UNIVERSITY OF NORDLAND

BODØ GRADUATE SCHOOL OF BUSINESS

MASTER THESIS

Time to take stock:

External capital and subsequent performance of academic spin-offs – participants of FORNY program

EK305E Finance and Capital Budgeting

Oxana Bulanova

Spring 2012

Sammendrag

Å skape nye bedrifter er i kjernen av entreprenørskap. Dessverre møter unge selskap mange hindringer i de første stadiene av deres utvikling. ”Det finansielle gapet”, eller mangel på finansielle ressurser, er ansett som den viktigste av dem. Disse selskapene søker finansiering fra mange forkjellige kilder. Man tror at valget mellom dem kan påvirke deres påfølgende ytelse. Jeg utforsker dette temaet gjennom å studere den innhentede eksterne kapitalen og den påfølgende ytelsen til 72 norske akademiske ”spin-offs”, deltakere av FORNY[1]-programmet. Resultatene mine indikerer klart at ekstern egenkapitalfinansiering øker sjansene for overlevelse mens gjeldsfinansiering minker sjansen for overlevelse. Disse funnene støtter ikke den tradisjonelle ”pecking order” teorien av *Myers and Majluf (1984)* men heller ”reverse pecking order” teorien av *Garmaise (2001)*. Tilstedeværelsen av venture capital både som aksjonærer og styremedlemmer fører til signifikant salgsvekst i organisasjonene, noe som er diskutert i forhold til prinsipal-agent teori av *Eisenhardt (1989)*.

Forskningens begrensninger og forslag for videre studier er fremhevet.

[1] Forskningsbasert nyskaping; see www.forskningsradet.no

Acknowledgements

First of all, it is my greatest pleasure to thank the Nordland University for giving me the opportunity to fulfill my desire and feel as an explorer of the economical field during the writing time of this master thesis! This work's aim is to serve as a successful ending of the Master of Science in Business program within the specialization "Finance and Capital Budgeting".

The topic chosen was originally triggered while I was working as a research assistant together with **Einar Rasmussen** and **Tommy Clausen** in a project focused on the impacts of academic spin-offs financed by the Norwegian Research Council. During this project I uncovered that there is a gap of knowledge on how different types of financial capital affects the performance of academic spin-offs, therefore I have independently extended our work substantially in this area.

Bearing in mind that time is the most precious treasure we possess; I want to thank the following persons for sharing a bit of it with me.

First of all, I want to express my gratitude to my specialization supervisor Professor **Frode Sættem** for his continuous mentoring through the writing time of this thesis; Associate Professor **Frode Kjærland** for support and understanding; Senior Researcher **Einar Rasmussen** for sharing his research data and encouragement; Senior Researcher **Tommy H. Clausen** for data and non-stop guidance through my journey.

Also, Professor **Paul Westhead,** who gave a presentation on the acquisition of formal Venture Capital in USOs, and for the following meeting. Thank you for listening carefully to my ideas and solutions and challenging and encouraging me to continue my research. Associate Professor **Espen Isaksen** for a personal meeting and his support.

And last but not least, **Are Jensen** for help with automation of secondary data gathering.

I must admit that during the writing time I had both very good and bad days when thoughts were changing in a diapason from "Something is not working here" to "Eureka!"

The final results of this investigation are given below for your judging.

Abstract

Creating new ventures lies in the foundations of entrepreneurship. However, young firms are known to face many constraints during their early stages of development and formation. "Financial gap", or the lack of the financing resources, is considered to be the most important of them. These firms seek financing from different sources. It is believed that the choice between them can influence the subsequent performance of the organizations. I am exploring this issue by investigating the external financing attracted and the further performance of the 72 Norwegian academic spin-offs, participants of the FORNY program. The results clearly indicate that external equity financing increases the chance of survival while debt financing decreases it. These findings do not support the traditional pecking order theory of *Myers and Majluf (1984)* but rather the reverse pecking order of *Garmaise (2001)*. The presence of venture capital (VC) as shareholders and on the board of directors significantly helps the organizations to grow sales-wise, something which is discussed in light of agency theory of *Eisenhardt (1989)*.

Limitations, implications and propositions for future research are highlighted.

TABLE OF CONTENTS

Survey of tables

Survey of figures

Survey of appendixes

(page numbers refer to the separate page numbering in the appendix section)

1 INTRODUCTION

Omnia mutantur, nihil interit

(Everything changes, nothing perishes)

Ovid

Entrepreneurship relies on the foundation of new ventures. Growth of entrepreneurial ventures creates wealth of the country's economy *(Robinson and Phillips McDougall, 2001)*. However, the way to become successful and create economic wealth lies through overcoming the difficulties and obstacles for the new firms. One of the main constraints named in the literature is shortage of funds that limits the development of the firm *(Wright et al., 2006, Pazos et al., 2010, Knockaert et al., 2009)* while profits remain low in the early stages of their development *(Lindelöf and Löfsten, 2005)*. This "financial gap" turns the firms to seek the external funding. Difference in the forms and amount of the attracted financing is believed to affect the subsequent performance of the new ventures *(Shane and Stuart, 2002)*. This work's aim is to investigate this statement utilizing as an example special type of new ventures – academic spin-offs (ASOs).

The choice fell on them; due to these firms are new ventures that represent the modern way of thinking how technology can be transferred from academia to business quite rapidly and start working for economy and social sphere by developing growth in industries *(Zahra et al., 2007, Pazos et al., 2010)* Researchers in this field like Ferrary and Granovetter *(2009)* confirm that academic spin-offs (ASOs) are also usually constrained in their internal sources and therefore the external funding is often sought to fill the "financial gap". The recent research on ASOs in Norway revealed that performance of these firms is low and they "*seem to fail to attract capital in the growth phase*" *(Borlaug et al., 2009)* Therefore it appears natural to explore the impacts of the external capital sources on the performance of the company in these firms' context.

One of the reasons that lead to "financial gap" is due to the owners/inventors of ASOs often possess less knowledge about optimal financing *(Lindelöf and Löfsten, 2005)*. *Heirman and Clarysse (2004)* support this by reporting that 42% of firms start as prospectors and have no clear plans on their business aim and strategy, something which entails that their founders might not have a solid aim of how to grow. This can turn that the financing sought is not

appropriate for the firm or is achieved on the higher cost than expected or is not obtained at all. To add, young ASOs, among other weaknesses, also lack managerial skills, have limited or no record history, usually no market-ready product to offer *(Lindelöf and Löfsten, 2005)*. These and other reasons make it difficult for the professional investors to obtain correct information on the opportunity and reliability of the statements and proposals of the founders' projects. Decision to seek the external finance and the type of obtaining thereof is often related to the *information asymmetries* (Figure 1 below) and its' constrains *(Cosh et al., 2009, Sørheim, 2003)*.

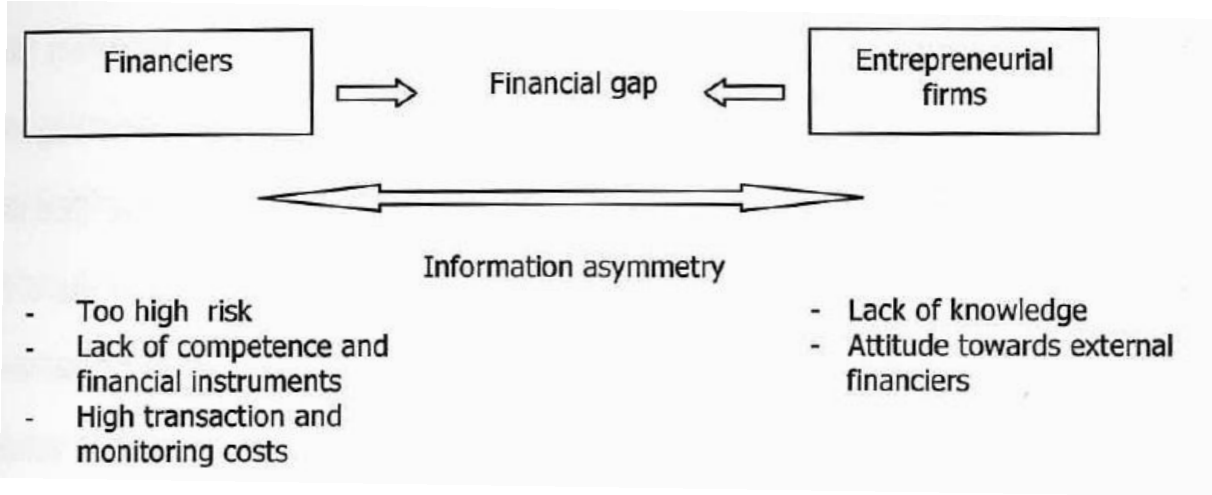

Figure 1 – Information asymmetry and financial gap adopted from *(Sørheim, 2003, p.5)*

Myers and Majluf (1984) revealed that entrepreneurs often have intimate information that investors do not possess, which makes it difficult to negotiate and reach a consensus about external financing for both sides. According to *Myers and Majluf (1984)* obtaining external equity capital, diluting the ownership share can be an indication of a low quality firm, if there exists unused debt capacity. In fact, this research direction, named *pecking order theory*, predicts that firm's priority of investments in new projects will follow a special order. Namely, first, internal cash flows will be used, therefore, if necessary external debt will be sought, and only as a last possibility an external equity capital. By extension, the pecking order theory predicts that the use of external capital will have a negative influence on firm performance, such as survival and growth.

On the other hand *Garmaise's (2001)* findings revealed that external equity finance can indicate a high quality firm, if the investors have the higher ability to recognize the projects

quality compared to the entrepreneurial firm managers/owners. *Mueller, Westhead et al. (2012)*, referring to *Colombo and Grilli (2005)* confirmed this finding in the question of venture capital (VC) investment and claims that it can stimulate the growth of ASO. In comparison with the traditional pecking order theory, the reverse pecking order theory suggests that the use of external equity capital will have a positive influence on firm performance, such as the survival and growth.

The question of the investor's contribution to the business, by not only choosing the best investees, but also assisting in the business development has been discussed broadly in the literature of spin-offs *(Cosh et al., 2009, Clarysse et al., 2007a, Bertoni et al., 2011)*. This can be tied to agency theory, and how venture capitalists acting as principals seek to minimize risks and moral hazards by gaining tighter control over the organizations *(Eisenhardt, 1989)*. However *Cosh, Cumming et al. (2009)* admits that there is a lack and large segmentation of studies that compare different types of external investors in their abilities to recognize the goodness of the idea and overcome information asymmetries. Importance of various capital sources to the entrepreneurial firms and subsequent performance is also under-investigated.

1.1 Research relevance

The researchers have tried to approach this revealed problem. In spite of studies have tried to link financing challenges with performance, there are, however still gaps in this field of study. The whole research field is named "young", presenting the studies that are based on different theories and sources, few analyzing same processes or utilizing comparable data *(Rasmussen et al., 2012)*.

The literature seems to be divided into two streams: one trying to capture and investigate what conditions and factors the ASOs should possess to be able to obtain the external financing and another flow inquires the relations between the investors and ASOs and their link to performance. *Pazos and Lòpez (2010)* claim that they "*have not found any work which analyses the factors which lie behind their (ASOs) capital structure*". *Cosh et al. (2009)* also claims that entrepreneurial finance literature focuses usually on one external capital source, as information is often obtained from the particular investor making the funding picture very fragmented. The most commonly studied therefore is the relationship between science-based entrepreneurial firms (SBEF) and venture capitalists *(Knockaert et al., 2009, Bertoni et al.,*

2011, Mueller et al., 2012). *Munari and Toschi (2011)* tried to reveal whether the last named have bias against investments in academic start-ups. *Shane and Stuart (2002)* concluded that venture funding is the most important determinant of the initial public offering (IPO) likelihood of the ASO. *Bertoni, Colombo et al. (2011)* concluded that VC investments have a significant influence on the growth of the ASOs. However *Knockaert, Wright et al. (2009)* claim that venture capital is improbable to help to overcome resource deficit or add value to SBEFs. Therefore I can conclude that my systematic literature investigation, presented in the next chapter, have not revealed any research on the establishment of the clear link between the differences in external funding and salient performance, though *Shane and Stuart (2002)* mentioned in their research that this variance has the place to be. Those studies that exist usually examine only one type of investors and as we can see on the example of the VC financing the findings are controversial.

Nevertheless, performance of the new ventures is highly appreciated theme in the field of economic research *(Zahra et al., 2007, Isaksen, 2006)*. Keeping in mind these issues and findings I formulated my research within following framework. This is a follow-up study of organizations- participants of the FORNY program, initiated by the government of Norway. All the participants were associated with Technology Transfer Offices (TTO). **The main concern of the study is to examine the links between the external capital acquisition (success/failure to attract different types of thereof) and subsequent survival and growth in sales.** Hopefully this will bring new approaches to the current research of ASOs' performance, and shed light on whether traditional pecking order theory or reverse pecking order theory is supported among the FORNY-organizations.

This research will adopt the relevant theories and their understanding of the entrepreneur's behavior and funding choices in the context of financial gap and information asymmetries, and will give a broader understanding whether and to what extent ASOs follow the patterns predicted by the pecking order theory, and its reversed kind. Agency theory's relevance will also be illustrated, when discussing venture capital's role as a member of the board of directors and its subsequent effect on performance.

One of the goals of this work is to extend the findings of the rapport on FORNY firms, that was aimed to evaluate the program *(Borlaug et al., 2009)* and contribute with additional knowledge on the existing literature. The decision in a follow-up study was among others made because on one hand the authors of the initial rapport were concerned of "*generally*

poor growth rate" of ASOs as well as on the other hand researchers often complain on the lack of systematic research in this field, fragmentation and inconsistency in findings and my investigation follows the development of the firms from the survey of 2008 until today *(Zhang, 2009b, Rasmussen et al., 2012)*. Let this follow-up set the new traditions in the aim of getting a complete, holistic picture of the processes influencing the performance of the ASOs.

After this brief introduction, the work proceeds as following: first, a framework where a literature review of my field of study, relevant theories and hypothesis are presented; second, research methodology that includes data gathering and measures used in this research; thirdly, empirical analysis is presented and finally discussion chapter introduces the results, limitations and implications for future research.

2 FRAMEWORK

In this study university spin-off (USO), academic spin-off (ASO) and start-ups and science-based new firms (SBEF) are to be understood as synonyms. All of the firms to be studied were started under the FORNY program and therefore can be considered as a homogenous group in this aspect. Their characteristic features are: 1) aim – they were founded to commercialize the results from publicly funded research institutions 2) are related to one of the Technology Transfer Offices (TTO) that Norwegian government is cooperating with *(NFR-2, 2011)*.

These TTOs in their turn have a network and connections with Universities, University Colleges, business actors and others. FORNY program points on the same problems that mainstream research is claiming: difficulties in obtaining the sufficient financing in early stages of USOs. To minimize this gap FORNY is holding verification to ensure the private and public actors to invest in a project. Patenting and licensing can be results of this verification *(NFR-2, 2011)*.

2.1 Literature review

Haurit aquam cribro, qui discere vult sine libro

(*The person who wants to learn without a book is gathering water in a sieve*)

To reveal whether there is a link between differences in the external financing and subsequent performance I have got a clear plan of actions to obtain and examine/study the relevant literature in this field. To my knowledge the most recent review of the performance of the new technology based firms is written by *Rasmussen et al. (2012)* where I have been one of the co-authors. This literature study was based on a data available from the ISI Web of Knowledge database and contains the relevant literature from year 1995 until 2011. During the writing time of that rapport I have been in the research team throughout the whole process. This entails that I have acquired the competency needed in order to know whether or not acquired article collection is saturated, i.e. whether or not I have acquired all relevant

literature. Included in these skills are the knowledge of proper word combinations, how to use Boolean operators, how to exclude improper terms, and of course manual filtering through the EndNote citation manager. Carrying this baggage of knowledge I decided to complete the literature that is revealed by the above named rapport/literature review and use the Scopus database to cross check the findings and add relevant articles that were not in the initial rapport but are nevertheless important for my study. Scopus is a credible data source, covering a large amount of acknowledged journals. In addition it supports bulk exporting of abstract and citations for EndNote, making it easier, and more practical to use when working with large amounts of articles.

