Table 1 - Literature Inclusion Criteria

Number	**Inclusion criteria**	**Description**
1	Time of publication after the year 1990	Include the most up-to-date literature. The temporal scope of the thesis (years 2001 - 2020) also decreases the relevance of articles before 1990, as well as the extremely low amounts of research on the Swedish VC industry before this time (Isaksson, 2006)
2	Full text acquirable online	The full content of the text must be able to be acquired through online databases with access
3	Language is Swedish or English	The English language is the most generally used language for research on the VC industries similar to the Swedish VC industry and the Swedish language is included as Sweden is the country of investigation.

Table 2 - Literature Keywords

Keywords (alternative keywords)	
Venture Capital (industry, market)	Funding (seed, startup, expansion)
Sweden (Swedish)	Financing
Crisis (crises, economic crisis/crises)	Entrepreneurial financing
Dot-com (dotcom, dot com)	Determinants
Financial crisis (2008, mortgage crisis)	Drivers of VC (Drivers of VC funding)
Eurocrisis (Euro crisis, 2011, greece, italy)	Principal component analysis (PCA)
COVID-19 (corona, covid)	

2.2 Venture Capital

This section provides a background on VC, the VC industry and VC firms, that is relevant for understanding the investigation carried out in this thesis. It is not the purpose to provide a full-scale description of the inner workings of the VC industry; for such descriptions, look to Isaksson (2006) along with Metrick and Yasuda (2011).

2.2.1 Purpose of the Venture Capital industry

The VC industry is an investment industry that is a part of the larger Private Equity (PE) industry. VC investors seek financial returns by investing in innovative ventures that are not publicly traded in exchange for part ownership in the venture. They then garden the investments through assistance in business development and monitoring of the venture's development (Isaksson, 2006). It is a common misconception that VC:s only provide capital to companies, they also provide non-financial value-adding benefits such as access to business networks, management and strategy development (Isaksson, 2006; Large & Muegge, 2008; Metrick & Yasuda, 2011). In many ways, VC acts along the lines of an "innovative gatekeeper" by choosing, developing and accelerating innovative technologies suitable for the business climate (Block & Sandner, 2009). The VC industry assists a majority of the innovations in the economy and VC-backed ventures produce patents with higher quality and more rigid innovations (Howell et al. 2020).

For a startup, entrepreneur or venture in general, funding is crucial for the success in realizing business ideas (Howell et al. 2020). Funding helps the new venture expand from a small entrepreneurial firm to a fully functioning and growing business. There are two ways for a venture to acquire funding. The first one is by debt, provided by a bank and usually involves some asset as collateral for the loan. The second one is by equity, which essentially is money provided by private investors, business angels or VC:s in exchange for part ownership in the venture. The funding of risky ventures and ideas is one of the primary purposes of the VC industry and is hereafter solely meaning funding of ventures by equity, referred to as VC funding.

2.2.2 Different types of Venture Capital firms in Sweden

There are three distinct types of VC:s that need clarification, especially for the Swedish VC industry. All types of VC firms are most often run by one or many general partners (GP:s) that make the operational and investment decisions in the firm. The first and the most common types of VC are privately owned firms in a business relationship with two or more partners called limited partners (LP), who are often wealthy individuals, businesses angel investors, corporate funds, public pension funds, endowments and other foundations. Therefore, such a VC is appropriately referred to as a limited partnership VC but is more often called Private VC. Examples of this type of VC in the Swedish VC industry are Creandum, Northzone and NFT Ventures. The second type of VC is owned by a parent

organization such as a bank, financial institution, insurance company or sometimes even a larger non-financial company. This type of VC firm is often called a corporate or captive VC and is funded mainly from internal sources of the parent organization. Examples here are SEB Ventures, Bonnier Ventures and Volvo Ventures. The last type of VC and one of the more important in the Swedish VC industry is the type of VC firm that is financed and controlled by government institutions, called Public Sector VC. In the founding days of the Swedish VC industry in the late 1970s up to the 1990s, Public Sector VC almost composed the entirety of the Swedish VC industry and have since been enormously important for the Swedish business climate in general (Isaksson, 2006). Examples of Public Sector VC are Almi Invest, Industrifonden and Fouriertransform. Regardless of the type of VC, they all have the same obligations to return capital to their supplier in a lucrative manner (Metrick & Yasuda, 2011). This thesis will not distinguish between the different types of VC but refers to the VC industry as the collective efforts and composition of all the three types of VC firms.

2.2.3 Activities of Venture Capital firms

The operations of a VC firm can be categorized into three main activities: *investing*, *monitoring* and *exit* (Metrick & Yasuda, 2011). In this thesis, the main focus is on the investment activity as the research question aims to understand what drives funding in the VC industry. A short description of the other two activities is also provided due to their importance in the VC firm as well as in their relation to the investing activity.

The first of the activities takes off in the investment stage after a new investment fund has been established and the partners of the firm have supplied capital. The GP:s take a small percentage of the supplied capital every year as a management fee for performing the activities and running the VC firm. With the access to capital secured, VC:s start to investigate the market for new ventures to invest in, often looking for companies within disruptive and innovative technologies (Isaksson, 2006). The investing activity is generally very thorough, as VC:s have to screen many potential investment opportunities until they find promising ventures in which to invest. The selected ventures get detailed attention and the most promising ones receive a preliminary offer for funding. Included in this offer is the valuation of the firm, firm type, risk valuation and the proposed control rights for the investment. If the entrepreneur accepts the offer, the VC firm digs deeper into the company and performs detailed due diligence in order to get a complete overview of the company's financials and operations. Finally, if the VC is satisfied with the analysis, they construct a contract of final terms and conditions of the funding that is to be signed by both parties (Metrick & Yasuda, 2011). When both parties have signed the contract, the firm becomes a VC-funded venture and is included in the VC:s portfolio.

Once the initial investment has been made and the capital has been provided to the venture, the monitoring activity commences which can be thought of as continued investment in the venture in a more non-financial manner. VC:s create a monitoring group to stay updated on

the investment and control the VC:s ownership in the company. Through this monitoring VC:s also seek to add value to their investments by recruiting the right competencies into key positions, developing the overall strategy and providing regular business advice. It is through the monitoring that VC:s are considered to be the most important, as they are adding a unique and hard-to-obtain value through their experience, networks and management, thus creating a competitive advantage for the venture as a whole (Metrick and Yasuda, 2011).

The exit activity is the last activity and the one where VC:s seek to liquidate their investments in their portfolio and provide a financial return to the partners. The investment horizon for a VC firm is seldom longer than ten years and is most often much shorter than that. The activity differs from the other activities as the expertise of how to perform the exit process is often not held by the VC firm itself, which means that external financial- and law firms often are a crucial part of the exit process. The liquidation of the investment can either be done through an initial public offering (IPO), a merger with or an acquisition by another company (M&A). The process entails large amounts of financial analysis, marketing and networking among acquisition candidates and are all crucial for the valuation of the venture; also, the more significant the competition for taking part in the deal, the more profitable the sale will be for the VC (Metrick & Yasuda, 2011). Exiting an investment through an IPO is often the most lucrative and easiest way to liquidate the investment. When all investments have been liquidated, the GP:s that have run the VC fund takes a carried interest, simply denoted "carry", of around 20-30% of the total profit of the fund, before any returns are provided back to the partners (Metrick & Yasuda, 2011).

These three activities are the overarching and continuous processes of VC firms in order for them to select, invest, assist and exit ventures that are promising investment opportunities. Their descriptions in this thesis are, of course, simplified and generalized to a large extent. In the individual firm, they are much more intricately connected and performed at the same time. The investment horizon of an investment fund creates the need for having multiple funds running at the same time in order to supply a steady stream of capital gains to the firm's partners. This essentially means that as one fund is entering the exit activity, another fund might just have been funded and have entered the investing activity whilst a third fund is in performing the monitoring activity of its portfolio companies.

2.2.4 Investment Stages

This section seeks to dwell deeper into the understanding of the investing activity due to its direct importance for the research question. VC firms differ heavily in which industry they focus on and on the size of their investments. These distinct sizes of investments are split up into investment stages. They are important to bring up as they can be affected differently by different drivers of VC funding and are also frequently used by other researchers, which further points towards the importance of their inclusion in the investigation in this thesis. It is important to note that the investment stage should not be confused with the definition of the

funding round, as they are commonly intertwined in the literature and the data. Within each of the discussed investment stages, there can be more than one investment round (Usually *Series A* through *Series D*), but the difference between the investment stages is not defined by the funding round. This is a common misconception as the size of the investment in the subsequent rounds often shifts the investment into the next investment stage. The exact definition of these stages and what distinguishes them from one another is fully expanded upon in section *3.2.3 Data*.

The first VC investment stage is Seed stage funding. It is the pre-marketing stage where capital is provided to an entrepreneur, innovation or inventor to prove a concept and take the first steps of creating a full-scale business. Such funding is usually used to develop a product or service, create a management team, develop a business plan and do market research. Seed funding tends to be done by business angel investors and some VC:s (Metrick & Yasuda, 2011).

After Seed funding, ventures enter the Startup (early) stage, usually distinguished by the venture's first larger round and somewhat faultily referred to as ventures having had their first *Series A* funding round. In this stage, the venture is still working with product development, marketing, assembling key management positions for future growth, further developing and testing the business plan and starting to test the product in the. This stage involves more institutional investors than the Seed stage and the venture starts inhibiting a larger number of investors (Metrick & Yasuda, 2011).

The last stage is the Expansion (Mid and late) stage and is usually distinguished by a venture having its *Series C* funding round. At this stage, capital injections are often used for the growth of the venture through increasing sales and profits (Isaksson, 2006). The company is now at full operation and the business plan is finalized. It is not unusual for companies at this stage to not have reached profitability yet, as they are spending more money than they are making throughout the prior stages. The role of the VC as an owner is changing from networking to more strategic decision making and planning an eventual IPO (Metrick & Yasuda, 2011).

2.3 Literature on previous crises

In order to investigate the first working hypothesis, literature on the economic crises has to be brought up. The economic crises that have occurred during the last two decades are very interesting for the Swedish VC industry as they may have impacted the amount of funding. Understanding their effects, separate from the working hypotheses for the determinants and dimensionality-reduction, is crucial as they cannot be directly derived to one variable. The assessment of them is much more qualitative than the rest of the thesis in this manner as the following literature is the base for investigating the first working hypothesis. Table 3 provides an overview of each crisis and following in sections 2.3.1 through 2.3.5 are more extensive descriptions.

Table 3 - Economic crises affecting the Swedish economy from 1990 - 2020

Crisis	**Brief description**	**Period**
Swedish real estate crisis	Hype around Swedish commercial real estate fueled by drastic increases in lending (100 % to 150 % of GDP from 1985-1990) and stock market development (1100 % return in 1980's, 350 % worldwide average). Crisis erupted in 1990 when real estate production caught up with the hype.	1990 - 1994
Dot-com bubble	Global hype around the possibilities of the digital world. "Innovative" tech-ventures and Venture Capital in the center of the hype. Bubble burst in 2000 due to a long range of events that led to the increased demand of substance in technology ventures; substance that didn't exist.	2000 - 2002
Global financial crisis (GFC)	Drastic increase in mortgages and in turn housing prices in the US economy, fueled by the easing of lending and capital restrictions on American investment banks. Advanced financial securities traded intensively between the banks in highly speculative manners. Erupted when large numbers of mortgage holders defaulted on payments starting in 2006.	2007 - 2009
Euro crisis	Many European economies misadjusted their fiscal policies after the introduction of the Euro, which led to some economies overheating. The GFC led to severe budget deficits and drastically increased interest rates, leading to difficulties in the financing of the economies (example Greece and Italy).	2009 (approx) - 2011
COVID-19 pandemic	Global outbreak of the coronavirus SARS-Cov-2 leading to severe lockdowns and restrictions on social gatherings and business operations.	2020 - 2021e

2.3.1 Pre-dot-com years and the Swedish real estate crisis (1990 - 2000)

Before the dot-com bubble is brought up, there should be a mention of the worst crisis to affect the Swedish VC industry, namely the Swedish real-estate crisis in 1990 - 1994. Even though this crisis is not included within the temporal scope of the investigation, its effects on the Swedish VC industry were drastic and truly molding for years to come. Isaksson (2006) states that the Swedish VC industry was hit so hard that almost all private VC:s disappeared and the Public Sector VC:s decreased significantly in both numbers of firms and funding. The crisis marks a shift of the Swedish VC industry into a "second phase" (first phase lasting from approximately 1965 - 1990) and is the primary reason why it was not hit as severely by the dot-com bubble that happened just six years later. The effects will not be brought up any more than this due to their insignificance to the temporal scope, but its mention when talking about economic crises in the Swedish economy is nonetheless important.

2.3.2 Dot-com bubble (2000 - 2002)

The first of the economic crises included is the dot-com bubble. The name of the bubble is derived from its close connection to the insane hype of technology companies and the rise of the internet in the late 1990s, whence the name ".com" or dot-com. The dot-com bubble has a special place among the crises discussed in this thesis, as it is the only one that is almost entirely caused and fueled by the VC industry itself.

Starting in the 1990s, technological advancements of semiconductors and logic chips had enabled the economy to take a disruptive leap in its development. The time for technology, information and the internet for the average consumer was ripe, enabling entrepreneurs and investors to capture newfound market opportunities through innovative ventures. The yet relatively untapped Information Technology (IT) industry quickly became the talk of the day, as more and more people saw the capabilities and potentials of a digitalized world with a heterogeneous and highly one-sided rhetoric surrounding the potential of computers and the internet (Goodnight & Greene, 2010). The startup-mentality consisted of quickly realizing business ideas, creating a growth-ready platform from the first days of the venture, over-investing in technological capabilities and acquiring as much customer data as possible. This increase in business activity was funded by many VC firms seeking a financial return in the tech hype. The capital inflow to tech startups during the 1980s and foremost during the late 1990s became a phenomenon in itself with escalating company valuations, funding rounds and IPO:s larger than the previous year, every year (Ofek & Richardson, 2003). Compared to many other industries during this time, the IT industry grew disproportionately and many VC:s quickly became poorly diversified in their investments. Funding rounds reached an all-time high, with amounts (Can somewhat be distinguished in the year 2001 as seen in Figure 1) and valuations that are not even beat to this day. The capital inflow to VC firms in the late 1990s was enormous and the Swedish VC industry doubled its size in just one year (1999 to 2000) as a direct effect of this increase in funding (Christenson &

Jakobsson, 2005). The amount of active VC firms also increased significantly during this period; Three (3) times as many VC firms were started in Sweden compared to "normal times" during these years (Isaksson, 2006).

The IT-hype reached its peak in March of 2000. The crash that followed occurred from a series of events that triggered a substantial sell-off in technology-related stocks on a worldwide scale. However, the stock market volatility started months before March in 2000 with the overhanging risk of the Y2K bug, a potential bug that would happen due to the calendars of the now computerized world not being able to handle the date change from 1999 to 2000. The bug never occurred, probably as preparations for it were so extensive, but nonetheless became a sobering up of the tech-entrepreneurs and the VC industry's seemingly erratic and immortal-like behavior. The USA was at the center of the tech hype and also triggered the bubble in 2000. US Federal Reserve chairman Alan Greenspan proposed a rapid and firm increase of interest rates in February of 2000, Yahoo and eBay ended merger talks in March of 2000 and a famous article in the magazine *Barron's* in March 2000 predicted a wide range of bankruptcies for IT companies as they were running out of cash (Willoughby, 2000; Wired, 2020). The crash became imminent and by November 2000, US tech-related stocks had lost 60% or 1.7 trillion dollars in market cap (Kleinbard, 2000). In Sweden, the crisis became a fact with the bankruptcy of the streetwear/fashion website *Boo.com* in May 2000. This was a cold shower for Swedish investors and VC firms, as the company had launched its over-engineered site in less than a year before its bankruptcy. Growing demand for substance in the highly valued startups became the start of widespread bankruptcies for Swedish tech firms, as the substance was not there due to the lack of market adoption (Aronsson, 2014).

The OMXSPI had seen an 80 % increase over the 5-month before the bubble in March of 2000 and was followed by an almost three-year-long decline that left the index at one-third of its peak value (see Figure 6 in section *5.1.1 Financial market conditions*). The appetite for new VC investments culminated and the Swedish VC industry took a big hit; total investments decreased by over 50 % and the number of deals decreased by 25% (Baygan, 2003). The exit climate also worsened, with time-to-exit becoming longer after the bubble erupted as the poor investment climate drove down the supply of IPO:s (Henricson, 2012; Christenson & Jacobson, 2005). The IPO:s in the Swedish market before the bubble were underpriced by up to 241 % at the peak and averaging returns of around 20% on their first trading day (Henricson, 2012), which points to a general over-belief in investments in general. Even though the investment climate worsened, the Swedish VC industry was less affected by the dot-com bubble than it would have been if the real-estate crisis had not happened six years prior. Some signs of this are shown in the manufacturing industry, which seemed unaffected by the crisis and expanded throughout the bubble (Li, 2010).

2.3.3 Global Financial Crisis (2007 - 2009)

In the aftermath of the dot-com bubble, another problem was brewing under the surface. Just seven years after the bubble, another crisis erupted that stemmed from the US economy. The Global Financial Crisis (GFC), also commonly referred to as the mortgage crisis or simply the financial crisis, created even more drastic and widespread effects for both the economy as a whole and the VC industry.

In the US economy, the regulation regarding bank lending had been significantly loosened since the 1990s and was deregulated in 2004 by the SEC. The deregulation meant that banks could lend out up to 40 times their capital base, from previously being able to lend out 10-12 times their capital base (Sherman, 2009). Mortgage lending drastically increased in the US economy, thus increasing house prices nationwide and in order to reduce the risk of the new mortgages, many mortgages were bundled up in securities called collateralized debt obligations (CDO). This securitization allowed the mortgages to be more easily traded between actors on the financial market and got fitted with a security- or risk-rating, reflecting the risk of mortgage holders defaulting on their payments. These ratings were falsely boosted in malicious and corruptive manners, which created a false sense of security from the risk of the mortgages in the CDO failing. The drastic increase in mortgages was unsustainable, and mortgage holders started defaulting at an alarming rate in 2006, which led to the inevitable sales of houses that, by the laws of supply and demand, also decreased house prices at an alarming rate. CDO securities with even the highest rating plummeted in value, causing consequential losses for financial actors holding them; many US investment banks went bankrupt, with well-known examples such as Bear Stearns and Lehman Brothers, both in 2008.

The crisis spread to many other countries as the US economy stood for a third of global consumption growth in the years after the dot-com bubble; attractive financial numbers for international investors looking to invest in the booming US economy. Investors across the globe owned US CDO:s and assisted in hedging these through credit default swaps (CDS), thus creating a dangerous intertwining of the global economy that affected other countries and sectors when the crisis started in 2007 (Stiglitz, 2010). The decline in the economy during the period resulted in a reduction in investment, output, IPO’s and employment across the world (Ollivaud & Turner, 2014). The Swedish economy was not highly exposed to the US housing market, which reduced the widespread effects of the financial crisis in the Swedish economy, but the OMXSPI still decreased by 57.8% from 2007 to 2008 due to the reduction in risk-taking and expectations on future consumption (Bergström, 2009; Ingves, 2018). Although the Swedish VC industry was not one of the primary stakeholders or actors in the financial crisis, it still had effects on the general investment climate and the risk-taking in the economy that in turn spilled over on VC investments (Block, Sandner & De Vries, 2012; Andersson, Ingelström & Östlund, 2009). The steep decrease in demand for both

consumption and investments during the financial crisis reduced the amount of available capital for VC firms, making funding hard to acquire for both new and existing entrepreneurial ventures (Croce, Martí & Reverte, 2019). As shown in Figure 1 in the introduction, VC funding in the Swedish economy that boomed in 2005 - 2006 experienced a drastic and rapid decrease. This decrease was the start of a multi-year decrease for VC funding in the Swedish economy, which was worsened by the impending Euro crisis.

2.3.4 Euro crisis (ca 2009 - 2011)

The Euro crisis began in the aftermath of the GFC with the collapse of Iceland's banking system in 2008. It eventually spread to other European countries such as Portugal, Italy, Ireland, Greece and Spain in 2009 and reached its peak in 2011-2012. The Euro crisis is sometimes called a debt crisis, as the crisis is created from rising government debt and the increased risk of insolvency for many European countries.

Before the financial crisis broke out, many European economies experienced overheating due to their inability to adjust their politics to the new monetary union under the Euro. The short and long interest rates on governmental bonds in these economies were too low, leading to booming housing markets, like in the US, and booming credit markets. This state of business was rather beneficial under the steady growth in the years after the dot-com bubble but quickly led to problems when the financial crisis broke out and demand plummeted. Governmental budget deficits in many European countries, especially Greece, lowered expectations on future spending and a negative spiral was created between banks and governments, leading to drastically increased interest rates as the risk in the economy increased. The crisis became a Euro crisis due to the connection between Euro states in many macroeconomic- and trade aspects. Many states were dependent on the politics and the spending of other states within the Euro-zone. Some affected countries raised taxes and slashed expenditures to combat the crisis, which contributed to social upset within their borders and a crisis of confidence in leadership, particularly in Greece (Riksbank, 2012; Kenton, 2020).

The Swedish economy was mildly hit by the Euro crisis, compared to prior crises and the GDP increased over the duration, but the OMXSPI decreased by around 18 % between the second and fourth quarter of 2011 (SCB, 2021b; Figure 6). Within the VC literature, it seems like the Euro crisis has evaded the interest of researchers, even though many European economies were hit hard by the effects of the crisis. The reason for this is unclear, but it can be speculated that the more impactful financial crisis caught the interest instead. The investment process of Swedish VC:s was nonetheless heavily influenced by the crisis, with both decreasing amounts of funding and number of deals, along with a heavily influenced exit market (Blommé & Prytz, 2013).

2.3.5 COVID-19 pandemic (2020 -)

The last of the crises included and the one still in effect at the time of writing this thesis is the COVID-19 pandemic. Its full effects on the economy and the VC industry cannot possibly be known yet, but the most current knowledge about its effects and what has already happened is shed light upon.

The coronavirus SARS-CoV-2 broke out in late 2019, hence the name COVID-19, but it was not until some months into 2020 that it had spread on a global level. The global reach due to the immense virality of the virus will make the year 2020 forever go down in history. As the virus spread throughout the world, it quickly became evident that the way business usually was conducted could no longer be followed and it was only a few weeks before governments imposed severe restrictions throughout the world to keep its citizens as safe as possible from the virus. Restrictions on social gatherings shifted the entire global economy digitally in just a few weeks and its effects have been widespread throughout the economies of the world, Sweden included. The digital shift was a drastic change, but some industries could not shift their business online due to obvious reasons. Many jobs have been lost and many businesses have failed because of the imposed restrictions. The IMF reckons that the GDP of some of the world's most developed countries declined by up to 12% between the last quarter in 2019 and the second quarter in 2020 and the Eurozone recorded its largest-ever increase of unemployed people in April of 2020 (World Bank Group, 2021a; Eurostat, 2021). The Swedish economy saw its largest-ever drop in GDP during the second quarter of 2020, decreasing 7.6 % (SCB, 2021b).

The impact of the virus on the VC industry can also be seen throughout the world and is expected to have widespread effects stretching far into the future (OECD, 2020). A Chinese VC firm reports that VC investments decreased by 60 % compared to the same period the year before (Brown & Rocha, 2020). In the United Kingdom, the number of VC deals declined by 31 % between the first and second quarter of 2020 (Brown, Cowling & Rocha, 2020). In the United States, Gompers et al. (2020) report that 38% of VC's portfolio companies were negatively affected and 10% critically affected due to the effects of the pandemic. The effects on the Swedish VC industry are not as thoroughly investigated and literature on it is very scarce, which is a gap that the investigation performed in this thesis hopefully fills a bit. From an early qualitative study, some VC:s in Sweden were interviewed and point towards longer screening processes, fewer investments and more active monitoring of the portfolio companies to assist them in handling the pandemic (Carlson & Henrikson, 2020).

2.4 Venture Capital determinants

For the VC industry to develop and prosper, the general business climate must enable it. Sobel (2008) confirms W.J. Baumol's highly influential economic theory on productive and unproductive entrepreneurship, pointing to entrepreneurial efforts being directed towards places with prevailing economic, political and legal institutions. Such business climates can be assumed to spur VC activity and due to the importance of the VC industry in the economy, researchers have been keen on investigating the characteristics of such business climates. Investigation on the level of VC activity in the economy is done through variables that "determine" the level of activity, conveniently called determinants. They are, as opposed to variables, assuming a causal connection between its changes and changes in what it determines. Examples of some determinants of VC activity can be found in Table 4:

Table 4 - Determinants of VC activity

Determinant category	**Determinant area**	**Determinants**
Formal	Regulatory / Fiscal	Fiscal Policy, High individual/corporate capital gain tax, High corporate income tax, Other regulatory aspects, Legal system structure (English), Investor protection, Liberal bankruptcy law, Rigid labor market regulations, Pension investments
Formal	Government quality	Governmental programs, Governmental effectiveness, Regulatory quality, Rule of law, Political stability, Voice and accountability, Corruption, World governance index
Formal	Financial market condition	Stock market development, IPO activity, M&A activity
Informal	Entrepreneurialism	Entrepreneurialism
Informal	Other cultural attitudes	Uncertainty avoidance, Individualism, Power distance, Masculinity, Cultural distance (four hofstede dimensions), Corruption perception
Informal	Social capital	Trust
Contextual	Technology	Innovation and R&D, Patents
Contextual	Macroeconomic conditions	GDP, GDP growth rate, Industrial protection, Interest rates, Unemployment rate, Inflation

This section seeks to shed light on the determinants of VC activity and is partly based on an extensive literature review on the area of determinants by Grilli, Latifi and Mrkajic (2019). As seen in Table 4, some areas within the literature and the findings on determinants can be grouped as they have similar denunciations and point at the same effect, even though the determinants themself do not have the same name. Grilli, Latifi and Mrkajic (2019) have

utilized this structure in their literature review and it is also used in this thesis for the following headlines that outline the determinant areas.

2.4.1 Formal - Regulatory / Fiscal

Gompers and Lerner (2000), Jeng and Wells (2000), along with Romain and van Pottelsberghe (2004), along with many other researchers, show that the impact of formal institutions on VC activity has been brought up as a primary area of determinants. *High income tax*, both corporate and individual, negatively affects VC activity as capital becomes more expensive and thus harder to utilize profitably (Bedu & Montalban, 2014; Cumming & Li, 2013; Bonini & Alkan, 2012). A *sound legal system* (Bonini & Alkan, 2012) and *investor protection* (Bedu & Montalban, 2014) are shown to increase VC activity, as the investors can more safely invest and enforce legal contracts. *Rigid labor markets*, like the one in Sweden, are shown to have a negative effect due to it creating friction for companies in hiring and firing employees (Jeng & Wells, 2000; Romain & van Pottelsberghe, 2004; Cumming & Li, 2013; Bozkaya & Kerr, 2014).

2.4.2 Formal - Governmental quality

In terms of *government effectiveness*, *regulatory quality*, *rule of law*, *political stability*, *voice and accountability* (free media and freedom of speech) and *corruption*, the effects on VC activity have been unclear (Grilli, Latifi & Mrkajic, 2019). Cherif and Gazdar (2009) argue that all of these determinants positively affect and increase VC activity, while Cumming, Henriques and Sadorsky (2016) argue that only some determinants have positive effects and most have no effect. Data on and the utilization of these determinants is hard to obtain, which might be why the stream of articles on this area of determinants is low and why there is an unclear conclusion regarding how they affect the VC industry (Grilli, Latifi & Mrkajic, 2019). However, Li and Zahra (2012) overcome this challenge by using the "World Governance Index" as a composite measure of governmental quality, pointing to its positive effects on VC activity.

2.4.3 Formal - Financial market conditions

Determinants on the financial market conditions are almost uniformly positive, as the VC industry is closely related to other financial markets. *Stock market development* is the most investigated determinant, with findings almost evenly pointing to increased VC activity with positive development in the stock market (Bonini & Alkan, 2012; Cumming, Henriques & Sadorsky, 2016; Li & Zahra, 2012; Groh & Wallermoth, 2016). Likewise, when the stock market is performing well, the *IPO Activity* is high along with the *M&A activity*, which in turn are found to have a positive effect on VC activity (Bonini & Alkan, 2012; Félix, Piles & Gulamhussen, 2013). These determinants are most directly explained by VC:s having a more clear and better road to exit their investment, which is a crucial aspect of the VC firm's activities (Grilli, Latifi & Mrkajic, 2019).

2.4.4 Informal - Entrepreneurialism

Of the more informal determinants, *entrepreneurialism* has been somewhat investigated. It is essentially a determinant signaling the level of entrepreneurial activities in the economy, which should increase VC activity as more entrepreneurs increase the demand for more funding. Indeed, both Romain and Pottelsberghe (2004) and Bonini and Alkan (2012) find that it does, albeit controversially as Li and Zahra (2012) argue that it does not affect VC activity at all. Félix et al. (2013) even find that the "Total Entrepreneurial Activity index" negatively affects VC activity, with the argument that an increase in entrepreneurial activity without increasing innovative entrepreneurship only harms VC:s as they have to spend both more time on screening less innovative ventures.

2.4.5 Informal - Other cultural attitudes

Some other cultural attitudes that affect VC activity are determinants such as *uncertainty avoidance*, *individualism*, *power distance*, *masculinity*, *cultural distance* and *corruption perception* (Grilli, Latifi & Mrkajic, 2019). *Uncertainty avoidance* is essentially a measure of risk-taking in the economy, where low levels indicate a lower VC activity (Li & Zahra, 2012; Cumming, Henriques & Sadorsky, 2016). Aggarwal and Goodwell (2014) find no significant effect of *individualism* (as opposed to a collectivistic approach in society) or *power distance* (acceptance of unequal power distribution in society), but a negative effect of *masculinity* (distribution of power towards the male gender). Hain, Johan and Wang (2016) further find adverse effects of *cultural distance* (distance between different values, business ethics and codes of conduct active in the economy) and *corruption perception* (perceived corruption of the public sector).

2.4.6 Informal - Social Capital

One of the smaller areas of determinants is *Social Capital* with one identified determinant.
Social Capital reflects the value of trust, social networks and civic participation, with the determinant *Trust* found to positively affect VC activity (Hain, Johan and Wang, 2016), albeit being one of the hardest determinants to measure.