First of all, specific word combinations were chosen to cover my field of study. There is a variety of terms used for technology commercialization in academia, and I have covered the ones most used. Such words as: spin-offs, spin-outs,. science-based entrepreneurial firms and start-ups were utilized. To reduce the quantity of results on the word "start-ups" words "academic" and "university" were used to limit my search hits. All findings were exported to EndNote and duplicates were removed. Table 1 presents my findings.

Table 1 – Word combinations used while searching the Scopus database per 13.02.2012.

(capital or "VC")	("academic spin-offs" OR "academic start-ups" OR "academic spin-outs")	AND (performance OR growth)	**117**
(capital or "VC")	("university spin-offs" OR "university spin-outs" OR "university start-ups")	AND (performance OR growth)	**288**
(capital or "VC")	("research-based start-ups" OR "research-based spin-offs" OR "research-based firms" OR "research-based spin-outs")	AND (performance OR growth)	**78**
(capital or "VC")	("science-based entrepreneurial firms" OR "SBEF")	AND (performance OR growth)	**210**

An example from the table above would be: (capital OR "VC") AND ("academic spin-offs" OR "academic start-ups" OR "academic spin-outs") AND (performance OR growth). This method of search gave me the possibility to add the articles which had at one time either word capital or VC and performance or growth and one of the names that ASO are usually called. The total sum of unique articles after deleting duplicates was **514**. I then checked my EndNote

database with the previous mentioned literature review of *Rasmussen et al. (2012)* and following literature reviews (Table 2):

Table 2 – Literature reviews on the ASOs.

Agrawal, (2001)	"University-to-industry knowledge transfer: Literature review and unanswered questions."
Djokovic and Souitaris,(2008)	"Spinouts from academic institutions: A literature review with suggestions for further research."
Mustar et al.(2006)	"Conceptualizing the heterogeneity of research-based spin-offs: A multi-dimensional taxonomy."
Rothaermel et al. (2007)	"University entrepreneurship: A taxonomy of the literature."

After these manipulations and careful reading of each abstract in EndNote I ended up with around 60 relevant articles. These have been printed out and studied to get the sense what drives the modern research in this area. Reference lists have been also studied and new works added. However the master thesis is very limited in the writing time and therefore the literature review has been reduced to around 35-40 articles, and some of them do not study ASO but have an important implication to the choice of measurements, econometric analysis and theoretical footing. These are for example the studies of corporate spin-offs and small and medium firms. The need to adopt these studies comes from the above mentioned argument in the introduction chapter: the research in this field of study is quite "young" and is still fragmented *(Rasmussen et al., 2012)*.

To sum up I should admit that such a detailed study of the literature has given me an opportunity to explore the available knowledge on ASOs from different sides. This includes their startup conditions, development, performance and impacts. On the other hand I got a deep knowledge about funding differences and how different authors interpret them to influence the performance of NTBFs. And at last the "performance" is measured differently from author to author. This was more time consuming but bearing in mind my earlier knowledge obtained from the previous project, strong interest for this theme and an additional literature research, I claim to have got a holistic picture of the phenomena studied that gives me an advantage and strength to perform the analysis further in this paper.

To save the space and the thread of my narrative I will not write a long conclusion on the literature derived. Some of the important articles that I have revealed during my literature review are coded and presented in the appendix section (see appendix 1 literature review). Below I have summarized my findings in a manner that is pertinent for my topic.

The research of the performance of the new ventures is a favorable theme in the field of entrepreneurship *(Isaksen, 2006)*. Most of the studies in my literature review are quantitative. I could not detect any prevailing theory, rather a mix of them. It can be partly explained to the above mentioned claims of the "youth" of the field of study of the ASOs *(Rasmussen et al., 2012)*. However one mainstream has been detected. Many of the presented studies indicate the presence of *information asymmetries* between the owners/founders of ASOs and potential investors (e.g. *(Shane and Stuart, 2002, Vanacker and Manigart, 2010, Mueller et al., 2012, Bonardo et al., 2011, Cosh et al., 2009, Wright et al., 2006, Knockaert et al., 2009)* which can worsen the "financial gap". While these authors have e.g., sought to offer an insight in how ASOs make decisions on what kinds of financing they prefer, how they internally assemble resource bases that signal credibility in order to attract venture capital, how non-financial capital can affect signaling towards debtors, and how information asymmetries' makes valuation of firms difficult, none have sought any link between the type of external financial capital attracted and its subsequent effects on performance. This is in spite of the acknowledgement that "access to financing is a key determinant of growth in any new technology-based firm" *(Bonardo et al., 2011:758)*.

A number of works tries to understand how to overcome information asymmetries and get access/attract to the external investors *(Lindelöf and Löfsten, 2005, Mueller et al., 2012, Knockaert et al., 2009, Munari and Toschi, 2011)*. However the subsequent performance, after the financing is achieved or not has not got the same attention. There are though, some authors who have tried to concentrate on individual external sources meaning that they have a superior/higher importance for the ASOs performance than others. The most often studied is the VC funding. The findings in this question however are controversial. One study claims that the attraction of VC is the only determinant of the successful IPO *(Shane and Stuart, 2002)*. While other authors conclude that only VC funding cannot resolve the problem of the resources lack or add value to the firm *(Knockaert et al., 2009)*. Some authors rank this type of financing so high that along with such outcomes as IPO or failure they hypothesize the attraction of VC funding as well *(Shane and Stuart, 2002)*. Variation in the performance measurements also leads to think that the researchers are trying to adopt the well known

measurements to this field that however is not always bringing the desirable results. For example profitability is named to be insufficient indicator due to the most of the ASOs make no or low profits in the young stages of development, due to they start without a clear product to introduce to the market *(Lindelöf and Löfsten, 2005)*. *Clarysse et al. (2011)* supports this saying that traditional accounting measurements are not suitable for these firms. Among those measures/ indicators that are often used are survival/success and failure and growth, particularly growth in sales and employment (e.g. *(Wennberg et al., 2011, Zhang, 2009b, Nerkar and Shane, 2003, Bonardo et al., 2011, Lindelöf and Löfsten, 2005, Clarysse et al., 2011, Vanacker and Manigart, 2010, Cosh et al., 2009, Robinson and Phillips McDougall, 2001, Evans, 1987, Davidsson et al., 2006)*. However in their studies of survival and growth authors turn to human capital and technology determinants. The investigation of the existence of previous relationships, education level and years of experience in industry as well as radicalness of technology are used among others to explain the performance *(Colombo et al., 2010) (O'Shea et al., 2005, Shane and Stuart, 2002, Mueller et al., 2012, Nerkar and Shane, 2003)*.

The lack of studies of how external capital can affect performance can be blamed on the youth of the ASOs phenomena, that the firms are unquoted and that their aim in developing a new technology is bearing high risks for potential investors and therefore the usual ways of accumulating and attracting the funding may not be appropriate or available *(Vanacker and Manigart, 2010)*. This makes it even more challenging to investigate how these firms act through the time while some succeed in attracting debt capital and some equity capital or both. Does the presence of external capital speed the growth or vice versa?

All the literature is used throughout this work in each chapter, with special attention given to the formulation of hypothesis, use of theories, models, variables and conclusions. Therefore in the next section I combine the findings in my field of study from the literature as well as derive my hypothesis.

2.1.1 Funding needs and availability in different stages of USOs

ASOs need funding through a long period of time from start-up until they are bought by an industry, started production or have in another way moved from the “commercializing

research" phase. Roger *Sørheim (2003)* in his doctoral thesis gives a very informative illustration of finance sources, usually obtained by entrepreneurial firms in different stages of their development. This is illustrated in Figure 2, p. 11.

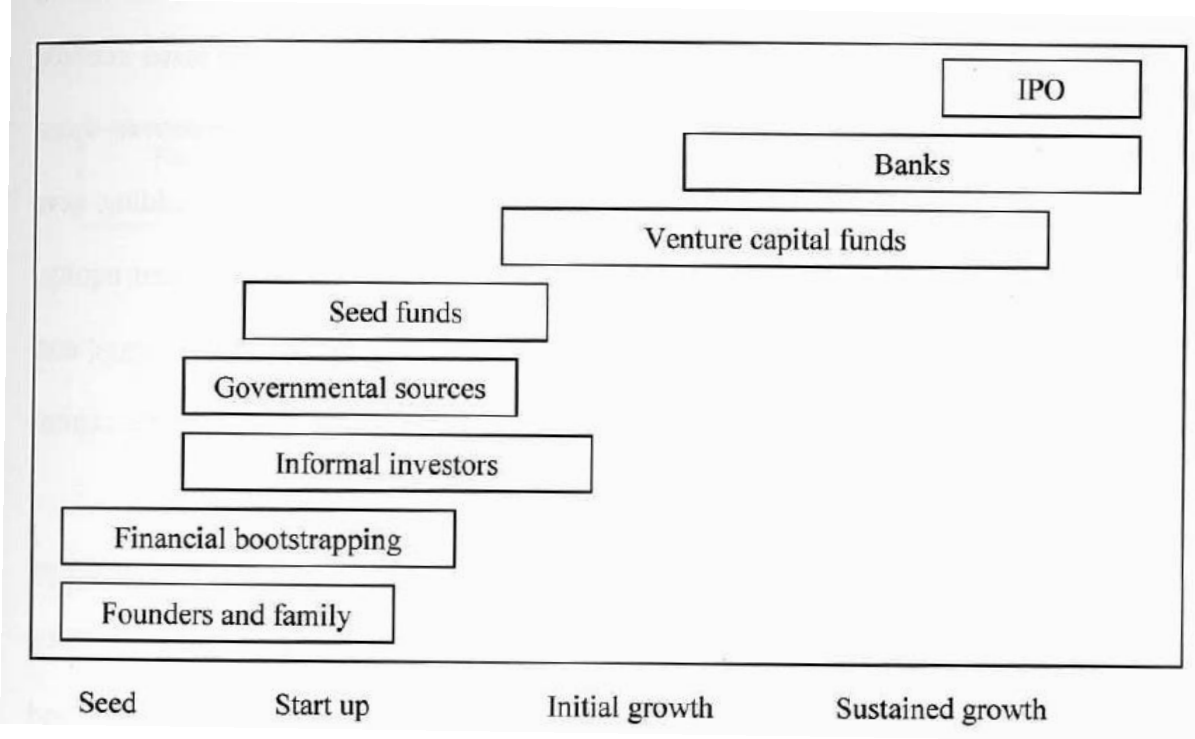

Figure 2 – Entrepreneurial firm's life cycle and appropriate financing sources *(Sørheim, 2003:3)*

As well as Neff has an informative figure of the general availability and ways of funding of start-ups presented bellow in Figure 3, p. 12.

Both figures have a common pattern. Young start-ups are first of all relying on the internal financing and help of friends and family at the start-up phase. Next step, according to figures is an achievement of equity financing with the help of angels, venture capitalists and others. Angels financing is usually insufficient and non-professional, while VC funding can help the USO to develop for IPO or trade sale *(Wright et al., 2006)*.

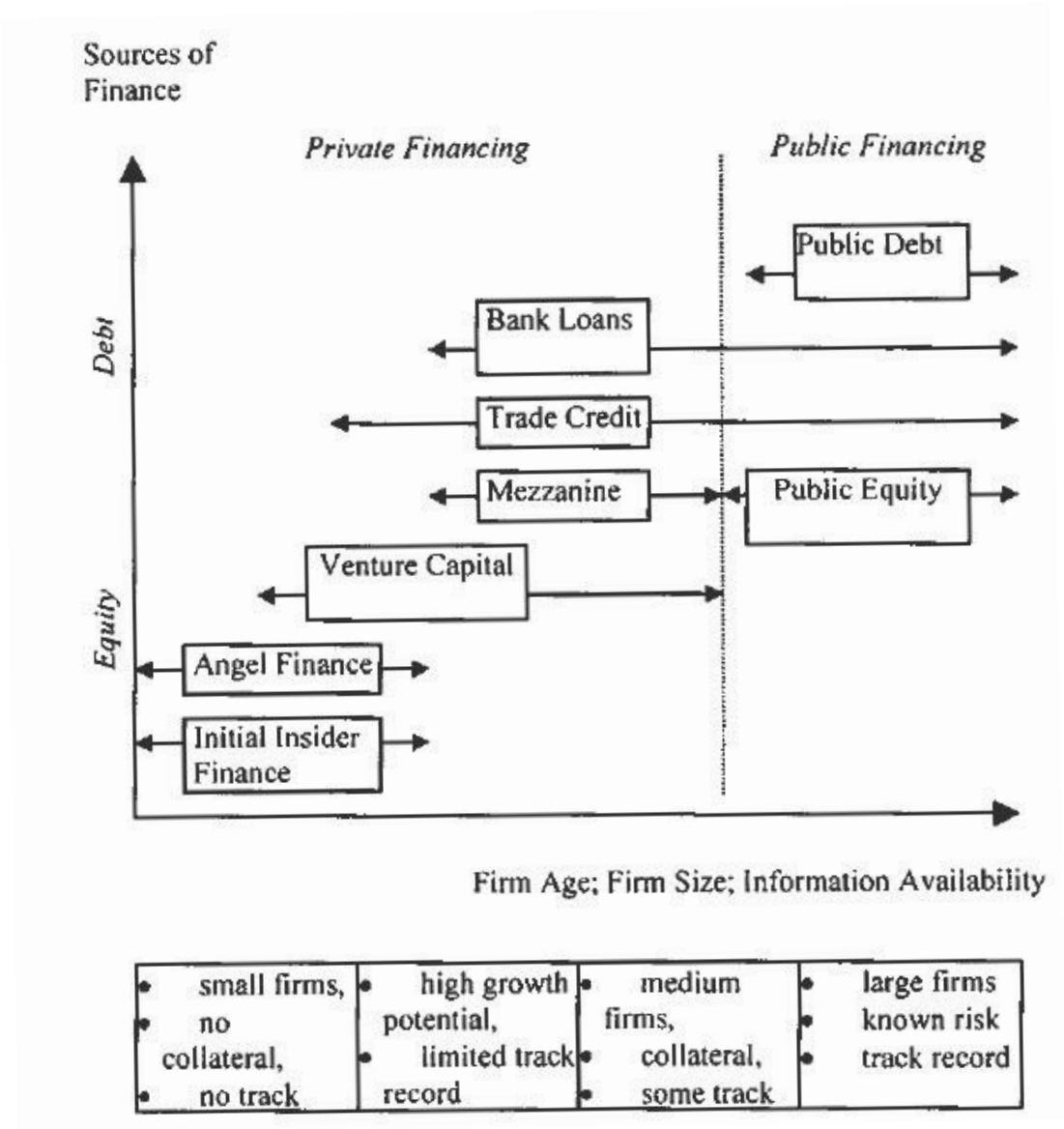

Figure 3 – The financial growth cycle. Obtained from Neff *(2003:108)*

Young firms according to Neff are unlikely to get bank loan due to lack of reputation and track records, though they can have promising innovative ideas and lack of self-funding. She also stresses that equity funding was not an interesting area of study before 1990s, though this pattern is rapidly changing *(Neff, 2003)*. *Wright, Lockett et al. (2006)* have come to the similar conclusion, referring to Lockett, they claim that venture capitalists and business angels tend to invest in early stages of firms cycle rather than traditional finance institutions (banks), meaning that the stage of investment has a lower risk factor than technology for them. They also discuss *information asymmetries* in earlier stages and their influence on VC funding *(Wright et al., 2006)*. New times dictate updated approaches and visual angle of the phenomena *(Wright et al., 2006)*. *Sørheim's (2003)* and *Neff's (2003)* research (as illustrated

in figure 2 and 3), shows that the predominant order of financing follows a *reversed pecking order*, preferring private external equity capital ahead of debt capital. In my work I will study whether or not these preferential of financing is beneficial to performance.