2.4.7 Contextual - Technology

Due to the inherently innovative nature of new and entrepreneurial ventures, *R&D expenditure* and *Patents* have been theorized to affect activity in the VC industry closely. The effect of *R&D expenditure* has been found to be positive, with increased spending in R&D also increasing the activity in the VC industry (Gompers & Lerner, 2000; Romain & van Pottelsberghe, 2004; Félix, Piles & Gulamhussen, 2013; Groh & Wallermoth, 2016). However, Bedu and Montalban (2014) find public R&D spending to be a positive determinant, while fiscal incentives for *R&D expenditure* negatively affect VC activity. The

determinant for *Patents* is almost uniformly positive, which implies that when the amount of patent applications is high, the activity in the VC industry is high as well.

2.4.8 Contextual - Macroeconomic conditions

Macroeconomic conditions such as *GDP*, *GDP growth rate*, *industrial production*, *interest rate*, *unemployment rate* and *inflation* reflect the general state of the economy. Determinants for the macroeconomic conditions on VC activity have been included in many articles, where *GDP* and *GDP growth rate* are the most often used and both with almost uniformly positive effects (Cumming, Henriques & Sadorsky, 2016; Félix, Piles & Gulamhussen, 2013; Hain, Johan and Wang, 2016; Gompers & Lerner, 2000; Romain & van Pottelsberghe, 2004; Li & Zahra, 2012; Bozkaya & Kerr, 2014; Aggarwal & Goodell, 2014). However, some articles point to both determinants having no significant effect on determining VC activity (Jeng & Wells, 2001; Bonini & Alkan, 2012; Cumming & Li, 2013). *Interest Rate* is shown to increase VC activity, as it is an alternative to other financial investments that becomes less sought after when interest rates rise (Romain & van Pottelsberghe, 2004; Félix, Piles & Gulamhussen, 2013). Ning, Wang and Ju (2015) confirm the positive effect of *Interest Rate* increases and show that high *industrial production*, displayed through the "Industrial Production Index" by the Federal Reserve Board, and *inflation* also increases activity, while a high *unemployment rate* negatively affects VC activity.

3. Method

This section describes the method carried out in this thesis to investigate the research question and the working hypotheses. First, reasoning around the selected research strategy and research design is provided in order to set up the choice of the following research method. The research method consists of two distinct statistical methods, that were selected based on other literature and on the structure of the working hypotheses. All steps are described to the furthest possible extent in order to provide a clear picture of how the subject is investigated.

3.1 Research strategy and design

The research conducted in this thesis aims to investigate what the driving forces of VC funding in the Swedish VC industry are. In order to contribute to the understanding of the driving forces, prior literature from other and larger VC industries is essential in the creation of the research method. Other researchers have taken a range of approaches to investigate the VC industry and because of the limited amounts of freely available data on VC activity, the methods utilized have varied a lot. A first-rate or preferred method for investigating questions similar to the research question in this thesis has not been found during the preparatory work or during the actual research conducted. This has complicated the construction of a well-grounded and generally accepted method, but it has also provided this thesis with a broader range of possibilities for carrying out research capable of answering the research question and proposing new ways to research drivers of VC funding. Therefore, to investigate the first and the second working hypotheses, inspiration is drawn from other researchers with similar research and research questions, often performed on other VC industries. Building on the results from this part, a second and more novel research method is used to investigate the third working hypothesis, which draws inspiration from the VC-determinant literature and seeks to advance its scope and what conclusions can be drawn about the overarching drivers of VC funding.

The first part of the method takes off in the findings from other researchers on determinants of VC activity and the ability to see how changes in these affect the VC industry. Determinants of VC activity have been widely investigated and been empirically confirmed numerous times in other countries, albeit not yet culminating into a general theory for determinants of VC activity. Two distinct areas of the research on determinants exist, where one has a naturally inductive approach to make more experimental observations on which determinants have affected the industry. While the other has a deductive approach to confirm the same determinants in other settings. The first part of this research does not seek to add any new determinants to the literature but instead seeks to confirm already established determinants but in the Swedish setting. The approach taken for the determinant research is thus exploratory and deductive. This approach is based on previous literature on determinants

for VC activity and is nuanced a bit by the literature on economic crises affecting the Swedish VC industry. By utilizing a deductive approach, the investigation will be able to draw conclusions about the previously established determinants but in the Swedish setting and thus provide a ground for concluding the first and second working hypothesis.

Investigating determinants is often done in cross-sectional studies, where the different settings of a country are compared to the different amounts of VC activity. Sweden has been included in such investigations numerous times due to its interesting VC industry and some evidence to the drivers of VC funding can be found in that literature. However, there exists a gap in the literature of an over-time perspective in the understanding of the driving forces of VC funding. By looking at how determinants affect Swedish VC funding over longer periods, their effects as driving forces can be more firmly established. The temporal scope of this research, therefore, consists of the years 2001 through 2020 and is quite large compared to other research on the Swedish VC industry. Despite this difference, having a larger temporal scope enables the investigation to capture over-time differences and better reflect the drivers of VC funding in Sweden. This perspective can easily be lost in the cross-sectional investigations that often have a much shorter temporal scope or even perform a true cross-sectional study at one distinct point in time. The longer time-perspective for the investigation of the Swedish VC industry is of great benefit for answering the research question due to the extra nuance that a longer perspective provides, especially in relation to the generally low understanding of the drivers of VC funding in Sweden. The research design for doing an over-time investigation is most suitably a retrospective longitudinal study, as there is only one investigated subject in question and the fact that the data is collected repetitively, not first-hand by the researchers but by the continuous collection of larger organizations and governments as discussed later in *3.2.3 Data*.

Determinant research on VC industries has generally taken a quantitative strategy to the data analyzed and the same strategy will be utilized in this thesis. The temporal scope creates a necessity of using quantitative data as it is hard to make reliable and foremost acquire extensive qualitative observations for the past two decades. It should be noted that a qualitative method or at least a mixed-method could have been preferred for some periods included in this research since quantitative data as up to date as the COVID-19 pandemic is hard to acquire and data on VC funding in Sweden is not generally available (Isaksson, 2006; Carlson & Henriksson, 2020). Such a mix of quantitative and qualitative data has been used by some researchers in order to strengthen the quality of the research but has significantly reduced the temporal scope of their research. However, this thesis will not take a mixed-methods approach to analyze the determinants of VC funding but instead rely on the quantitative data available as the investigation possible with a quantitative approach provides more relevant results for analyzing the entire temporal scope. Drawing conclusions from the quantitative data is most suitably done using the statistical method OLS linear regression, which is further discussed in section *3.2.4.1 Regression model - determinants*.

By utilizing the same research strategy (quantitative) and design (longitudinal study) as the first part of the method, the second part seeks to investigate the third working hypothesis. In this part, changes in VC funding will be explained by changes in larger effects of the economy or groups of determinants rather than by changes in the individual determinants, which is lacking in the current state of VC research (Grilli, Latifi & Mrkajic, 2019). Investigating these hypothesized effects is done by breaking down the multivariate dataset of the determinants into their fundamental directions using a statistical method called Principal Component Analysis (PCA). This is done inductively due to the novelty of applying a dimensionality-reduction technique for the VC industry and the lack of literature on it. The components acquired from such dimensionality-reduction are orthogonal (completely uncorrelated) and show the overarching effects of the determinants (Joliffe & Cadima, 2016). More concretely, PCA reduces the determinants to fewer variables which capture as much of the variation as possible in the original dataset. By utilizing PCA, the components are merely investigated to find out if there are valid common factors and how much each of the determinants explains them. The PCA analysis does not assume the existence of common factors between the investigated variables, compared to factor analysis that is based on making such an assumption. PCA is a method that is very useful when variables are highly correlated (Costello & Osborne, 2005), which is suggested (or rather assumed) in the case of the determinants often used in explaining VC funding. This is the case as the determinants are drawn from the same economy and often affect each other as well as the amount of VC funding. Examples of the application of PCA for explaining other hard-to-explain areas of economics can be easily found, with increased popularity in later years (Li & Zahra, 2012; Suh, Song & Lee, 2014; Joliffe & Cadima, 2016; Lamichhane et al. 2021; Khan et al. 2021). The benefits of applying PCA are many and its application to testing the Swedish VC industry is a reasonable way to deepen the discussion around what really drives funding and to provide an answer to the third working hypothesis.

To sum up, the method used in this thesis to test the three working hypotheses is twofold, with both parts being based on quantitative data with longitudinal research designs. The deductive part is the determinant research that follows the methods and extensive work of other researchers, applying it to the under-investigated VC industry in Sweden to investigate the second working hypothesis. Such an investigation seeks to confirm determinants that have been previously confirmed in other countries but not in the Swedish setting. On top of this, the larger economic crises are investigated partly through the literature and through the use of a crisis dummy in the regression models to answer the first working hypothesis. Partly building on the findings from this deductive research, inductive research is conducted to further contribute to the VC literature by proposing a novel way to investigate the overarching drivers of VC funding. By analyzing the principal components of the determinant data, the overarching effects of the determinants can be investigated in order to provide an answer to the third working hypothesis.

3.2 Research methodology

This section explains the six steps of the research method utilized in this thesis. The first step is to select the dependent variable based on the research question. The second step is to select which determinants to test as determinants for VC funding in Sweden. These determinants are based on the literature provided in the theoretical framework and, through selection criteria, are deemed suitable to test or not. Data on the dependent variables are then collected in the third step and the selected determinants are collected in the fourth step, with each variable and data source being as extensively described as possible to enable a high reproducibility of the results. The fifth step describes how the regressions are modeled to confirm the variables as determinants in the Swedish setting empirically and the sixth step describes how the PCA is set up to investigate the overarching effects in the determinants data. Throughout the research method, the reasoning is backed by the research question set up in *1.1 Research Question,* the working hypotheses set up in *1.2 Working Hypotheses* and the choices made in section *3.1 Research strategy and design*.

3.2.1 Dependent variables - Venture Capital Investments

Similar research almost always uses the amount of VC activity as the dependent variable. A more active VC industry implicitly means that more time and effort is spent on all or one of the three activities of a VC firm (*investing*, *monitoring*, *exit*). The definition of what the amount of VC activity actually measures is somewhat vague, but guidance can be found in the sub-activities. *Monitoring* is tough to quantify, compare and reliably acquire data on, especially over long periods, but *investing* and *exit* are relatively easy to measure. The *investing* activity has been the most commonly used and preferred proxy for VC activity in previous literature. It can be directly translated into the amount of funding that VC:s give entrepreneurial ventures and data on it has become more transparent and accessible than just two decades ago. VC activity is, however, not completely and uniformly proportional to the amount of funding in the economy, as VC:s can have high activity but reflect this on one of the other two stages (*monitoring* or *exit*). From the article by Grilli, Latifi and Mrkajic (2019), an exact definition of what is meant by VC activity or how it is measured cannot be found, but there is strong evidence in the literature that VC activity implies VC funding, as most researchers use it (Bedu & Montalban, 2014; Bonini & Alkan, 2012; Cumming, Henriques & Sadorsky, 2016; Félix, Piles & Gulamhussen, 2013; Gompers & Lerner, 2000; Groh & Wallermoth, 2016; Hain, Johan & Wang, 2016; Jeng & Wells, 2000; Li & Zahra, 2012; Ning, Wang & Ju, 2015; Romain & van Pottelsberghe, 2004). Utilizing the implication that greater amounts of VC activity can be reliably proxied by measuring VC funding and the fact that it has been used by the majority of other articles on the subject makes the amount of VC funding arguably the best choice to be the dependent variable in this research as well. The variable is called *Venture Capital Investments* and is split into four separate dependent variables, where three (3) are the distinct investment stages (Seed funding, Startup funding, Expansion funding) and the last is the Total amount of VC funding in the Swedish economy.

3.2.2 Determinant selection

The second step in the method is to identify what kind of determinants to investigate for VC funding in Sweden. Many different determinants have been used in attempts to explain the amount of VC activity in other settings. Grilli, Latifi and Mrkajic (2019) identified 46 empirically proven determinants in the literature through their literature review that investigated over two decades of articles on the subject. Investigating 46 determinants is in no way suitable for this thesis, but the extent to which 46 different determinants have been found to explain the VC activity is mildly put impressive and points to the immense breadth of possible driving forces to investigate. For filtering out which determinants are suitable for this research, selection criteria are applied to the 46 determinants found in the article by Grilli, Latifi and Mrkajic (2019).

Starting with the general significance of the determinant, which is arguably the most imperative criterion, the determinant must be significant in explaining the dependent variable. This criterion might seem excessive and relatively self-explanatory, as the variable category of determinants is called explanatory variables and is expected to be such in the later used regression models. Since many determinants can explain the same effect in different nuances, a clear distinction to the effect of the variable itself needs to be made as well.

On the topic of significance but rather towards relevance, other researchers' use of the determinant and the empirical confirmation by them is a crucial criterion. As the first part of the research method is deductive and not inductive, hence no new effects or explanatory factors are sought after and the used determinants rely on assumptions that come from the articles in the theoretical framework.

On top of the relevance and the use by other researchers, the following criterion is that the effect of the determinant must be generally accepted in the literature. This criterion can be problematic due to the broad range of research performed on VC determinants, as different researchers have found some determinants to have positive effects while some have negative or no effects. This difference probably stems from the different settings, countries or economic systems in which the researchers have investigated the determinants. The criteria disregard in which setting the determinant has been investigated but instead look to the consensus about the direction of the effect being agreed upon by previous research in any setting.

The last criterion used for the determinant selection is specific to the setting and the country of investigation: Sweden. Many researchers have pointed out country-specific traits and, in turn, determinants of VC activity in different countries, so the determinants utilized in this research have to be applicable to the Swedish setting. This criterion further opens for the inclusion of determinants specific to the Swedish setting, determinants which might not have

been determined as valid in other countries but can be more relevant in this setting. In Table 5, all selection criteria are presented in order to provide an overview.

Table 5 - Determinant selection criteria

Number	Criteria name	Description
1	Significance	Determinant significant in explaining the dependent variable to some degree (most likely significant)
2	Relevance	Determinant is generally used in similar research
3	Direction consensus	General consensus in research of the direction of the effect of the determinant in explaining the dependent variable
4	National relevance	Determinant relevant to the Swedish setting

The criteria in Table 1 are applied to the 46 determinants found in the article by Grilli, Latifi and Mrkajic (2019) in order to acquire the most fitting determinants to investigate in relation to the second working hypothesis. The acquired determinants are presented in Table 2 and a full table of all the 46 determinants with their respective evaluation based on the criteria in Table 5 is presented in Appendix 1.

Table 6 - Selected determinants

	Type of institution	
Name	**Determinant Category**	**Determinant Area**
IPO Activity	Formal	Financial market conditions
Stock Market Development	Formal	Financial market conditions
Corporate Tax Rate	Formal	Regulatory
Labor Market Rigidity	Formal	Regulatory
Interest Rate	Contextual	Macroeconomic conditions
GDP Growth	Contextual	Macroeconomic conditions
Unemployment Rate	Contextual	Macroeconomic conditions
R&D Expenditure	Contextual	Technology
Patents	Contextual	Technology

From the 46 determinants in the literature, the selection results in 9 determinants that fulfill the set-up criteria. The selected nine determinants are highly relevant in other literature for explaining the amount of VC funding in the economy and in cohesion compose a well-rounded and nuanced selection of the possible driving forces for VC funding in Sweden. The categories show which climate the determinants exist in, while the area specifically shows where the determinants are found or from where they stem. The explanatory range of the selected determinants is quite wide and probably suitable for representing the different possible driving forces of VC funding in Sweden due to this width. The second working

hypothesis does not state which sort of determinants are reasonable as driving forces but merely makes the assumption of their existence as determinants, but for the sake of this research and because of its novelty in the Swedish VC industry, as broad a scope as possible is desirable. Worth noting here is that there are three areas of determinants that are not represented by this research: The informal areas *Social Capital* and *Entrepreneurialism* and the formal determinant area *Government Quality*. Data on informal determinants is challenging to obtain and is, therefore, excluded as it is more suited for qualitative research. It has only been studied by very few researchers, which probably is because of this lack of generally available data, as opposed to the other areas of determinants. There might be a risk of omitted variables by not including any informal determinants in this research, especially since they have been argued to have a large impact on the amount of funding in more recent literature (Hain, Johan and Wang, 2016; Aggerwal & Goodell, 2014; Cumming, Henriques & Sadorsky, 2016). However, this risk is accepted at the cost of poorer nuance in the results for the second working hypothesis. Regarding the Governmental Quality area, the setting in Sweden reduces the risk of its exclusion significantly. In all categories of the World Governance Index, Sweden has ranked in the 90th percentile (except the category *Political Stability and Absence of Violence/Terrorism*, which has decreased to above the 80th percentile in the last decade) since 1996 with little variation, implying a highly stable government and governmental quality (World Bank Group, 2021b). Therefore, the exclusion of these three determinant areas is not deemed to be crippling in terms of the nuance and reliability of the results, as the selected determinants most likely will provide sufficient ground for reasoning around working hypothesis 2.

3.2.3 Data

The third and fourth steps in this thesis' method is collecting relevant and reliable data on the dependent variables and selected determinants. Throughout this thesis, restrictions on data have been brought up and are more heavily discussed in this section because of its hindering effect on research on the VC industry in general and for this thesis in particular. Many articles in the theoretical framework have also brought it up as a highly significant problem for why the literature and the insights into the VC industry are relatively scarce. However, there are ways to work around this lack of data that are further described in this section and can be seen in how the dependent variable is pieced together.

High granularity in time-series observations is desirable due to the higher information density and less information loss from changes in between observations. As high granularity as possible is strived towards throughout the dataset in this research. However, the same granularity of each variable is hard to establish and many of them have to be transformed to acquire comparable periods. All of the contextual determinants measure data on a quarterly or monthly basis, while the formal regulatory determinants are strictly measured on a yearly basis and the formal financial market conditions determinants are measured on a daily basis. For the dependent variable, newer data shows that the funding can be traced to the ultimate

granularity of the individual deal and the day it occurred, but data with such high granularity cannot be found for the entire period on a freely accessible basis. Such data would naturally be the best sort of data, as it represents the most complete picture of the VC industry, but it is excluded for the benefit of consistency of the granularity throughout the dataset. The approach taken to handle different granularity in the variables used is that the most granular with the least data-loss is strived towards, which in the case of this thesis and the data collected is observations on a quarterly basis. Therefore, the final dataset will consist of observations made on a quarterly basis, even if the data from some of the sources are measured on a daily or an annual basis. The transformation and how the imputation of data is made to turn it into representative quarterly observations is explained in sections *3.2.3.1 Venture Capital Investments data* and *3.2.3.2 Determinant data collection*.

3.2.3.1 Venture Capital Investments data

Collecting data on the dependent variable is by far the most extensive part of the data collection. Information on how much VC funding has occurred in the Swedish economy is not freely available for the entire temporal scope, especially not from a single source. Having multiple sources for the same variable is not preferred, as different sources might have different definitions of what is included in the variable measurement and how the data for the measurement is acquired. Defining what is included in the variable *Venture Capital Investments* and how to overcome it is one of the main challenges in collecting reliable data, yet it is a topic that is surprisingly lightly discussed in similar research. In this thesis, the dependent variable uses data from multiple sources to embrace, rather than disregard, the different definitions which ultimately makes the risk of the data becoming biased towards one definition, method of measuring or general errors in the data as small as possible. Using multiple sources also helps overcome the problems of insufficient availability of data, as one source does not provide a measure of VC funding for the period 2001 - 2020.

The problem of availability has somewhat crippled research about the VC industry in general. The inherent lack of data on the industry comes from the lack of necessity in reporting VC deals, funding amounts and other information about the operations of the VC firm. As mentioned in *2.2 Venture Capital*, VC is a branch of the Private Equity (PE) industry; a name literally coming from the equity deals being private and not public. In contrast to the PE industry, public equity companies have a heavier reporting burden to their shareholders, the public and essentially anyone interested to reduce problems arising from information asymmetry. Such a reporting burden does not exist for VC companies in Sweden or most other VC industries, making it problematic to obtain data on the amount of VC funding in Sweden.

Data on VC funding exists, but it is collected through other means than through a reporting burden on VC companies. VC associations, governments and organizations frequently send out surveys to VC companies, entrepreneurs and angel investors to acquire the amount of VC activity in the economy and how it is developing over time. This way, somewhat

representative data on VC funding is acquired by the organization and often published in extensive annual reports. Organizations performing this collection are, for example, OECD, Invest Europe, SVCA and Tillväxtverket.

Another way of acquiring representative data is how commercial actors rely on news reports, annual reports from entrepreneurial ventures, annual reports from VC companies, social media such as Twitter, and essentially any other online source of data. This data flow is then pieced together into the deals occurring in the economy, ultimately arriving at an amount of funding in the economy. This is a much more up-to-date and meticulous collection of data on the VC industry, but it is hard to replicate retroactively. The structure of this process might be a reason for why the total amount of funding reported in recent years, where such methods have become much better, is drastically higher than what is reported by organizations, governments and VC associations for the same period. The commercial actors performing this type of collection in the Swedish VC industry are, for example, Crunchbase, Pitchbook, Prequin and Dealroom. Obtaining data for the entire temporal scope through both ways of measuring VC funding is not suitable. Most other researchers with the same dependent variable as this thesis use data from Crunchbase or Thomson Reuters, both of which are commercial actors and require payment for using the data. This is unacceptable in this thesis as it impairs the reproducibility of the results drastically. Crunchbase is also not fitting for this research as it drastically under-reports the number of deals in the first years included in the research, which is probably erroneous due to the dot-com years being a highly active period for Swedish VC:s shown in other reports (Strömberg, 2005; Karaömerlioglu & Jacobsson, 2000).

Sufficiently reliable data on VC funding to base the dependent variable *Venture Capital Investments* on is derived as secondary data from VC associations, governments and the aforementioned organizations for the years 2001 - 2019. This data is obtained through freely available reports and data sets over the period. After the extensive search for data on VC funding performed in this thesis, it can be concluded that the data collected in the period 2001 - 2019 represent the broadest available spectrum of reliable and freely available data on *Venture Capital Investments* in the Swedish economy. The year 2001 is a lower limit for reliable data due to the low amounts of data available before this year, which can be seen in the Crunchbase case and from the earlier reports used in this thesis. The lack of data before, or rather the relative abundance of data after, this period can also be because of the drastic increase in quality in the quarterly statistics from SVCA and NUTEK starting in 2001, which Isaksson (2006) brings up as a valid explanation for this relative abundance. For the period that could be included in this thesis, data is withdrawn from reports made by SVCA and Tillväxtverket as well as from datasets by OECD, Invest Europe and Eurostat. Data on the year 2020 is by the time of writing this thesis not available from any of the sources as mentioned earlier. However, the commercial source Dealroom is used for this year with a modified definition of what rounds are included in the funding measure that matches the definition of the other sources for some years before 2020. All of the sources and what period

their data is used for filling out *Venture Capital Investments* are shown in Figure 2. How and from where the data is collected is shown in Table 7.

Figure 2 - Venture Capital Investments, data availability by source

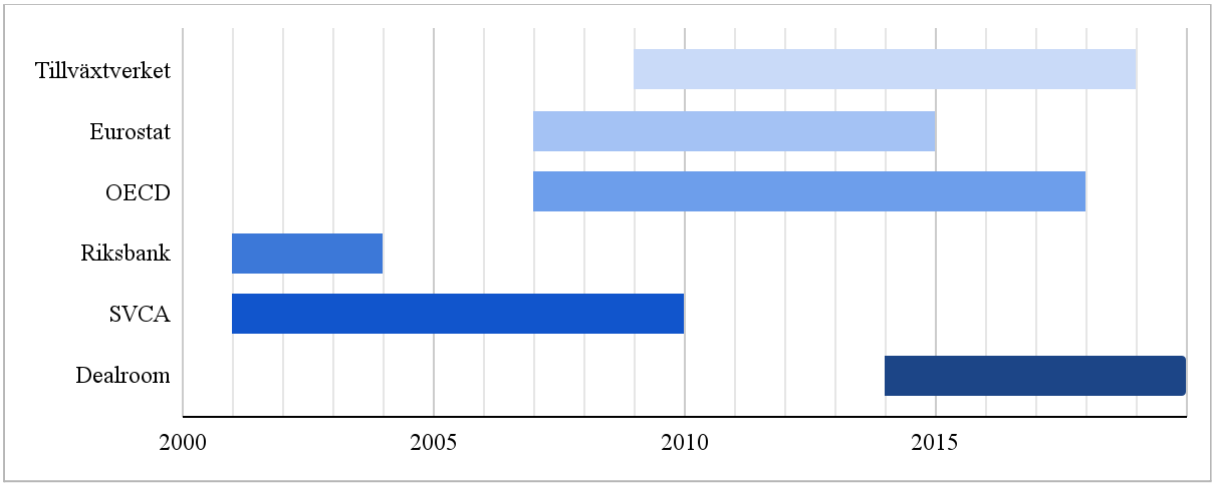


Table 7 - Data sources for Venture Capital Investments

Source	Obs.	URL
Invest Europe	13	https://investeurope.eu/research/activity-data/
Tillväxtverket	11	https://www.tillvaxtanalys.se/publikationer/statistik/statistikserien/2020-12-07-riskkapitalstatistik-2019---venture-capital.html
Eurostat	9	https://data.europa.eu/euodp/data/dataset/jrc-10113-rio_venture
OECD	12	https://stats.oecd.org/Index.aspx?DataSetCode=VC_INVEST
Riksbank	4	http://archive.riksbank.se/Upload/Dokument_riksbank/Kat_publicerat/Artiklar_FS/FS_05_1_artikel1.pdf
SVCA	40	1. https://docplayer.se/4203621-R-2006-16-riskkapitalbolagens-aktiviteter.html 2. https://www.menon.no/wp-content/uploads/26svca_halvarsrapport2011.pdf
Dealroom	7	https://dealroom.co/

The inclusion of many sources in the data for *Venture Capital Investments* over the investigated period provides this research with the most authentic and accurate measure of the actual amount of VC funding in the Swedish economy. This has to do with the earlier mentioned definition of what is included in the measure of VC funding, which varies from organization to organization. Having different definitions of where the borders of inclusion go for the measure of VC funding is problematic but inevitable due to how the organizations are making the measurements. For example, in the databases supplied by commercial actors,

Total VC funding includes every round from Seed funding up to as late as Series I or Series H funding. This definition is not at all comparable to the definition used in other literature and other sources. It is hard to fully frame the definition, which is probably why different organizations provide different values for the Total amount of VC funding in every year of the data. However, it is essential to have for the reliability of the dependent variable and the reproducibility of the research performed in this thesis. The definition used for the variable *Venture Capital Investments* in this thesis is the definition closest to the majority of the data sources, which means that the measure of VC funding includes every VC investment in a Swedish portfolio company by a Public Sector VC, Private VC (angel investors included) and Corporate VC.

Further, the division of VC funding into distinct stages is defined as follows: *Seed-stage funding* includes every VC investment before *Series A*, *Startup stage funding* includes every VC investment made in *Series A* and *Series B* and *Expansion stage funding* includes every VC investment made in *Series C* and *Series D*. This division is made because of the common misconception that *Series A* funding equals funding in the Startup stage, which is not the case but is presented as such in many of the sources. This is also the case with the division between Startup and Expansion funding, for which the line is drawn in a somewhat erroneous manner between the *Series B* and *Series C* funding. Again, to clarify this misconception: Investment stages do not change depending on what series-funding round the venture is in, but change depending on the total amount of raised capital for the venture, which in turn often changes drastically between rounds. No capital limits or average deal sizes are used to make the distinction between the stages, which might seem strange, but the distinctions only rely on what funding series the venture is in.

In the data sources, the definitions of different stages are surprisingly uniform across all sources. Tillväxtverket is the only source that has chosen to split the intermediate stage, Startup funding, into two separate stages called “Startup” and “Launch”. Both are merged into the *Venture Capital Investments Startup*-variable in this thesis to follow the definition used by the other sources. Table 8 shows how the dependent variable is divided, with the separate definitions for the stages of *Venture Capital Investments* included.

Table 8 - Venture Capital Investments, dependent variable division definitions

Variable	**Description**
Venture Capital Investments Total	Every Seed and Series A to Series D private equity investment made by a VC or an angel investor into a Swedish venture
Venture Capital Investments Seed	Every Seed stage private equity investment made by a VC or an angel investor into a Swedish venture
Venture Capital Investments Startup	Every Series A and Series B private equity investment made by a VC or an angel investor into a Swedish venture
Venture Capital Investments Expansion	Every Series C and Series D private equity investment made by a VC or an angel investor into a Swedish venture

A risk with the data on VC funding in general, which came to light after discussions with SVCA, Tillväxtverket and Invest Europe, is the imprecise measurements of VC funding that often leads to the organizations changing the value retroactively. These changes mean that the results would most likely differ if the same investigation as this thesis was performed five years ago or is performed five years into the future. This is a poor outlook for the exact reproducibility of the results presented in this thesis, but it is somewhat solved by providing the entire dataset on the *Venture Capital Investments* variable in Appendix 2. The retroactive changes are most likely not something that will disappear any time soon from the VC research sphere, as the development of more precise methods for measuring and reporting VC funding are in their early days, but the risk of it for this thesis still has to be acknowledged.

The type currency of the VC funding measure is different in the data sources depending on the organization. This difference naturally arises from the preferred currency of measure for the organization but requires a transformation of the obtained data for the dependent variable. From the Swedish Riksbank, the annual average exchange rates between the used currency and the Swedish Krona (SEK) are acquired for the entire temporal scope (Riksbank, 2021). This way, *Venture Capital Investments* can be displayed in SEK for the whole period. Table 9 shows the currency and size transformations necessary to perform on the separate data sources and Appendix 2.2 states the used exchange rates used for every currency pair over the entire investigated period. The full dataset on *Venture Capital Investments Total*, after the homogenous currency transformation, is shown in Appendix 2.1.

Table 9 - Venture Capital Investments, currency and size transformation

Source	Currency and size used in the acquired data	Transformation of currency	Transformation of size
Invest Europe	€ thousand	€ / SEK	Divided by 1000
Tillväxtverket	SEK million	-	-
Eurostat	€ million	€ / SEK	-
OECD	$ thousand	$ / SEK	Divided by 1000
Riksbank	SEK million	-	-
SVCA	SEK million	-	-
Dealroom	€ million	€ / SEK	-

Finally, the data acquired from the different sources is uniformly defined and transformed to an equal scale and currency of MSEK. In the variable used in the regression and PCA later in the method, there cannot be different data sources as it would complicate the comparability of results. Therefore, the last transformation that merges the data from the different sources into one variable for each stage is necessary. The reasoning behind merging different data sources has to do with the measuring and definition differences aforementioned. Relying on one source of data makes the research prone to the errors of the specific data sources, which is a problem that is seldom discussed in other literature. Making the dependent variable as reliable as possible is crucial for the research results acquired in this thesis or any investigation on the VC industry, which is why the average of the different sources for any given year is used as the measure for *Venture Capital Investments*. This reduces the differences in the individual sources and creates a more authentic, accurate and rightfully representable value of VC funding in the Swedish economy.

The granularity of the obtained data from the sources for *Venture Capital Investments* is mostly yearly, which is unfortunate. It results in only 20 observations over the temporal scope and would most certainly not be suitable in relation to the number of selected determinants. If the perfect data was available, the dataset would consist of 80 true observations over the temporal scope, one for each quarter in all the 20 years. The approach taken here is to split up all the yearly data into quarters, as most of the determinants are observed on a quarterly basis. However, the data from SVCA is presented quarterly for the years 2001 - 2010 and thus results in 40 observations over this period. With the last ten years being measured on a yearly basis, the remaining 30 observations have to be estimated from this data.

Starting with the transformation necessary in the first ten years. The sum of all the sources in each of the years (i.e., not the SVCA-data) is divided by 4 in order to get a quarterly sum of sources and the quarterly observation from SVCA is then added as follow:

Formula 1 - Annual observation transformation, 2001 - 2010

$$x_i = \frac{Sum\ of\ sources_j}{4} + x_{i,SVCA}$$

Where x_i is the total value of the quarterly observation of VC funding made in observation i, j is the year where i is and $x_{i,\ SVCA}$ is the SVCA quarterly observation in i. This step is a preparation and is clarified after the following formula, in which this sum (x_i) is divided by the total number of sources used in the sum above.

Formula 2 - Venture Capital Investments, 2001 - 2010

$$Venture\ Capital\ Investments_i = \frac{x_i}{n}$$

Where n is the number of data sources for the quarter i. This results in the observations' arithmetic mean and lead to an average VC funding amount in each quarter. This is done for the first ten years ($i(0 \Rightarrow 40)$). The second 10 years in the dataset are only available on an annual basis, for which the steps are a bit different. In order to not end up with four identical observations for each year over the period 2011 to 2020, an assumption is made that the annual observation can be adjusted by identifying the quarterly quota of the first ten years and applying it to the annual observations. Firstly, the total value of each of the four quarters over the 40 observations ($i(0 \Rightarrow 40)$) is extracted and divided by the total value of all the observations. This is done to get the differences between the quarters from the first 40 observations ($i(0 \Rightarrow 40)$). Secondly, that seasonal quota is used to impute the data in the following 40 observations($i(41 \Rightarrow 80)$). The two steps are performed as follow:

Formula 3 - VCI quarterly quota 2001 - 2010

$$Quarterly\ quota\ for\ quarter_{(Q1,Q2,Q3,Q4)} = \frac{Sum\ of\ all\ quarters_{(Q1,Q2,Q3,Q4)}}{Sum\ of\ all\ quarters}$$

Formula 4 - Venture Capital Investments, 2011 - 2020

$$Venture\ Capital\ Investments_i = Sum\ of\ sources\ in_j * Quarterly\ quota\ for\ quarter_{(Q1,Q2,Q3,Q4}$$

These calculations lead to quarterly-adjusted observations for VC funding for the period 2011 - 2020, which is much more suitable for the statistical methods applied than having four identical observations in each of the quarters in a year. The quarterly quota for each quarter and the average value used for the imputation are visualized in Appendix 2.3. However, the number of true observations does not change through these transformations and imputations; The number of true observations is still 50 (40 from 2001-2010, 10 from 2011-2020). The individual values of the quarterly-adjusted observations in the 40 last quarters are assumed to be as close to the actual value of VC funding as possible. This is a crucial assumption because the observations are estimated and imputed instead of displaying the true value.

All data sources are equally weighted through the calculations performed and compose the final measure of the dependent variable, *Venture Capital Investments,* reflecting the amount of VC funding in the Swedish economy. The variable is calculated in the same way for each of the three individual investment stages, but the amount of quarterly observations ends in 2007 instead of 2010, which increases the number of imputations for the investment stages as opposed to the measure of Total funding. The data obtained from the different sources and its transformation to the composite value, with complete calculations in the individual steps taken above, are presented in Appendix 2 with the final values for all investment stages presented in Appendix 2.4 along with visualizations of the values in the investment stages in Appendix 2.5 and in the sources in Appendix 2.6. Shorter summaries are shown in Table 10, Table 11 and Figure 3.

Table 10 - Dependent variable data collection and transformation

			Number of Sources used for period (max)			
Variable	**Formula name**	**Obs. (true)**	**2001 - 2005**	**2006 - 2010**	**2011 - 2015**	**2016 - 2020**
Venture Capital Investments Total	*vciTot*	80 (50)	2	5	5	4
Venture Capital Investments Seed	*vciSeed*	80 (38)	1	3	4	4
Venture Capital Investments Startup	*vciStartup*	80 (38)	1	3	4	4
Venture Capital Investments Expansion	*vciExp*	80 (38)	1	3	4	4

Table 11 - Summary of Venture Capital Investments

Variable	**Unit**	**Mean**	**Std.**	**Max**	**Min**
Venture Capital Investments Total	MSEK	805	330	2 422	321
Venture Capital Investments Seed	MSEK	320	144	709	115
Venture Capital Investments Startup	MSEK	434	296	1 801	145
Venture Capital Investments Expansion	MSEK	570	165	891	376

Figure 3 - Venture Capital Investments, all investment stages

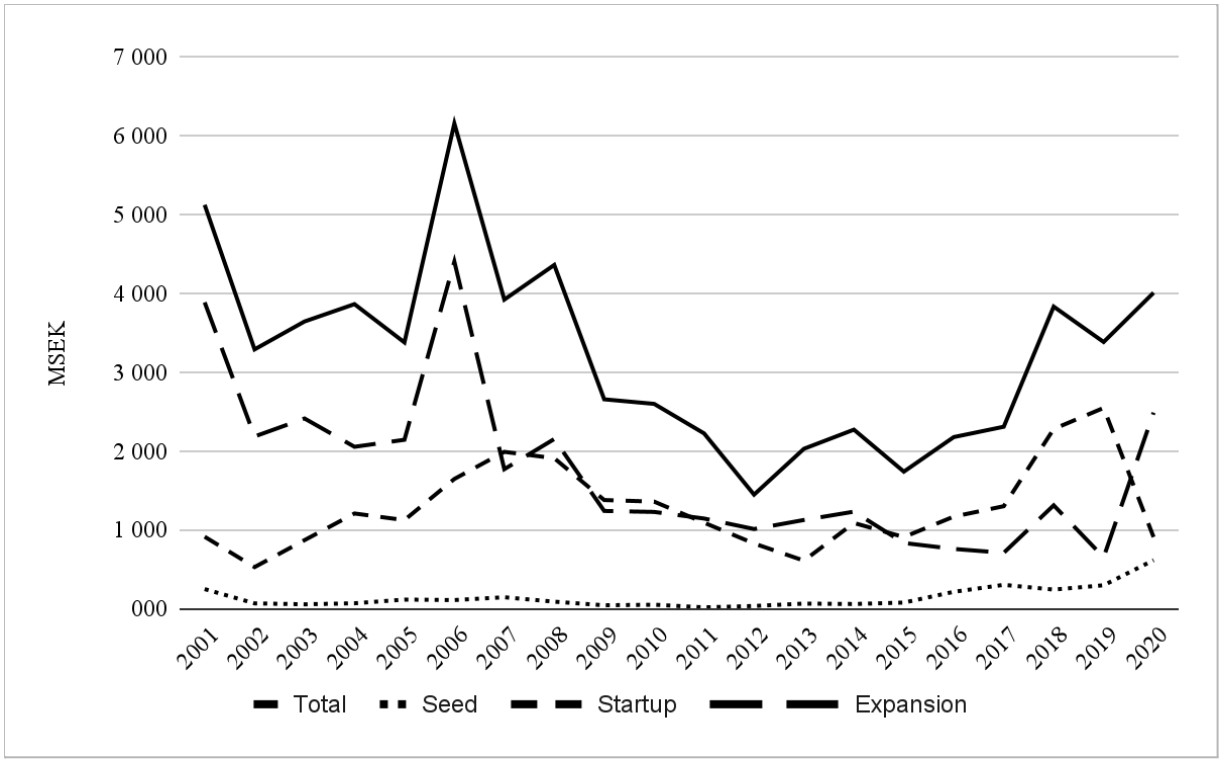


Figure 3 shows the values of the four dependent variables: Total, Seed, Startup and Expansion funding.

To round up the dependent variable data collection, it can definitely be concluded that relying on one source without having to perform all the transformations and imputations would be preferred. This research is, like many others seeking to investigate VC funding specifically, highly constrained by the available data. The imputation of missing data observations may increase the error in the approximation of the true value of the dependent variable in some observations, which can affect the degree of explanation in the regression models and the credibility of the result. It is, however, the best possible representation of VC funding in Sweden unless complete data for the entire period can be acquired with the same definition and without missing observations. The most accurate value should always be strived for but in future studies the missing data in this investigation could easily be replaced by the true values. The risk for error in the dependent variable has been minimized to the furthest extent possible in this research but can, of course, be further developed by other researchers looking to use the amount of VC funding in Sweden or any other country of investigation for that matter. With the developments of online databases, which all have very high granularity in the data such as Pitchbook, Crunchbase and Dealroom, amongst others, research in the future will most likely be able to take advantage of this dramatic increase in granularity and find changes on a monthly, weekly or even daily level.

3.2.3.2 Determinant data collection

Data collection on the explanatory variables is a much simpler task than acquiring and transforming the relevant data for the dependent variable. In this section, each of the determinants will be explained regarding how the data is collected and what kind of transformation is necessary, following the order of the determinants established in Table 6 from section *3.2.2 Determinant selection*. After all the determinants have been collected and transformed, the sources for all the determinants and a summary of their values are presented in Table 12 and Table 13.

Almost all of the determinants are displayed on other granularities than quarterly bases, which means that they have to be transformed in order to be comparable to the *Venture Capital Investments* measure, that is measured quarterly, in the statistical models. It might seem problematic to transform a large number of determinants but the values are merely smudged out on the observations where they are missing and not created anew, which is a crucial distinction to make for the validity of the results and for not having to create assumptions around the changes in each of the determinant values as is done by the quarterly quota for *Venture Capital Investments*.

Starting with the determinant named *IPO Activity*. In the literature, the reasoning behind using the IPO market as a measure for VC activity has to do with the natural desire of the VC as an investor. They seek to exit their investments in as lucrative ways as possible and a vibrant and active IPO market is thus implied to increase with the amount of VC activity as more VC:s seek to exit their investments in such an IPO climate. The measure of *IPO Activity* is naturally the number of IPO:s performed in a year, but data on this measure for the entire temporal scope has been troublesome to acquire for this thesis. Somewhat reliable information can be acquired through the Swedish webpage “Nyemissioner.se”, but not for the entire temporal scope. Thus, the measure for *IPO Activity* has to be proxied for a measure capable of explaining the same effect. Statistics Sweden (SCB), via Finansinspektionen, records how many companies are publicly traded on all Swedish stock exchanges every year, which can be used as a proxy for the number of IPO:s. The total number of public companies only increases by new IPO:s and decreases with companies delisting on the public markets (often because of financial difficulties). This measure does, therefore, show the change in the number of IPO:s on all Swedish public markets and the decrease of companies available on the public markets, which cannot be shown by only using the number of IPO:s. However, using this measure as a proxy could potentially be problematic. There could be a large number of IPO:s obstructed in the data through an equally large number of companies delisting at the same time. These two effects might be unrelated, leading to the proxy measure under- reporting good exit climates and over-reporting bad exit climates. This risk is deemed minimal and acceptable, to be further discussed in the analysis. Data for the years 2006 to 2020 is provided on a semi-annual basis, while data from 2001 to 2005 are provided

on an annual basis. Using a quarterly transformation, the total number of companies in each quarter becomes the same as the semi-annual or annual number:

Formula 5 - IPO activity annual transformation

$$Annual\ observations\colon\ x_{\ i} = x_{\ j}$$

Formula 6 - IPO activity semi-annual transformation

$$Semi - annual\ observations\colon\ x_{\ i} = x_{\ j}$$

Where i is the quarter, *j* is the year where *i* is from and *l* is the half-year from where *i* is. The total number of public companies annually is positioned in every quarter across the dataset from this transformation. In order to make the quarterly observations more suitable and correctly reflecting the actual number of public companies in each observation. The time-series observations are transformed into a moving average, which is the last transformation and is calculated as follow, with the final name of the determinant as *IPO*:

Formula 7 - IPO activity

$$IPO_{\ i} = \frac{x_{\ i} + x_{\ i-1} + x_{\ i-2} + x_{\ i-3}}{4}$$

The next determinant is *Stock Market Development*. For the Swedish VC industry, this is the measurement of the development of the Swedish stock market as a whole, which is reflected by the OMX Stockholm PI market capitalization; OMX is the identification of nordic indexes, after the merger of the Swedish company OM AB and the Finnish company Hex Plc, whilst PI means Price Index. The OMXSPI is also called the "Stockholm all-share" and weighs together the value of all shares listed on the Stockholm Stock Exchange, which provides an overall picture of developments on the Swedish stock exchange. Data on the development of the OMXSPI is publicly available on NASDAQ OMX Nordic, displayed daily. In order to transform the daily observations into quarterly observations, the average market cap during the quarter is calculated in Formula 8. It takes the sum of all closing prices for OMXSPI during the quarter and divides it by the total amount of trading days, as follow:

Formula 8 - Stock Market Development (Average quarterly market cap)

$$stkmkt_{\ i} = \frac{1}{td_{tot,\,i}} \sum_{td_{\ 0}}^{td_{\ tot,\,i}} Closing\ price_{\ td}$$

Moving on to the determinant *Corporate Tax Rate*. It is one of the two regulatory determinants used in this thesis and it is defined as the level of tax that companies pay on their profits in the Swedish economy and is measured as a percentage of those profits. Data

on it is measured on a yearly basis from SCB and is freely available. The quarterly transformation necessary takes the same form as that of Formula 5 for *IPO Activity*, shown in Formula 9 below:

Formula 9 - Corporate Tax Rate

$$corptax_{i} = x_{j}$$

The second regulatory determinant and one of the more interesting determinants is *Labor Market Rigidity*. Its definition and what is included in its value is quite vague, but the effect sought after in the determinant is not. A high rigidity (antonym to flexibility) in the labor market creates a labor market environment where employees are more stable in their employment, as it is harder for companies to fire employees due to long notice periods. However, it also makes it harder for unemployed people to find work, as the hiring processes are more selective and careful due to this rigidity. Entrepreneurial activity is expected to be lower in rigid labor markets, as it is harder to be an entrepreneur due to employment being more highly valued, which is expected to reduce VC activity. The measurement of *Labor Market Rigidity* is created with inspiration from Bozkaya and Kerr (2014) along with Félix, Piles and Gulamhussen (2013), two articles from the literature review in Grilli, Latifi and Mrkajic (2019). Results in the paper by Bozkaya and Kerr (2014) show that stricter labor market regulation increases *Labor Market Rigidity* and, in turn, reduces VC activity. The article by Félix, Piles and Gulamhussen (2013) argues that the long-term unemployment in a country is higher in countries with stricter labor market rigidities through their cross-country study in Europe. By combining these two findings, the determinant *Labor Market Rigidity* will be reflected by different measures. The first is labor market regulation, which is conveniently measured by Fraser Institute as a part of their "Economic Freedom Index" on an index scale of 1 to 10 (1 being the most regulated and 10 being the least regulated). The labor market regulation index is in turn composed of 6 individual measures, which are: Hiring regulations and minimum wage, hiring and firing regulations, centralized collective bargaining (unionization), hours regulations, mandated cost of worker dismissal and lastly, conscription. However, it is shown on an annual basis, which requires a quarterly transformation as follows in Formula 10. The data ends in 2018 and has to be imputed for 2019 and 2020, which is done by taking the average value of the three preceding years and then transforming it the same way as the other data.

Formula 10 - Labor Market Rigidity (Labor market regulation)

$$rigidLMR_{i} = \frac{LMR\ index_{j}}{4}$$

The other measure for *Labor Market Rigidity* is long-term unemployment. Data on long-term unemployment is acquired from SCB, but interestingly enough has to be calculated and is not shown as a separate measure. When someone is classified as unemployed or long-term

unemployed is defined by SCB as 27 weeks of unemployment and is measured quarterly. In the data acquired, the total number of people unemployed longer than 27 weeks is divided by the total number of people in the workforce, as follows in Formula 11.

Formula 11 - Labor Market Rigidity (Long term unemployment)

$$rigidLTU_i = \frac{Unemployed\ longer\ than\ 27\ weeks_i}{In\ the\ workforce_i}$$

The first of the contextual determinants is the determinant *Interest Rate*. It is measured as the Riksbanks' repo interest rate in Sweden, called the "Repo rate" and is the rate at which commercial banks can borrow from and get returns from supplying money to the Swedish government. Data on the Repo rate is freely available on a monthly basis from the Swedish Riksbank. This requires a transformation of the data, which is done by taking the average rate in the three months per quarter as shown in Formula 12:

Formula 12 - Interest Rate

$$interest_i = \frac{(Month_{1,i} + Month_{2,i} + Month_{3,i})}{3}$$

The next determinant to collect data on is *GDP Growth,* one of the most commonly used determinants for VC activity in an economy. The GDP is a measure of the economic output in a country and its growth rate measures how fast the economy is growing. Data on *GDP Growth* is generally available and is collected from SCB, measuring the *GDP Growth* in one quarter as the change in the value of GDP from the previous quarter. The measurement from SCB is available quarterly, which means that no transformation of the data will be necessary.

Unemployment is also one of the most commonly used determinants and shows the general condition of the labor market. The determinant *Unemployment rate* is the percentage of people in the labor force without a job. In 2001, the definition of people capable of being in the labor force in Sweden was changed from the interval 15 - 64 years to 15 - 74 years to follow the improving health and working capabilities of the population. This change led to a split in the measurement of unemployment in the SCB data source in order to keep the comparability over time. Fortunately for this determinant, the new definition can be used as it was introduced in the first year (2001) of the temporal scope in this thesis. The data is gathered from SCB, measured monthly, thus having to be transformed like the determinant *Interest Rate* mentioned earlier. The formula used is the same as Formula 12, with different input:

Formula 13 - Unemployment rate

$$unemploy_i = \frac{(Month_{1,i} + Month_{2,i} + Month_{3,i})}{3}$$

The last two of the determinants to collect are the technology determinants, starting with *R&D expenditure*. Investing in R&D is tightly linked with innovation, with an increase in R&D often leading to more innovation and, in turn, probably more VC activity. The data used for this determinant is acquired from the Main Science and Technology indicators from OECD and is measured as a percentage of GDP. The exact name from OECD is "GERD as a percentage of GDP", measured on an annual basis, creating a need for a quarterly transformation. Data on the year 2020 is also missing and the imputation made is the same as for *Labor Market Rigidity* by taking the average of the prior three years.

Formula 14 - R&D expenditure

$$rnd_i = \frac{GERD_j}{4}$$

The final determinant for the dataset in this thesis is *Patents*. Other researchers commonly use it as a measure of innovation in a country and it is filling the same purpose in this thesis. The patents included in *Patents* are defined as patent applications that originate from Sweden, while applications from abroad are excluded. The governmental agency Swedish Intellectual Property Office (PRV) keeps online records of how many patent applications are made yearly, which will be used for the measure. A transformation into quarterly observations is necessary and done in the same order as the prior determinants, along with a moving average:

Formula 15 - Patent quarterly

$$x_i = \frac{Total\ patent\ applications_j}{4}$$

Formula 16 - Patents

$$patents_i = \frac{x_i + x_{i-1} + x_{i-2} + x_{i-3}}{4}$$

An overview of the data collection with all the shortened determinant names, sources and observations can be found in Table 12. A summary of the values for all determinants is displayed in Table 13 and visualizations of the determinants are shown in cohesion to the discussion in section *5.1 Determinants of VC funding*.

Table 12 - Determinant data collection and transformation

Determinant	Formula name	Source	Original Obs. (Transformed Obs.)
IPO Activity	*IPO*	SCB	20 (80)
Stock Market Development	*stkmkt*	Bloomberg	5021 (80)
Corporate Tax Rate	*corptax*	SCB	20 (80)
Labor Market Rigidity	*rigidLMR, rigidLTU*	Fraser Institute, SCB	20 (80) 80
Interest Rate	*interest*	Riksbank	242 (80)
GDP Growth	*gdpg*	SCB	80
Unemployment Rate	*unemploy*	SCB	20 (80)
R&D Expenditure	*rnd*	OECD	20 (80)
Patents	*patent*	PRV	20 (80)

Table 13 - Summary of determinants

Determinant	Unit	Mean	Std.	Max	Min
IPO Activity	Amount of listed companies	567	164	891	376
Stock Market Development	Mkt cap in SEK	378	150	742	145
Corporate Tax Rate	%	25,2	2,8	28,0	21,4
Labor Market Rigidity LTU	%	1,9	0,5	3,0	0,9
Labor Market Rigidity LMR	Index 1-10	6	1	7	4
Interest Rate	%	1,4	1,6	4,6	−0,5
GDP Growth	% (quarterly growth)	0,5	1,4	6,4	−7,6
Unemployment Rate	%	7,2	1,0	9,4	5,4
R&D Expenditure	% of GDP	3,4	0,2	3,9	3,1
Patents	Number of patent applications	656	114	1038	548

Table 13 shows descriptive data on the complete dataset of the ten independent variables (determinants)

3.2.4 Modeling the amount of Venture Capital funding

3.2.4.1 Regression model - determinants

The fifth step in the method is to create regression models to empirically test the significance of the individual determinants as quantitative longitudinal explanations of VC. The time-series data collected on the individual determinants and the dependent variable is suitable for a time-series regression, which is quite different from a regular regression in terms of the assumptions made. Hereafter, steps are taken not to violate the Gauss-Markov time-series assumptions of OLS and lastly, the regressions are modeled to investigate both the first and the second working hypothesis.

The first assumption is that the dependent variable can be explained by a linear model for each parameter (variable, determinant) used. This assumption is the ground for the validity of the entire linear model for explaining VC funding. In section *3.2.2 Determinant selection*, this assumption can be seen as underlying the first criteria of the determinant relevance, which stated that they have to be able to explain VC funding. It is hard to know for sure about the determinant's explanatory ability or inability beforehand. However, relying on the literature framework in this thesis and the current state of research on determinants, the first assumption can be assured as researchers have confirmed the linear explanation of VC funding by using the same determinants as this thesis.

Assumption 2 (no perfect collinearity between the explanatory variables) and Assumption 3 (expected value of error uncorrelated to the explanatory variables) are, however, harder to assure. In economic systems, most variables are expected to depend on each other and, therefore, usually have a high correlation or causation. A high correlation between variables in regression models often leads to one of the variables being excluded, which is a logical step to take in order to remove excess estimators and therefore improve the explanatory power of the remaining variables. It can also be dangerous to exclude variables as the results of the regression might become misleading. Under Assumption 2, the determinants used in the linear model can be correlated but not perfect explanations of each other. A correlation matrix of all determinants and the dependent variables is shown in Table 14 to discuss this further. A full correlation matrix, with the dependent variables included, is shown in Appendix 3.1.

Table 14 - Correlation matrix

	1	2	3	4	5	6	7	8	9	10
(1) IPO	1									
(2) stkmkt	**0,554**	1								
(3) corptax	−0,475	**−0,872**	1							
(4) rigidLMR	0,367	**0,677**	**−0,808**	1						
(5) rigidLTU	0,140	0,244	−0,335	**0,658**	1					
(6) interest	−0,475	**−0,752**	**0,844**	**−0,792**	**−0,594**	1				
(7) gdpg	0,158	0,014	0,024	0,015	0,142	−0,056	1			
(8) unemploy	−0,038	0,094	−0,217	0,436	**0,776**	−0,434	0,065	1		
(9) rnd	−0,468	−0,500	**0,515**	**−0,764**	**−0,759**	**0,619**	−0,044	−0,464	1	
(10) patent	−0,459	**−0,651**	**0,573**	**−0,713**	**−0,616**	**0,690**	0,049	−0,377	**0,831**	1

Table 14 shows the correlation matrix of the complete dataset of the determinants.

The correlation matrix shows the pairwise unconditional relationship between the determinants. If the correlation coefficients are between 0.5 and -0.5, there is no indication of problems due to collinearity and confounding effects. By looking at the correlation matrix and hypothetically changing each of the determinants while keeping the others constant, it can be investigated if any of the other determinants must change due to the change in the first determinant. No direct collinearity violations are identified for the determinants in this way, but a grey area was identified: *R&D expenditure, Interest Rate, GDP Growth, Stock Market Development and Unemployment rate*. For example, increasing the growth of the economy can most likely not be done by keeping *Unemployment rate* nor *Stock Market Development* fixed, as more people working, productivity growth or expectations on future growth are tightly linked to the growth in the economy. Another way to assure that the assumption holds is by testing the determinants' variance inflation factor (VIF). From the VIF-table, the results of which are shown in Appendix 3.2, the determinants corptax and rnd has a VIF over 10.0 (a generally accepted upper bound limit for when collinearity exists (Wooldridge, 2018)), which is worrying as they to some extent can be explained as a linear combination of other independent variables. The average VIF value across the entire dataset is 6.31, below the 10.0 threshold, and Assumption 2 can therefore be confirmed to hold.

The problem with the correlation of the determinants becomes even more troublesome for fulfilling Assumption 3. As previously mentioned, the correlation of determinants stems from them existing and co-creating the economic system in which they are measured (Sweden), so they cannot directly be declared exogenous. In social sciences in general, endogenous variables are a striking problem and for this thesis, the endogeneity of the dataset has to be discussed as well. If the used determinants are endogenous, they are explained within the model and are defined as correlating with the error term in the OLS regression due to either measurement error or omitted variable (OV) bias. Excluding variables is not a viable solution to this problem, which can be done to work around the problem of multicollinearity in

Assumption 2, but some other things can be done to confirm the third assumption. In STATA, the Ramsey OV-test is used to check for any missed variables in the model and the residuals of the model and their average value are plotted over time, shown in Appendix 3.3, in order to see if the determinants can be related to it, which would be a violation of Assumption 3. The results of the Ramsey OV-test is also shown in Appendix 3.3 and empirically confirm that the model used has no omitted variables. The average value of the residuals is extremely low (0,036) and uniformly and randomly distributed over time, so the determinants are most certainly not related to the error term and Assumption 3 can most certainly be assumed to hold. This declaration is, however, not certain but rather probable, even with the two tests performed. For the OLS regression, this subject will not be further dwelt upon, but the endogenous aspect of the variables be solved and is wholly adjusted for with the PCA discussed later in the method.

The assurance of the first three assumptions confirms that the OLS estimators are unbiased. Further assumptions need to be made about the variance of the errors, starting with the homoscedasticity of the errors in Assumption 4. Heteroscedasticity, the opposite of homoscedasticity, is problematic and happens when the standard deviations of the errors vary over time and often exist in financial and economic data for bonds and stocks, but could also be the case for the independent variables in this thesis. The determinant *Stock Market Development* is the most susceptible of the determinants to heteroscedasticity since its future value is unpredictable and has a changing variance over time due to fluctuations in the economy as a whole. Such heteroscedasticity in the determinants could potentially affect the regression results by making the OLS coefficients less precise. Checking for heteroscedasticity is done in STATA with a Breusch-Pagan / Cook-Weisberg test for the residuals. The test shows no heteroscedasticity in the errors and the results are shown in Appendix 3.3, which confirms that Assumption 4 holds.

Assumption 5 is based on the over-time changes in the errors, much like Assumption 4, but rather the correlation of them in between periods is called autocorrelation. Some changes in the economy can be lagged so that an autocorrelation-relationship between variables arises; for example when the stock market decreases drastically in one quarter and is displayed as an increase in unemployment two quarters later. Assumption 5 does not allow such autocorrelation at all and can be assured in STATA through a Breusch-Godfrey LM test. The result of the test is shown in Appendix 3.3 and does not show autocorrelation in the errors. Assumption 5 can therefore be confirmed to hold.

The last time-series OLS assumption is Assumption 6, regarding the distribution of errors. Time-series regressions investigate the linear coefficients of the determinants as explanations for the dependent variable over time but violate the classic regression assumption that the observations are uncorrelated and independent. This is important for the OLS estimators in the regression model, as the statistical results differ if the stochastic process in the random variable is not truly random. The explanatory variables can still be seen as random stochastic

processes because they would produce different realized values than those collected for this research should the context be different. This is crucial for performing an OLS regression at all, but the errors of the OLS model should be normally distributed for such stochastic variables as they are a function of a random process. Non-normal distribution of errors indicates problems with the randomness of variables under different contexts, implying that the OLS estimators might not be consistent. The normality of the errors is tested in STATA through a Shapiro-Wilk W test and Skewness and kurtosis tests for normality. All tests and a graph of the error distribution are shown in Appendix 3.3 and confirm that the residuals are normally distributed and Assumption 6 holds.

All Gauss-Markov assumptions for time-series regression can be confirmed to hold for the data on the determinants in this thesis. The real issue is Assumption 3 around variable exogeneity, but this is an issue for all determinants research on VC funding and an apparent reason for further developing the method into the PCA later in the thesis. Before the OLS regression model can be created, the dataset needs to be standardized. This is because both the PCA and the OLS regression are sensitive to variance in and value of the determinant, especially when the determinants are measured differently. The determinants have already been transformed to as uniform a measure as possible before the standardization, which makes the standardization itself redundant, but this transformation is vital in the understanding and displaying of the variables nonetheless. The OLS estimators in the regression model have to be measured by the same unit and, through standardization, approximately reach a normal distribution, thus better reflecting the magnitude of the determinant's effect on the dependent variable (Wooldridge, 2018). By standardizing the data, the determinant coefficient in the regression becomes harder to interpret as they are measured in standard deviations instead of in the unit MSEK, used for the dependent variable. However, this research does not try to find out how much funding increases or decreases in absolute terms but instead investigates whether there is an effect and the relative magnitude of this effect on funding. The entire dataset is standardized according to Formula 17:

Formula 17 - Dataset standardization

$$Standardized\ observation\ = \frac{Unstandardized\ observation - \mu_{\ all\ obs}}{Var(all\ obs)}$$

Finally, once all assumptions have been assured and all necessary modifications to the dataset are performed, the creation of the regression models can commence. This thesis utilizes four different regression models, one for each dependent variable (Total, Seed, Startup, Expansion). Each model consists of one dependent variable and the same ten determinants discussed earlier in this method. An overview of each model can be found below through formulas 18-21.