2.2 Theoretical approaches

The *Modigliani-Miller (MM) theorem* of firm's capital structure was proposed by *Franco Modigliani* and *Merton Miller* (1958,1963). Since then many authors have tried to develop their theories of optimum capital structure *(Copeland and Weston, 2005, Pazos et al., 2010).*

Modern literature has revealed that MM assumptions are not met in market economy. The existence of agency costs, bankruptcy expenses and differences in the acquisition of external debt and equity both in risk and costs turned the researchers into this field of study and resulted in the development of new theories *(Copeland and Weston, 2005)*. After completing the literature review the following theories were chosen for this work: pecking order theory, reversed pecking order theory and agency theory; and are presented below.

2.2.1 Pecking order theory, and its reversed version

According to Brealey et al. pecking order theory relies on information asymmetries. This information "*affects the choice between internal and external financing and between new issues of debt and equity securities*" *(Brealey et al., 2011:460)*. Herein lies the pecking order; the idea that internal capital is spent before external funds if the investments are needed. One of the most important reasons is that managers want to keep control from being diluted *(Neff, 2003)*. Another reason is that issuing debt requires less convincing of external finances than issuing equity. This is because the risk for the creditor is lower than for a shareholder in case of liquidation.

Since the manager has a better understanding of internal affairs in her organization she is in a better position to understand this risk of deploying this capital. While she might know that this capital will be used for growth instead of survival, this is something that investors cannot be sure of. Thus, debt is preferred over equity as equity holders lack the information that managers have *(Brealey et al., 2011)*. The same goes for issues with bank: a creditor has less

information than entrepreneur, but has initially lower risk than the equity holders, because in a liquidation process they are preferred over them. This is the pecking order in which internal funds are primarily preferred second to debt and finally to new issues of equity *(Brealey et al., 2011)*.

This leads to a circularity where potential investors who see skeptically on issues of equity because they believe that the firms debt capacity has been exceeded, which in its turn can point to a financial distress. This is because highly profitable firms are better able to finance their own growth and expansion.

However some precaution should be taken with the use of this theory for my work, due to some authors came to a conclusion that pecking order theory does not reflect all the stages of firms development and is little informative in the context of small firms *(Neff, 2003)*. Traditional pecking order theory indicates that acquiring external equity capital ahead of debt capital is not beneficial, as it increases information asymmetry and dilution. This can indicate that the firm is of low quality, as it is not able to grow enough to sustain itself without inviting help from external owners.

As we have seen the pecking order of capital structure limits information asymmetries, but that does not mean that it is necessarily good for the performance of young spin-offs. External capital can bring positive effects with their entry into the firm (e.g., professional management, contact networks, or signaling of quality) *(Garmaise, 2001)*. If this is the case, pecking order theory might in fact be reversed when using it as a predictor for future performance – having greater amount of external capital, and not relying on debt can be a sign of quality. Some researchers have explored this avenue, among others *Garmaise (2001)* and *Cosh et al. (2009)* They have found that in the context of ASOs, the *pecking order appears to be reversed*. This *reversed pecking order* entails that taking external capital on board has a higher saliency than debt. Even internal funds can have a lower priority than attracting some forms of external capital, according to *Wright et al. (2006)*. In this case, the external capital, and possible added value that comes with it, surpasses the drawbacks of information asymmetries. This will be tested in hypothesis H1, and H2, where I will see whether or not increased levels of debt and equity, affects non-financial and financial performance.

Garmaise (2001) claims that the empirical evidence shows that external capital have experience and information that "*enable them better to judge entrepreneurial ventures than the entrepreneurs themselves" (Garmaise, 2001:2)*. His argument is that this makes the

reversed pecking order more sensible for smaller firms seeking growth, while the ordinary pecking order is more adapted to firms of larger size. This entails that for these firms investors may have *more* information than the owners themselves.

In the next section, agency theory, it will be shown that venture capitalists have several instruments by which they can reduce risk and ensure control from an equity holder stand-point, making the gap between internal funding and venture equity smaller in the pecking order.

2.2.2 Agency theory

"Agency theory provides a unique, realistic, and empirically testable perspective on problems of cooperative effort." *(Eisenhardt, 1989)*

According to Eisenhardt's claim above, agency theory might be considered to be an interesting choice for a theoretical framework in my paper. Below agency theory will be presented, and tied to my study to show why I believe Eisenhardt were right. I am not the first in employing agency theory in studying how external equity capital affects performance, as can be seen from my literature review. In their studies, agency theory gave consistent results, something that my study will benefit from. For a general overview of the theory, Table 3 to the right might be of help.

Table 1
Agency Theory Overview

Key idea	Principal-agent relationships should reflect efficient organization of information and risk-bearing costs
Unit of analysis	Contract between principal and agent
Human assumptions	Self-interest Bounded rationality Risk aversion
Organizational assumptions	Partial goal conflict among participants Efficiency as the effectiveness criterion Information asymmetry between principal and agent
Information assumption	Information as a purchasable commodity
Contracting problems	Agency (moral hazard and adverse selection) Risk sharing
Problem domain	Relationships in which the principal and agent have partly differing goals and risk preferences (e.g., compensation, regulation, leadership, impression management, whistle-blowing, vertical integration, transfer pricing)

Table 3 – Overview of agency theory from Eisenhardt *(1989)*

Central to agency theory is the idea of

the principal and agent and the contract governing this relationship *(Eisenhardt, 1989)*. A principal in this context can be seen as the owner of some resources, such as financial capital, while the agent is the steward[2] of these resources. In this relationship we assume that the agent is self-seeking, and knows more about the everyday affairs of the organization than those owning it *(Eisenhardt, 1989)*. A contract on the other hand is in this context not necessarily a piece of paper with conditions about what is allowed and disallowed in the relationship between principle and agent, but rather a metaphorical construct that can take form as a legally binding document *(Eisenhardt, 1989, Jensen and Meckling, 1976)*. This contract (or agreement) is needed because there is asymmetric information between the agent and principal, and so the principal needs to ensure that the agent follows his wishes *(Eisenhardt, 1989)*. In our case, this is most likely done through a legal contract when, most often studied, the venture capital funds come into our companies as owners.

According to *Eisenhardt (1989 :58)*, *"agency theory is concerned with resolving two problems that can occur in agency relationships. The first is the* ***agency problem*** *that arises when (a) the desires or goals of the principal and agent conflict, and (b) it is difficult or expensive for the principal to verify what the agent is actually doing ... The second problem is of* ***risk sharing*** *that arises when the principal and agent have different attitudes toward risk."* (emphasis by the author)

As for the first challenge, the agency problem, there can be many different reasons for both conflicting interests and goals between venture capitalists and academic spin-offs. Research has shown *(Fini et al., 2009, Meyer, 2003)* that many founders of academic spin-offs are more interested in developing their own academic skills and products, than actually growing the company and becoming financially successful. This is an example of moral hazard *(Eisenhardt, 1989)*, or a lack of interest in doing what the principle wants. Incentive systems would in theory be a good candidate to resolve this issue *(Merchant and Van der Stede, 2007)*, but there is the possibility that the founders themselves already have stock in the company, making options or stocks a weaker tool for aligning interests of the principal and agent. Also, the high degree of technological refinement in many of the concepts and products sold by the company makes it harder for the venture capitalists to verify what the founders are actually doing. This is an example of adverse selection *(Eisenhardt, 1989)*. One solution for this problem would be to hire external managers, that are paid for by the investors themselves *(Eisenhardt, 1989, Ortín-Ángel and Vendrell-Herrero, 2010)*. Again the high-tech nature of

[2] Steward is here defined as a person who manages another's property or financial affairs

the product makes this a challenge. Here becoming part of the board of directors may be a more practical solution to the problem, as it gives both the power to change the strategic focus of the company, and with enough shares, a majority influence over major decisions. Other tools for solving this problem can be investing in *more complex information channels, such as complex budget systems (Mellemvik et al., 1988, Eisenhardt, 1989)*.

The second challenge, that of risk sharing *(Eisenhardt, 1989)*, lies on the assumption that managers are more risk averse than the owners of the company. The background for this reasoning is that while the venture capitalists have a possibility to diversify their investments, this option is not as readily available for the managers of the company. In our case we can assume the managers of the company are often the founders themselves, and are therefore less risk averse than the average manager. They have, after all, started their own company, and is risking their academic career by placing publishing on hold, or at least slowing down their publishing rate.

In this study, agency theory can be useful for understanding how investors asserts their rights as shareholders, and through this strives to ensure optimal financial performance. Coupled with pecking-order theory, this will give me good understanding of both the capital structure of the firm, as well as how the governance of these firms are upheld by the external shareholders, particularly venture capitalists. Since my sample has both academic spin-offs that have venture capital, and some that do not, I can analyze whether the lack of said capital is a characteristic that leads to worse performance. This is not to say that the capital itself is not the only influence external capital backing can have; managerial competency, networking effects, marketing and commercial capabilities and financial know-how can all be important factors determining the financial performance of these firms *(Ferrary and Granovetter, 2009, Ortín-Ángel and Vendrell-Herrero, 2010)*.

The relevance of agency theory in my research is coupled with the possible value added that might come from external capital sources. The most typical of this kind is ASOs is when venture capital both invests in a company and at the same time takes a place on its board of directors. Through this channel they can provide networks and managerial competency among other factors *(Garmaise, 2001)*. This link between agency theory and venture capital has been explored by a handful of authors (i.e., *(Clarysse et al., 2007a, Knockaert et al., 2009, Pazos et al., 2010)*. While they have explored how venture capital can bring human capital to the board of directors, the link between performance and venture capital's presence on the board remains underexplored. The venture capitalists may suffer from information asymmetries, and

the unwillingness of founders to give up controls (as explained by agency theory), but having them on-board might overcome this challenge as it reduces the asymmetries. In hypothesis H3, I will test whether or not they will be able to overcome these challenges, and provide added value to the firm in financial terms.

2.2.3 Theoretical summary

Below is a short summary of the theories employed in my research. Beneath the table below, I provide a more extensive discussion of their implications.

Table 4 – Short summary of theories

Theory	Selection of capital preference	Key features
Pecking order theory	Equity financing is preferred in the following order: - internal capital - debt - external equity capital	Owners/founders have superior information that investors do not possess. The preference in the choice of financing is due to the unwillingness of paying extra fees (debt) and to share power with external (new) investors meaning that the original ones will lose some decision making strength
Reversed pecking order theory	Equity financing is preferred in the following order: - internal capital - external equity capital - debt	Outside investors have greater expertise in projects' quality evaluation than the entrepreneur/founder *(Garmaise, 2001)* This is the common pattern of financing for young firms.
Agency theory	- agency costs associated with external equity - optimal capital structure will have an amount of debt and external equity minimizing agency costs	External shareholders have monitor costs used to assure that owners and managers are acting in their favor

There is an inherent contradiction between pecking order theory (see Table 4 above), and the reversed pecking order. While the former prefer debt over capital due to information asymmetry, signaling effect, and dilution, the reversed pecking order admits the advantages

external capital can bring to new, small firms. Pecking order theory assumes that the entrepreneurs possess information that investors do not possess, while reverse pecking order assumes the opposite. If the reverse pecking order is more correct in describing the phenomenon, then the presence of external equity capital would lead to enhanced performance in the young entrepreneurial firms.

Agency theory is useful for understanding the complex relationship between principals (investors) and agents (founders). Employing this theory in my research helps me understand how information asymmetries and the problems associated with them, like moral hazard and adverse selection, but also the management competency and networks VC, can affect the performance of ASOs.

2.3 Research question/ Hypothesis

There were some drawbacks and limitations in my research that influenced the construction of the hypotheses. The most crucial is that the respondents did not specify what kind of external financing was tried to be obtained first and why. To compensate for this, broad information on the shareholders, as the amount of shares owned and time since these shares have been purchased is known, as well as data on what type of investors did issue debt to the company has been collected. However the aim of this work was mainly to show the ability for independent work with data, theories and literature as well as performing the analysis and deriving conclusions from it and I think this task is achieved.

For my study I am trying to define how the acquisition of external sources of financing has influenced the performance of the ASOs, measured in survival and growth in sales (the choice of dependent variables are thoroughly discussed in the next sub-chapter.) There is evidence that the early decisions of companies tend to persist for considerable period of time and develop a reputation for future *(Shane and Stuart, 2002)*. I hypothesize on the possible outcomes, and use the literature and theories outlined to explain the relationship between the variables.

ASOs start as a new firm often without any clear products to sell and are therefore constrained in resources generated internally *(Lindelöf and Löfsten, 2005)*. Even profitable ASOs can experience an under-investment problem and necessity of external financing can become

inevitable. *Shane and Stuart (2002)* claim that founders of USOs "*vary in their ability to obtain the support of resource holders, and this variance likely has a salient effect on venture performance*". Surely there is a connection between the types of external founds attracted, their conditions of use/application and the subsequent performance of the firm. This part of the literature on USOs is highly fragmented giving a small amount of studies to refer. To support this, I will cite *Vanacker and Manigart (2010)*, who refers to Eckhardt et al. (2006):

"most studies in entrepreneurial finance have therefore focused on private equity financing, ignoring other potentially important sources of financing such as retained earnings and debt financing"

Therefore we can conclude that external resources can be achieved in form of external debt and equity capital and their subsequent effect on development of the firms can be different *(Vanacker and Manigart, 2010, Neff, 2003)*. Young firms' decision to seek external financing and type of it is often related to the *information asymmetries* faced by potential investors about the firms' quality *(Cosh et al., 2009)*. In USOs managers are often the owners, aimed to develop high-technological products and will avoid the entry of new shareholders due to the concerns of plagiarism, as well as the possibility to lose control over their company (dilution). According to *agency theory*, these owners will then prefer debt financing over equity, when the shortage of funds occurs in their profitable enterprise. This is motivated by the self-preservation of managers' power.

Pecking order theory is also predicting that debt will be used first in this situation due to greater information asymmetries. USOs are small firms and lack of track history are subject of higher level of uncertainty though maybe higher growth opportunities at the cost of higher risk, and this will raise the cost of external funding. Therefore, c*onflict of interests* between owners and creditors is one of the problems in USOs. As it was discussed before many ASOs start without clear perspectives on their business model *(Heirman and Clarysse, 2004)* and owners tend to be less committed to the growth of USOs due to their partial employment in the universities *(Lindelöf and Löfsten, 2005)*. *Wright et al. (2006)* refer to findings of Keasey and Watson (1992) and Scherr et al. (1993) and say that most small businesses rely on debt capital rather than venture capital. *Vanacker and Manigart (2010)* also suggest that debt is the easiest and cheapest way of obtaining of outside financing. If USOs are following *the pecking order*, this is their choice in case of insufficient internal funding for the current projects. Most often it is obtained in form of a bank debt and only interest is expected to be paid back, and no share of wealth creation is sought after/asked for in contradiction with external equity

shareholders. However increasing the leverage can lead to *financial distress* *(Vanacker and Manigart, 2010)* and increase in *moral hazard* problems *(Vanacker and Manigart, 2010)*. Firms will carry a higher financial risk, giving less protection for debt investors, due to less amount of equity to rely on in case of liquidation. Vanacker and Manigart *(2010)* also remind us that banks are the firms "cash flow lenders"; building on the assumption that interest and debt will be paid back from the firms future cash flows. However the previous evidence and findings assume that USOs in early stages of development do not introduce the new product to market and therefore the proportion of firms making profits is actually low *(Lindelöf and Löfsten, 2005)*. Adding to this the fact that USOs will often have inexperienced management teams that have a lack of knowledge related to financing needs *(Lindelöf and Löfsten, 2005)*, I suggest that their decisions about the quantity and amount of debt capital can be mismatched with the real needs and possibilities of the firm to carry debt obligations.

Additional external capital, on the other hand is not emphasizing moral hazard problem, not claiming for mortgage/collateral and therefore not increasing the failure. External equity funding is therefore seen as "assets lender" in contrast to debts "cash flow lender" *(Vanacker and Manigart, 2010)*. *Fama and French (2005)* in their research revealed that over half of the small unprofitable high-growth ventures issue outside equity. However we discussed this issue, being unprofitable quite a long period after start-up is common for this type of firms, as technologies often need long-time exploratory development and funding *(Lindelöf and Löfsten, 2005)*. Their revenues and profits are often hoped-for and lie in future *(Shane and Stuart, 2002)*. Therefore the firms that have been granted external equity financing are thought to have overcome uncertainties and *information asymmetries* during their quality evaluation process *(Shane and Stuart, 2002)*.

Empirical findings of ASOs suggest that these firms actually follow *a reversed pecking order* in their decisions *(Garmaise, 2001, Cosh et al., 2009, Wright et al., 2006)*. This entails that external equity is preferred before debt and in some cases even above internal earnings. On the other hand some small business entrepreneurs may never consider attracting external debt and equity financing *(Howorth, 2001).* Those young firms, who are seeking for finance, surprisingly prefer external equity *(Vanacker and Manigart, 2010, Garmaise, 2001)*. It is further claimed that for innovative entrepreneurial firms debt is "*an unsuitable source of financing*" *(Vanacker and Manigart, 2010 :54)* with referral to Gompers and Lemper (2001). Other researchers that have not used the pecking order theory as their theoretical basis, have also found there to be a reverse pecking order in place *(Sørheim, 2003, Neff, 2003)*, but also

they deferred searching for any links between this often occurring pattern and performance. This link is the basis for my study.

Hypothesis 1 and 2 will test which of the two different variants (ordinary and reversed) of the pecking order theory of capital structure is supported (if any at all.)

As discussed previously (and more deeply in the next subchapters) performance should be measured in both financial (e.g. growth in sales) and non-financial terms (e.g. survival.) Hypothesis 1 which is presented below relates to non-financial performance, and if the reversed pecking is correct in the context of ASOs it should be supported:

H1a Additional financial debt increases the probability of failure in ASOs (*ceteris paribus*).

H1b Additional external equity reduces the probability of failure in ASOs (*ceteris paribus*).

While these hypotheses consider the linkage of whether or not following the reversed pecking order correlates with increased chances of survival, I also took financial performance into consideration and tested the following hypotheses as well:

H2a Ceteris paribus, additional financial debt will lower the growth in sales of ASOs

H2b Ceteris paribus, additional external equity will increase the growth in sales of ASOs.

I could not ignore that the majority of the literature that is describing the influence of external capital on the performance of USOs is actually concerned about the presence of venture capital (VC) investors as shareholders or on the board of these organizations *(Mueller et al., 2012, Colombo and Grilli, 2005)*. Extensive research has been done and most authors conclude there is a strong positive relation between VC investment and the growth of a NTBF *(Colombo and Grilli, 2005, Bertoni et al., 2011)*. *Shane and Stuart (2002)* even mentions the presence of VC investors in the firm is the major determinant for the firm to undergo the IPO. Not only the presence in and by itself seems to be important; also the form VC comes into the firm seems to be consequential *Clarysse et al (2007a). Knockaert et al. (2009)* found that having VC on the board of directors, can have a positive influence on performance of ASOs. However, according to *Bertoni et al (2011)* most of studies suffer from some weaknesses, among others that most of studies include only IPO firms and it is questionable whether these results can be generalized to privately held organizations. My study is addressing this issue. It

has been discussed that entrepreneurs attract VC for the unique features that are provided alongside the funding as possibility of firms to obtain lacking managerial skills and expand their networks *(Ferrary and Granovetter, 2009)*. VC on their side are carefully choosing the projects growing performance by examining not only financing features but also the "*unobservable characteristics*" like the innovation of the technologies, owner-managers team and others *(Bertoni et al., 2011)*. These firms have another view on the firm's quality and future development than debt lenders for example.

To study and discuss whether or not venture capital's presence affects financial performance in my sample, I will use *agency theory*, as it is well suited for exploring the effects that venture capital can bring with them when entering USOs *(Clarysse et al., 2007a, Knockaert et al., 2009, Pazos et al., 2010)*. While this is the case, their studies primarily focused how the human capital affected the internals of the organization – little research has been done on how their presence on the board of directors can influence financial performance (which is ultimately VCs goal). This is something I will test by hypothesis 3:

H3 Presence of VC on board and as shareholders increases ASOs' growth in sales (ceteris paribus).

As mentioned previously, I will below explain the choice of the performance measures chosen for this research. I have taken into account the common features of ASOs such as small, young, entrepreneurial forms with high risk, as well as their unique properties such as new technologies development, strong academic ties, etc.

2.3.1 Performance

As stated in hypotheses I want to explain the relationship between performance and financing decisions/acquisitions that influence on it.

As declared before, researchers put a broad number of measures in this abbreviation. Such indicators in the studies about spin-offs can be: survival rate, growth, success, profitability of initial public offering and so on.

In the hypothesis I presented survival and growth as indicators of non-financial and financial performance. Some of the studies that use both of the measures are *Wennberg et al. (2011), Zhang (2009b), Evans (1987).*

2.3.1.1 Survival

Survival, chosen as one of the measures of performance, is quite used in the context of USOs and other newly started firms *(Clarysse et al., 2011)*. The reason for this is that traditional accounting based measures may not always be appropriate for companies that have just recently been established. Here, other measures such as survival are more important in the first phase of the business's life *(Clarysse et al., 2011)*. Another reason for choosing survival together with growth, is that sometimes growth is not an objective for the companies by itself – trade sale or a successful IPO might be just as desirable. An example of this can be in the biotech industry: lengthy approval processes for new drugs as well as a large chance of doing a trade sale instead of undertaking one's own production, makes profitability a possibly poor measure for performance *(Zhang, 2009b, Lindelöf and Löfsten, 2005, Shane and Stuart, 2002)*.

Many authors have contributed to the explanation of this phenomena/variable. *Nerkar and Shane (2003)* explored the effect of using of radical technologies by USOs; *Zhang (2009a)* and *Buenstorf (2007)* compared survival rates of USOs with other companies. *Walter (2006)* saw on the influence of network capability of the ASOs on their long-term survival.

Survival is a good measure of performance for USOs due to their unique positioning and activity orientation (focus). *Rasmussen et al. (2012)* claims that studies included in their rapport suffer from survival biases, due to their survey only those organizations that have survived. Therefore, being a follow-up study this work will address this issue and concretize what have happened with the respondents of the initial survey in the past years taking into account both existing and non-existing respondents per today.

2.3.1.2 Growth

Performance measures calculated from the accounting data of young, unquoted new-technology firms can be inappropriate to use. These companies often report losses in early stages of development *(Shane and Stuart, 2002)*. Therefore this work will focus on growth in sales, in line with the recent works of *Clarysse et al. (2011), Lindelöf and Löfsten (2005), Evans (1987), Cosh et al. (2009), Robinson and Phillips McDougall (2001)*. Growth in sales

was the most frequently used performance indicator in over 30% of growth studies according to the investigation of *Davidsson et al. (2006)*.

According to *Walter (2006)* growth in sales shows "*markets acceptance of a spin-off's commercialized technologies*". Therefore they attribute the success of technology transfer to this measure. *Clarysse et al. (2011 :11)* come with a similar suggestions and add that these firms will turn profitable faster, "*burn less cash*", and achieve IPO or a profitable trade sale. In my test I have included all firms that had available accounting data for year 2010, without removing the firms that did not survive until 2012. This helps to eliminate survival bias and increases the power of the models *(Mueller et al., 2012)*.

3 RESEARCH METHODOLOGY

"figures will not lie" ...but "liars will figure". It is our duty, as practical statisticians, to prevent the liar from figuring; in other words, to prevent him from perverting the truth, in the interest of some theory he wishes to establish.
(Michigan Legislature, 1889 :311)

3.1 Introduction

In quantitative analysis all steps and stages of research need to be performed correctly. This includes data gathering: sampling, choosing the way to contact the study object, data interpreting and coding, choosing right methods of analyzing it, building up models and constructs, and deriving conclusions. Each step is of crucial significance and therefore a straight plan of actions is needed *(Easterby-Smith et al., 2008)*. Below are presented the assumptions about data and variables that will be further used in the testing models.

3.2 Ontology and epistemology

My study is in the field of social science while my research question is formulated in a form of hypothesis that are to be tested, a large number of data and numbers is therefore been used. The research to be performed is of quantitative nature, to say more explanatory – hypothetic – deductive and is closer to positivists view on the world and science. Therefore ontological position of this study is representationalism - finding of truth requires verification of predictions and research results should reflect accurately the reality *(Easterby-Smith et al., 2008)*. My role as a researcher will be in observing and collecting data without interfering with the object studied, so that "facts can speak for themselves".
However some participation is inevitable: the questionnaire is made by a researcher; some interviews were conducted to clarify the answers, analysis and conclusions are performed and found by her, so I cannot make the presupposition that my work is founded on a theory neutral observational language *(Johnson and Duberley, 2004)*. This excludes me from naïve

positivism, but my research is definitely of a positivistic nature, something which is common in the field of finance.

I am not claiming that my findings are telling the absolute truth; my research will either strengthen or weaken my hypothesis, in line with Popper's ideas of falsification. While Poppers ideas of critical rationalism can to some be argued as a removal from positivism, I argue that it is merely an evolution of the principle of verification towards a principle of refutation of imperfect views of truth *(Johnson and Duberley, 2004)*.

3.3 Design

My study is quantitative, that means that systematic process of utilizing numerical data will be used to obtain information about the world, in other words casual relationships between the events *(Cormack, 2000)*.

As mentioned above, approach is hypothetic deductive - hypothesis is derived and needs to be tested in the real world. Pay attention to that I am not trying to say that my findings are truth in itself, I am merely trying to strengthen or falsify my hypothesis in line with Popper's falsification principle *(Johnson and Duberley, 2004)*. Following, there are two events in my hypothesis: first is the presence or absence of external debt or equity financing and second is firm's survival and growth. I am trying to model this condition and find if there is relationship between these events with the help of econometric methods. The level of analysis is organization. I am studying academic spin-offs.

Now it is logical to present data sampling and collection first before we delve into the world of measures.

3.4 Data

As my thesis is a follow-up study of previous research, the initial data for my work is taken from the survey that has been conducted late in 2008 for the evaluation of the FORNY program *(Borlaug et al., 2009)*. The response rate was 72 out of 162 companies, giving a response rate of over 44% *(Borlaug et al., 2009)*.

I had to extract and code all the data from the survey, as well as collect a substantial amount of additional accounting data for all companies. This data was collected with the help of the

commercial RavnInfo database[3], and automated data gathering tools[4]. The data was quality checked by hand as well. Subsequently this data was manually coded into the SPSS program for further use in the econometric analysis.

Firms that have gone through a merger in this period of time 2008-2012 have been contacted through telephone as to establish the effect the acquired ASOs had on the sales of the new company.

44% is quite a high answer rate for this type of studies, compared with other authors. The questionnaire was sent by email to the USOs- participants of the FORNY program. Therefore the sample is homogenous and purposeful. Questionnaire was presented in the official language of the country of Norway – Norwegian. The electronic web-tool for conducting surveys, Questback, was used for obtaining data. The receivers of initial email needed to follow the link and answer the pop-up questions from their computer, which subsequently allowed the researchers to obtain the full answers electronically. Questback also offers a feature of one-click exporting data into SPSS, the program that was used for analyzing the data and testing of my hypothesis.

As it was partly mentioned in introduction chapter, I am not conducting a new survey, because on one side this is a follow-up investigation that will be built on initial data, with the supplement of rich secondary data on the sampled USOs, where I can use the conclusions derived from the rapport to support/prove my findings. On the other hand, the reason is that it is not sure that the results of a new survey would have been comparable to the initial sample if I performed it, (no guarantees that same firms will answer) and the conclusions derived from the initial rapport would have been hard to base my research on. It is worth mentioning that senior researchers of Bodø Graduate School of Business and Nordland Research Institute conducted the original survey. These are the main points. Among others are the lack of time given for the writing of master thesis and the fact that the FORNY program is officially over and the new FORNY 2020 has taken its place.

3.4.1 Survey

According to my literature review (see appendix) almost all quantitative studies of this kind make a questionnaire that they send by post or email to the research objects. My research is

[3] http://ravninfo.no
[4] Developed in-house by Nordland Research Institute

one of them. Positive sides of it are that it is fast and cheap and allows covering a large amount of respondents *(Easterby-Smith et al., 2008)*. It is impossible to think that a scientist could have asked over a 40 questions all 72 respondents of the survey in such a short time giving the credit to airline costs, remoteness of each respondent from each other and so on. Being presented by email the respondent can devote her time when it is appropriate without disturbing her plans. One can critique the usage of e-mail as something that can skew the results towards high-tech users, or in another way make the sample not representative for the whole population. When it comes to e-mail I would argue that this critique is not sufficiently grounded as the respondents are all taking part in business, are used to electronic communication from academia, and have a higher education. This leads me to conclude that there is no sample bias inherent in the usage of e-mail as a tool for collecting data. As it was mentioned Questback tool was used. Practically survey is a number of questions that ask either to type your data yourself or choose an answer from a variety given. All the respondents of this survey have a high degree of education (founders and managers of USOs) that gives a confidence that questions were understood and answered properly.

However not everything is so easy and good with surveys. Not having a personal contact may seem to be of high importance. Email surveys can be ignored and answer rate can be low. There is a probability that the questions can be misunderstood or respondents will try to answer what he thinks the researcher wants to get from him instead of telling the true story. Here is the choice and construction of questions, possibility to choose one of the answers, instead of thinking and typing in your own data are useful *(Easterby-Smith et al., 2008, Collis and Roger, 2003)*.

3.4.2 Data representativeness

In order to check the representativeness of my sample, I have gathered the survival rates of the non-respondents to obtain the picture of the whole population of the Norwegian ASO - participants of the FORNY program. The results are represented in the table below.

Table 5 – Survival rates of the organizations

	Survey respondents	Whole survey population
N of companies	72	162
Survived per 01.03.2012	58	124
- of them merged	5	10
Survival rate in %	**0,806**	**0,765**

As we can see the survival rates of the organizations were nearly identical, while slightly higher in my respondents' sample. It is important to keep in mind that the "whole survey population" counts for almost **all** participants of the FORNY program at the time of the data collection, something that assures the data representativeness of my sample. On recommendation of my colleagues I did not perform any extensive representativeness check since the deviation in survival rates is so small. In addition, the response rate of 44%, helps ensure the high quality of my data.

All the data obtained was coded according with the recommendations of the researchers in this field of study, as well as screened and cleaned for errors with the help of SPSS program. Dependent variables were measured in 2010 and 2012, while independent ones are coming from a survey of late 2008, endogeneity problem should be minimized. This conclusion is made after the similar conclusions of the authors in the same field e.g. *Clarysse et al. (2011)*.