Formula 18 - Regression Model 1, Venture Capital Investments Total

$$vciTot_t = \beta_0 + \beta_1 IPO_t + \beta_2 stkmkt_t + \beta_3 corptax_t + \beta_4 rigidLMR_t + \beta_5 rigidLTU_t + \beta_6 interest_t + \beta_7 gdpg_t + \beta_8 unemploy_t + \beta_9 rnd_t + \beta_{10} patent_t + d_1 * crisis + ę_t$$

Formula 19 - Regression Model 2, Venture Capital Investments Seed

$$vciSeed_t = \beta_0 + \beta_1 IPO_t + \beta_2 stkmkt_t + \beta_3 corptax_t + \beta_4 rigidLMR_t + \beta_5 rigidLTU_t + \beta_6 interest_t + \beta_7 gdpg_t + \beta_8 unemploy_t + \beta_9 rnd_t + \beta_{10} patent_t + d_1 * crisis + ę_t$$

Formula 20 - Regression Model 3, Venture Capital Investments Startup

$$vciStartup_t = \beta_0 + \beta_1 IPO_t + \beta_2 stkmkt_t + \beta_3 corptax_t + \beta_4 rigidLMR_t + \beta_5 rigidLTU_t + \beta_6 interest_t + \beta_7 gdpg_t + \beta_8 unemploy_t + \beta_9 rnd_t + \beta_{10} patent_t + d_1 * crisis + ę_t$$

Formula 21 - Regression Model 4, Venture Capital Investments Expansion

$$vciExp_t = \beta_0 + \beta_1 IPO_t + \beta_2 stkmkt_t + \beta_3 corptax_t + \beta_4 rigidLMR_t + \beta_5 rigidLTU_t + \beta_6 interest_t + \beta_7 gdpg_t + \beta_8 unemploy_t + \beta_9 rnd_t + \beta_{10} patent_t + d_1 * crisis + ę_t$$

Where β_0 is the constant, *t* is the quarter in the model (used as *i* and *j* in other formulas) and $ę_t$ is the error term. The crisis dummy d_1 reflects the crisis years, as found in Figure 1 and Table 3, with a one-year (4 periods) lag. STATA is used to run all regressions, using the standard command "regress" which is a linear estimation of the parameters in the regression. The total number of degrees of freedom is commonly determined by the program itself but imposes a risk in this case due to the number of "true" observations being lower than that of the observations regressed in the model. This can be reasoned to be an important adjustment as the test-statistic depends on the number of true observations, leading the program to believe that the entire dataset consists of true observations and thus showing faulty rejection limits. This adjustment is not made in this thesis due to the advanced and somewhat excessive method for adjusting the degrees of freedom. The approach taken here is to accept the increased risk of Type II error, which is when the significance test leads to accepting actually false determinants, but regarding the results as a bit less reliable than the ideal case. The

number of true observations is shown in earlier Table 10 in section *3.2.3.1 Venture Capital Investments data*.

The regression models are run for each of the dependent variables, without lags, for reference and then the variables are lagged one at a time to arrive at the model with the best fit. Attempting to determine the appropriate level of lag in the individual determinants is done by changing the amount of lag on each of the determinants that might have lagged effects one at a time to investigate if the level of significance and the model fit is increasing or decreasing. Lagging some determinants is done due to effects in the economy being delayed and impacting VC funding in a later period. Which determinants to lag are hard to foresee before doing this testing, even in the other literature. The number of lagged determinants is not reasonably many, as they have causal explanations for VC funding to be called determinants, which is somewhat violated if the determinant is temporally shifted. The outcome of the lag-testing resulted in one two-period lag of the determinant *rigidLTU,* which seems reasonable as it displays changes in long-term unemployment, people unemployed longer than 27 weeks (approx. two periods in the data). The number of observations decreases by two periods in the dataset due to the lag in *rigidLTU*, but this can be said to have been already adjusted for in the adjusted degrees of freedom earlier. The results of the regressions are presented in section *4.1 Determinant regressions*.

3.2.4.2 Principal Component Analysis

The sixth and last step in the method is to propose a model to test the effects behind the determinants used in the regressions. As mentioned earlier, this thesis seeks to contribute to developing the determinants research further and believes that an inductive approach by applying Principal Component Analysis (PCA) and Principal Component Regression (PCR) is a reasonable way forward in understanding what really drives VC funding. All separate steps taken in order to perform a PCA and PCR for the dataset are described below.

The first step is to obtain the principal components of the entire dataset, which is done by calculating them as linear combinations of the original variables so that the variation in the components is maximized and the principal components become completely uncorrelated from each other. The PCA is run in STATA due to the extensive calculations and includes all the selected determinants but not any of the dependent variables, as they cannot be explanations of themselves. This distinction is crucial as the PCA is used to find the overarching effects (hereafter components) of the determinants, not of the dependent variables. The output of the *pca* command is two separate tables, which are both highly relevant for the later discussion and definition of the component dimensions. This thesis will not dwell too much deeper into the inner workings of PCA but rather focus on its purpose, the reasoning for applying it and the input and output in the model to keep the argument light and relevant for the performed investigation.

The first table shows an example of how the output is presented, which starts with how many components are identified in the data (the same number as the number of determinants used), their eigenvalues, the difference in eigenvalue between components and the proportion of variance explained. This is relevant output for deciding how many components to keep in the PCR and how many dimensions to analyze concerning VC funding. As is expected in the PCA method, the first principal component explains the most variation in the dataset, the second component explains less variation and the third even less, with the first component being the most important, the second component a little less important and the third even less important. This variance is called the "Eigenvalue" of each component and the sum of all eigenvalues is the total variance in the data.

Table 15 - PCA formula example output 1

Component	**Eigenvalue**	**Proportion**	**Cumulative**
Component 1	Component 1 variance	Proportion 1 = Component 1 variance / Total variance	Proportion 1
Component 2	Component 2 variance	Proportion 2 = Component 2 variance / Total variance	Proportion 1 + Proportion 2
. . .	. . .	. . .	. . .
Component *n*	Component n variance	Proportion n = Component n / Total Variance	Sum of Proportion 1 through n

The following output table is even more relevant when the components are used as explanatory variables in the PCR model for *Venture Capital Investments*. The values in Table 16 are called the "Eigenvectors" of the variables, which are essential in understanding to what extent the individual variables are explaining the individual components, commonly referred to as how prominent their "loadings" are in each component. Eigenvectors are central in explaining and defining the individual components to find out what their dimensions represent and the loadings are thoroughly discussed in *5.2 Principal Component Analysis discussion* to define the dimensions acquired from the PCA in this investigation.

Table 16 - PCA formula example output 2

Determinant	**Component 1**	**Component 2**	**Component n**
Determinant 1	Eigenvector for Det 1 in PC1	Eigenvector for Det 1 in PC2	Eigenvector for Det 1 in PCn
Determinant 2	Eigenvector for Det 2 in PC1	Eigenvector for Det 2 in PC2	Eigenvector for Det 2 in PCn
. . .	. . .	. . .	. . .
Determinant n	Eigenvector for Det n in PC1	Eigenvector for Det n in PC2	Eigenvector for Det n in PCn

The next step in the PCA is to confirm that the eigenvectors and eigenvalues are valid for the dataset used. This validity can be assured through a Kaiser-Meyer-Olkin (KMO) test, which indicates the proportion of the variance in the underlying data that some overarching and cohesive factors might explain. It is crucial for the PCA that the KMO-test has a value greater than 0.5 for the set of determinants used in the analysis; if not, the variables do not correlate sufficiently to be able to use the PCA efficiently, as the overarching factors might still exist but will be significantly harder to explain. The creator of the test declared a list with names of the value ranges that the KMO-results can take, for which the results will be compared. This characterization can be found in Appendix 4.1 and is used to grade the individual determinants' fit for a PCA, but the primary use is to grade the overall dataset to confirm if the determinants are collectively fit for a PCA. The definition of "fit" in this thesis is any KMO-value above 0.5, but higher values are better and are expected to provide more precise results. The dataset has a KMO of 0.73, which is defined as "middling" and is very assuring for the validity of the results from the PCA. The result of the KMO test is shown in Appendix 4.2.

Once the variance in the principal components (Eigenvalues) are calculated and sorted along with the direction of the effects from each variable (Eigenvectors), the fourth step of the PCA is to select how many of the components to test in the PCR model. A general rule of thumb is to plot the Eigenvalue against the number of components and select all the components before the elbow (the plotted line looks like a bent elbow) starts in the graph. This rule is highly vague but generally used in PCA for selecting components. It is essentially saying that when the marginal explanatory effect of adding an additional variable is close to 0, no more components should be added. This change in marginal explanatory effect happens at the elbow in the graph, which for the data investigated in this thesis can be seen to happen already at the first component, as seen in Figure 4. Following the elbow rule would mean that the rest of the investigation on the components should move forward with only one component, which from the perspective of components as overarching drivers of VC funding surely cannot be sufficient in providing a nuanced explanation of these driving forces.

Figure 4 - Component eigenvalues and cumulative explanation of dataset variance

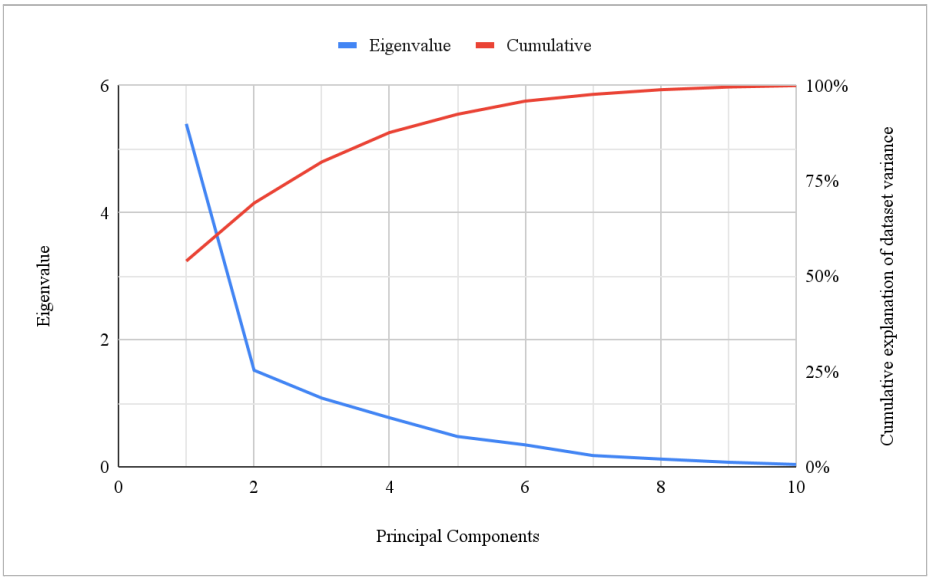


Table 17 - Component Eigenvalues

	Eigenvalue	Proportion	Cumulative
Component 1 (PC1)	5,398	0,540	0,540
Component 2 (PC2)	1,520	0,152	0,692
Component 3 (PC3)	1,081	0,108	0,800
Component 4 (PC4)	0,772	0,077	0,877
Component 5 (PC5)	0,477	0,048	0,925
Component 6 (PC6)	0,345	0,035	0,959
Component 7 (PC7)	0,177	0,018	0,977
Component 8 (PC8)	0,122	0,012	0,989
Component 9 (PC9)	0,071	0,007	0,996
Component 10 (PC10)	0,037	0,004	1,000

Table 17 shows the same values as Figure 4 numerically and assists in deciding how many components to keep for further investigation as the elbow rule does not work in this case. The first component has a very high Eigenvalue, as can be expected, of 5.398, thus explaining 53.98% of the total variance in the dataset. The marginal Eigenvalue decreases quickly after the first component, as shown in Figure 4, which means that adding many components after component 1 is not reasonable. The limit is set at a 5 % proportional explanation of the variance, as any effect of the component that explains less than 5 % of the total dataset variance is less than ten times as important as the first component with its 54 % explanation. This reasoning leads to the inclusion of the first four components out of the ten components, which means that the four selected components explain 87.7 % of the total dataset variance.

The fifth and final step of the PCA-part is to utilize the PCA components to validate their effects on VC funding through a linear regression model. Such a model is called a Principal Component Regression (PCR) and is essentially a standard linear regression model where *Venture Capital Investment Total* is regressed on the four selected components. The PCR is modeled as follows in Formula 22.

Formula 22 - PCR regression model

$$vciTot_t = \beta_0 + \beta_1 * comp1 + \beta_2 * comp2 + \beta_3 * comp3 + \beta_4 comp4 + ę_t$$

The regression result is the ground for drawing empirical conclusions about this inductive research, as this part of the research method is fundamentally based on the speculation that there does exist some overarching and unexplained effects in the determinants data as stated in working hypothesis 3. Significant components in the PCR provide empirical evidence of the existence of such underlying dimensions in the data.

4. Results

This section presents the results of the research method carried out in this thesis. Firstly, in section *4.1 Determinant regressions*, all four of the OLS regressions models are presented in Table 18 with their respective coefficients, p-values and the model fits (R-squared). This table provides an overview of all the regressions and how individual determinants vary in explaining the different dependent variables that reflect the different VC investment stages. The individual determinants are in this section referred to by their formula name, as the results tables from the regressions use the formula names.

After the determinant regressions, in section *4.2 Principal Component Analysis and Principal Component Regression*, the results of the Principal Component Analysis (PCA) are presented in Table 19 with the eigenvalues of each component and the eigenvectors (loadings) of the individual determinants in the components. The result of the PCR is then shown in Table 20 with the component coefficients on *Venture Capital Investments Total* and the model fit of the PCR as a whole.

4.1 Determinant regressions

Table 18 - Determinant Regression results

Determinant	Model 1 - Total	Model 2 - Seed	Model 3 - Startup	Model 4 - Expansion
Financial market conditions				
IPO	0,49 (0,07)	0,42 (−0,06)	0,93 (−0,01)	0,61 (0,05)
stkmkt	0,05* (0,40)	0,00*** (1,17)	0,20 (0,34)	0,18 (0,28)
Regulatory				
corptax	0,35 (−0,22)	0,10 (0,28)	0,27 (0,34)	0,44 (−0,18)
rigidLMR	0,00*** (−1,08)	0,83 (−0,03)	0,06* (−0,52)	0,00*** (−0,82)
rigidLTU (2 period lag)	0,00*** (0,62)	0,33 (−0,12)	0,46 (−0,16)	0,00*** (0,69)
Macroeconomic conditions				
interest	0,03** (0,37)	0,74 (0,04)	0,26 (−0,25)	0,02** (0,42)
gdpg	0,42 (−0,06)	0,01*** (−0,16)	0,87 (0,02)	0,36 (−0,07)
unemploy	0,47 (0,06)	0,00*** (0,21)	0,06* (−0,23)	0,05** (0,18)
Technology				
rnd	0,00*** (0,98)	0,00*** (0,57)	0,90 (−0,04)	0,00*** (0,88)
patent	0,01*** (−0,68)	0,26 (−0,21)	0,01*** (−0,93)	0,27 (−0,29)
crisis dummy (4 period lag)	0,04** (−0,49)	0,20 (−0,22)	0,36 (0,29)	0,02** (−0,60)
Cons.	0,29 (0,09)	0,83 (−0,01)	0,36 (−0,10)	0,20 (0,11)
R-squared	0,690	0,848	0,516	0,596

Significance: 90, 95**, 99****

Table 18 shows each of the determinants' impact on Total, Seed, Startup and Expansion funding through four different regression models: *Model 1 - Total, Model 2 - Seed, Model 3 - Startup and Model 4 - Expansion*. Model 1 has an R-squared of 0.690, which indicates that the selected determinants explain the variation of the dependent variable *Venture Capital Investment Total* by 69.0 %. The R-squared of model 2 is the highest of all models and

explains 0.848 (84.8 percent) of the dependent variable *Venture Capital Investment Seed*. Model 3 has an R-squared of 0.516, which is the lowest level of explanation in any of the four models. This indicates that the determinants could only explain 51.6 % of the variance in the dependent variable *Venture Capital Investments Startup.* The R-squared of model 4 is 0.596 and could explain 59.6 percent of the variance in the dependent variable *Venture Capital Investment Expansion*, which is the second-lowest of the four models. Therefore, the selected determinants are best at explaining changes in Seed funding followed by Total funding, Expansion funding and, lastly, Startup funding over the years 2001 - 2020 in Sweden. Hereafter, the individual results are discussed from the point of view of each of the areas of determinants, all of which show mixed results.

The two determinants within the area *Financial market conditions* are expected to have positive coefficients due to the close connection between *Venture Capital Investments* and a sound financial market. The estimated coefficient on *IPO* is positive but not significant in any of the regression models, which makes the effect of *IPO* on *Venture Capital Investments* impossible to ascertain. The estimated coefficient on *stkmkt* is positive in all models and statistically significant in models one (1) and two (2). This indicates that a positively developing stock market increases the amount of funding in Total and in the Seed stage.

The three determinants within the area *Regulatory* also show mixed results and are expected to have negative coefficients throughout the investigated models. *Corptax* has a positive coefficient in models two (2) and three (3) and negative in one (1) and two (2) but is insignificant in all four models. The estimated coefficient on the first *Labor Market Rigidity* measure (*rigidLMR*) is negative and statistically significant in models one (1), three (3) and four (4). This implies a negative relationship between the level of *Labor Market Rigidity* and all *Venture Capital Investments* except for Seed funding. The second measure of *Labor Market Rigidity* (*rigidLTU*) has a positive coefficient and is statistically significant in models one (1) and four (4). This suggests that an increase in long-term unemployment increases Total and Expansion funding, which is somewhat surprising but consistent with other research.

The three determinants within the *Macroeconomic conditions* area are expected to reflect that better *Macroeconomic conditions* are better for *Venture Capital Investments*. The coefficient on *interest* is positive and significant in models one (1) and four (4). The results show that an increase in *Interest Rate* increases funding in Total and in the Expansion stage. The estimated coefficient of *gdpg* is consistently negative in all models and statistically significant in model two (2). This implies that an increase in *GDP Growth* decreases the amount of funding in the Seed stage. *Unemploy* has a positive coefficient in model one (1), two (2) and four (4) and a negative coefficient in model three (3). It is, however, only statistically significant in models two (2), three (3) and four (4), which indicates that an increase in the *Unemployment rate* increases the amount of Seed and Expansion funding whilst it decreases Startup funding.

The two determinants within the *Technology* area show positive and negative coefficients and a generally good significance. The estimated coefficient of *rnd* is positive and is statistically significant in models one (1), two (2) and four (4). This confirms a positive relationship between *R&D expenditure* and Total, Seed and Expansion funding. The determinant *Patent* shows a significant negative coefficient in models one (1) and three (3), showing that a decreased number of patents increases Total and Startup funding in the economy.

The crisis dummy variable measures the impact of economic crises on VC funding with a one-year lag. The results show that the coefficient is negative and statistically significant in model one (1) and model four (4). This essentially means that the economic crises (dot-com, GFC, Euro crisis and COVID-19) have a lagged negative effect on Total and Expansion funding. This further confirms that there is an effect of the economic crises on Total and Expansion funding outside of the effects that the economic crises might have on any of the investigated determinants that is already reflected in their values.

4.2 Principal Component Analysis and Principal Component Regression

Table 19 - PCA results

	Component 1 (PC1)	**Component 2 (PC2)**	**Component 3 (PC3)**	**Component 4 (PC4)**
Eigenvalues	5,398	1,520	1,081	0,772
Proportion	0,540	0,152	0,108	0,077
Cumulative	0,540	0,692	0,800	0,877
Eigenvectors				
IPO	0,229	−0,401	0,343	−0,454
stkmkt	0,347	−0,388	−0,033	0,142
corptax	−0,360	0,302	0,104	−0,366
rigidLMR	0,388	0,055	−0,086	0,181
rigidLTUlag2	0,310	0,454	0,100	−0,199
interest	−0,380	0,096	0,023	−0,316
gdpg	0,020	0,081	0,914	0,264
unemploy	0,195	0,562	−0,054	0,331
rnd	−0,365	−0,238	−0,040	0,432
patent	−0,368	−0,032	0,110	0,320

Table 19 presents the loadings for each of the determinants in the four selected components; complete results of the PCA, with all ten components included, are shown in Appendix 4.3. Component 1 shows large positive eigenvectors for *IPO* (0.229), *stkmkt* (0.347), *rigidLMR* (0.388) and *rigidLTU* (0.310). This implies that *Financial market conditions* and *Regulatory* determinants have a large positive explanation in the first component, while the rest of the determinants have large negative explanations. *patent* (-0.368), *rnd* (-0.365), *corptax* (-0.360) and *interest* (-0.380) are the prominent negative loadings in component 1, which due to the negative coefficient in the PCR, provides an interesting ground for analysis. Component 2 has larger eigenvectors for fewer determinants, where *rigidLTU* (0.454) and *unemploy* (0.562) are protruding, both pointing towards unemployment of some kind. Negative loadings in component 2 are *IPO* (-0.401), *stkmkt* (-0.388) and *rnd* (-0.238), which also are interesting due to the negative coefficient of component 2 in the PCR. The third component shows even fewer protruding determinants, with *gdpg* having a value close to 1 (0.914), clearly reflecting the growth of the economy as a whole. Component 4 is more diluted and shows high loadings for *gdpg* (0.264), *unemploy* (0.331), *rnd* (0.432) and *patent* (0.3198), which points to the importance of *Macroeconomic conditions* and *Technology* in this component. A visualization of the Eigenvectors for the individual components is shown in Figure 5 to provide a better overview of the determinant loadings in each of the four components.

Figure 5 - PCA results, Eigenvector visualization

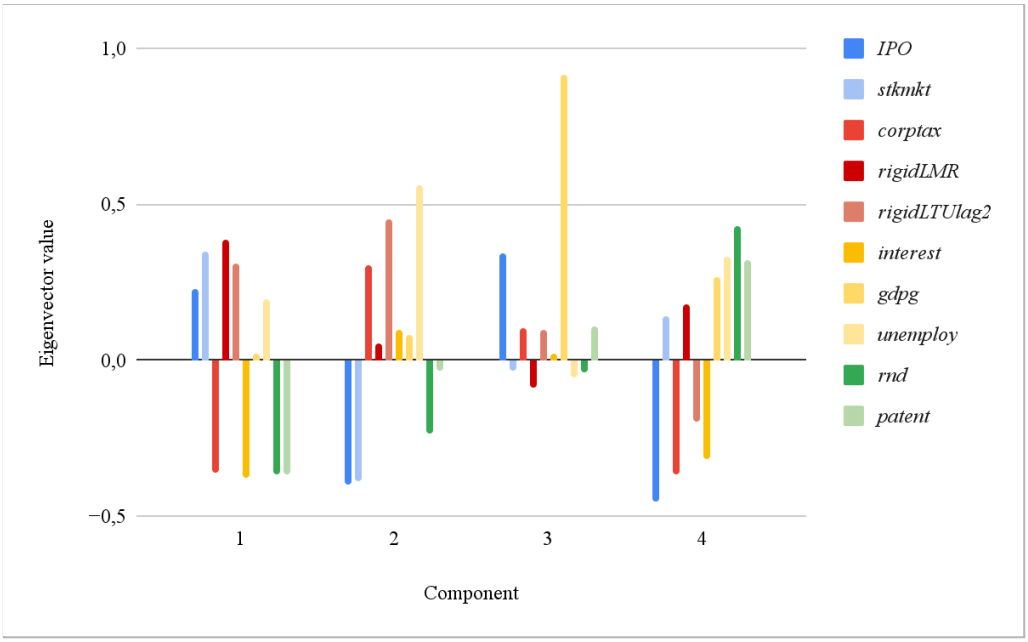


Table 20 - PCR results

Component	**Model 1 - Total**
Component 1	0,000*** (−0,20)
Component 2	0,011** (−0,18)
Component 3	0,730 (0,03)
Component 4	0,202 (−0,13)
R-squared	0,422

Significance: 90, 95**, 99****

The PCR results shown in Table 20 confirm that some of the components are significant in explaining *Venture Capital Investments Total*. Components 1 and 2 have significant coefficients, with component 1 being significant even at the 1% level. The direction of the coefficients and their effects cannot directly be interpreted without relating them to the values of the eigenvectors (loadings). This is done to the furthest possible extent in section *5.2 PCA-discussion* in order to analyze what the components represent.

5. Analysis / Discussion

The results provide an intriguing ground for discussion about the research question and the working hypotheses. They are related to the other literature, discussed and finally analyzed in relation to the research question in this section in the search for a nuanced answer to the research question posed in *1.1 Research question* and the working hypotheses in *1.2 Working Hypotheses*.

5.1 Determinants of VC funding

The regression model tests for the individual determinants show that this method has succeeded in selecting and establishing some determinants of VC funding in Sweden. The determinants selected for the investigation in this thesis (selected in section *3.2.2 Determinant selection*) come from four out of total eight determinant areas: *Financial market conditions*, *Regulatory*, *Macroeconomic conditions* and *Technology*, as defined by (Grilli, Latifi and Mrkajic, 2019). The determinants and explanation of variance differ heavily between the regression models, confirming that the different investment stages have distinctly different characteristics and, in turn, different determinants. The notable findings for each of the determinants are hereafter discussed, focusing on why the results look this way and how they are related to other research and ultimately how the results relate to the first and second working hypothesis.

5.1.1 Financial market conditions

The first determinant in the area *Financial market conditions* is *IPO Activity* which, throughout all models, is never significant at any level. This is surprising as IPO:s are one of the main ways, along with M&A deals, for VC:s to realize investment profits. A vibrant and growing IPO market should be assumed to substantially impact the amount of VC activity and VC funding in the economy. The insignificance of the determinant is also not in line with the majority of literature, where most researchers find *IPO Activity* statistically significant and a positive determinant of VC funding (Jeng & Wells, 2000; Bonini & Alkan, 2012; Félix, Piles & Gulamhussen, 2013; Ning, Wang & Ju, 2015). Jeng and Wells (2000) show that *IPO Activity* has a significant and positive impact on VC funding, but only for later stages of VC investments, where Sweden is included. Bonini and Alkan (2012) and Félix, Piles and Gulamhussen (2013) confirm the same results for more recent periods in Sweden. They all perform cross-sectional investigations, as opposed to the longitudinal study in this thesis, of around 17 countries each, which might explain the difference in results. Ning, Wang and Ju (2015) conclude that *IPO Activity* is one of the strongest drivers of VC funding and its differences over time in a longitudinal study of the US VC industry. Another explanation for the difference in results might arise from the different uses in the measurement for *IPO Activity*, for which this study uses a proxy measure and most other studies rely on either the

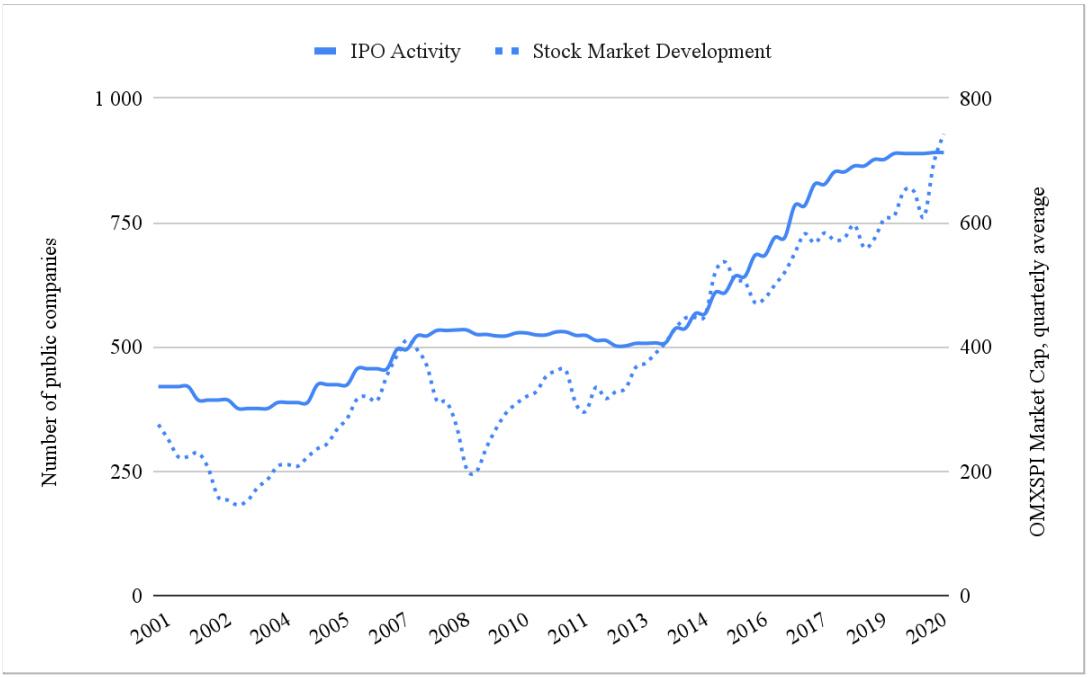
actual number of IPO:s or the total size of all IPO:s. Considering the inconsistent results with other literature, the capacity of using the number of public companies as a proxy for the amount of IPO:s in the Swedish economy might be misguided. Much like the reasoning in Wang (2019), data on Swedish IPO:s was not available for this research, but the proxy is nonetheless an insufficient determinant of VC funding and the real data would most likely be more suitable to provide a better measurement for the real effect behind *IPO Activity*.

The determinant *Stock Market Development* shows significant results in explaining Total and Seed funding but is insignificant in explaining Startup and Expansion funding. The climate on the stock market is viewed much in the same manner as the exit market: a vibrant and steadily growing stock market should be beneficial to VC:s, as it reflects the general investment climate in the country. If the investment climate is hampered by overhanging risks of recession, crisis, and uncertainty in general, it is quickly reflected in the development of the stock market, the investment climate and the amount of VC funding. When the stock market is performing well, there might also be a relative abundance of investment opportunities through more ventures seeking funding and therefore increasing the ability for VC:s to invest their capital. In terms of the economic crises, the development of the stock market in relation to VC funding can be intuitively confirmed as well. For example, the VC funding and the stock market increased in the year 2020 compared to the previous year, despite the ongoing COVID-19 pandemic. In the prior economic crises, like the dot-com bubble and the 2008 financial crisis, the stock market experienced a fall of around 30 - 60% (see Figure 6) and VC funding decreased along with it. However, the stock market recovered a lot faster in 2020 than the prior crises, where it took several months or even years to recover, which indicates the quickly changing aspect of the investment climate in the country as reflected by the *Stock Market Development*. The reasoning behind why the regression results differ between the investment stages can be found in the different characteristics of those stages. Seed funding has a much shorter and less rigorous investment process than the later stages. Larger investments implicitly mean that more screening and information is needed. The larger investment size by default makes them riskier which should make the investment process longer and costs more resources for the VC firm in order to compensate for the additional risk. When a drastic decrease in the stock market occurs, later-stage investments might, in many cases, have surpassed the threshold of an accepted offer or even earlier when a large amount of screening work has been done. Therefore, the opportunity cost of dropping the larger investment is deemed higher than continuing the investment process, but the VC adjusts the bid according to the stock market circumstances. With the shorter investment process of Seed funding, the cost is much smaller and the investment can more easily be canceled to a lower cost and loss to the VC.