3.5 Measures

My hypothesis has a character of multivariate analysis, meaning that several variables are taken into consideration at the same time *(Easterby-Smith et al., 2008)*. The measures were developed following the literature review conducted. Survival is measured by Cox regression of proportional hazards *(Bertoni et al., 2011, Wennberg et al., 2011, Luke and S.M., 1998)*. In proportional hazards models time to event is taken into consideration, in my case time to fail. According to *Bertoni et al.(2011 :1032)*, who have also used this regression, the use of it "*gives maximum flexibility in the specification of the duration dependence of the hazard rate*". Hazard models are preferred over logit models for survival analysis as they can deal with

censored data *(Zhang, 2009b, Buenstorf, 2007)*. In my case the right-censored data. I believe that event occurrence is unrelated to censoring and Cox regression of proportional hazards can produce unbiased estimates of survival statistics. My observation has finished on the first of March in 2012, revealing 58 firms that have survived and 14 that have not. This model however assumes that some of the survived firms will also end their business in the future. Binary logistic regression and was used for the robustness check of the models *(Bertoni et al., 2011)*. Hypothesis **1a** and **b** were both tested first separately (model 1 and 2) and then joined together to the full model (model 3); and only independent variables were checked in model (4). There were several reasons for that. First of all the probability of debt financing is not eliminating the probability of external equity funding and vice versa, in other words none of them is mutually exclusive *(Vanacker and Manigart, 2010)*. Therefore both types of financing can be presented in an USO at once, while having the opposite effect on the survival (as predicted by H**1a** and **b**). Model 3 is then a confirmation of the robustness of the results and is believed to better reflect/suit the situation that organizations are in (e.g. of testing several hypothesis in one model *Clarysse et al. (2011)*. However model 1 and 2 are also important, as the number of useful cases is slightly higher there. For example not all of the firms are joint stock companies, and therefore could not be used for the H1b, however are included in H1a.
Growth is a continuous variable and is measured by multiple linear regression in H**2a** and **b** and H**3**. This is in line with the literature review made (e.g. *Cosh (2009), Bertoni et al. (2011)*; *Clarysse et al. (2011); Zhang (2009a)* and due to certain degree of availability of data and time. All the models are presented as "base", including only predictors and "full", including both predictors and independent variables adopted from *Clarysse et al. (2011)*. I have also performed regressions with only independent variables to investigate if their explaining power of the growth variance is higher than predictors, and for use as a sort of a robustness check. The presentation of the independent variables alone and together with predictors gives a picture of additional additive effects that variables attribute to the dependent variable (see e.g. *Robinson and Phillips McDougall* (2001), *Clarysse et al. (2007b) Shane and Stuart (2002), Munari and Toschi (2011)).*

3.5.1 Dependant variables

As it was presented before, I measure performance with two variables survival and growth in sales.

Below I explain the methods of their calculation for the further use in the econometrics analysis.

3.5.1.1 Survival

My dependent variable took the form of dummy (yes/no; 1/0) and indicates if the firm has or has not survived from the date of survey 2008 until 01.03.2012. Some assumptions though need to be cleared. As non-survivors I have included firms that went bankrupt or were dissolved before 01.03.2012 for survivors I have included firms that are operating in their original organization number as well as merged ones. This assumption is consistent with the research of *Zhang (2009a)* who supports my assumption: "*from an economic point of view it is still alive*". I have contacted all firms that have merged in these years and asked to estimate what size of annual sales in the firm that purchased them could have been explained as a result of a merge (to be included in the growth models). During the interviews it was also confirmed that the personnel of the initial firms was retained and technologies continued to operate in new firms *(Zhang, 2009a)*. Among the survivors there are two specific firms. One firm is currently a subject to bankruptcy proceedings for the second year, however is still registered. Another was recently deleted from the registry 17.03.2012 (no further information currently available).

Those companies that have survived at least until 2011 and have delivered the annual accounting information for 2010 to the tax organizations, regardless to what have happened after, are further included in the model capturing the influence of indicators on growth. This particular design (from survival to growth) is adopted from *Evans (1987)*.

3.5.1.2 Growth

Relative measures of growth as a dependant variable have been used in half of studies that *Davidsson et al. (2006)* have collected and over 29% were absolute measures. This work is following this pattern to easy the comparable strength of this study that is believed to be of high importance for the development of scientific knowledge *(Davidsson et al., 2006)*.

My decision was therefore to count both of them, check the statistics and representativeness, correlations and decide which one to use for the models or both.

For this work growth in sales is measured in line with *Vanacker and Manigart (2010)* as following :

- absolute measure: growth in sales is presented as a difference between two points of time, more specific "sales 2010- sales 2008", in line with *Cosh et al. (2009)*. Due to low inflation in these years, it did not affect the strength of analysis. (this has been tested in SPSS, no major differences revealed and therefore are not presented in this work).
- relative measure: growth in sales (turnovers), adopted from *Lindelöf and Löfsten (2005)* and *Robinson and Phillips McDougall (2001)* after the following model:

$$\bar{g}_{\frac{Growth\%}{year}} = \frac{\left(\frac{x_{n+1}}{x_n}\right) - 1 + \left(\frac{x_{n+2}}{x_{n+1}}\right) - 1}{2} \qquad (1)$$

Wennberg et al. (2011), Robinson and McDougall (2001) and *Cosh et al. (2009)* have logarithmized their growth variables to reduce the skewness and approximate to the normal distribution. The same procedure was applied for my research.

3.5.2 Independent variables

Align with the study of *Vanacker and Manigart (2010)* I am not focusing on the amount of initial financing, rather on the amount or share of external investors that the USOs have succeeded to attract and the subsequent financial decisions. The last named was highlighted as an avenue for the further research and I am gladly following it.

3.5.2.1 Debt capital

The results of the survey give the possibility to obtain various information about the presence of debt capital and its sources. Therefore External debt capital was achieved by counting the number of investors while eliminating founders and such type of investors as family members and friends. Their willingness to continue the business can be different from traditional profit

making, as well as other conditions of obtaining may apply, usually easier and less demanding. Often being unprofessional their movements are not predicted by the theories but are rather spontaneous and are often based on close relationship to the founder(s). They are also less affected of information asymmetries *(Karra et al., 2006).* External debtors' categories: universities, TTO and other commercializing actors, private equity funds, public institutions, banks and other financial institutions, other companies and others *(Neff, 2003, Sørheim, 2003)*. The variable is coded with reference to the work of *Vanacker and Manigart (2010)* and *Moray and Clarysse (2005)*.

3.5.2.2 Equity capital

Equity or external capital (1) took form of a cumulative variable taking into amount the proportion of the equity shares of different external shareholders (universities, TTO, seed and venture capital funds, banks and finance institutions, other companies and actors, excluding entrepreneurs-founders, friends, family and management of the company). I believe that excluded investors do not have *information asymmetries* problems and are not following the predictions of theories, rather their relations and internal wishes as it was described in this work before. This variable is coded with reference to the work of *Cosh et al. (2009)* and *Vanacker and Manigart (2010)*.

VC or external capital (2) *(Lockett and Wright, 2005)*. This variable was coded as a multiplication of a dummy variable "Venture capitalists are presented in board" on the amount of "private equity funds as shareholders". The result is ranking USOs from 0, meaning that there is either no VC funds in board or private equity funds are not shareholders in the company, to 4, meaning that VC funds are in board and own 50% and over of the shares in the company.

3.5.3 Control variables

Control variables are also predictors *(Easterby-Smith et al., 2008)*. They do explain some of the behavior of dependant variable, though my interest is not primary lying in their explanation of the phenomena.

3.5.3.1 Age

Age as a predictor is commonly used in this field of study e.g. *Munari and Toschi (2011)*, *Mueller et al. (2012)*, *Zhang (2009b)*; *Clarysse et al. (2011)*. The longer the firm have existed, the longer is its tracking history, hence more possibilities of obtaining external finance that leads to higher performance rates.

As the time goes, firms obtain credible history, tracking record and reputation. In their development new ties and networks are being established. These factors reduce the information asymmetries and attract the potential investors to these companies, as the searching costs reduce for potential finance providers *(Wright et al., 2006)*. Age is important variable, as entrepreneurs learn through time *(Evans, 1987)*. In his study of 100 manufacturing industries he came to a conclusion that age is positively correlated with survival, however negative with growth of the firm *(Evans, 1987)*.

Age (1) This variable captures the age of company from the founding date until 2012 or until the year when the company was dissolved or went bankrupt. Variable is measured in years.

Age (2) Measures the age of the companies until the year 2010 for the growth models. This variable was coded with reference to *Clarysse et al. (2011)* who also used this variable as a predictor in a study of growth of Spin-off companies.

3.5.3.2 Size

Size is measured using the spin-offs assets (in thousands of NOK) *(Zahra et al., 2007)*. *Zahra et al. (2007)* explains that larger USOs join more external networks, gaining more knowledge and use more resources in new technologies/products. *Evans (1987)*, who examined firms in manufacturing industries, revealed that there is a negative relationship between firms growth and size, however the probability of survival increases.

For the survival the Size (1) measure was calculated, simply the natural logarithm of firms total assets in 2008. For the growth variable Size (2) was calculated as a natural logarithm of firm's total assets in 2009. This measure is lagged to reduce the mentioned endogeneity e.g. *Bertoni et al. (2011)*, *Vanacker and Manigart (2010)*. Logarithms of Size (1) and Size (2) have reduced dramatically skewness (indication of how symmetric the variable distribution is) and kurtosis (the 'peakedness', or "spikiness", of the variable), which is good for the

regression results (normal distribution) and is in line with the recent research in this field of study *(Pallant, 2007).*

Descriptive statistics of all absolute and logarithmised values are presented in appendix. Overall the correlations between absolute/relative values and their logarithms are significant at $p<0.01$ level. Therefore I assume that the logarithms are representing the variables correct, while the suitableness for the regression increases as skewness and kurtosis have been significantly lower *(Nerkar and Shane, 2003)*.

Below I have summarized the variables used for the further analysis:

Table 6 – Variables used for the econometrical analysis

Name of variable	Definition	N of observations	Min	Max	Mean	St. deviation	Reference to literature
Dependent variables							
Survival	Dummy variable 1/0; where 1=survived per 01.03.2012; 0= have not survived	69	0	1	Categorical		*Wennberg et al.(2011)*; *Zhang (2009a); Nerkar and Shane (2003)* measure failure;
Ln (Growth absolute)	Ln(sales 2010-sales 2008+ constant)	59	8,44	10,33	9,2279	,24893	*Bonardo (2011); Lindelöf and Löfsten (2005); Clarysse et al (2011)*; see *Davidsson et al (2006)*; *Vanacker and Manigart (2010)); Cosh et al.(2009)*
Ln(Growth relative)	Ln((sales2010-sales2009)/sales 2009+(sales 2009-sales2008)/sales2008)/2years+constant)	59	-1,48	2,81	,1097	,6683	*Robinson and Phillips McDougall (2001)*; *Lindelöf and Löfsten (2005);* similar logarithmised measure *Evans (1987)*; *Wennberg et al (2011)*
Independent variables							
Debt	Sum of external debt investors at the time of survey (2008)	68	,00	4,00	,6765	,9214	*Moray and Clarysse (2005)* use number of founders etc; *Vanacker and Manigart (2010)* – amount of share; *Lindelöf and Löfsten (2005)* percent of each debt investor;
Equity	The proportion of shares of external shareholders in the company (2008) From 0=0% to 4=over 50%	66	,00	4,00	2,1426	1,1884	Similar measure (% of shares owned) see *Cosh et al. (2009)*; similar measure (proportion of independent TMT members) see *Bonardo et al (2011)*; in percent per investor see *Lindelöf and Löfsten (2005)*

Name of variable	Definition	N of observations	Min	Max	Mean	St. deviation	Reference to literature
VC	VC in board and as shareholders in 2008(dummy 1/0)*proportion of shares of venture capital funds in the company from 0=0% ; 2=1-25%; 3=25-50% to 4=over 50%	59	,00	4,00	,6441	1,3867	Similar measure (% of shares owned) see *Cosh et al. (2009);* interaction variables (multiplication) see *Mueller et al. (2012)*; similar measure VC-backed firms (measured as dummy variable) see *Bonardo et al. (2011)*; in percent per venture capital and venture capital (board) yes/no see *Lindelöf and Löfsten (2005)*
Predictors							
Age (1)	Age in years from start-up until 01.03.2012 or until the organization finished it's activity (rounded to the nearest whole)	69	3,00	11,00	7,4348	2,0471	*Robinson and Phillips McDougall (2001); Cosh et al. (2009); Mueller et al. (2012); (Zhang, 2009b)*(in months); *(Clarysse et al., 2011); (Munari and Toschi, 2011)*
Age (2)	Age in years from start-up until 2010 (rounded to the nearest whole)	59	2,00	9,00	5,6610	1,9880	*(Robinson and Phillips McDougall, 2001); (Cosh et al., 2009); (Mueller et al., 2012); (Zhang, 2009b)*(in months); *(Clarysse et al., 2011); (Munari and Toschi, 2011)*
Size (1)	Ln(total assets 2008)	69	,00	12,31	6,9569	2,5888	*(Vanacker and Manigart, 2010);* *(Cosh et al., 2009); (Bertoni et al., 2011)*
Size (2)	Ln(total assets 2009)	59	3,71	12,26	7,5990	1,6672	*(Vanacker and Manigart, 2010);* *(Cosh et al., 2009); (Bertoni et al., 2011)*

As you can see the variables chosen are well grounded in existing literature in my field of research which gives me confidence that my work will be able to contribute with the additional knowledge on the subject after the hypothesis are tested by the means of econometrical methods.

4 EMPIRICAL ANALYSIS

In this part of my work I present the calculations made with the SPSS program, shortly explaining my findings.

4.1 Descriptive statistics

First of all, 14 of 72 companies do not exist per date (01.03.2012), representing over 19% of sample. They were either dissolved or went bankrupt. Additional 5 companies have merged (7%). All companies that do not exist longer under their initial organization number (merged, dissolved and bankrupt) were under 9 years old. This is an interesting finding that I can try to explain. These companies are coming with a new idea or technology that is hopefully needed and demanded. Those who do not get the desired attention in the first years, therefore no foundation either are probably finishing their activity without achieving results. Those, on the other part, who seem very promising, are merging rather fast also. The destiny of the companies that are remaining active is then a puzzle. None of the companies in my sample have gone public (IPO) or undergone a trade sale.

For the further analysis I had to reduce the number of respondents as there were 3 firms that finished their activity before the year 2008 that is taken as a start point for my analysis.

By the end of 2008 over 72% (50/69) of firms have succeeded in attracting some form of external capital, over 56% (39/69) issued shares and over 50% (35/69) received a loan. Of them over 34% (24/69) of firms got both external debt and equity financing.

Investors of debt capital were divided in 9 groups, and each respondent could have chosen several of them. The maximum score was 4 investors represented at once; minimum 0. (See appendix “descriptive statistics” for frequencies, percent and statistics).

The average age of the company is a little over 7 years both for survival and growth analysis. 10 of 12 companies that had private equity funds (VC) as shareholders have survived. The remaining two had the amount of shares under 50% and another under 25%.

4.2 Results

H1a and b were tested by the Cox regression of proportional hazards in several steps in the SPSS program. Predictors Age and Size were taken in the base model, Debt was included to the base model in model 1; Equity was included to the base model in model 2; and at last both equity and debt were included to base model in model 3. Model 4 includes just independent variables to check whether their influence on the survival is significant without the predictors. SPSS statistics is in the appendix section, while here I present some of the findings in the table below:

Table 7 – Determinants of the likelihood of failure. Cox regression.

	Base model	Model 1 (Debt)	Model 2 (Equity)	**Model 3 Full**	Model 4 (Debt+ Equity)
Predictors					
Age (1)	0.729* (0,175)	0.709* (0.196)	0.663** (0.187)	**0.627** (0.207)**	
Size (1)	0.741*** (0,107)	0.745*** (0.109)	0.768** (0.109)	**0.769** (0.113)**	
Independent variables					
External Debt		1.639** (0.223)		**1.892*** (0.230)**	2.063*** (0.236)
External Equity			0.676 (0.242) (Sig. p=0.105)	**0.532** (0.296)**	0.545** (0.287)
Results					
N of observations	69	68	66	**65**	65
-2 Log likelihood	78.347	73.965	75.568	**69.059**	80.154
Chi-Square	15.520	21.511	16.625	**23.206**	11.032
Model significance	*p*<0,001 Supported	*p*<0,001 Supported	*p*=0,001 Supported	***p*<0,001 Supported**	*p*=0,004 Supported

Coefficients in Hazard rate format. Standard errors in brackets
* - significant at 0,1 level; ** - significant at 0,05 level; *** - significant at 0,01 level

All the models tested are statistically significant at p=0.01 level. Variables below the value 1 (hazard ratios) are reducing the chance of failure and increasing the survival. These are Equity, Size (1) and Age (1). Debt, has a hazard ratio over 1 and each additional investor is increasing the chance of failure. Standard errors are all low. Correlation matrixes of regression (all models) do not have values that are over 0.5, thus I assume that multicollinearity is not an issue for these models. However it is noticeable that Debt is negatively correlated with Equity in models 3 and 4 with value over 0.4.