Concerning the other literature that has included stock market development, there is also a general confirmation of it as a determinant of VC funding (Gompers & Lerner, 2000; Bonini & Alkan, 2012; Li & Zahra, 2012; Ning, Wang & Ju, 2015; Groh & Wallermoth, 2016; Wang, 2019). Gompers and Lerner (2000) and Ning, Wang and Ju (2015) show in

longitudinal investigations of the US VC industry that *Stock Market Development* is significant for explaining VC funding. Bonini and Alkan (2012), Groh and Wallermoth (2016), Li and Zahra (2012) along with Wang (2019) further confirm the importance of the stock market in the Swedish setting. However, Jeng and Wells (2000) do not find *Stock Market Development* significant in any of their cross-sectional regression models, for which Sweden was included as a country of investigation. This could point towards the stock market becoming a more important determinant in later years, as the more recent investigations have shown significance and the temporal scope of the investigation by Jeng and Wells (2000) is stretching from the 1980s to the late 1990s.

Figure 6 - Financial Market Conditions determinants



(Source: See method-section)

5.1.2 Regulatory

The *Corporate Tax Rate* is insignificant in all four regression models and its use as a determinant for VC funding in Sweden cannot be established. A lower corporate tax should imply the establishment of more companies in the economy as it makes it more lucrative to run a business. With more companies in the economy, some of these should be innovative ventures, which are the targets in which VC:s seek to invest. Notably, more companies should not directly lead to more VC funding, as the quality of the ventures might not be sufficiently good for VC:s to seek more funds or increase the level of investments. However, it is reasonable to believe that an increase in the number of new companies would increase, ceteris paribus, the number of innovative ventures entering the market, which would most likely increase the level of VC funding. High corporate taxes are also shown to skew the preferred source of income towards taking employment rather than being an entrepreneur, which drives down the number of ventures. The inconsistencies in the determinant results in

the Swedish setting can also be seen in other literature. *Corporate Tax Rate* as a determinant has a somewhat divided consensus on whether high corporate taxes really decrease VC funding (Gompers & Lerner, 2000; Cumming & Li, 2013; Bedu & Montalban, 2014). Romain and van Pottelsberghe (2003) first confirm the negative effect of the income tax but one year later finds no significance for the same countries with just two more years of data included. The later findings of Romain and van Pottelsberghe (2004) align with Jeng and Wells (2000) in not being able to confirm the effect of *Corporate Tax Rate*. The insignificance in this investigation could be explained because of its relatively low variance over the temporal scope of the investigation. In the summary of the determinant seen in Table 13, the range of the *Corporate Tax Rate* in Sweden has varied from 28 % in the early 2000s to 21.4 % in 2020, a change happening in three small steps over the 20 investigated years. This points to a fundamental issue in using *Corporate Tax Rate* as a determinant for increasing VC funding directly, but its use as a general increase in the number of companies might be a better fit. The use of *Corporate Tax Rate* in the cross-sectional studies mentioned earlier and the divided conclusion to its actual effect on VC funding is interesting. However, it points towards it not being a sufficiently consistent determinant of VC funding and, through the result in this thesis, cannot be established as a determinant of VC funding in Sweden.

The findings on *Labor Market Rigidity* are exciting and are in some ways consistent with other researchers. As one of the two measurements for *Labor Market Rigidity,* labor market regulation is significant in explaining Total, Startup and Expansion funding. The results show that an increase in labor market regulation harms funding in these stages. It can be explained by the increasing expected cost of starting and growing a business when labor market regulations are high, much like for the high *Corporate Tax Rate*. This, in turn, affects the VC industry negatively as it decreases the supply of new ventures in need of capital (Lerner & Tåg, 2013). An increase in labor market regulation also increases unemployed people, as employment protection laws make it harder to fire workers and make it harder for employees to change jobs, even though they want or should change jobs, which drives up the frictional unemployment in the labor market. This further increases the value of employment as opposed to entrepreneurship. The second measure for *Labor Market Rigidity* is long-term unemployment, which is shown to have positive and significant coefficients in the regressions on Total and Expansion funding. The results suggest that an increase in long-term unemployment would increase the amount of funding in the two stages, in contrast to the effect of labor market regulation. This is surprising, as a higher long-term *Unemployment rate* is connected to a higher *Labor Market Rigidity* which should, much like the labor market regulation, decrease VC funding. However, the reason for this could be that when individuals are facing a market with low numbers of job opportunities, it may influence them to become self-employed and the likelihood of starting a business increases, which may lead to more investment opportunities for VC:s; much the same reasoning as for *Corporate Tax Rate*.

Labor Market Rigidity can be concluded to display two effects. In highly rigid environments, the fluidity of employments decreases, making it harder for companies to hire, fire, and generally find the most suitable employees, which in turn affects the long-term *Unemployment rate*. The contrast is that more unemployed people in the long term show an increased willingness to start ventures and therefore drive up VC funding. This is a rather intriguing finding, as high *Labor Market Rigidity* has been unanimously established to negatively affect VC funding (Jeng & Wells, 2001; Romain & van Pottelsberghe, 2004; Félix, Piles & Gulamhussen, 2013; Bonini & Alkan, 2012; Bozkaya & Kerr, 2014; Cumming & Li, 2013). The net effect of the two coefficients for *Labor Market Rigidity* indicates that the negative effect is drastically more substantial than the positive effect and the findings are therefore consistent with other literature.

Figure 7 - Regulatory Determinants

(Source: See method-section)

5.1.3 Macroeconomic conditions

In the determinant area *Macroeconomic conditions*, *Interest Rate* has been frequently used and discussed in the determinants literature, with results more or less coherent with this thesis. The coefficient for *Interest Rate* is positive and significant for Total and Expansion funding, suggesting that the amount of VC funding would increase with an increase in the interest rate. This is surprising as lower interest rates make it less expensive to borrow money, which boosts capital availability and the number of investments. One explanation could be that low interest rates could shift the investment focus from VC funding to loan-based investments such as in the housing market or other financial securities.

On the other hand, higher interest rates increase the attractiveness of VC funding compared to financing the venture through financial institutions, as entrepreneurs seek more investments from VC:s when interest rates rise due to the increased cost of debt (Wang, 2019). The higher levels of interest rates from 2001 until 2008 might explain why the amount of funding was higher during those years than the relatively low level of interest in cohesion with the relatively low levels of funding after 2008. Furthermore, the interest rate was increased by Riksbanken for the first time since 2008 during the COVID-19 pandemic, which might explain the relatively high levels of VC funding despite the worldwide pandemic. In terms of other literature, the interest rate findings are coherent and also point to a positive coefficient for VC funding (Gompers & Lerner, 2000; Romain & van Pottelsberghe, 2004; Félix, Piles & Gulamhussen, 2013).

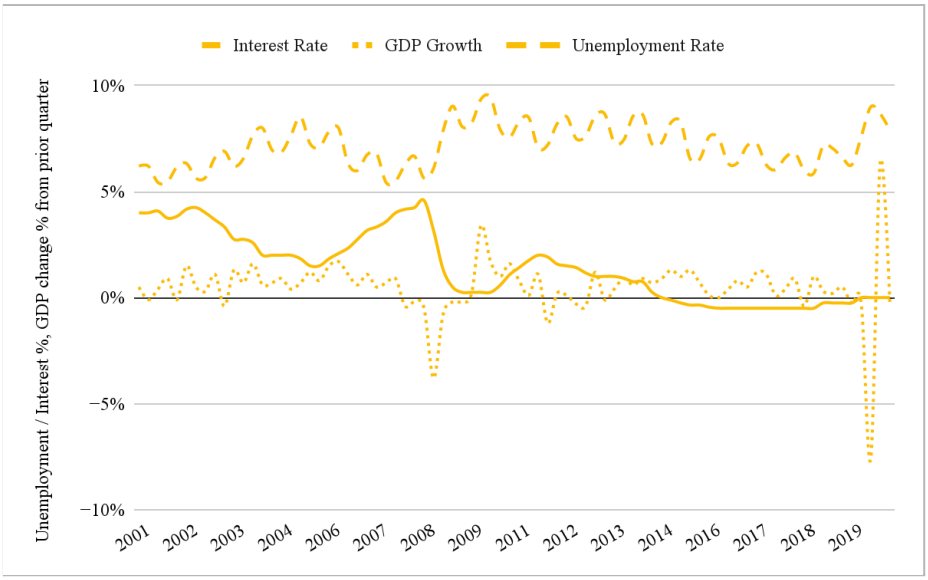
GDP Growth is only statistically significant in the Seed stage, which is surprising. It is the complete opposite finding of what can be assumed for the determinant, as high growth in the economy should be supported by and changing with an increased amount of funding. These results conflict with most other research that finds a strong significant relationship between the overall growth of the economy and VC funding (Romain & van Pottelsberghe, 2004; Li & Zahra, 2012; Félix, Piles & Gulamhussen, 2013; Cumming, Henriques & Sadorsky, 2016; Hain, Johan & Wang, 2016). Romain and van Pottelsberghe (2004) argue that because of the inherent cyclicality of VC investments, there is a natural relationship to the cyclical growth of the economy. However, they find that this relationship is severely damaged by high *Labor Market Rigidities,* which could explain why the determinant is not significant in the Swedish setting on a longitudinal basis, as Sweden has had relatively high *Labor Market Rigidities* for quite some time. Most of the studies that found a positive coefficient were based on cross-sectional data between many countries, which is a forthcoming difference in the structure of the regressions. Many investigated countries in other literature might not be as developed as Sweden regarding the business climate in general and VC industry in particular, which could mean that the *GDP Growth* determinant has different importance in different economies.

Furthermore, the Swedish VC industry is one of the most developed and best performing VC industries in the world, which in itself could mean that it is more independent and therefore less affected by the growth of the rest of the economy. On the other hand, Jeng and Wells (2000) and Wang (2019) found similar results as this thesis on *GDP Growth as a determinant*. Jeng and Wells (2000) expected *GDP Growth* to be a significant determinant in their dataset and Wang (2019) also found it significant only for the early-stage VC with a negative coefficient. One reason for the negative correlation and coefficient between Seed funding and GDP could be connected to a structural change and characteristic in the ventures that VC:s invest in, as the entrepreneurs quickly make fundamental changes to their business faster than other companies even though the GDP is decreasing. An example of this can be especially seen in the COVID-19 pandemic, where entrepreneurs recovered quickly and, in some cases, completely changed important business model aspects to handle the new

pandemic climate, opening up for investments to keep coming. This argument is backed by the reasoning seen in the study by Devece, Peris-Ortis and Rueda-Armengot (2016), where they prove the proposition that entrepreneurs handle recessions and crises better than prosperous times. This, in turn, could imply that because they handle recessions better, entrepreneurs create more ventures looking to take advantage of new market opportunities because of the decrease in GDP and thus need earlier stage funding for these new ventures. This could explain *GDP Growth* as a determinant for Seed funding in the regression models, but it is hard to know for sure as its insignificance in the other models makes it hard to arrive at a more definitive conclusion.

Much like the reasoning around the long-term unemployment in the economy creating incentives for workers to become entrepreneurs, the *Unemployment rate* determinant is also consistent with this reasoning as it shows a positive and significant coefficient for Seed and Expansion funding. This essentially means that a higher *Unemployment rate* increases Seed funding in the economy, probably due to more new ventures being created by the people becoming unemployed and those ventures applying for Seed and Startup funding. It could also reflect the state in the economy, which is quickly reflected in increased unemployment and, therefore, an increased need for people to find employment that drives the increased willingness to become entrepreneurs in general. In contrast to these results, literature using the *Unemployment rate* as a determinant shows a significant negative impact between the *Unemployment rate* and funding (Félix, Piles & Gulamhussen, 2013). They suggest that increased self-employment in periods of high unemployment is not enough to counteract the negative influence that the *Unemployment rate* may exert on the supply of and demand for VC funding through the changing expectations for the economy. This reasoning contrasts the findings posed in this thesis' model on Seed funding and the negative effect of the incentives for an employed individual to start up a new business in such a business climate. Again like the reasoning for the effects behind the determinant *Labor Market Rigidity*, the *Unemployment rate* can be assumed to have an inherent multifaceted effect on the economy and VC funding.

Figure 8 - Macroeconomic Conditions Determinants



(Source: See method-section)

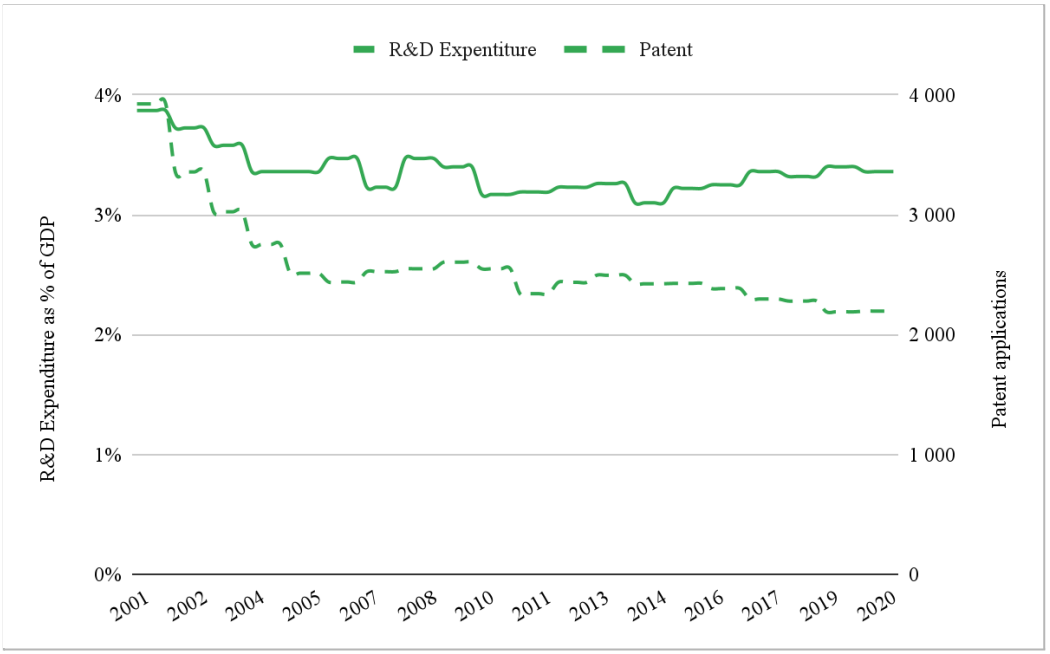
5.1.4 Technology

The determinant *R&D expenditure* is highly significant in explaining VC funding and has a positive significant coefficient for the three stages Total, Seed and Expansion funding. The outcome of governmental *R&D expenditure* is probably some form of innovation in terms of ventures or new ideas for existing ventures but is nevertheless a measure for the innovation in the economy. With increased *R&D expenditure*, it is more lucrative and foremost financially defensible to pursue otherwise profoundly risky and non-lucrative research, ideas and innovations. Many entrepreneurs derive from companies that spend large sums of money on R&D, which means that increasing the funds for such companies can attract even more VC funding from private and public organizations. Increased entrepreneurial activity due to an increase in *R&D expenditure* cannot directly and uniformly be assumed to increase VC funding, as the innovativeness of these ventures also must keep up with the increase in venture activity in general. If not, VC funding decreases from an increase in *R&D expenditure* as VC firms have to spend more time screening ventures that, on average, have a lower quality (Félix, Piles & Gulamhussen, 2013). Concerning other research, the positive results of *R&D expenditure* are consistent and generally concluded by other researchers (Gompers & Lerner, 2000; Romain & van Pottelseberghe, 2004; Félix, Piles & Gulamhussen, 2013; Groh & Wallermoth, 2016). This is reassuring and points to the use of *R&D expenditure* as a valid determinant of VC funding in Sweden.

The last investigated determinant and the second determinant in the *Technology* area is *Patents*. Its significant negative coefficient on Total and Startup funding is somewhat counterintuitive, like many of the prior results from the determinants show. The results mean that when patents decrease, VC funding increases which is the complete opposite of what can be expected. With more VC funding in the economy, there should be more patent applications

as it is easier for ventures with more funding to apply for more patents. More funding also means extra capital to ventures that otherwise might not have been able to seek IP protection of their innovation(s) actually to do so. However, these results might miss the point of structural changes occurring in the economy and the VC industry over the temporal scope, as the data on *Patents* shows a steady decrease to half the amount of patents in just 20 years. This is vaguely connected with the changing tides of VC funding but has a lot more to do with the changing tides in the economy at large. Innovative ventures were more focused on the manufacturing industry 20 years ago and by 2020 are more focused on service and software ventures, which are often based on non-patentable innovations. The determinant itself has been tested in different versions with lags in the regression model, but no lagged setup has been a better explanation than the original data, which is strange, as patents should be expected to be delayed some periods after funding. The negative coefficient is also inconsistent with other literature; both Cumming and Li (2013) and Romain and van Pottelsberghe (2004) find it positive and significant in the explanations of VC funding. This inconsistency, along with the highly unexpected negative coefficient, could be an explanation as to why *Patents* is not a valid determinant of VC funding in Sweden.

Figure 9 - Technology Determinants



(Source: See method-section)

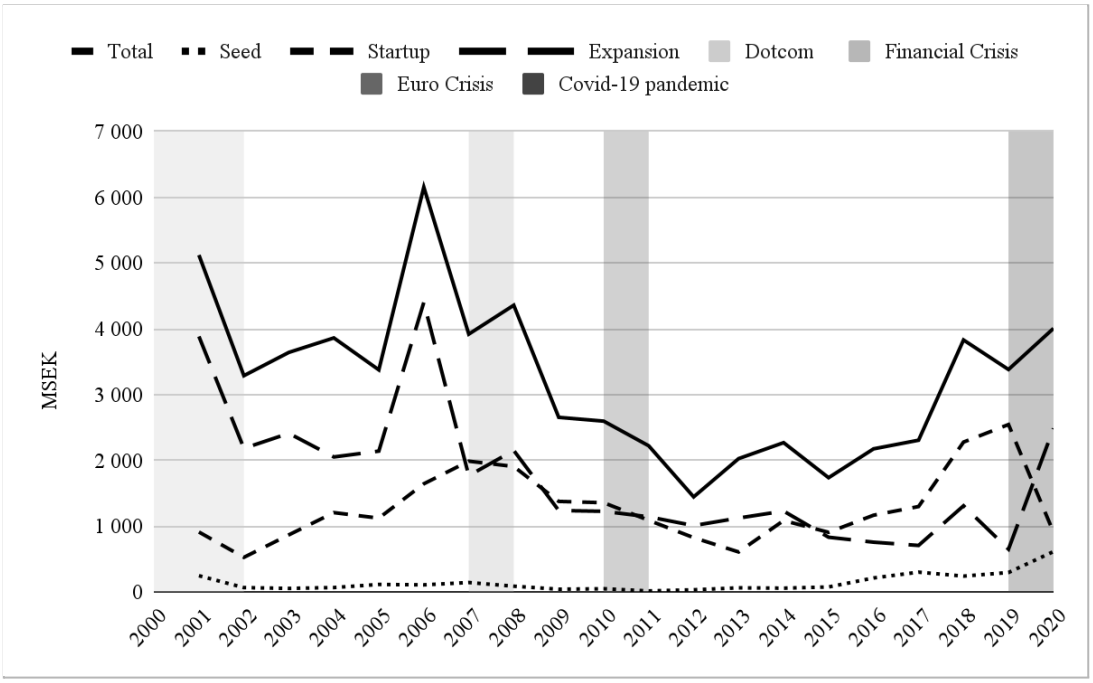
5.1.5 Economic crises

The economic crises affecting the economy over the temporal scope of the investigation can be confirmed to have affected VC funding in Sweden but have been hard to confirm by only relying on the effects seen in specific years in the determinants. Their overarching effect on all the tested determinants is in itself a venue of research, as can somewhat be seen in the theoretical framework. However, the tested crisis dummy provides a clear distinction that the

determinants cannot solely explain the effects of the crises. Both Total and Expansion funding show statistically significant negative coefficients for the crisis dummy, confirming that the crises affect the overall VC funding and mostly later-stage funding.

Worth mentioning is that the results are confirmed by other researchers such as Howell et al. (2020), Blommé and Prytz (2013), Brown, Cowling and Rocha (2020) and Gompers et al. (2020). However, In contrast to the results in this thesis, their research shows that early-stage funding is more heavily affected by exogenous shocks and economic downturns than later-stage funding that is more robust. In terms of the investment climate, Pierrakis (2010) reports that VC funds had a more difficult time raising capital and therefore had to reduce investments in new ventures during the dot-com bubble. The opportunities for investing in interesting technology also decreased as many IT companies went bankrupt after the bubble burst. The same effect can be seen during the GFC, where VC funds had difficulties raising money from investors who are typically pension funds, insurance companies, and larger banks that were all heavily affected by the GFC. There could also be other factors such as shifts in investment opportunities or difficulty evaluating them, shifts in the entrepreneurs' human capital and other frictions or constraints in the supply of capital to the VC firms during economic crises in the Swedish economy. These effects are highly speculative but can be somewhat seen in the literature on the crises (Sundqvist, 2014; Blommé & Prytz, 2013; Romain & van Pottelsberghe, 2004). Figure 10 provides the same visualization as Figure 3, but with the crisis-years marked gray in the graph to distinguish the effects on VC funding more intuitively.

Figure 10 - Venture Capital Investments, all investment stages and economic crises



(Source: See method-section)

5.1.6 Conclusive findings on determinants

The findings on the determinants of VC funding in Sweden show some interesting results discussed in sections 5.1.1 through 5.1.5. The regression models included many of the determinants tested in previous studies: *IPO Activity*, *Stock Market Development*, *Corporate Tax Rate*, *Labor Market Rigidity*, *Interest Rate*, *GDP Growth*, *Unemployment rate*, *R&D expenditure* and *Patents*. Along with testing these determinants, a dummy variable was included in the regression models to test whether the dot-com bubble, GFC, Euro crisis and COVID-19 pandemic had some unexplained aspect that could not be reflected by changes in the determinants. The crises are confirmed to be crucial negative factors in explaining VC funding in Sweden. The results show that the *Stock Market Development*, *R&D expenditure*, *Interest Rate* and the overall state of the economy are the main driving forces behind VC funding in the Swedish economy. The results are pretty much in line with other studies and confirm a lot of prior findings. It is also confirmed that the different investment stages are affected quite differently by the determinants. Total and Seed funding is impacted to a larger extent by *Financial market conditions,* such as the development of the stock market, and *Technology,* represented by *R&D expenditure* and *Patents*. Expansion funding is driven mainly by *Regulatory* and *Macroeconomics conditions*. Surprisingly, the only driver for Startup funding is *Technology,* particularly by *Patents*. The crisis dummy is found to have a significant impact on Total and Expansion funding. The outcome of the investigation of the determinants contributes significantly to the understanding of individual economic variables being identified as the determinants of VC funding in Sweden. However, it also points to the need for further research focusing on each separate investment stage to reinforce the notion that the individual stages of VC funding are fundamentally affected by different determinants.

There are some counterintuitive results from this deductive research that need to be addressed. Firstly, given the importance of IPOs in the VC industry, it is surprising that the *IPO Activity* determinant does not show significant results in any of the models. The reason for this is believed to lie in the proxied measurement used for the variable. However, it is also possible that the exit market, specifically IPO:s, is not as relevant for the VC industry in Sweden as in other countries, which would be surprising. This is something that needs to be investigated further in order to draw a certain conclusion on the matter. Secondly, *GDP Growth* does not impact any of the investment stages except Seed funding. It is shown in the literature that the *GDP Growth* of a country would affect investments and, in turn, the VC industry. It does, however, not seem to be the case in the Swedish VC industry, at least not according to these results. The VC industry in Sweden may be more sturdy than other countries, as the business climate is more developed in general and the industry itself is one of the best-performing ones in the world, which could potentially be a reason for the insignificance of *GDP Growth* in this research. Thirdly, interest rate is commonly used as a determinant in the literature and the results are more or less coherent with this research. A higher interest rate is shown to impact VC funding positively, which is a bit surprising as

lower interest rates should, in theory, increase the number and amount of investments in the economy. However, lower interest rates may still increase overall investment in the economy, but not at all in the VC industry. One potential reason for this is that a higher interest rate increases the attractiveness of VC investments compared to other alternatives. Future research can use two types of interest rates, short and long term, as they could affect VC partners, VC firms and ventures differently. The measure for the interest rate in this thesis is based on the repo interest rate set by the Swedish Riksbank, which does not directly decide the economy's short- or long-term interest rates but has an indirect effect on them. Therefore, the short- and long-term interest rates could affect different aspects of VC funding, separately and with different delays. Something to investigate is if the stream of investments to the VC industry in terms of private and public funds, increase or decrease during lower or higher interest rates.

Worth mentioning is that some determinants remain unexplained as they were not captured in the regression models by the selected determinants. The exclusion of all determinants in the *Government Quality* area does most likely not fill this explanatory void, as the other already included determinants that were strict and with low variance proved to be poor determinants. This might be because of the longitudinal research design and the steady value over time being unfit to regress VC funding, that varies heavily, on. There is, however, still room for the inclusion of any informal determinant. The investigation performed in this thesis could not include any informal determinants due to the nature of the utilized data, the research strategy and the research design used to investigate the other determinants. Informal measures as determinants have been shed light upon in more recent years as a missing link in the determinants research in general and have a good explanatory effect for VC funding, at least from what is implied in the few articles that have managed to investigate them (Grilli, Latifi & Mrkajic, 2019). The way that data is collected on them is often through interviews, which significantly decreases the possible temporal scope of the investigation. The informal determinants or other qualitative measures might be hard to include without creating an overarching representative measure or a proxy but should definitely be sought out to be further understood.

The fruitful results of the investigation of both the economic crises and the determinants of the Swedish VC industry enable the application of a similar method to investigate other VC industries to strengthen the understanding of the drivers of VC funding for their specific setting. This discussion provides some guidance for future investigations of the drivers of VC funding, specifically in the Swedish VC industry, and is further developed and merged with the conclusion of the PCA discussion in section *6.2 Future research*.

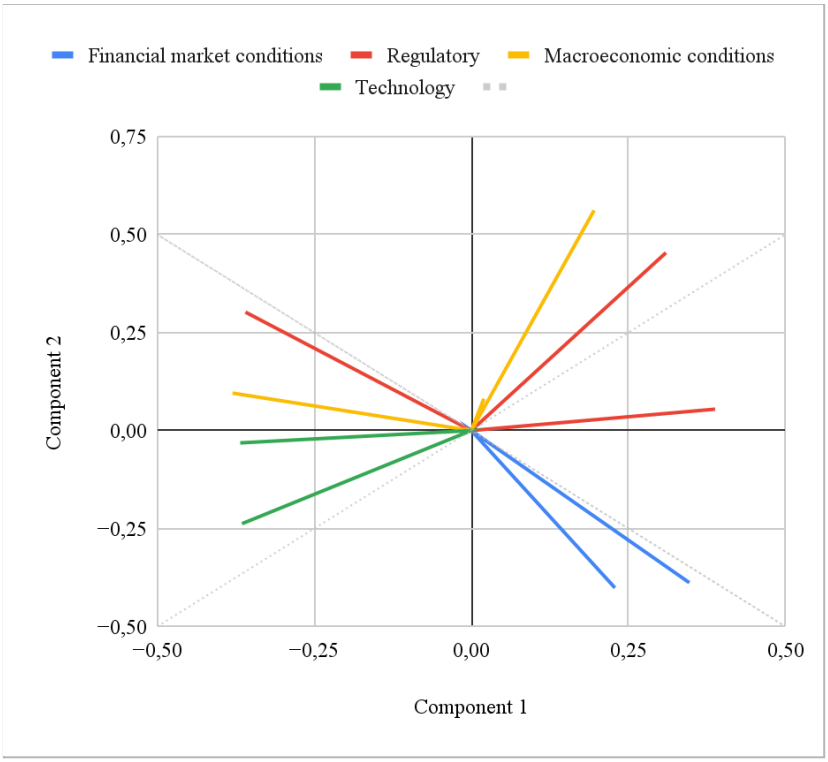
5.2 Principal Component Analysis discussion

The extracted principal components represent the overarching effects in the determinants and the fact that two (2) out of the four (4) selected components were statistically significant in the PCR confirms that there exist common and overarching aspects of the determinants. This confirms the speculation and indications from prior literature that there is a fundamental problem in using individual variables for explaining what drives VC funding. The dimensions that the components explain are unclear but can be unveiled by analyzing the determinant eigenvectors (loadings) in each component. By visualizing the loadings in loading plots with one component per axis along with analyzing the component's score under different conditions, the dimension that these components reflect can be unveiled. One of the most crucial parts of understanding PCA is that any determinant can have a relatively large loading in two components but the two dimensions are completely uncorrelated and cannot at all explain similar concepts or effects, despite this similarity. This is important in the visual understanding of the loading- and score-plots and in the reasoning posed by what the dimensions of the components represent. The individual components are hereafter analyzed as thoroughly as the results and the plots allow, searching for the explanation of their representative dimensions and ultimately in the search for an answer to the last working hypothesis.

5.2.1 Loadings

The first component and the dimension it is displaying is somewhat hard to interpret. However, it does explain over half of the variation in the dataset, which makes it by far an essential component of the ones identified. It is also empirically confirmed in the PCR at the 1% level, further strengthening its explanatory power for VC funding in Sweden. The coefficient of the PCR is negative, which means that it is the positive values of determinants with negative eigenvectors or negative values of determinants with positive eigenvectors that drive VC funding. This can be hard to imagine but can be more easily understood by looking at the loading plot Figure 11. The determinant areas protruding as positively loaded are *Financial market conditions* and *Regulatory*. Likewise, negatively protruding or negatively correlated to the positive loadings are the determinants in *Technology* and almost all of the determinants in the *Macroeconomic conditions* area. This essentially means that the dimension of component 1 represents a positive driving force for VC funding through positive values in *Technology* and *Macroeconomic conditions* or through negative values in *Financial market conditions* and *Regulatory*.

Figure 11 - Loadingplot Component 1 and 2



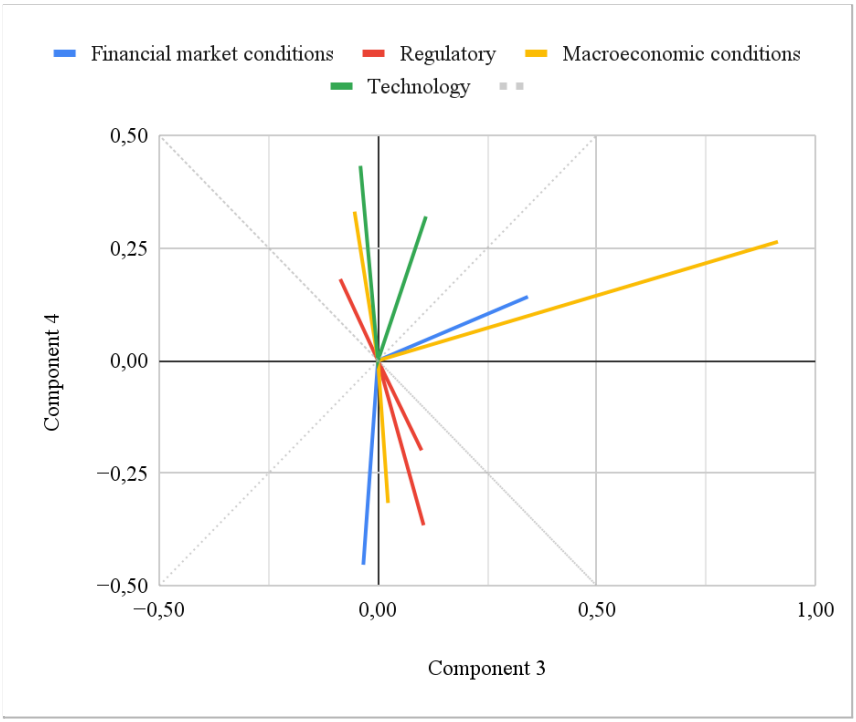
The second component in the PCA is visualized on the Y-axis in Figure 11. The component is also significant in the PCR and has a negative coefficient, much like component 1, which means that the dimension increases VC funding in Sweden through positive values in the negative eigenvectors or negative values in the positive eigenvectors. Component 2 has large loadings in *Regulatory* and *Macroeconomic condition*. However, it is completely uncorrelated with the determinant *GDP Growth,* which is part of the *Macroeconomic conditions* area. It has an extremely low loading in components 1 and 2, along with an almost orthogonal (completely uncorrelated) relation to any loading in component 2. The negative loadings are found primarily in *Financial market conditions* and secondarily in *Technology*. It means that VC funding is driven by, in this dimension at least, increases in *Financial market conditions*, secondarily by increases in *Technology* and by decreases in *Macroeconomic conditions* and *Regulatory*. Three determinants have extremely low loading for component 2: *Interest Rate*, *Labour Market Rigidity LMR and Patent,* which means that they cannot be assumed to affect the dimension to any significant degree.

Component 3 has one of the highest loadings of any of the determinants in any of the components. *GDP Growth* has a positive loading of 0.914, with almost all other determinants having comparatively small loadings except the determinant *IPO Activity*. The determinant areas that could be distinguished for components 1 and 2 are non-existent in component 3; it is instead almost solely driven by the determinant *GDP Growth*. However, the component is not significant in the PCR and its coefficient is very close to 0, which makes it hard to understand its relation to VC funding other than its non-significance as an explanatory

variable in the regression. This result is coherent with the *GDP Growth* determinant not being significant in the determinant regression and even more troubling results for the use of *GDP Growth* as a determinant for VC funding in Sweden at all.

The fourth component has large loadings of the determinants in the *Technology* and one determinant in *Macroeconomic conditions* along with having low loadings in *Financial market conditions*, *Regulatory* and the last determinant in *Macroeconomic condition*. It is shown in the large loadings of the determinants *Patents*, *R&D expenditure*, *GDP Growth* and *Unemployment rate*, along with the low loadings in *IPO Activity*, *Corporate Tax Rate*, *Labor Market Rigidity LTU* and *Interest Rate*. The PCR does not show that component 4 is significant in explaining VC funding and the direction of the coefficient cannot be determined, which makes its relation to VC funding impossible to establish. The confidence interval shows that the component is close to having a negative coefficient, but it cannot be fully confirmed. Its insignificance might be due to two things: either the explained strength of the dimension is insufficient, based on variables missing, or the dimension is not valid for explaining VC funding. As of now, without further investigation, there is no reason to further dwell on the subject of the component's explanatory power for VC funding as it cannot be concluded to affect it at all.

Figure 12 - Loadingplot Component 3 & 4

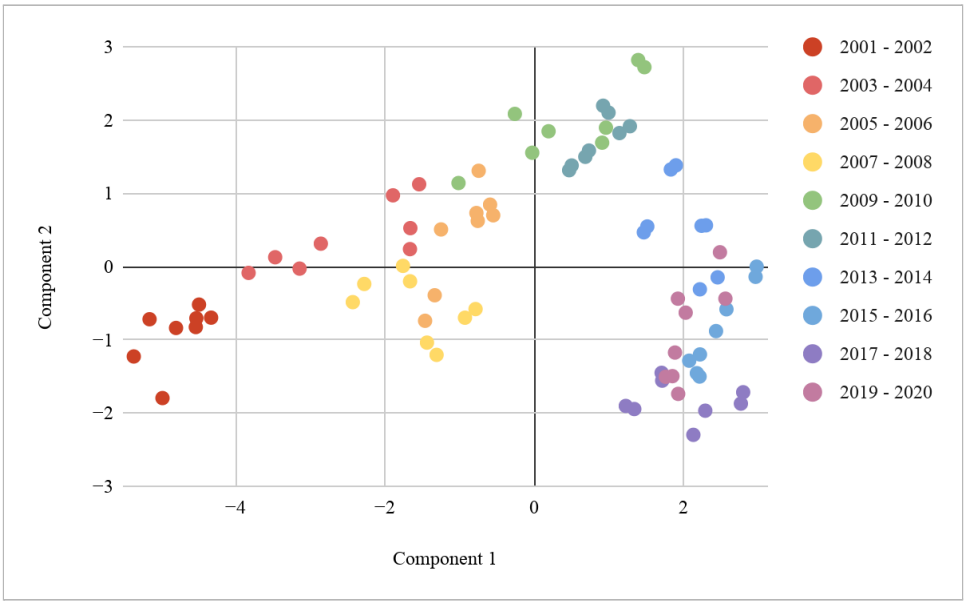


5.2.2 Scores

The scores of the components are essentially their estimated value in a given quarter and change depending on the values in the loaded determinants. By utilizing the knowledge of the circumstances in these quarters from the literature, the data on the determinants and the results of the determinant regressions, the dimension of the component can most likely be explained and its relation as an overarching driver of VC funding be better understood.

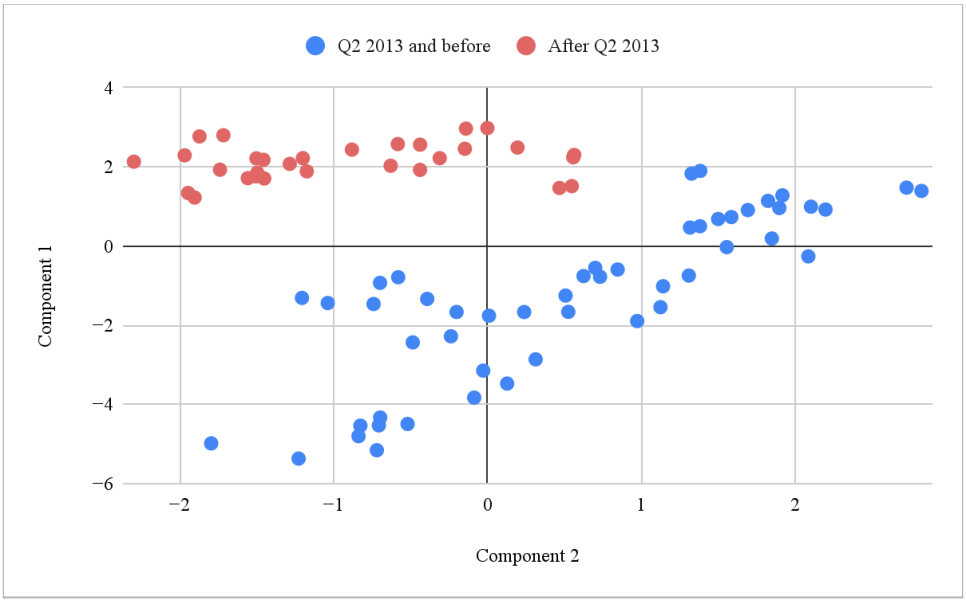
The score plot on the first and second components is intriguing. As shown in the score plot Figure 13, the changing value of component 1 over different periods and the steadiness in this change can be identified. Almost all of the scores can be divided into distinct 2-year intervals, identified by the different colored dots, which is surprising. The components should not reflect such steady time-dependent trends, but since it has been identified here and been empirically proven in the PCR, there is a clear indication that the dimension of component 1 has something to do with the time aspect concerning all of the determinants. The score is steadily increasing from the negative value of almost -5 in the years 2001 - 2002, increasing up to a value of 0 by 2009. With the negative coefficient of the PCR in mind, the dimension positively affects VC funding from 2001 until 2009 - 2010. After this point, it falters off and becomes positive, thus affecting VC funding negatively. This can be because of the steady decrease in values of the determinants with negative loadings (*Technology* and *Macroeconomic conditions*) and the determinants with positive loadings (*Financial market conditions* and *Regulatory*) having increased over time, with the critical switch-point occurring in 2009 or 2010. As mentioned in section *5.2.1 Loadings*, these are the conditions for the loadings that lead to the dimension driving down VC funding in the economy.

Figure 13 - Scoreplot Component 1 and 2



Component 2 is displayed on the Y-axis and should not be mistaken for having as significant a time-dependent change as the first component, even though it is changing over time. For reference, the same score plot as above is shown with switched axes and different groupings in Figure 14 below. In terms of the grouping of the data, many different combinations of conditions and components were tried but rather unsuccessfully. The only grouping that could be identified is shown in Figure 14 and has similar aspects as the one shown previously, as it is based on the conditional change of time for the scores. The coefficient of the component is negative, so the X-axis is read in the opposite manner and component 2 drives down VC funding for positive scores, which can be seen when component 1 is negative, which is to the right of the Y-axis. Component 2 does positively drive VC funding in two periods as seen in Figures 13 and 14. First early in the data around 2001 - 2006 and then late in the data after 2013.

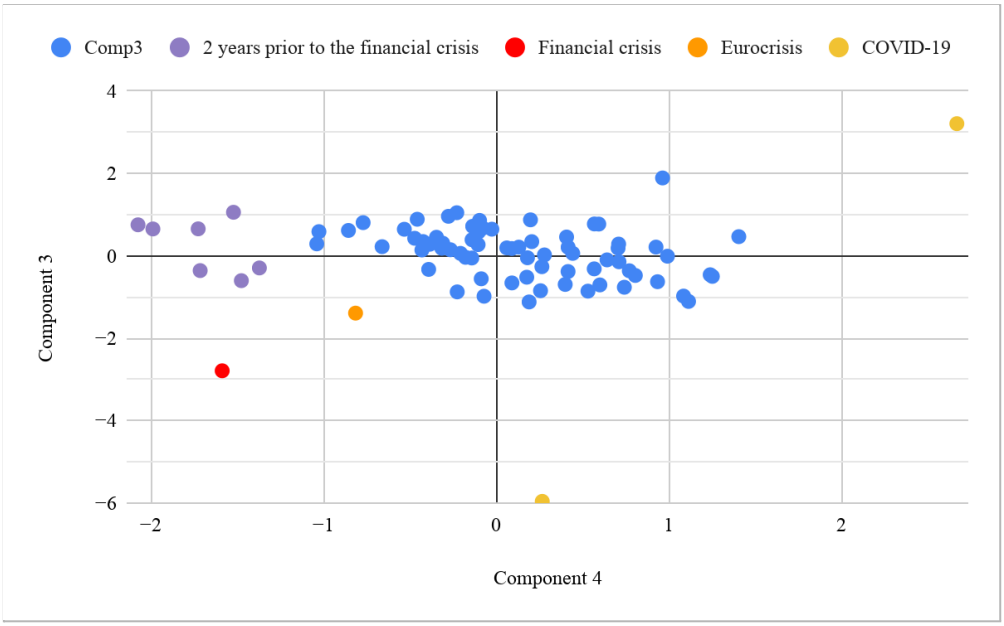
Figure 14 - Scoreplot Component 1 and 2, switched axes



The third and fourth components are due to their insignificance in the PCR not nearly as interesting for VC funding as the first two components, but their scores are brought up in Figure 15 due to their importance and protruding dimensions from the determinants. As can be seen in the score plot, most scores from components 3 and 4 are concentrated in a rectangle about one standard deviation from both the axes. This makes it hard to find any specific identifiers or distinct groups in most of the scores, but some outliers can be categorized. All economic crises except the dot-com bubble differ distinctly in scores and are shown as differently colored dots. One group can also be identified in the very low scores of component 4, which are categorized by the common denominator of occurring exactly before the financial crisis broke out (colored in purple). These categorized scores have no explanatory validity for VC funding but show that the dimensions of components 3 and 4 are

highly affected by the crises, along with component 4 experiencing low values specifically before the financial crisis.

Figure 15 - Scoreplot Component 3 and 4



5.2.3 Defining the dimensions of the components

The scores and loadings of each of the components are established and show some explanation of what they represent. In this section, the discussion is deepened about the real-world effects and explanations of the influences of the dimensions on VC funding in Sweden.

5.2.3.1 Principal Component 1: Investor focus on VC investments and innovation

The first component is confirmed to be significant in the PCR for explaining VC funding, relatively precise in its loadings for the individual determinants and displaying a clear pattern in its score across the dataset. The dimension of component 1 can be established to positively influence VC funding in the first part of the dataset, for which the negative loadings and the values of the determinants for those loadings were relatively high compared to the rest of the investigated period. Examples of the positive effect of the negative loadings can be found in the data. The *Interest Rate* in the Swedish economy was relatively high during that time, which probably made VC investments more sought after than other investments due to the higher cost of financing and investing with loans. The corporate tax was also high, but low compared to the OECD- and the EU-averages at the time, which can be seen as a natural filter to bad or mildly lucrative ideas. Ventures with incredibly good or genuinely innovative ideas survive in the economy due to their uniqueness, even though the corporate tax makes them less lucrative. The number of patent applications and *R&D expenditure* as a percentage of

GDP has decreased steadily over the temporal scope. The decrease in patent applications is an interesting find and points to a more fundamental and structural change in the business sphere, where the focus has been shifted from manufacturing and industrial ventures in the early 2000s towards non-patentable software and services through the late 2010s. The decrease in the determinant itself can be seen as a phasing out of older ways of thinking around VC investment focus, resulting in less industrial focus and more focus on the internet of things, software and the digital sphere in general. The decrease in the *Technology* determinants over the temporal scope is the main reason for the decrease in the explanation of VC funding from component 1, which points to an interesting nuance of the dimension at large.

Further, the values of the determinants with positive loadings were relatively low early in the investigated period. It means that VC funding was driven up by their low values and is partly reflected in the uncertainties in the stock market, the relatively low unemployment and the rigid labor market of the time. Even though the stock market was developing well from 2002 until the financial crisis in 2008, there are signs in this dimension of increased VC funding due to its uncertainty stemming from the dot-com bubble. It had just erupted and many investors had experienced lost investments due to the drastic decreases in valuations, so they might not have been too keen on searching for new VC investments right away. The positive effect on VC funding might come from rational VC investors not factoring in lost investments when making future investments (i.e., no sunk cost fallacy) or from stock market investors that wanted to escape the uncertain stock market climate. The effect might also be from any other investor seeking alternative investments for diversification or superior returns in the VC industry. The strictness of the labor market and the relatively low unemployment rate are also drivers during this time and in this dimension, which can be seen as the effect of people staying at companies longer and therefore producing superior value through innovations that otherwise might be hard to do for new employees when movement on the labor market is high. This is, of course, a highly speculative effect, but the climate of low unemployment rate but high *Labor Market Rigidity* was driving up VC investments in this dimension, which is both counterintuitive and interesting at the same time. As mentioned earlier in the discussion of the determinants, high *Labor Market Rigidity* increases the value of employment and that could explain its positive effect on VC funding. The higher value of employment lowers, ceteris paribus, the value of other sources of income, making employees spend less time looking for new employment, working on other ideas and reducing the cost of hiring and firing employees for the company. As mentioned, these effects are somewhat speculative yet very interesting as higher labor market rigidities should reduce funding as implied by the regression of the individual determinant.

After the breaking-point in 2008 or 2009, most likely due to the financial crisis, the dimension negatively affected VC funding in Sweden. A way for the Riksbank to induce spending in the economy to keep inflation in check after the severe recession was to lower the interest rate. Such a change in the interest rate can explain the withdrawal of money from the

now comparatively risky investments of VC, as opposed to the stock market or the housing market, which benefits drastically from lower interest rates, as it significantly reduces the cost of financing investments. The decrease in corporate taxes after the financial crisis also made running a company more lucrative and opened the possibility for new ventures that were otherwise deemed too non-lucrative to enter the market, ultimately resulting in more companies on the market. It is a good thing, already discussed in the determinants research, as more companies increase (most likely) the number of innovative ventures but have the negative effect of VC:s having to screen more investment applications instead of spending time assisting portfolio companies or making other investments. The decrease of patents over time as an adverse driver in this dimension continues after the financial crisis and never recovers. The structural change brought up earlier leads to a new baseline of patent applications over the last period in the data, affecting VC funding negatively through "fewer" innovations being created and thus less funding being required. Now, this is genuinely counterintuitive if the aspect of dimensions and principal components are not fully understood, as can be seen later in the discussion and as has been shown throughout this research, but to clarify: VC funding is increasing along with the innovation in the economy at large, while VC funding is decreasing along with the innovation in this dimension. However, the decrease is explained by the structural change leading to the average number of ventures requiring less capital due to a decrease in manufacturing ventures that need capital-intensive machines and commercial real estate (factories and offices). Software or service ventures that have become more abundant do not require as much capital as they are not as capital-intensive and represent the other side of the spectrum as explained by the dimension of component 1.

The positive loading determinants also drove down VC funding in Sweden after the financial crisis. Again, a counterintuitive finding in this dimension is that the increasing stock market and the better financial climate, reflected by the increasing *Financial market conditions* area, negatively affect VC funding. This can be easily explained in the same manner as the *Interest Rate*; Investors seek other investments than VC investments due to the increased attractiveness of investments outside the VC industry. A drastically increasing stock market can be seen as more "secure" as the investments can easily be increased, decreased and diversified in the more liquid public markets instead of the much less liquid private equity markets. The *Labor Market Rigidity* decreased and the unemployment increased after the financial crisis, both negatively affecting VC funding in this dimension. It is most likely the opposite effect of increasing the value of employment discussed earlier, where employments become less important and workers start moving around between work-places more, reducing the "real" value they create at each of the places due to the increased cost of information asymmetries and the increased time until they are working at full capacity. Regarding the high unemployment, the decrease in funding stemming from it has to be unrelated to the positive effect, discussed in the determinants section, of unemployment on people creating their jobs through venture creation when they become unemployed. Therefore, high

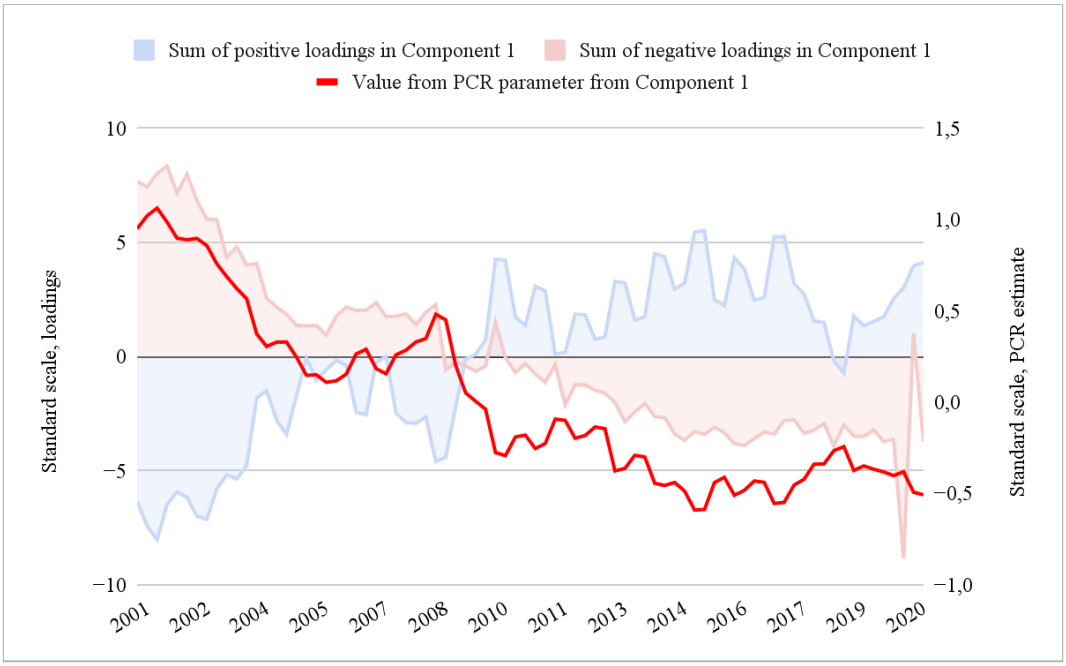
unemployment equals less work performed in the economy, decreasing the innovative power in the dimension and ultimately VC funding.

The dimension of component 1 shows from the data gathered in this thesis has many entry points, as can be noticed from the multifaceted discussion. The overarching theme does seem to be the fundamental and structural changes that the Swedish VC industry has passed through over the last 20 years, partly because of the effects of the economic crises and partly from inevitable changes in the determinants. The patent change over time is an excellent example of this as the VC industry funds innovation and at an increasing rate, but how the most tangible measure of that innovation through patent applications is decreasing steadily over the last two decades. The dimension of component 1 captures this decrease, along with the decrease in *R&D expenditure*, as one of the most crucial aspects in the data and shows that it is significant in explaining VC funding. The aspect of VC funding that has been decreasing over time, ceteris paribus, can therefore be directly derived from a decreased number of patent applications and a decreased expenditure on R&D as a % of GDP, along with the less loaded effects from the other determinants discussed in regards to the dimension. With this in mind, a suitable name for component 1 could be the "Investor focus on VC investments and innovation". A summary of the discussion around the dimension of component 1 is found in Table 21 and a visualization of the dimension can be seen in Figure 16, reflecting the changing focus of the determinants in the dimension discussed earlier along with the value from the PCR parameter for component 1 in explaining VC funding.

Table 21 - Summary of Component 1 definition

Important Determinants	**Loaded**	**Component coefficient**	**Output**	**PCR parameter positive when determinant is**
IPO Activity	+	-	-	-
Stock Market Development	+	-	-	-
Labor Market Rigidity LMR	+	-	-	-
Labor Market Rigidity LTU	+	-	-	-
Corporate Tax Rate	-	-	+	+
Interest Rate	-	-	+	+
R&D Expenditure	-	-	+	+
Patents	-	-	+	+

Figure 16 - Component 1 and sum of both positive and negative loadings



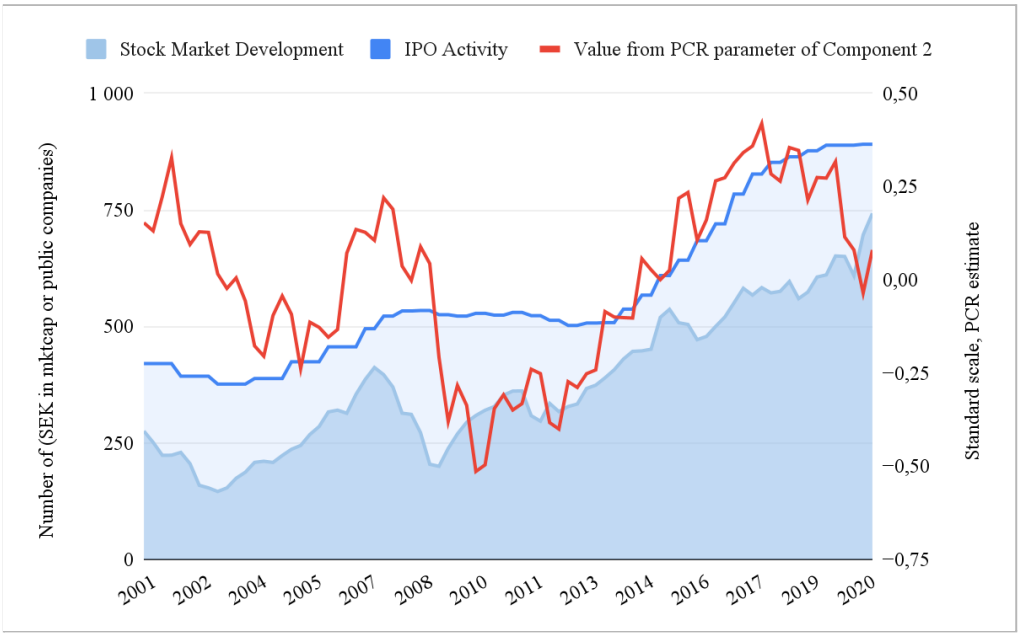
5.2.3.2 Principal Component 2: State of the financial market

The second component provides ground for more intuitive reasoning around its definition and has some backing from the literature and the earlier determinant findings in this thesis. It is significant in the PCR but only explains around 15 % of total dataset variance, which is only one-third compared to component 1, explaining 54 % of the dataset variance. Nonetheless, it is confirmed to be a solid overarching effect of the determinants and a driver of VC funding in Sweden, with a clear pattern of what it represents. Before bringing up any loadings, scores or determinants, it is essential to again remind that the dimension discussed here for component 2 is orthogonal (completely uncorrelated) to that of the dimension of component 1, even though they have similar loadings or effects from some determinants.

The coefficient for the component is negative, which again means that the negative loadings are the positive drivers of VC funding. The low importance of the area *Financial market conditions* in component 1 is weighed up in component 2, as it is the primary explanation with a negative loading for this dimension. When the stock market is performing well, it reflects low uncertainty, stability, and growth in the economy, which often spills over into other industries. Good development of the stock market over some periods can be referred to as a good investment climate in general and in the VC industry as well. Good investment climates make (almost) everyone in the economy more prone to invest and VC funding from the VC industry is no exception. Rather: when uncertainty and the risk of recession decrease, investments increase in general and for the VC industry, as explained in this dimension. Besides the increase from a generally good investment climate, there might also be a demand for VC investments in particular during good times, as they can provide far superior returns to other more common securities. This effect might also be because of a demand for

diversification of the investors' portfolios in general when the stock market is performing well. The determinant *IPO Activity* also has a strong explanatory effect in this dimension, which signals for the good health of the exit market in good investment climates and its positive effect for VC funding. A good exit market is crucial for VC:s and when the exit climate is good, it can undoubtedly be beneficial for VC funding, as shown in the dimension. The importance of the area *Financial market conditions* is crucial in the dimension and in order to show this, the value of the determinants *IPO Activity* and *Stock Market Development* is shown beside the predicted value from the PCR parameter of component 2 in Figure 17.

Figure 17 - Component 2 and Financial Market Condition



The positive effect on VC funding from component 2 is also driven by the determinant *R&D expenditure*, which also has a central role in the dimension of component 1. It means that the effect of *R&D expenditure* explained in component 1 must be different from the effect in component 2, as they are completely uncorrelated. The effect might be that when the overall financial climate improves, there is an increase in *R&D expenditure* due to the improved investment climate. Spending money on research and development activities is directly a form of investment activity that is not often performed by investors but rather by companies or governments. Its driving effect of VC funding in this dimension is therefore not so far-fetched, as a better financial climate leads to more *R&D expenditure*, which creates more innovative ventures and thus opens up for more VC funding, naturally, along with the increase in the financial climate in itself.

For the positive loadings that affect VC funding negatively in this dimension, the primary determinants are *Labor Market Rigidity LTU*, *Unemployment Rate* and *Corporate Tax Rate*. Unemployment, both long-term and short-term, can be seen as an indicator of the labor market's inability to put people to work. This is most likely because of a poor financial

market and cut-downs in companies due to this climate, which leads to increases in both types of unemployment. As speculated earlier and shown in the dimension of component 1, this effect has the same direction but cannot be the same. Therefore, the effect shown in this dimension is most likely the collective decrease of spending from companies due to poor financial markets or uncertainty that leads to higher unemployment and less VC funding. This effect is indirect but is negatively correlated with the negative loadings of the *Financial market conditions* that are the primary drivers of VC funding, which essentially means that high unemployment is the opposite of good financial markets in this dimension. The effect is quite the same for corporate tax, but also indirect. High corporate taxes reduce the profits of funded ventures and public companies on the stock market, leading to lower dividends and, in turn, a more inadequate, not as lucrative, investment climate.

The dimension of component 2 is much more straightforward than that of the first component, which can be expected from how PCA works and the fact that it explains a lower amount of variance. *Financial market conditions* as a determinant area is the collective driver of VC funding from this dimension and is best shown in Figure 17 displayed earlier. The name for the component can not be named *Financial market conditions*, due to the risk of intertwining its interpretation with the area of determinants identified in the determinant literature. However, a proper name can be similar to it, as its effect is almost identical: “State of the Financial Market”.

5.2.3.3 Principal Component 3: Growth of the economy

The dimension of the third component has almost already been completely established, but a discussion around it is necessary nonetheless. From the loadings, *GDP Growth* can be seen as the sole driver of the dimension, which points to a strong focus on the overall growth of the economy. Under the assumptions of PCA and the exclusivity in-between dimensions, one might wonder why the overall growth of the economy is not included as a sub-factor in any of the two first dimensions. Both “Investor focus on VC and innovation” along with “State of the Financial Market” seem like two dimensions highly affected and driven in turn by the growth of the overall economy. However, this is a misguided assessment, as the growth of the economy does not have to at all affect the focus of investors on VC and innovation along with the state of the financial market, shown by the distinctly different dimension of component 3. This is closely related to one of the reasons for utilizing PCA discussed in the introduction and one of the problems in the second and third OLS assumptions for the determinants: the relation between growth in the economy and all the other determinants. The dimension broken out by the PCA in component 3 shows that the growth of the economy at large is only related to the growth of the GDP and to a much smaller degree, of the number of public companies. PCA is hard to grasp in this aspect, but it can be clarified significantly.

Component 3 is not significant in the PCR for VC funding in Sweden over the last 20 years. It means, essentially, that the growth of the economy as a whole and signaled by the dimension of component 3 has no driving force in the amount of VC funding. This finding is

consistent with the insignificance of the *GDP Growth* determinant in the earlier regression and further confirms the result. The reason why the economy's growth is not a driver of VC funding is most likely because VC funding is already driven by other dimensions that somewhat represent, not show, the same aspect as the economy's growth. Here, the connection to the first two components has to be made. The first component reflects the investors' willingness to invest in VC and innovation, which is reflected by the state of the economy as a whole and affected by the growth of the economy. The second component is tightly linked to the economy's growth, as financial market booms and busts are quickly shown in the *GDP Growth*. However, they do both exclusively not explain anything about the growth of the economy, as component 3 is solely doing that, but a correlation of the determinants shows fragments of it. Remember, the dimension explained by the third component has to describe something else concerning the growth of the economy that is not at all explained in the first two dimensions and also not significant as a driver of VC funding.