Model 3 have the highest value of Chi-Square and the lowest value of -2Log likelihood and will be explained further and checked. Model 3, including all the independent variables and predictors was statistically significant, $X^2(4, N=65) = 23.21$, $p<0.001$. All variables are significantly contributing to the model at 5 percent level, while Debt at 1 percent level.

Before we delve into conclusions, I want to present the results of the robustness check (model 3). Robustness check was computed by the means of binary logistic regression, taking into account that dependant variable – survival is categorical (1/0). Binary logistic regression is calculating odd rates instead of hazard rates in Cox regression, and cannot deal with censored data, as well as not taking time to failure into consideration unlike Cox regression, where time to failure was coded in months and tied to the survival variable. While performing the test it was found that the predictor variable Size is disturbing the results, influencing on the significance of other variables, bringing multicollinearity (correlations between independent variables in a model over 0.7 and 0.8), and in the end found not to be significantly contributing to the model even if the order of inclusion in the model was changed. The results are represented in appendix. In the first step (block 1) independent variables Debt(1) and Equity(1) were included. This model is statistically significant, $X^2(2, N=65)=10.52$, $p<0.01$. This model as a whole explained between 14,9% (Cox and Snell R Square) and 25% (Nagelkerke R squared) of the variance in survival, and correctly classified 84,6% cases. In step 2 (block 2) Age was included to the previous variables. Overall model was still significant, $X^2(3, N=65) = 15.33$, $p<0.01$. Between 21% and 35,2% of the variance of survival was explained, correctly classifying 89,2% of cases. All variables were significantly contributing to the model each with $p<0.05$. Size was added to the above named 3 variables in step 3 (block 3). While the model was still statistically significant ($p<0.01$), this step contribution was not significant for the model $p > 0.3$, and the overall fit of the variables decreased. The percent of correctly classified cases did not improve and was still 89,2%. The same results were reported when the variable Size was tried to be added right after independent variables, before Age predictor. The contribution of the step was not significant.

Hosmer and Lemeshow test, which is stated to be "*the most reliable model fit in SPSS*" *(Pallant, 2007: 178)*, was above 0,05 in all steps of the model, therefore indicating it's support. Overall robustness check has confirmed the statistical significance of the model.

Below in Table 8 I conducted model 3 (excluding the predictor Size (1) from the model 3) for the comparison purposes and below have extracted the statistics of the variables in the equation for both Cox regression and binary logistic regression (Table 9) as a visual presentation of the above mentioned manipulations.

Table 8 – Cox regression of proportional hazards, model 3 (without Size (1))

Variables in the Equation

	B	SE	Wald	df	Sig.	Exp(B)
Debt	,651	,227	8,211	1	,004	1,917
Equity	-,751	,296	6,412	1	,011	,472
Age (1)	-,479	,210	5,210	1	,022	,620

Table 9 – Binary logistic regression, predicting survival (step 2), constant included in model

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Debt	-1,061	,419	6,410	1	,011	,346
	Equity	,757	,359	4,436	1	,035	2,131
	Age (1)	,461	,234	3,876	1	,049	1,586
	Constant	-2,071	1,758	1,388	1	,239	,126

a. Variable(s) entered on step 1: Age (1).
(Exact model, without constant included have also been performed (note constant is not significantly contributing). The results remained within the same boundaries, while only 86,2% of cases were classified against 89,2% in the model presented).

Note that Cox regression predicts that company will not survive (hazard), while binary logistic regression predicts the survival of the organization. This explains the difference in signs and size for B and Exp(B), however the interpretation remains the same. All variables included are significant at $p<0.05$.

After performing these regressions I can deliver the results. Hypothesis 1a and b are supported. Further discussion will be presented in the next chapter.

H2a and b will follow a multiple linear regression method of approaching, as growth is a continuous variable. Coding of variables was already discussed in the measures section and descriptive statistics is presented in the appendix.

Before I present the models I would like to say some words about the correlations revealed. Both growth measures are significantly correlated with each other at p<0.05. Therefore I believe both can be used for further analysis. However, due to the limit of space and time, I will use the natural logarithm of absolute measure for the models. Size of the firms was found to be significantly positively correlated with growth at p<0.05 level. Noticeable that Equity variable is negatively correlated with age at p=0.055 level, meaning that younger ASOs have higher amount of shares in the hands of external shareholders than more mature/ older ones. Testing of H2a and b is presented in the table below.

Table 10 – Influence of external funding on growth in sales

	Base	Model (5) Debt	Model (6) Equity	Model (7) Full	Model (8) Independent variables
Predictors					
Age (2)	-0,054	-0,052	0,016	0,023	
Size (2)	0,260**	0,264**	0,309**	0,316**	
Independent variables					
Debt		0,072		0,123	0,101
Equity			-0,010	-0,025	0,013
Results					
N observations	58	57	55	55	54
R Square (Adjusted R Square)	0.069 (0.036)	0.075 (0.024)	0.095 (0,043)	0.11 (0.039)	0.011 (-0.27)
Model significance	*p*>0.134 Not supported	*p*>0.236 Not supported	*p*>0.154 Not supported	*p*>0.203 Not supported	*p*>0.75 Not supported

Standardized coefficients beta are presented.
* - significant at 0,1 level; ** - significant at 0,05 level; *** - significant at 0,01 level

Interactions in each model were added simultaneously to control for possible multicollinearity. Model, including only independent variables and omitting predictors was tested, though without success. None of the models was statistically significant; therefore H2a and b are not supported. Noticeable that size remained strongly significant, positively contributing to the growth. Further conclusions are presented in next chapter.

H3 was suggested to be checked in the same regression type (multiple linear regression) including predictors, and debt variable along the independent variable VC. This is also due to the access to VC does not diminish the opportunity of an USO to obtain debt capital. However the variable Equity cannot be applied for this analysis as it is partly containing VC variable. Correlations and descriptive statistics are represented in the appendix. Note that already outside the model, VC is significantly correlated with growth (at 0.01 level) and both size 2 and debt (at 0.05 level). Size 2 is still correlated with growth at 0.05 level. The size of the Pearson correlations is under 0.4 which allows me to include these variables in the model, however attention to possible multicollinearity should be kept in mind *(Pallant, 2007, Hair et al., 2009)*. The results of the regression analysis are presented in the appendix chapter, while the main conclusions are in the table 11. Interactions in each model were added simultaneously to control for possible multicollinearity. Statistics was checked for each model. However no multicollinearity was revealed with SPSS tests (all tolerance values over 0.1 and variance inflation factors under 10), after including the VC variable in base model, the Size (2) variable has lost its statistical significance. As we see beta coefficient of Size (2) have also reduced, due to all the overlapping effects of these variables have been statistically removed *(Pallant, 2007, Robinson and Phillips McDougall, 2001)*. Debt and Age (2) variables were not significant in any model.

Table 11 – Influence of presence of VC on board and as shareholder on growth in sales

	Base (obtained from previous testing)	Model (9) VC	**Model (10) VC+Size(2)**	Model (11) VC+Debt full model	Model (12) No Age (2)	Model (13) Debt+Equity (independent variables)
Predictors						
Age (2)	-0,054	-0.007		-0.010		
Size (2)	0,260**	0.160	**0.160**	0,159	0.158	
Independent variables						
Debt				-0,024	-0.024	-0.045
VC		0,344***	**0,345*** **	0,352**	0.354**	0,403***
Results						
F statistics, variance	*F*(2,56) =2,082	*F*(3, 55) =3,914	***F*(2, 56) =5,976**	*F*(4, 53) =2,863	*F*(3, 54) =3,886	*F*(2, 55) =5,045
R Square (Adjusted R Square)	0.069 (0.036)	0.176 (0.131)	**0.176 (0.146)**	0.178 (0.116)	0.178 (0.132)	0.155 (0.124)
Model significance	*p*>0.134 Not supported	*p*<0.05 Supported	***p*<0.01 Supported**	*p*<0.05 Supported	*p*<0.05 Supported	*p*=0.01 Supported

Standardized coefficients beta are presented.
* - significant at 0,1 level; ** - significant at 0,05 level; *** - significant at 0,01 level

The highest Adjusted R Square was achieved in model (10) explaining 14,6% of the variance, *F* (2, 56)=5,976, p<0.01. The only variable that was statistically significant was VC with beta = 0,345, p<0.01.

H3 is supported. Further discussion is presented in next chapter.

5 DISCUSSION

In this chapter I present the results of the econometric analysis performed, discuss my findings and bring forward suggestions for future research. Limitations and implications are also provided.

5.1 Results

The aim of this paper was to reveal the differences between the influence of external debt and equity financing on the performance of the young new ventures. As a performance measures survival and growth in sales were utilized as commonly used indicators in this field of study (e.g. *Bertoni et al. (2011)*; *Cosh et al. (2009)*; *Vanacker and Manigart (2010)*; *Lindelöf and Löfsten (2005)*; *Zhang (2009a)*. For data set new academic start-ups, participants of the FORNY program were used.

In my sample of 72 organizations only 58 are still in business per 01.03.2012. The remaining 14 were either dissolved or went bankrupt. Currently one company has finished its activity (17.03.2012) however no information about the reason of closing down is yet available. One company is currently under the bankruptcy procedures. 4 of the organizations that do not exist per today were related to commercializing actor Norinnova & TTO Nord. The rest of TTO have lost 1 or 2 companies through this period (see appendix-conclusion).

Though it was not in the aim of the study, the testing of hypothesis have revealed that age is positively correlated with survival, meaning that older firms survive better than younger. This finding is in line with the findings of *Evans (1987)* who tested 100 manufacturing industries in the UK. Larger firms also survive better than smaller ones and grow better as well. *Evans (1987)* on his turn concluded that larger firms survive better, however there is a negative relationship between their size and growth. This contradiction in the relationship between growth and size is therefore interesting and might be a subject for further research.

Now let us turn to hypothesis. **H1 a and b were supported**. The higher the amount of shares of external shareholders the organization has, the higher are its chances to survive, while each external lender of debt capital reduces the chance of survival. This finding can be possibly

explained out from the nature of these external funding possibilities. External equity investors are "assets lenders" however debt investors are "cash flow lenders". The increase in the amount of debt issued also increases the probability of a *financial distress* and *moral hazard*, while the issue of additional capital does not *(Vanacker and Manigart, 2010)*. As it was highlighted ASOs often start without clear product for market and need time to develop the technology, therefore the earnings are low and the possibility to repay the debt in time can be reduced *(Lindelöf and Löfsten, 2005)*. On the other hand, to succeed in obtaining external shareholders the firm and investors should overcome the problem of *information asymmetries (Cosh et al., 2009)*. Different authors stress the attention on that NTBF have rather immature top management team, compared to other ventures *(Ensley and Hmieleski, 2005)*. Others add that scientists and business people have different views on the development of the firm that often contradict with each other. *Gurdon and Samson (2010)* concluded that those scientists who had conflict between science and business values have failed. Therefore the presence of the external investors can be thought to increase the firm's quality. *Clarysse et al. (2007a)* prove this by pointing that ASOs are usually resource-poor and external shareholders "*may play an important role in accessing critical external resources*". Among them are: adding complementary skills to the founding team and expanding the networks of the ASOs *(Clarysse et al., 2007a, Ortín-Ángel and Vendrell-Herrero, 2010)*.

As I have suggested, since the hypothesis are supported, following the *pecking order* will be counterproductive. In contrast with this theory debt and equity capital cannot be seen as equal substitutes to the internal funding *(Vanacker and Manigart, 2010)*. Also *agency theory* is not a reasonable choice to behave after since following it the debt financing is preferred to equity funding due to the unwillingness of owners to have a capital dilution. **H2a and b** failed to reveal whether it is a relationship between additional debt and equity and the growth in sales of the ASOs. There was however found that the size is positively and significantly correlated with the growth in sales.

Percent of external equity in a firm was also negatively correlated with age in this hypothesis meaning that younger firms gain more external equity financing. One of the reasons that can explain this phenomena is that the rules of becoming a member of the FORNY project and get a proof-of-concept have been continuously strengthening during the project time of 1995-2010 and projects with better quality has been chosen. Also, as the time went this project has gained more attention and attracted more investors.

H3 was supported. The findings suggest that venture capital investments and presence of venture capitalists in board significantly influence the growth in sales of the firm. This is consistent with the recent findings of *Bertoni et al. (2011)*. *Mueller et al. (2012)* with reference to *Colombo and Grilli (2007)* also suggests that Venture Capital investment may stimulate growth of the USOs. In my sample it has been also revealed that VC backed firms grow in size and have attracted more debt financing actors than other firms. *Cosh et al. (2009)* also revealed that recent literature confirms that venture capitalists assist in the development of the firm not only by supplying it with finance. *Shane and Stuart (2002)* have concluded that presence of venture investors increases chances of obtaining external funding and is the only determinant for the successful IPO. However *Knockaert et al. (2009)* concluded that only venture capital is improbable to add value and overcome the resource deficit in ASO.

However presence of external shareholders bears the consequences. The owner-founder is not the only leader of the company and is often required to follow the milestones obliged by a VC shareholder. This finding therefore is contradicting with the traditional *pecking order theory*. According to *Myers and Majluf (1984)* the loss of control is the worst scenario and the firms should avoid this by all means by first funding the projects with their internal earnings, then addressing themselves to the debt market and finally as the last resort try an additional equity financing.

Agency theory suggest that it is advisable for venture capital to have outside board members in order to monitor the behavior of management *(Clarysse et al., 2007a)*. In addition, it can add value by bringing management skills, networks and other forms of human capital *(Clarysse et al., 2007a)*. If this is the case, performance of ASOs that have venture capital on the board of directors should be higher, and my findings in regards to hypothesis 3 supports this. As discussed by *Bertoni et al. (2011)* it is difficult to ascertain whether or not this performance effect is due to "treatment" (what value VC adds) versus the "selection" effect (potential profitable a priori.) For other investors that are looking for signaling effects, this does not matter.

Overall the findings suggest that differences in the funding of the ASOs contribute differently to its subsequent performance. I suggest that these findings are consistent with *Garmaise (2001)* and indicate the *reverse pecking order*, meaning that investors have better understanding of the quality of the company rather than entrepreneurial firm and their presence adds value to the firm. It then gets understandable why a vast amount of literature is

concerned about equity funding, particularly VC funding. This study was not an exeption and confirmed that external equity funding enhances the survival and VC funding and presence in board helps firms to grow.

However this research was not without limitations. Therefore they and proposals for future studies are presented below.

5.2 Limitations and suggestions for further research

As any study of this type, this one is also not without limitations. In my study I have utilized the data on the resources that are already successfully achieved. However it would be of great interest to determine whether the achieved ones and those that have been sought for are the same or the companies had to find substitutes and on what costs. How much of these decisions are influenced by the *information asymmetries*? This would share more light on whether the firms in their prior actions are following the *pecking order theory, the reversed pecking order* or *agency theory*

From the investors' side it is interesting what procedures, documents and numbers different investors ask for prior to funding. Do they differ from those that are asked from corporate spin-offs or other young firms? What mechanisms lie in their actions to eliminate the *information asymmetries*? And what differences there are among the variety of the investors and whose investments are more successful.

The most interesting is probably to observe the dynamics of the process: whether the influence of venture capitalists funding and presence in board of directors changes towards ASOs over time? Do the founders-owners of ASO learn by doing? Do they feel the limits of their debt capacity better and whether their knowledge of the utilizing different financing sources improves?

By performing a longitudinal study on a selection of ASOs I could be able to see if there is a development over time in the above mentioned areas. It would be particularly interesting to investigate how the role of the external financing develops, as the benefits that external capital brings to ASO might not be as useful for older, larger and more mature firms.

Comparative studies utilizing this work as a reference are highly appreciated.