This effect can have something to do with how well developed the Swedish economy is and can make VC:s disregard additional growth in the economy, as the marginal effect compared to the VC industry as a whole will probably be diminishingly small. This reasoning is viable compared to the other studies performed for which the economy's growth was an essential part in the reasoning in explaining VC funding. In cross-sectional studies, it is not reasonable to assume that all economies investigated have the same level of development in their economy or specifically their VC industry, which is bound to display the effect of different focuses on the growth of the economy as a driver of VC funding. The dimension of component 3 and its insignificance in the PCR can therefore be a display of Swedish VC:s disregard, on average, of the economy's growth as a whole when they are deciding when to make investments. This effect has not been shown in the prior dimensions and gives some guidance to explain the dimension of component 3, but it is, due to its insignificance, hard to establish any further. A proper name of the dimension is established as the “Growth of the economy”, but a further assessment has to be made to relate this dimension to the effect explained above to provide a more suitable name.

5.2.3.4 Principal Component 4: Entrepreneurial drive

The last of the included components is component 4, which is unfortunately not significant as a driving force of VC funding in Sweden. However, like component 3, it is essential to discuss it due to it explaining a significant part of the variance in the underlying data at 7.7 % of the total dataset variance, which is half that of the significant component 2 at 15.2 %. There might be a risk of missing variables that could present a better picture of component 4 and further investigation through an expansion of the dataset might make it a significant factor in explaining VC funding.

The direction of the effects in the loadings is twofold, as the direction of the coefficient cannot be established and this dimension’s explanatory effect could point towards both positive and negative loadings. From the positive loadings, the area *Technology* and the

determinant *Unemployment Rate* are protruding. As component 1 is primarily explained by the *Technology* determinants and *Unemployment Rate* has a large part in components 1 and 2, this dimension has to capture an effect not yet captured in these dimensions. If the dimension has a positive effect on VC funding, it could be showing that more innovation and unemployment increases VC funding which is interesting. In component 1, it is established that the investor focus and the overarching business focus around patents and innovation of the older ways are explained, for which this component, therefore, can explain the effect of innovation as a part of the economy. This means that by higher unemployment, people are more willing to focus on innovation and the positive correlation between unemployment and innovation, as seen by the loadings, is established. If the PCR coefficient for component 4 is negative, the high loadings in the determinants *IPO Activity*, *Corporate Tax Rate*, *Interest Rate* and *Labor Market Rigidity LTU* become the drivers of VC funding. The effect explained here could be that of demand for VC investments, as higher corporate taxes, long-term unemployment and interest makes business less lucrative for public companies, for which public market investors would seek to increase their presence in the VC industry. However, this is pretty much explained by the first component, which would make this a faulty explanation for this component if the coefficient is negative.

Without further investigation, a conclusive answer to what dimension four shows cannot be made. It can be stated that there is an opposite correlation of *Technology* determinants and *Unemployment Rate* with the *Regulatory* determinants, *Interest Rate* and *IPO Activity*. This could mean that the dimension explains the willingness for people to become entrepreneurs in the economy, which in turn drives the VC funding. It can be seen from the rise in innovation and unemployment, with the opposite being high corporate taxes, high interest and high long-term unemployment, which means that there should be a drive for people to become entrepreneurs instead of taking employment. Such a drive is thus shown as a positive effect in the dimension of component 4 and affects VC funding positively if the PCR coefficient is positive. The name for this component could therefore be “Entrepreneurial drive”, but at a more considerable certainty with more information, this dimension could quickly shift towards a slightly different direction.

5.2.4 Conclusive findings on the components

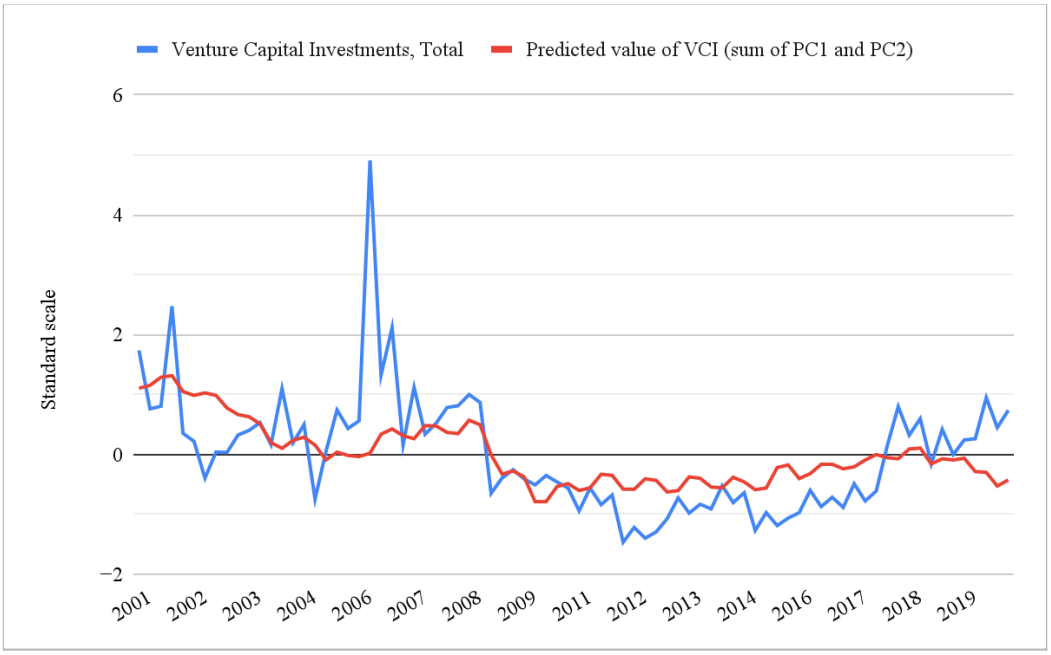
A summary of the discussion around the dimensions of the components is shown in Table 22 as a definition for each of the dimensions of the four components. The suggested names of the components are the primary and secondary effects from the determinants that are protruding in each respective dimension.

Table 22 - All Principal Components defined

Component	Suggested name of component	Primary effect in dimension	Secondary effect in dimension
1	Investor focus on VC and Innovation	Technology	General condition and attractiveness of VC investments
2	State of the Financial Market	Financial market condition	Poor financial markets due to poor company output and profit
3	Growth of the Economy	GDP growth	Amount of companies created, more output in total for the economy
4	Entrepreneurial drive	Technology, unemployment, IPO	Long term unemployment, poor corporate climate due to high interest rates and corporate tax

For even more clarity around the two significant components and their relation as drivers of VC funding, Figure 18 shows the estimated value from the PCR of the two components. It is essentially the parameter of each of the components times their respective score in each of the observations over the dataset. This is an interesting visualization, as the apparent trend of VC funding over the temporal scope can quite easily be distinguished in the prediction. The predicted value compared to the actual amount of VC funding points towards the ability of only the first two components to provide a reasonable explanation of VC funding in Sweden over the period 2001 - 2020. It also points towards room for improvement, as there are some periods with unexplained errors by the two components, which seems to be the periods around the crises in the dataset. This concludes that the drivers of VC funding definitely cannot be grasped and entirely explained by only two dimensions; at the same time it can be concluded that they, to a fair extent, actually are explained by only two dimensions.

Figure 18 - PCR-estimated value of Venture Capital Investments, from PC1 & PC2



Including more determinants will most likely improve the results from the PCA. More data in general would make it easier to distinguish specific clusters in the scores that could be used to more easily identify different effects in the economy and in turn better explain what drives VC funding. Due to the dimensionality reduction of PCA in general, the number of variables included could increase drastically without decreasing the reliability of the findings. As long as VC funding is regressed on the components acquired from the PCA, the additional variables added could better explain the dimensional effects on VC funding that might have been missed in this investigation. More variables make the discussion around the specific dimension of the components much more straightforward and enable more accurate groupings of the score plots. This room for improvement through adding more variables and adding more components is evident due to the R-squared value of the PCR being lower than that of the determinant regression model.

6. Conclusion

The investigation in this thesis sought out to understand the driving forces of VC funding in Sweden. It has been performed by sampling and testing economic variables and data from the VC industry across two decades (2001-2020) to answer the overarching research question and accept or reject the stated working hypotheses. Longitudinal studies like the one performed in this thesis on the Swedish VC industry are scarce, despite Sweden's relatively interesting VC industry. The outcome of the investigation shows exciting findings, discussed thoroughly in the prior section and sheds much-needed light on the determinants and principal components as drivers of VC funding in the Swedish economy.

The economic crises and their effects on VC funding are hard to overlook and are confirmed in numerous ways throughout the investigation in this thesis. Their identified effects in the literature by other researchers point to a breadth of their effects on the VC industry as a whole. The worsening of the investment climate, structural changes to the business climate, drastic changes in macroeconomic variables and decreases in the risk-attitude of investors are the primary effects identified in this literature, all pointing towards the negative effect of economic crises on VC funding in Sweden. The lagged dummy variable with a negative coefficient in the determinant regressions also provides empirical confirmation of the effect of the economic crises on VC funding in the dataset. Through the literature findings and the significance of the dummy in the regression, the first working hypothesis can be confirmed as accurate: Economic crises have a negative effect on VC funding in Sweden over the investigated period.

The investigation of the determinants proved very fruitful and helped establish a sense of the drivers of VC funding in Sweden. All of the investigated determinants have already been investigated and empirically confirmed by other researchers in other settings, countries and sometimes also in Sweden through cross-sectional investigations. This longitudinal study of determinants for VC funding in Sweden for this scope is the first of its kind, making the results quite intriguing. The regressions show that the drivers of VC funding in Sweden trickle down to the positive development of the stock market, a low labor market rigidity, a high interest rate, large amounts of spending on R&D and lastly, contrary to the general understanding, fewer patent applications. The results vary between different investment stages, but the second working hypothesis can be confirmed nonetheless: Economic variables from different institutional environments in the Swedish economy can be used as causal explanations (determinants) of VC funding in the Swedish VC industry.

The most exciting and novel finding of this thesis is the analysis of the overarching effects, as shown by the outcome of the PCA. The speculation about the existence of cohesive effects in the determinants themself can be confirmed, for which four components are identified as suitable to further investigate of which two are confirmed to be significant in explaining VC

funding in Sweden. The two significant components: Component 1, “Investor focus on VC and Innovation”, and component 2, “State of the Financial Market”, show that the determinants collectively represent cohesive effects and should therefore not be investigated on their own without a larger picture in mind. The former points to the importance of the investor focus and the overall attractiveness and state of the VC industry, as opposed to other industries in the economy, whilst the latter points to the importance of a sound investment climate in the economy. A few researchers have used PCA, but seldom PCR, for research about the VC industry in other settings, but this thesis is the first investigation to use both these methods for investigating the Swedish VC industry. The significance of the results and the overarching findings of dimensional explanations for VC funding in Sweden provide an inductive ground for other exciting research and enable academics, VC:s and entrepreneurs, amongst others, a way to understand the industry of financing innovation better. The third working hypothesis can be confirmed: There are overarching and cohesive effects in the determinants that explain VC funding in Sweden.

6.1 Contributions

The confirmation of the working hypothesis concludes the investigation performed in this thesis. It has been able to answer the stated research question through rigorous data collection, variable transformation, two distinct statistical models and an extensive analysis. Therefore, it has been shown that it is possible to contribute to the understanding of the drivers of VC funding in Sweden with a quantitative longitudinal study consisting of both deductive and inductive approaches. The drivers are broadly concluded to be the negative effects from economic crises, both positive and negative effects from individual economic variables and nuanced cohesive effects from multiple economic variables in the form of more overarching dimensions.

This thesis has contributed to the literature with an increased understanding of the driving forces of VC funding in Sweden. The understanding of these driving forces are essential to the understanding of the VC industry in Sweden and its place as an important actor in the modern economy. A well-working and soundly managed VC industry that provides sufficient amounts of capital to the innovative ventures in the Swedish economy is incredibly important to keep developing the economy and society moving forward. The knowledge acquired from the confirmation that economic crises have an effect, despite the already obvious and intuitive understanding of economic crises being horrific to the economy as a whole, points to the importance of supporting the VC industry in times of hardship. The confirmation of some determinants of VC funding in Sweden also provide guidance to the important areas to support in order to make the efforts of establishing an even better working VC industry and entrepreneurial ecosystem in general as direct as possible. Further, understanding that the economic climate around VC as a type of investment, the changing attractiveness of fundamentally different types of ventures and ideas along with the state of the financial market are confirmed to be important and cohesive factors affecting VC funding is an

important insight moving forward. It points to the need for an overarching view of the VC industry when discussing the driving forces of VC funding. Despite the VC industry's secluded and shrouded aura as an important actor of further developing society as a whole, these insights into the Swedish VC industry provides a somewhat better understanding of it.

6.2 Future research

The interesting insights into the Swedish VC industry shown by the investigation performed in this thesis does, however, not provide a complete explanation of the drivers of VC funding in Sweden; There are more aspects to investigate in future research to get a complete picture of all the drivers of VC funding in the Swedish economy.

Firstly, more determinants should be explored, as only four out of eight determinant areas were included in this research. Determinants within the category *Government quality* and the area *Informal determinants* had to be excluded due to the nature of the investigation but would most likely provide exciting insights. There are also more individual determinants to investigate as potential drivers of VC funding within all areas, as only nine out of 46 were included in this thesis.

Another way to further develop and deepen the analysis of the Swedish VC industry would be to perform a cross-sectional study within the Swedish VC industry. Different types of VC firms (public, private or corporate) would be affected differently by different determinants. In the data utilized for the dependent variables in this thesis, the types of firms could not be distinguished as all of the sources used only provided a measure of the total amount of all firms. With a firm-level granularity of the dependent variable, a better understanding of the differences in VC funding from different types of firms could potentially be established.

A venue for future research on the determinants area is a more profound dwelling of the two other activities of VC firms. VC funding is merely the outcome of one of these activities and even though it reflects the purpose of the VC industry in the economy (supplying capital to ventures, that is), it does not provide a complete picture of the workings of the VC industry. Understanding changes in the exit climate in relation to the VC industry and what determines the amount of time that VC:s spend on monitoring are also imperative parts in fully understanding the VC industry; both of which seem to be less investigated than VC funding from the literature investigated in this thesis.

Regarding the PCA, the two significant components are a very sound starting point to find other overarching drivers of VC funding in the Swedish economy. The PCA performed is, however, only scratching the surface for a complete understanding of the possible dimensional explanations of VC funding and has the potential to be further developed. As mentioned earlier, adding more determinants to the PCA or generally expanding the dataset

in some other way would probably lead to the identification of other significant components and interesting dimensions that should definitely be investigated further in future research.

Another suggestion for future research on the overarching effects could be to use the PCA components to predict the amount of VC funding in Sweden. Data on most of the determinants become available before data on VC funding is made available through more reliable sources. This opens a venue for creating a prediction of the amount of VC funding based on changes in the determinants that change the components and provide values for VC funding. As shown in Figure 18 at the end of the PCA discussion, there is a clear indication that the first two components explain some part of the drivers of VC funding and by adding other significant components, the use of PCA as predictions is not so far-fetched. Performing predictions does, of course, require more advanced statistical methods than the ones brought up in this thesis, but the significance in the components provides some indication of its possibility.

The last suggestion for future research is to further compare and contrast Sweden's position as a prominent country for VC. The longitudinal research design lacks in the contrasting of the investigated subject with other similar subjects, which might be a reason for why so many cross-sectional studies can be found in the literature as opposed to longitudinal studies. The findings in this thesis would be interesting to contrast to very similar investigations of other VC industries. It would partly provide a deeper insight into the individual VC industries than the cross-sectional studies performed and the contrast of the findings to the Swedish setting as performed in this thesis.

In conclusion, the driving forces identified in this thesis provide some explanation but the understanding of VC funding in the Swedish economy is still far from complete. Expanding the dataset through more determinants, other variables or other geographical areas would be the most suitable places to pick up in the search for investigating this subject further. Also, applying this knowledge in deductive qualitative studies or in domestic cross-sectional studies would be suitable in order to get the first-hand perspective from VC firms in Sweden and a more narrow but deep confirmation of the driving forces of VC funding.

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Appendix

Appendix 1 - Determinant selection

Complete set of the 46 determinants identified by Grilli, Latifi and Mrkajic (2019) with the selection criteria applied in this thesis. The criterias are shown and discussed in section *3.2.1 Determinant selection.*

Number	Criteria name	Description
1	Significance	Determinant significant in explaining the dependent variable to some degree (most likely significant)
2	Relevance	Determinant is generally used in similar research
3	Direction consensus	General consensus in research of the direction of the effect of the determinant in explaining the dependent variable
4	National relevance	Determinant relevant to the Swedish setting

				Criteria				
Nr.	**Name**	**Determinant Category**	**Determinant Area**	**1**	**2**	**3**	**4**	**Include**
1	**Formal institutions**							
2	**Regulatory institutions**	**Formal**		X	X	X	X	No
3	Fiscal Policy	Formal	Regulatory institutions	X	X	X		
4	High individual/corporate capital gain tax	Formal	- " -		X	X		
5	High corporate income tax	Formal	- " -	X	X	X	X	Yes
6	Other regulatory aspects	Formal	- " -		X	X		
7	Legal system structure (English)	Formal	- " -		X	X		
8	Investor protection	Formal	- " -		X	X		
9	Liberal bankruptcy law	Formal	- " -					
10	Rigid labor market regulations	Formal	- " -	X	X	X	X	Yes
11	Pension investments	Formal	- " -				X	
12	**Government quality**	**Formal**		X	X		X	
13	Governmental programs	Formal	Government quality	X	X		X	

14	Governmental effectiveness	Formal	- " -	X		X	X	
15	Regulatory quality	Formal	- " -					
16	Rule of law	Formal	- " -					
17	Political stability	Formal	- " -	X	X			
18	Voice and accountability	Formal	- " -					
19	Corruption	Formal	- " -	X	X			
20	World governance index	Formal	- " -			X		
21	**Financial market conditions**	**Formal**		X	X	X	X	
22	Stock market development	Formal	Financial market conditions	X	X	X	X	Yes
23	IPO activity	Formal	- " -	X	X	X	X	Yes
24	M&A activity	Formal	- " -	X		X	X	
25	**Informal institutions**			X			X	
26	**Entrepreneurialism**	**Informal**		X			X	
27	Other cultural attitudes	Informal		X			X	
28	Uncertainty avoidance	Informal	Other cultural attitudes	X	X	X		
29	Individualism	Informal	- " -					
30	Power distance	Informal	- " -			X		
31	Masculinity	Informal	- " -			X		
32	Cultural distance (four hofstede dimensions)	Informal	- " -			X		
33	Corruption perception	Informal	- " -			X		
34	**Social capital**	**Informal**		X		X	X	
35	Trust	Informal	Social capital	X		X	X	
36	**Contextual determinants**				X		X	
37	**Technological opportunities**	**Contextual**		X	X	X	X	
38	Innovation and R&D	Contextual	Technological opportunities	X	X	X	X	Yes
39	Patents	Contextual	- " -	X	X	X	X	Yes
40	**Macroeconomic conditions**	**Contextual**		X	X		X	
41	GDP	Contextual	Macroeconomic conditions		X	X	X	
42	GDP growth rate	Contextual	- " -	X	X	X	X	Yes
43	Industrial protection	Contextual	- " -			X		
44	Interest rates	Contextual	- " -	X	X	X	X	Yes
45	Unemployment rate	Contextual	- " -	X	X	X	X	Yes
46	Inflation	Contextual	- " -	X			X	

Appendix 2 - Calculating the dependent variable Venture Capital Investments

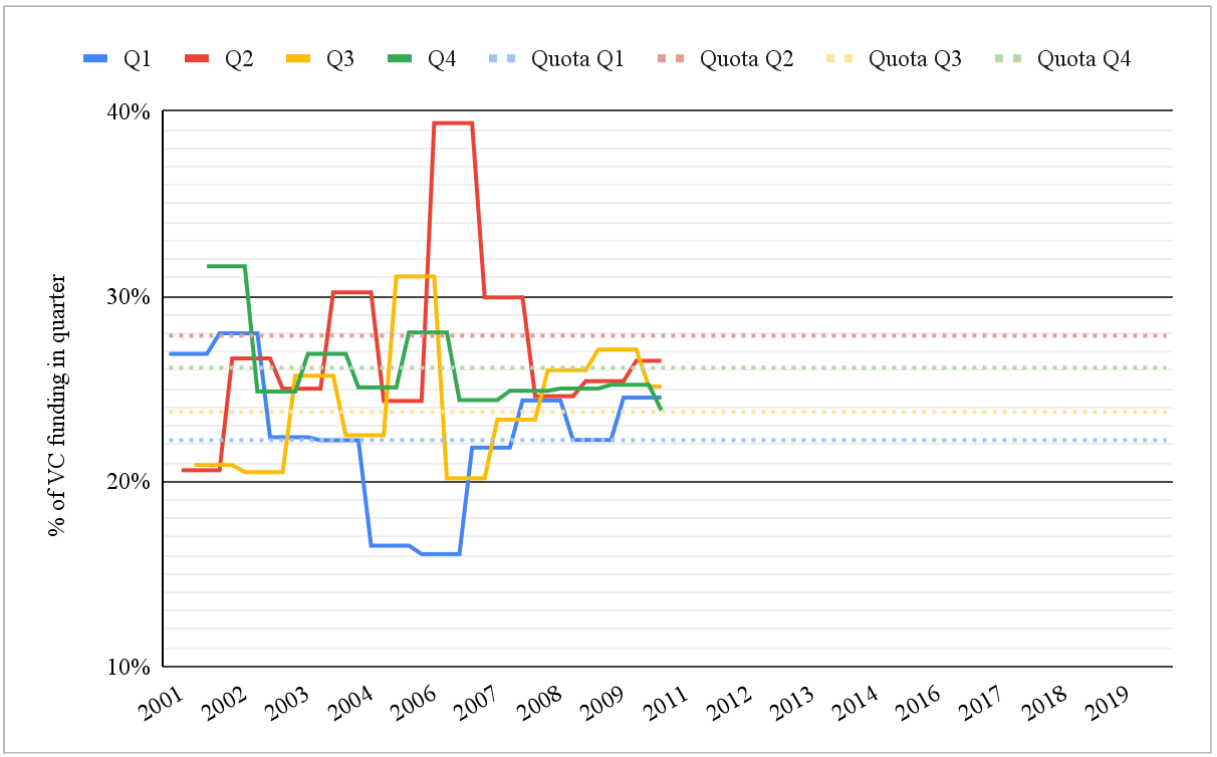
Appendix 2.1 - Venture Capital Investments data, by source, homogenous currency (MSEK)

	Total funding by source (MSEK)						
Year	**Invest Europe**	**Tillväxt-verket (2020)**	**Eurostat**	**OECD**	**Riksbank (2005)**	**SVCA**	**Dealroom**
2000							
2001					5 200	5 042	
2002					3 800	2 775	
2003					3 950	3 333	
2004					4 400	3 323	
2005						3 376	
2006						6 153	
2007	3 927		3 903	3 872		3 975	
2008	4 352		3 343	3 938		5 801	
2009	2 365	3 166	2 315	2 438		2 987	
2010	2 444	2 860	2 347	2 628		2 702	
2011	2 030	2 420	2 123	2 315			
2012	1 754	1 941	1 889	195			
2013	1 925	2 134	1 937	2 112			
2014	1 880	2 613	1 801	2 624			2 429
2015	1 598	1 639	1 403	1 629			2 414
2016	2 056	2 238		2 239			2 169
2017	2 474	2 331		2 388			2 032
2018	3 327	3 817		4 494			3 682
2019	3 856	3 789					2 499
2020							4 006

Appendix 2.2 - Exchange rate per year

Year	Euro /SEK	USD / SEK	Year	Euro /SEK	USD / SEK
2001	9,25	10,33	2011	9,03	6,50
2002	9,16	9,72	2012	8,71	6,78
2003	9,13	8,09	2013	8,65	6,51
2004	9,13	7,35	2014	9,10	6,86
2005	9,28	7,48	2015	9,36	8,44
2006	9,25	7,38	2016	9,47	8,56
2007	9,25	6,76	2017	9,63	8,54
2008	9,61	6,58	2018	10,26	8,69
2009	10,62	7,65	2019	10,59	9,46
2010	9,54	7,20	2020	10,49	9,20

Appendix 2.3 - Venture Capital Investments, quarterly quota

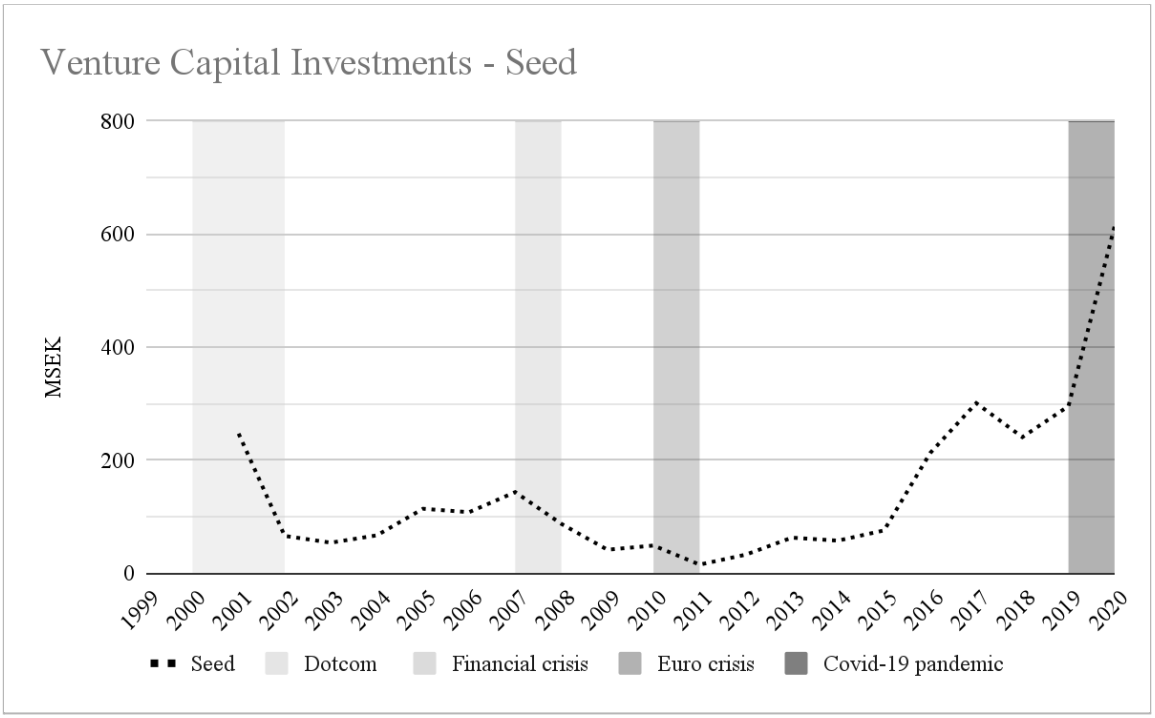


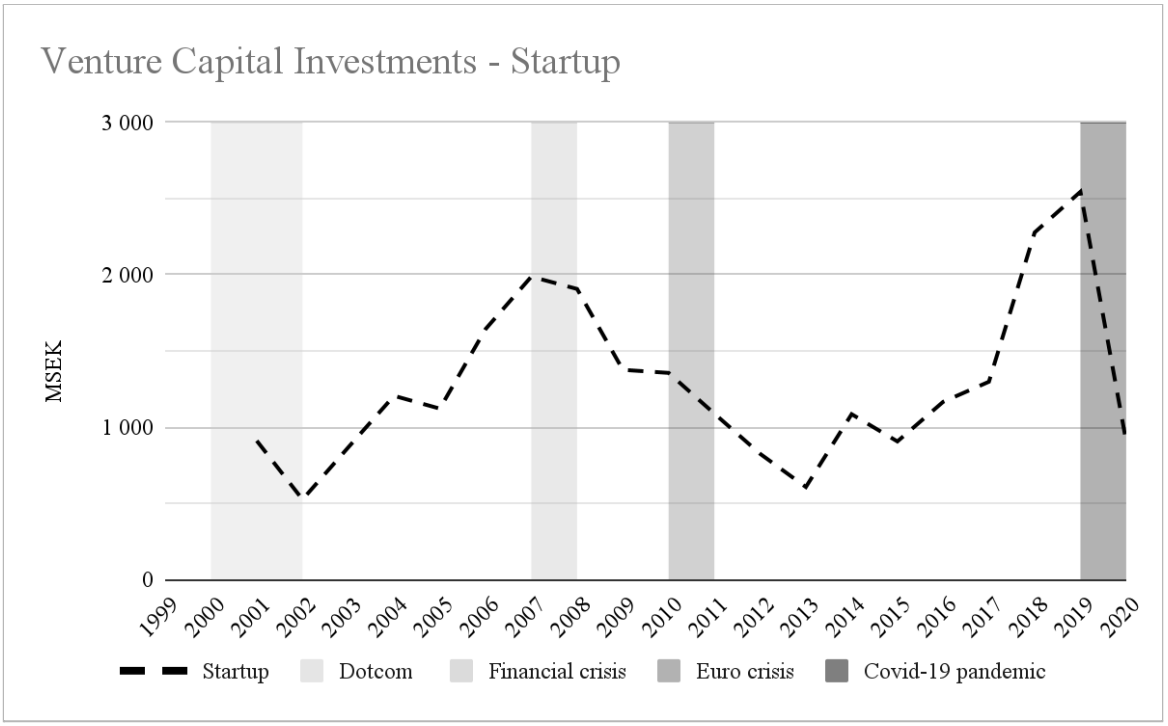
Appendix 2.4 - Venture Capital Investments data, by investment stage, transformed and calculated (MSEK)