5.3 Implications

This research has been conducted to fill the gap of the empirical research in the area of information asymmetries, external capital acquisition and subsequent performance. The existence of the gap was indicated in the works of *Garmaise (2001)*, *Pazos et al*. *(2010)* and *Cosh et al. (2009)*. This question was tested on the specific form of start-ups – academic spin-offs, participants of the FORNY program in Norway. This research have revealed that the behavior patterns of the firm do not follow the *traditional pecking order*, rather the *reverse pecking order (Garmaise, 2001)*.

The findings are consistent with the recent findings of the researchers in this field, namely that the presence of external equity can ensure the survival and that venture capital funding is of highest importance for the growth of the firm. Therefore FORNY program and TTOs particularly should include the establishment of broader networks and relationships with external investors. It is proven that among others the unique network system that is established by the venture capitalists, firms, media etc lies in the grounds of the Silicon Valley success history *(Ferrary and Granovetter, 2009)*. I believe that by establishing these ties the problem of *information asymmetries* can be reduced and the amount of successful IPO and trade sales increases.

For the ASOs it would be reasonable to weigh all advantages and disadvantages of the external financing particularly thinking about the possibility to deliver it to the end and get the product ready for the market. Therefore funding through external shareholders or "asset lenders" should be sought prior to debt financing due to the extras that this type of finance cares with itself. These are among others the lacking managerial skills and network ties as well as the possibility of long-time utilization of the financing *(Zahra et al., 2007)*. Utilizing *agency theory* I found that the presence of external shareholders in the form of VC increases the value of the firm if they are also present in the board of directors. This places my study in line with *Shane and Stuarts' (2002)* research.

While my study does not cover whether there is a selection or treatment effect of VC on ASOs, it does seem like their active presence improves performance. This makes it seem like taking active ownership is a better investment strategy than just providing financial capital. This might be the case for such potential shareholders such as banks and financial institutions; public organizations and others.

5.4 Conclusions

As predicted relying on debt and excluding external capital is correlated with a higher rate of failure, which makes my findings support the *reversed pecking order theory (Garmaise, 2001)*. One possible explanation for this observation may be due to poor cash-flows in the ASOs, which makes it difficult to handle debts. Well informed equity holders on the other hand, will most probably be aware of the unstable, and often non existing revenue streams from the ASOs and will rely on future payouts in the form of increased stock price, either through an IPO or a trade sale. This indicates that the external equity holders are able to overcome the information asymmetries inherent in their relationship vis-à-vis the ASOs, something that is in line with the reverse pecking order theory. My contribution to the extant literature is that I have found that increasing external equity and avoiding debt, is also true for pre-IPO companies. While current research only studies post-IPO businesses, a flaw which has been pointed out by *Bertoni et al. (2011)* and *Cosh et al.(2009)* among others, my research amends that by showing external capital's positive influence on survival on pre-IPO companies. Another flaw that plagues this field of study is the perception of external capital as a homogeneous factor according to *Shane and Stuart (2002)*, and *Vanacer and Manigart (2010)*. I have shown that differing external capital sources can have different effects on performance in the form of survival.

Hypothesis 2, unlike 1, was not supported. No research has been done on this relation in the field of ASOs to my knowledge. As ASOs typically have either low production or underdeveloped products, and therefore long time to market, debt does not seem to increase production and sales. Gathering external capital seems to be of the same reasons, and is thus not correlated to increase in sales. In other words, my hypothesis has failed in showing significant correlations between performance in the form of growth in sales and different sources of external funding. *Pazos and Lòpez (2010)* urged for the study of certain kinds of external capital in this context, but my research was not able to show any significant correlations.

My final hypothesis was supported, indicating that venture capitalists in particular have a positive influence on the growth of sales in ASOs as long as they are present on the board of directors. While this might appear to be incongruent with my findings in hypothesis 2, this is not necessarily the case. VC's involvement can be due to the wish to be more engaged in the

operation of companies that are already in the sales phase. In this scenario, they can contribute positively in areas that the founders themselves are not proficient in, such as business management, production networks and market know-how.

My contribution to the extant body of theory is that I discovered that the capital structure of the ASOs seems to affect the performance but only in non-financial terms. However I discovered that financial performance increases when the external equity is in the form of venture capital as long as they also have members on the board of directors. The deviation between hypothesis 2 and 3 might be explained by the strengths that VC can bring to the managerial side of the firm. Also the effect of contributing with networks and other forms of human capital might be the reason to why firms that have venture capitalists on the board of directors fare better than those who do not. This can be explained by *agency theory* as a means for the principal (venture capital) to avoid moral hazard (focus on technology development instead of performance), and overcome information asymmetry (venture capital arguably have more information about what is needed to grow a business).

While I have shown that external equity does have a positive contribution to success in at least one area of performance, much work remains to be done. After all, no on single theoretical perspective can fully explain this complex phenomenon *(Clarysse et al., 2007a)*. I hope that my thesis will be able to contribute to the growing body of research regarding external capitals roles in the performance of ASOs.

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7 APPENDIXES

1 Literature review

Table 1 Literature review

Author, year	Framework /perspective/design	Qualitative	Quantitative	Sample Size	Method of data collection	Method of analysis	Authors	Research	Key findings
Bertoni et al. (2011)	panel data methodologies; agency theory	0	1	Longitudinal dataset of 538 Italian NTBFs	From 2004 RITA directory	Cox semi-parametric survival model, Gibrat-law-type dynamic panel-data models	IT	IT	VC investments have a significant influence on the growth of high-tech start-ups. In Italian context the selection effect of VC financing is negligible.
Clarysse et al. (2007a)	agency theory, resource dependence theory, social network theory	0	1	140 companies	secondary source data	descriptive statistics, correlations, binary logistic regression,	BE, UK	BE	High-tech start-ups that have a public research organization as external equity stakeholder develop better boards with outside members with complementary skills to the founding team
Clarysse et al. (2011)	novel	0	1	48 corporate and 73 USO	hand-collected dataset; telephone	multiple regression analysis	UK	BE	Novelty of the technology has a negative effect on USO unless an experienced TTO support them an no effect on CSO; USOs

Author, year	Framework /perspective/design	Qualitative	Quantitative	Sample Size	Method of data collection	Method of analysis	Authors	Research	Key findings
					screening; interviews				benefit from a broad technology and CSO grow most if they have started with a narrow-focused technology
Clarysse et al. (2007b)	valuation theory	0	1	97 SO from PROs across five European countries	face-to-face interviews	descriptive statistics; general least squares regression analysis with logarithmic transformations	BE, UK	BE, DE, FR, IT, UK	SO with formal technology transfer (TT) start with a larger amount of capital afterwards do not raise more capital than SO without formal TT. TTO are influencing the development of SO in those countries where they are most developed and institutionalized
Colombo et al. (2010)	empirical; absorptive capacity theory	0	1	487 firms, 48 of which are ASO	survey; longitudinal dataset, secondary sources; phone or face-to-face follow up interviews	Econometric analysis; augmented Gibrat panel data model	IT	IT	research quality positively contributes to the growth of USO and has no effect on non-academic USOs. Commercial orientation has a negative effect on the growth of ASO while scientific quality has a positive effect.
Cosh et al. (2009)	pecking order theory; reversed pecking order	0	1	2520 UK entrepreneurial firms	survey;	descriptive statistics; correlation matrix; multivariate empirical analysis	UK	UK	External finance is seldom available in the form that the organization wishes, however firms are usually able to secure funding from at least one source. Author's findings support the traditional pecking order theory.

Author, year	Framework /perspective/design	Qualitative	Quantitative	Sample Size	Method of data collection	Method of analysis	Authors	Research	Key findings
Dittmar (2004)	Trade-off theory	0	1	129 corporate spin-offs	Security data Company's Worldwide acquisitions database	Descriptive statistics; regression analysis	US	US	Corporate spin-offs weigh costs and benefits of debt in their decision making process. These results are consistent with the trade-off theory.
Ensley and Hmieleski (2005)	institutional theory	0	1	102 high-technology USO; 154 independent high-technology new ventures	personalized letters to managers; interviews of non-respondents	Perceived Cohesion Scale; Interpersonal conflict scale, Blau's Categorical Index; correlations	US	US	USO are more immature in their top management team (TMT) dynamics, also their TMTs are more homogenous
Evans (1987)	theories of firm growth	0	1	All firms operating in 100 manufacturing industries (42339 firms)	Data from Small Business Data Base (SBDB)	Descriptive statistics; second-order logarithmic expansions; variability functions	US	US	Probability of firm failure and growth decreases with age, consistent with predictions of Jovanovic (1982). Growth also decreases with firm size, meaning that Gibrat's Law fails for small firms.
Ferrary and Granovetter (2009)	complex network theory (CNT); systemic	1	0	Twelve economic agents types interacting in Silicon Valley (among	literature on the field of study; secondary source data (	case study of complex network of Silicon Valley	FR, US	US	Innovation and entrepreneurship is driven by high number of agents; CNT points to unique (particular) functions of VC that provide (support) robustness of the system: funding, selecting the projects, signaling, accumulating

Author, year	Framework /perspective/design	Qualitative	Quantitative	Sample Size	Method of data collection	Method of analysis	Authors	Research	Key findings
	perspective			them universities, different companies, newspapers)	among other National- and European Venture Capital Associations)				and spreading knowledge, plant the interdependent agents of the network
Gurdon and Samsom (2010)	exploratory	1	0	17 scientist-started ventures	previous research; longitudinal dataset	multiple case study design	US, NL	US	Successful ventures had effective management team processes and access to capital. Scientists and business people share different frames of reference. Those scientists who failed had conflict between business and science values.
Heirman and Clarysse (Heirman and Clarysse, 2004)	descriptive	0	1	99 unique cases (of 300 RBSUs founded in Flanders between 1991-1997)	structured questionnaire	cluster analysis; Pearson chi-Square test of significance; Kruskal-Wallis test of significance	BE	BE	Authors found a considerable heterogeneity (variety) of RBSUs starting conditions. They suggest that financial, technological and human capital influence each other; 42% of start-ups were prospectors with no clear picture of their business model, 22% as pure service start-ups and only ; only 6% of start-ups succeed in obtaining VC in the first year.
Knockaert, M., M. Wright, et al. (2009)	agency theory, human capital theory	0	1	68early stage VC investment managers Europe	interviews	descriptive statistics; Mann-Whitney U test; binary logistic regression; correlation	BE, UK	EU	VC funds that received public capital and funds working close with entrepreneurs are looking more optimistic (confident) on investing in academic SOs. VC are improbable to add value or overcome resource deficit in ASOs
Lindelöf, P.	descriptive	1	1	134 NTBF in	questionnaire	Pearson	SE	SE	Science Parks play an important role to start a

Author, year	Framework /perspective/design	Qualitative	Quantitative	Sample Size	Method of data collection	Method of analysis	Authors	Research	Key findings
and H. Löfsten (2005)				Sweden: 74 from academy and 60 from private sector		correlations; t-tests;			USO and attract financing, serves for advisory functions. USOs perform lower due to academic entrepreneurs are partly employed in universities and are less committed to the growth.
Moray and Clarysse (2005)	longitudinal case study; organizational/institutional perspective	1	1	one public research organization	interviews with senior managers involved in technology transfer; secondary data	descriptive statistics; correlations	BE	BE	Establishing an incubator is a learning process where managers adapt their decisions through the time and conditions. Managing finance resources has been the largest difference since then. As seed phase was not interesting for VC, Incubation Fund was established; IRR management was changed; international business attracted for coaching etc
Munari and Toschi (2011)	descriptive	0	1	247 new ventures (123 ASO; 124 other companies)	Use of databases like Venture expert	descriptive statistics, correlations, logit regressions	IT	UK	private VC in contrast with public VC devote less attention to the scientific reputation of the university for their financing decisions on ASOs. VC have no bias in investing in ASOs (invest in both ASOs and non ASOs the same)
Nerkar and Shane (2003)	study industry concentration and radicalness of technology	0	1	128 of 134 USO licensed between 1980 and 1996	data from Technology Licensing Office of the Massachusetts Institute of Technology;	model "failure" of a start-up; Weibull model; descriptive statistics; event history analytical	US	US	Patent scope and technological radicalness reduce failure of new firm only in fragmented markets

Author, year	Framework /perspective/design	Qualitative	Quantitative	Sample Size	Method of data collection	Method of analysis	Authors	Research	Key findings
					secondary data; unstructured interviews with company founders;	techniques			
Niosi (2006)	descriptive	0	1	65 publicly quoted companies (spin-offs from Canadian universities)	NRC database; SEDAR website and other	descriptive statistics; correlations; regressions	CA	CA	ASOs who obtained help from Industrial Research Assistance Program and patents grew more than venture backed biotechnology spin-offs
Ortín-Ángel, P. and F. Vendrell-Herrero (2010)	pecking order theory; complementary assets view	0	1	64 Spanish technological firms: 40 university spin-offs (8%) and 24 independent start-ups	questionnaire	cross-section analysis; testing of 4 hypothesis	ES	ES	In consistency with complementary assets view academic entrepreneurs use venture capitalists for access to managerial skills. Same results after control of finance constraints, debt levels and protection of intellectual property
O'Shea, R. P., T. J. Allen, et al. (2005)	resource-based view	0	1	141 U.S. University, giving 987 university-year observations (141*7)	database; survey	Negative binomial models	US	US	Higher degree of industry-university collaboration is recommended by authors; they found positive effect of industry-level funding to increase in technology transfer
Pazos, D. R.,	pecking	0	1	72 Spanish	survey;	econometric	ES	ES	Growth opportunities of USOs are negatively

Author, year	Framework /perspective/design	Qualitative	Quantitative	Sample Size	Method of data collection	Method of analysis	Authors	Research	Key findings
S. F. Lòpez, et al. (2010)	order theory; agency theory; trade-off theory			USOs (19% response rate)	S.A.B.I. database	analysis; regression; univariate, multivariate analysis;			related to debt level; authors define pecking order theory and agency theory to be more explicate and capturing than trade-off theory
Shane and Stuart (2002)	Social capital theory; historical study	0	1	134 firms founded during 1980-1996	Technology Licensing Office archives and interviews with firms principals	covariations; piecewise-exponential function; approach from Kalbfleisch and Prentice (1980)	US	US	Authors found that presence of VC funding is the most important factor contributing to the probability of university start-up to undergo IPO; "the presence of direct and indirect ties to venture investors prior to firm founding" decreases mortality probability and increases chances for obtaining external funding
Walter (2006)	network capabilities	0	1	149 USO	questionnaire (mail)	correlations, moderated regression analysis	DE, DK	DE	Performance variables and long-term survival are influenced by USO network capability. Entrepreneurial orientation (EO) did not have a significant effect financial growth of USO.
Wennberg et al. (2011)	industrial research	0	1	528 ASO and 8663 corporate spin-offs	Longitudinal dataset from various sources	unviariate, multivariate analysis; event history analysis	SE, US, UK	SE	Parent organization means more for CSO than ASOs, while industry experience means more for ASOs.
Wright, M., A. Lockett, et al. (2006)	finance pecking order theory	1	1	124 of 125 universities members AURIL & UNICO; 27 VC firms in UK; 50	questionnaire; detailed interviews; face to face interviews	? triangulation; statistical analysis	UK	UK, EU	"mismatch between demand and supply side of market", authors find consistency and inconsistency with pecking order theory: VC prefer to invest after proof of concept has been gained, in other words after seed stage; however TTOs do not see internal funds to be

Author, year	Framework /perspective/design	Qualitative	Quantitative	Sample Size	Method of data collection	Method of analysis	Authors	Research	Key findings
				universities in Europe and 65 VC firms					more important in early stages, but rather VC
Wright, M., A. Vohora, et al. (2004)	inductive	1	0	4 university spinouts: 2 USOs and 2 JVSOs	36 in-depth face-to-face interviews; telephone interviews; observations	multiple case study design	UK	UK	JVSO have advantage (competencies) before USO in opportunity recognition, creating a balanced team, "attaining credibility in the business environment"; "achieving sustainability through the ability of these new venture to become established firms within their respective markets"
Zahra et al. (2007)	Knowledge -based theory	0	1	91 CSO and 78 USO	mail survey; secondary sources	Means and standard deviations, intercorrelations, MANCOVA, regressions	US, ES	US	Corporate and USO differ in their performance. USOs lack commercial skills and do not benefit from their parent universities as CSOs do from their parent firms. CSOs outperform USOs in ROA; while USOs outperformed CSOs in revenue growth
Zhang, J. (2009)	exploratory	0	1	10530 entrepreneurs associated with 6359 firms; 903 academic entrepreneurs founded 704 university spin-offs	data from VentureOne database	Pearson's *X2* tests; multivariate analyses; OLS regression analysis; logit regressions; probit models	US	US	Authors findings include that USO have a higher survival rate than other SO; however there are no differences in amount of VC raised per round and totally, probability of profit making or increasing the number of employees.