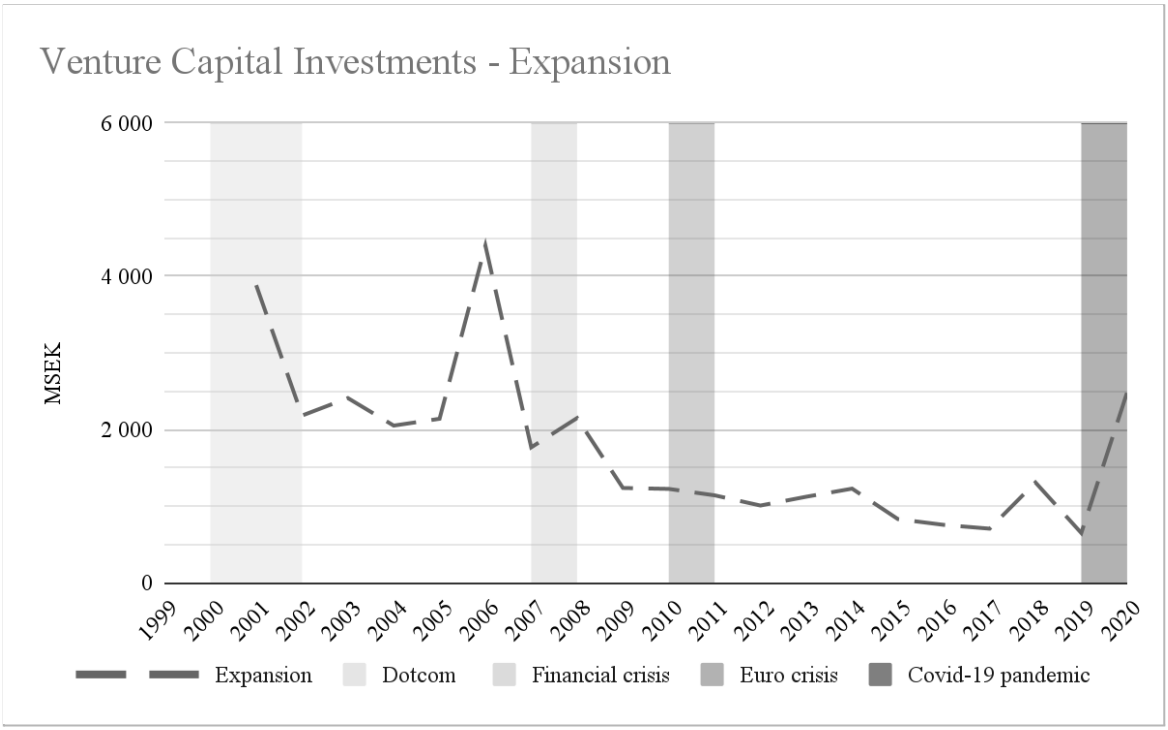
Year	Q	Total	Seed	Startup	Exp
2001	1	1 377	125	335	994
2001	2	1 055	59	254	497
2001	3	1 070	39	166	634
2001	4	1 620	24	156	1 759
2002	1	921	29	115	747
2002	2	876	13	138	651
2002	3	674	14	135	249
2002	4	817	10	138	536
2003	1	815	12	229	402
2003	2	911	13	178	643
2003	3	936	14	170	701
2003	4	979	15	291	665
2004	1	858	27	175	413
2004	2	1 167	18	527	688
2004	3	869	10	214	416
2004	4	969	12	290	535
2005	1	558	29	134	396
2005	2	822	28	288	506
2005	3	1 049	17	315	717
2005	4	947	40	385	522
2006	1	989	26	306	656
2006	2	2 422	14	608	1 801
2006	3	1 241	10	314	917
2006	4	1 501	58	416	1 027
2007	1	855	32	442	393
2007	2	1 173	40	554	493
2007	3	915	34	472	420
2007	4	976	38	520	462
2008	1	1 062	19	424	478
2008	2	1 072	24	532	599
2008	3	1 134	21	453	511
2008	4	1 090	23	499	562
2009	1	590	9	306	275
2011	1	494	3	242	254
2011	2	619	4	304	318
2011	3	528	4	259	271
2011	4	581	4	285	299
2012	1	321	7	184	224
2012	2	403	9	230	281
2012	3	343	8	196	240
2012	4	378	9	216	264
2013	1	451	14	135	250
2013	2	565	18	169	313
2013	3	482	15	144	267
2013	4	530	16	159	294
2014	1	504	13	241	273
2014	2	633	16	303	343
2014	3	539	14	258	292
2014	4	593	15	284	321
2015	1	386	17	202	185
2015	2	484	21	253	232
2015	3	413	18	215	198
2015	4	454	20	237	217
2016	1	484	47	259	168
2016	2	606	59	325	211
2016	3	517	51	277	180
2016	4	569	56	305	198
2017	1	513	67	289	157
2017	2	643	84	362	197
2017	3	548	71	308	168
2017	4	603	79	339	185
2018	1	851	54	506	291
2018	2	1 068	67	635	365
2018	3	910	57	541	311
2018	4	1 001	63	595	342
2019	1	752	66	566	145

2009	2	675	12	384	345	2019	2	942	82	709	181
2009	3	720	10	327	294	2019	3	803	70	605	155
2009	4	669	11	360	324	2019	4	884	77	665	170
2010	1	637	11	302	272	2020	1	890	136	202	552
2010	2	688	14	378	342	2020	2	1 116	171	253	693
2010	3	652	12	322	291	2020	3	952	146	216	591
2010	4	619	13	355	320	2020	4	1 047	160	237	650

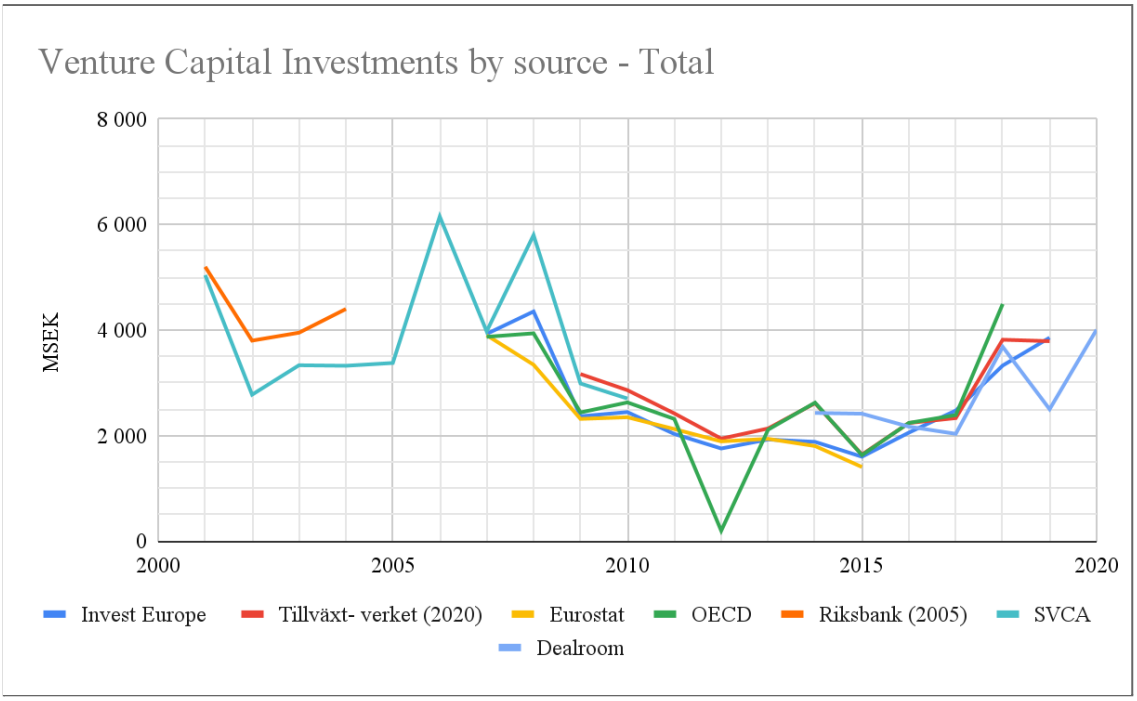
Appendix 2.5 - Venture Capital Investments visualizations, by investment stage

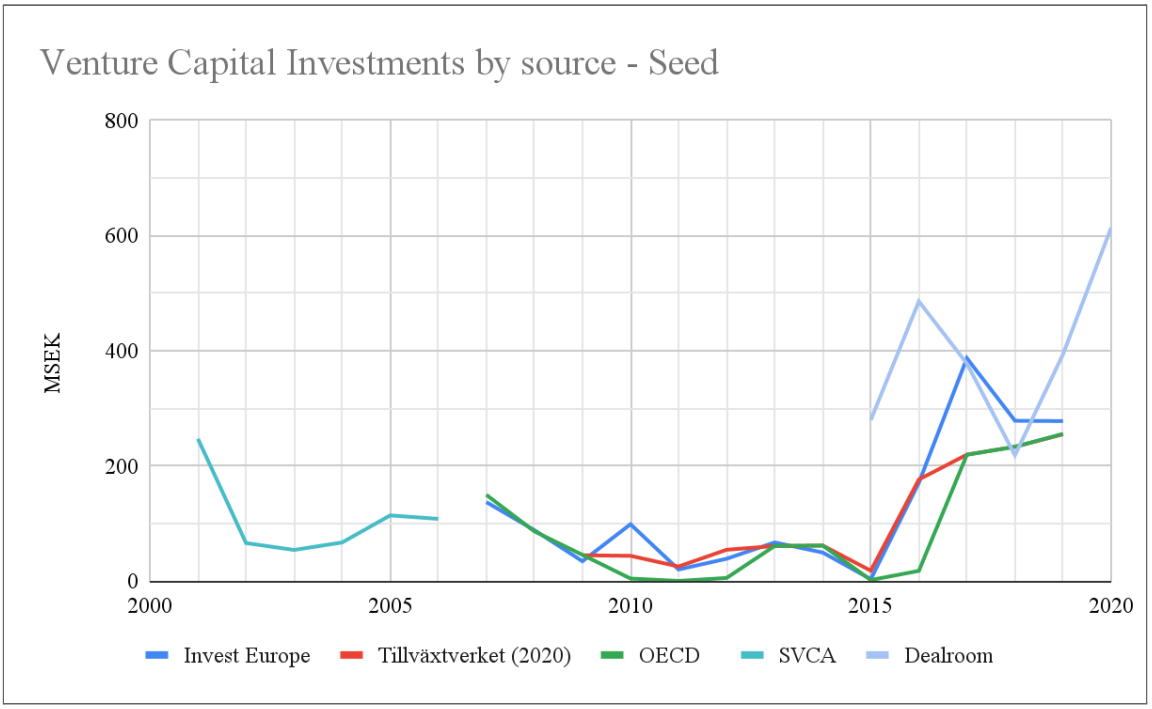


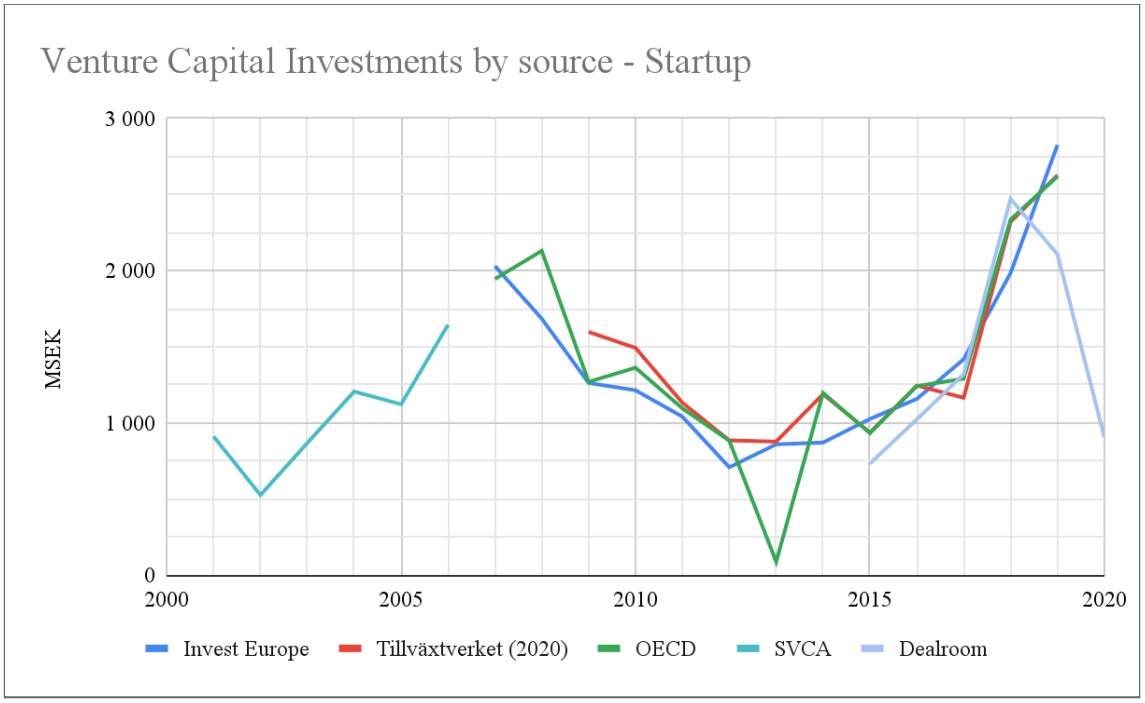

Venture Capital Investments - Startup
3 000
2 000
1 000
0
MSEK
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Startup
Dotcom
Financial crisis
Euro crisis
Covid-19 pandemic

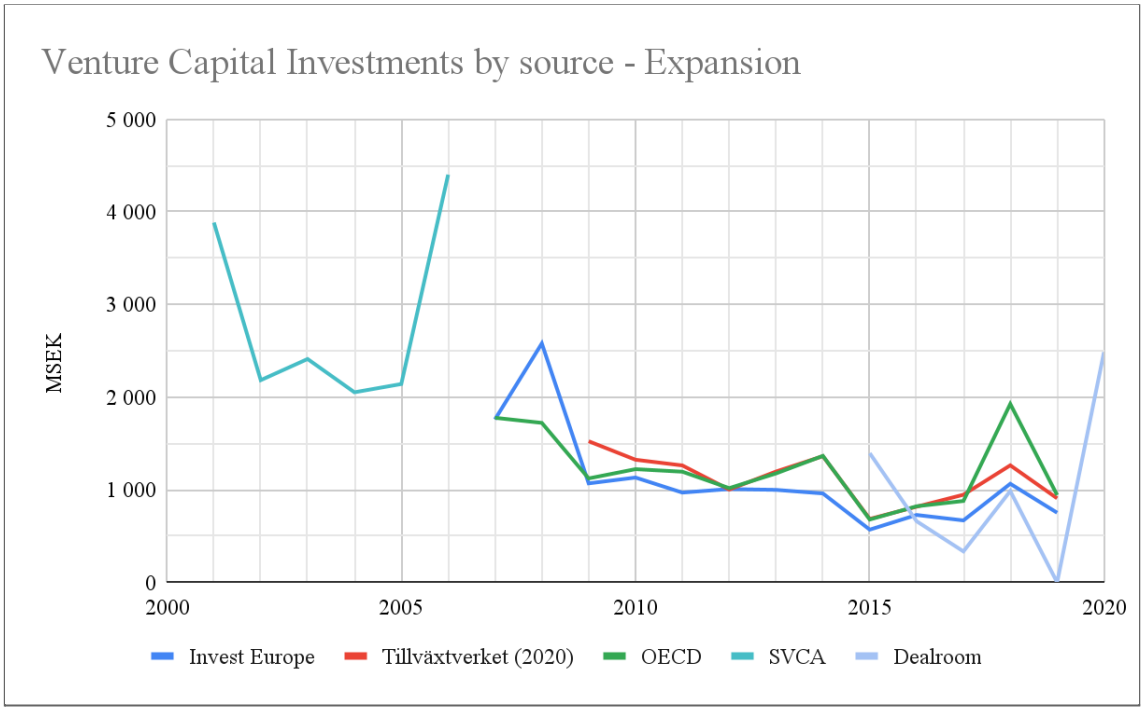

Venture Capital Investments - Expansion
6 000
4 000
2 000
0
MSEK
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Expansion
Dotcom
Financial crisis
Euro crisis
Covid-19 pandemic

Appendix 2.6 - Venture Capital Investments visualizations, by source






Venture Capital Investments by source - Startup
3 000
2 000
1 000
0
MSEK
2000
2005
2010
2015
2020
Invest Europe
Tillväxtverket (2020)
OECD
SVCA
Dealroom


Venture Capital Investments by source - Expansion
5 000
4 000
3 000
2 000
1 000
0
MSEK
2000
2005
2010
2015
2020
Invest Europe
Tillväxtverket (2020)
OECD
SVCA
Dealroom

Appendix 3 - Determinant Regression assumptions

Appendix 3.1 - Full Correlation matrix, dependent variables and determinants

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
(1) vcitot	1													
(2) vciseed	0,24	1												
(3) vcistartup	0,41	0,21	1											
(4) vciexp	0,87	0,06	0,01	1										
(5) IPO	−0,06	0,11	0,26	−0,13	1									
(6) stkmkt	−0,12	0,03	−0,04	−0,03	0,22	1								
(7) corptax	0,41	−0,47	−0,09	0,50	−0,36	−0,16	1							
(8) rigidLMR	−0,66	0,14	−0,05	−0,64	0,28	0,18	−0,81	1						
(9) rigidLTU	−0,52	−0,20	−0,07	−0,43	0,19	0,42	−0,34	0,66	1					
(10) interest	0,44	−0,32	−0,16	0,51	−0,39	−0,38	0,84	−0,79	−0,60	1				
(11) gdpg	−0,03	−0,17	−0,07	0,02	0,17	0,35	0,02	0,02	0,14	−0,06	1			
(12) unemploy	−0,32	−0,06	−0,19	−0,20	0,03	0,45	−0,22	0,44	0,77	−0,43	0,07	1		
(13) rnd	0,52	0,08	−0,16	0,55	−0,50	−0,21	0,52	−0,77	−0,76	0,62	−0,04	−0,46	1	
(14) patent	−0,20	0,13	0,26	−0,26	0,28	0,16	−0,38	0,40	0,47	−0,37	−0,12	0,27	−0,59	1

Appendix 3.2 - Time-series Assumption 2 - Collinearity (VIF test)

Determinant	**VIF**	**1/VIF**
corptax	12,39	0,081
rnd	10,88	0,092
stkmkt	8,03	0,125
patent	7,42	0,135
rigidLMR	7,36	0,136
interest	5,99	0,167
rigidLTUlag2	5,87	0,170
IPO	2,15	0,465
unemploy	1,82	0,549
gdpg	1,19	0,841
Average:	**6,31**	**0,276**

Appendix 3.3 - Time-series Assumptions 3 - 6

OLS Time-series regression assumptions

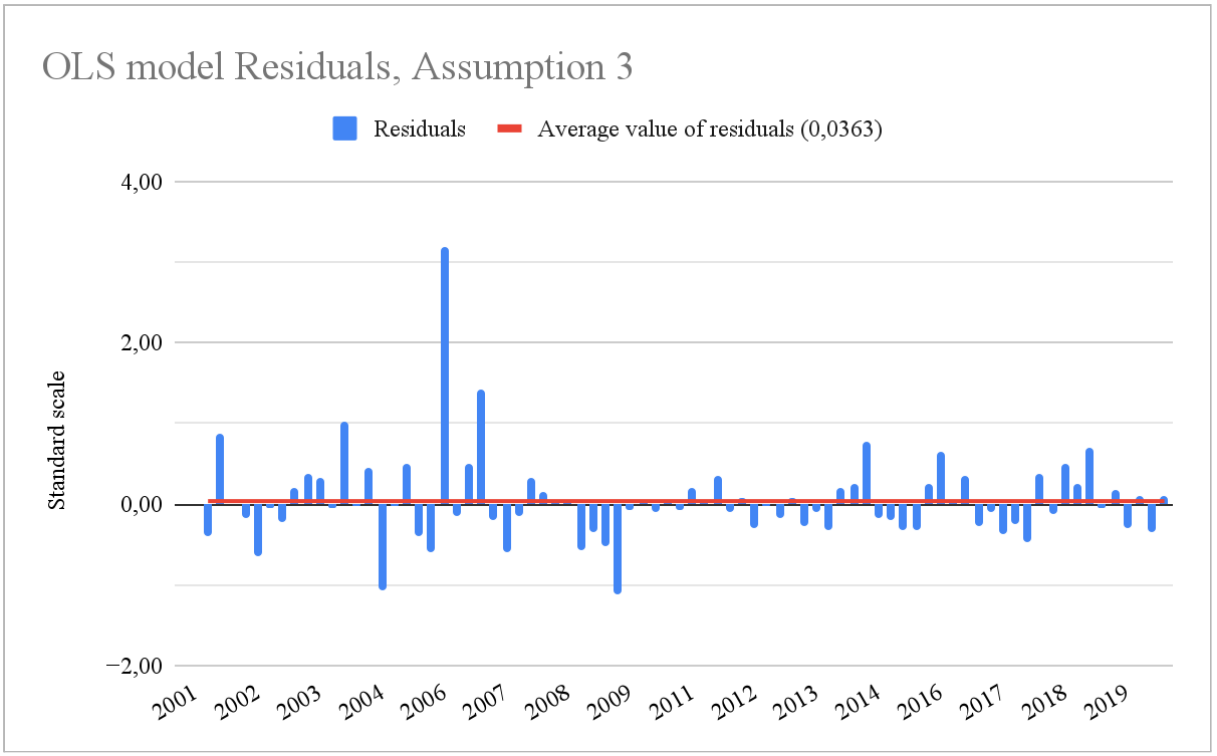
Assumption 3 - Exogeneity	
H0: model has no omitted variables	
Ramsey RESET test for omitted variables	
F(3, 64)	13,34
Prob > F	0,000

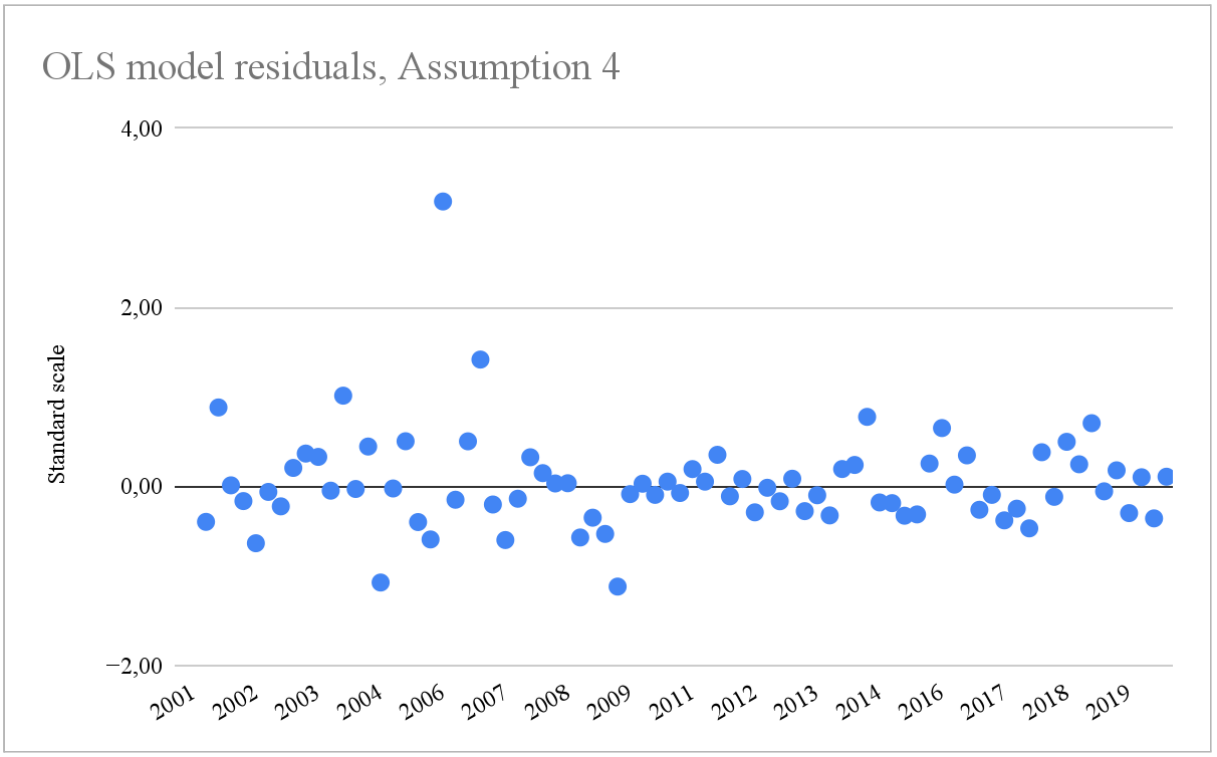
Assumption 4 - Homoscedasticity	
H0: constant variance	
Breush-Pagan / Cook-Weisenberg test for heteroscedasticity	
chi2(1)	190,27
Prob > chi2	0,000

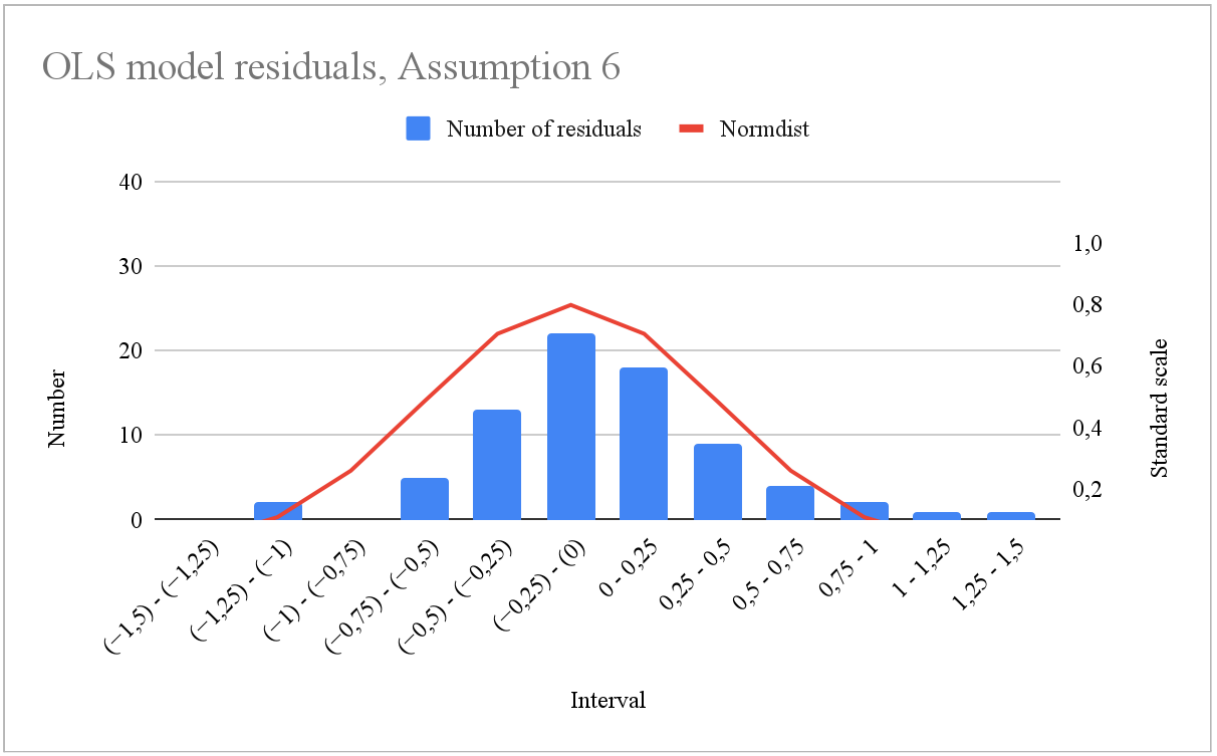
Assumption 5 - Autocorrelation	
H0: no serial correlation	
Breusch-Godfrey LM test for autocorrelation	
chi2	0,761
Prob > chi2	0,383

Assumption 6 - Normality	
H0: errors normally distributed	
Shapiro-Wilk W test for normality	
W	0,8177
V	12,253
z	5
Prob > z	0,000
Skewness and kurosis test for normality	
Pr(skewness)	0,000
Pr(kurtosis)	0,000
Adj chi2(2)	45,05
Prob > chi2	0,000

Appendix 3.4 - Assumption 3, 4 & 6, OLS model residuals visualized






OLS model residuals, Assumption 6
Number of residuals
Normdist
40
30
20
10
0
1,0
0,8
0,6
0,4
0,2
Number
Standard scale
(−1,5) - (−1,25)
(−1,25) - (−1)
(−1) - (−0,75)
(−0,75) - (−0,5)
(−0,5) - (−0,25)
(−0,25) - (0)
0 - 0,25
0,25 - 0,5
0,5 - 0,75
0,75 - 1
1 - 1,25
1,25 - 1,5
Interval

Appendix 4 - PCA

Appendix 4.1 - Kaiser-Meyer-Olkin Characterization

Value range	Kaiser definition
0.00 - 0.49	Unacceptable
0.5 - 0.59	Miserable
0.6 - 0.69	Mediocre
0.7 - 0.79	Middling
0.8 - 0.89	Meritous
0.9 - 1.00	Marvelous

Appendix 4.2 - Kaiser-Meyer-Olkin Results

Determinant	kmo
IPO	0,649
stkmkt	0,730
corptax	0,694
rigidLMR,	0,871
rigidLTU	0,704
interest	0,796
gdpg	0,256
unemploy	0,825
rnd	0,683
patent	0,691
Overall	**0,732**

Appendix 4.3 - Complete PCA results

Component	Eigenvalue	Difference	Proportion	Cumulative
Component 1	5,398	3,878	0,540	0,540
Component 2	1,520	0,438	0,152	0,692
Component 3	1,081	0,309	0,108	0,800
Component 4	0,772	0,295	0,077	0,877
Component 5	0,477	0,132	0,048	0,925
Component 6	0,345	0,168	0,035	0,959
Component 7	0,177	0,056	0,018	0,977
Component 8	0,122	0,050	0,012	0,989
Component 9	0,071	0,035	0,007	0,996

Determinant	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9	PC10
IPO	0,229	−0,401	0,343	−0,454	0,540	0,363	0,063	0,047	0,153	−0,105
stkmkt	0,347	−0,388	−0,033	0,142	−0,079	−0,341	0,225	0,619	0,027	0,387
corptax	−0,360	0,302	0,104	−0,366	0,082	−0,163	−0,165	0,098	0,519	0,543
rigidLMR	0,388	0,055	−0,086	0,181	−0,308	0,358	0,367	−0,317	0,574	0,139
rigidLTUlag2	0,310	0,454	0,100	−0,199	−0,303	0,292	−0,275	0,560	0,034	−0,284
interest	−0,380	0,096	0,023	−0,316	−0,169	−0,044	0,776	0,192	−0,036	−0,275
gdpg	0,020	0,081	0,914	0,264	−0,163	−0,213	0,050	−0,111	−0,009	−0,026
unemploy	0,195	0,562	−0,054	0,331	0,664	−0,083	0,277	0,103	−0,010	−0,001
rnd	−0,365	−0,238	−0,040	0,432	0,116	0,000	−0,150	0,282	0,550	−0,451
patent	−0,368	−0,032	0,110	0,320	0,004	0,676	0,065	0,226	−0,268	0,406

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