2 Descriptive statistics

Preparing and improving data for testing. Descriptive statistics of absolute, relevant and logarithmised measures of variables Growth

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Ln(Growth absolute)	59	8,44	10,33	9,2279	,24893	1,899	,311	10,363	,613
Growth absolute 2008-2010	59	-5352,00	20679,00	557,1071	3675,90945	4,149	,311	20,008	,613
Ln(Growth relative)	59	-1,48	2,81	,1097	,66832	1,250	,311	4,348	,613
Growth relative	59	-,77	15,67	,5312	2,22904	5,856	,311	38,316	,613
Valid N (listwise)	59								

Preparing and improving data for testing. Descriptive statistics of absolute, relevant and logarithmised measures of variables Size

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Size (2)	59	3,71	12,26	7,5990	1,66720	,327	,311	,660	,613
totassabs2009	59	41,00	210322,00	9905,2606	30589,25020	5,432	,311	33,070	,613
Size (1)	59	,00	12,31	7,2527	2,14706	-,688	,311	2,278	,613
totassabs2008	59	,00	222501,00	9888,7593	32160,92860	5,576	,311	34,459	,613
Valid N (listwise)	59								

Correlations between logarithms and original variables, proving that the pattern is remaining the same:

Correlations for Growth variables

		Ln(Growth absolute)	Growth absolute 2008-2010	Ln(Growth relative)	Growth relative
Ln(Growth absolute)	Pearson Correlation	1	,955**	,276*	,097
	Sig. (2-tailed)		,000	,034	,465
	N	59	59	59	59
Growth absolute 2008-2010	Pearson Correlation	,955**	1	,219	,064
	Sig. (2-tailed)	,000		,096	,629
	N	59	59	59	59
Ln(Growth relative)	Pearson Correlation	,276*	,219	1	,802**
	Sig. (2-tailed)	,034	,096		,000
	N	59	59	59	59
Growth relative	Pearson Correlation	,097	,064	,802**	1
	Sig. (2-tailed)	,465	,629	,000	
	N	59	59	59	59

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Correlations for Size variables

		Size (2)	totassabs2009	Size (1)	totassabs2008
Size (2)	Pearson Correlation	1	,634**	,709**	,612**
	Sig. (2-tailed)		,000	,000	,000
	N	59	59	59	59
totassabs2009	Pearson Correlation	,634**	1	,525**	,994**
	Sig. (2-tailed)	,000		,000	,000
	N	59	59	59	59
Size (1)	Pearson Correlation	,709**	,525**	1	,533**
	Sig. (2-tailed)	,000	,000		,000
	N	59	59	59	59
totassabs2008	Pearson Correlation	,612**	,994**	,533**	1
	Sig. (2-tailed)	,000	,000	,000	
	N	59	59	59	59

**. Correlation is significant at the 0.01 level (2-tailed).

3 H1 a and b

Correlations between independent variables for the survival models

		Size (1)	Age (1)	Debt	Equity
Size (1)	Pearson Correlation	1	.204	-.110	.272*
	Sig. (2-tailed)		.093	.370	.027
	N	69	69	68	66
Age (1)	Pearson Correlation	.204	1	-.071	-.125
	Sig. (2-tailed)	.093		.568	.318
	N	69	69	68	66
Debt	Pearson Correlation	-.110	-.071	1	.103
	Sig. (2-tailed)	.370	.568		.413
	N	68	68	68	65
Equity	Pearson Correlation	.272*	-.125	.103	1
	Sig. (2-tailed)	.027	.318	.413	
	N	66	66	65	66

*. Correlation is significant at the 0.05 level (2-tailed).

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Size 1	72	.00	12.31	6.6670	2.89453	-.945	.283	.833	.559
Age 1	69	3.00	11.00	7.4348	2.04708	.149	.289	-.685	.570
Debt	71	.00	4.00	.6901	.91950	1.345	.285	1.557	.563
Equity	69	.00	4.00	2.1654	1.18358	-.621	.289	-.212	.570
Valid N (listwise)	65								

Base model (Cox Regression)

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	11	15.3%
	Censored	58	80.6%
	Total	69	95.8%
Cases dropped	Cases with missing values	3	4.2%
	Cases with negative time	0	.0%
	Censored cases before the earliest event in a stratum	0	.0%
	Total	3	4.2%
Total		72	100.0%

a. Dependent Variable: survival; time, (observation from 2008 until 01.03.2012)

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
91.401

Block 1: Method = Enter

Omnibus Tests of Model Coefficients[a]

-2 Log Likelihood	Overall (score)			Change From Previous Step			Change From Previous Block		
	Chi-square	df	Sig.	Chi-square	df	Sig.	Chi-square	df	Sig.
78.347	15.520	2	.000	13.053	2	.001	13.053	2	.001

a. Beginning Block Number 1. Method = Enter

Variables in the Equation

	B	SE	Wald	df	Sig.	Exp(B)
Age (1)	-.317	.175	3.288	1	.070	.729
Size (1)	-.299	.107	7.865	1	.005	.741

Correlation Matrix of Regression Coefficients

	Age (1)
Size (1)	-.250

Covariate Means

	Mean
Age (1)	7.435
Size (1)	6.957

Model 1 (Debt)

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	11	15.3%
	Censored	57	79.2%
	Total	68	94.4%
Cases dropped	Cases with missing values	4	5.6%
	Cases with negative time	0	.0%
	Censored cases before the earliest event in a stratum	0	.0%
	Total	4	5.6%
Total		72	100.0%

a. Dependent Variable: survival; time, (observation from 2008 until 01.03.2012)

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
91.052

Block 1: Method = Enter

Omnibus Tests of Model Coefficients[a]

-2 Log Likelihood	Overall (score)			Change From Previous Step			Change From Previous Block		
	Chi-square	df	Sig.	Chi-square	df	Sig.	Chi-square	df	Sig.
73.965	21.511	3	.000	17.087	3	.001	17.087	3	.001

a. Beginning Block Number 1. Method = Enter

Variables in the Equation

	B	SE	Wald	df	Sig.	Exp(B)
Age (1)	-.344	.196	3.077	1	.079	.709
Size (1)	-.294	.109	7.328	1	.007	.745
debt	.494	.223	4.931	1	.026	1.639

Correlation Matrix of Regression Coefficients

	Age (1)	Size (1)
Size (1)	-.178	
debt	-.095	.042

Covariate Means

	Mean
Age (1)	7.412
Size (1)	6.955
debt	.676

Model 2 (Equity)

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	11	15.3%
	Censored	55	76.4%
	Total	66	91.7%
Cases dropped	Cases with missing values	6	8.3%
	Cases with negative time	0	.0%
	Censored cases before the earliest event in a stratum	0	.0%
	Total	6	8.3%
Total		72	100.0%

a. Dependent Variable: survival; time, (observation from 2008 until 01.03.2012)

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
90.338

Block 1: Method = Enter

Omnibus Tests of Model Coefficients[a]

-2 Log Likelihood	Overall (score)			Change From Previous Step			Change From Previous Block		
	Chi-square	df	Sig.	Chi-square	df	Sig.	Chi-square	df	Sig.
75.568	16.625	3	.001	14.771	3	.002	14.771	3	.002

a. Beginning Block Number 1. Method = Enter

Variables in the Equation

	B	SE	Wald	df	Sig.	Exp(B)
Age (1)	-.410	.187	4.830	1	.028	.663
Size (1)	-.264	.109	5.903	1	.015	.768
equity	-.392	.242	2.623	1	.105	.676

Correlation Matrix of Regression Coefficients

	Age (1)	Size (1)
Size (1)	-.167	
equity	.365	-.190

Covariate Means

	Mean
Age (1)	7.303
Size (1)	6.918
equity	2.143

Model 3 Full model (Debt+Equity)

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	11	15.3%
	Censored	54	75.0%
	Total	65	90.3%
Cases dropped	Cases with missing values	7	9.7%
	Cases with negative time	0	.0%
	Censored cases before the earliest event in a stratum	0	.0%
	Total	7	9.7%
Total		72	100.0%

a. Dependent Variable: survival; time, (observation from 2008 until 01.03.2012)

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
89.972

Block 1: Method = Enter

Omnibus Tests of Model Coefficients[a]

-2 Log Likelihood	Overall (score)			Change From Previous Step			Change From Previous Block		
	Chi-square	df	Sig.	Chi-square	df	Sig.	Chi-square	df	Sig.
69.059	23.206	4	.000	20.913	4	.000	20.913	4	.000

a. Beginning Block Number 1. Method = Enter

Variables in the Equation

	B	SE	Wald	df	Sig.	Exp(B)
Age (1)	-.466	.207	5.054	1	.025	.627
Size (1)	-.263	.113	5.452	1	.020	.769
debt	.638	.230	7.671	1	.006	1.892
equity	-.632	.296	4.557	1	.033	.532

Correlation Matrix of Regression Coefficients

	Age (1)	Size (1)	debt
Size (1)	.005		
debt	-.119	-.023	
equity	.308	-.098	-.444

Covariate Means

	Mean
Age (1)	7.277
Size (1)	6.916
debt	.662
equity	2.137

Model 4 Only independent variables (Debt+Equity)

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	11	15.3%
	Censored	54	75.0%
	Total	65	90.3%
Cases dropped	Cases with missing values	7	9.7%
	Cases with negative time	0	.0%
	Censored cases before the earliest event in a stratum	0	.0%
	Total	7	9.7%
Total		72	100.0%

a. Dependent Variable: survival; time, (observation from 2008 until 01.03.2012)

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
89.972

Block 1: Method = Enter

Omnibus Tests of Model Coefficients[a]

-2 Log Likelihood	Overall (score)			Change From Previous Step			Change From Previous Block		
	Chi-square	df	Sig.	Chi-square	df	Sig.	Chi-square	df	Sig.
80.154	11.032	2	.004	9.819	2	.007	9.819	2	.007

a. Beginning Block Number 1. Method = Enter

Variables in the Equation

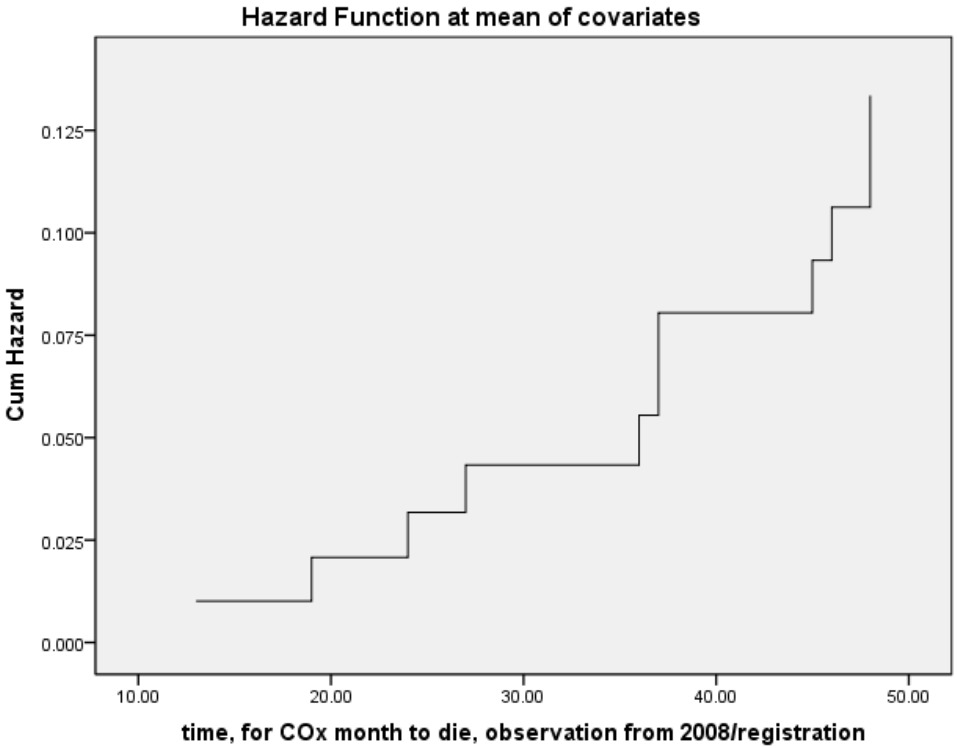
	B	SE	Wald	df	Sig.	Exp(B)
debt	.724	.236	9.443	1	.002	2.063
equity	-.607	.287	4.484	1	.034	.545

Correlation Matrix of Regression Coefficients

	debt
equity	-.420

Covariate Means

	Mean
debt	.662
equity	2.137



Logistic regression (Robustness check)

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	65	90,3
	Missing Cases	7	9,7
	Total	72	100,0
Unselected Cases		0	,0
Total		72	100,0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original Value	Internal Value
did not survive	0
survived	1

Block 0: Beginning Block

Classification Table[a,b]

			Predicted		
			survival 2012		Percentage
	Observed		did not survive	survived	Correct
Step 0	survival 2012	did not survive	0	11	,0
		survived	0	54	100,0
	Overall Percentage				83,1

a. Constant is included in the model.
b. The cut value is ,500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	1,591	,331	23,135	1	,000	4,909

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	debt	7,502	1	,006
		equity	2,080	1	,149
	Overall Statistics		10,510	2	,005

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	10,525	2	,005
	Block	10,525	2	,005
	Model	10,525	2	,005

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	48,581[a]	,149	,250

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than ,001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	48,581[a]	,149	,250

1	6,365	7	,498

Contingency Table for Hosmer and Lemeshow Test

		survival 2012;		survival 2012		
		Observed	Expected	Observed	Expected	Total
Step 1	1	5	4,118	3	3,882	8
	2	1	1,538	5	4,462	6
	3	2	2,200	8	7,800	10
	4	2	1,144	5	5,856	7
	5	0	,671	6	5,329	6
	6	0	,630	9	8,370	9
	7	0	,368	7	6,632	7
	8	1	,214	5	5,786	6
	9	0	,118	6	5,882	6

Classification Table[a]

			Predicted		
			survival 2012		Percentage
	Observed		did not survive	survived	Correct
Step 1	survival 2012	did not survive	2	9	18,2
		survived	1	53	98,1
	Overall Percentage				84,6

a. The cut value is ,500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	debt	-1,044	,394	7,010	1	,008	,352
	equity	,661	,340	3,774	1	,052	1,936
	Constant	1,266	,651	3,775	1	,052	3,546

a. Variable(s) entered on step 1: debt, equity.

Correlation Matrix

		Constant	debt	equity
Step 1	Constant	1,000	-,234	-,608
	debt	-,234	1,000	-,444
	equity	-,608	-,444	1,000

Block 2: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	4,810	1	,028
	Block	4,810	1	,028
	Model	15,335	3	,002

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	43,771[a]	,210	,352

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than ,001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	10,587	7	,158

Contingency Table for Hosmer and Lemeshow Test

		survival 2012		survival 2012		
		Observed	Expected	Observed	Expected	Total
Step 1	1	6	4,514	1	2,486	7
	2	0	2,269	8	5,731	8
	3	1	1,675	7	6,325	8
	4	2	,951	5	6,049	7
	5	2	,623	5	6,377	7
	6	0	,460	7	6,540	7
	7	0	,278	7	6,722	7
	8	0	,161	7	6,839	7
	9	0	,070	7	6,930	7

Classification Table[a]

Observed			Predicted		
			survival 2012		Percentage Correct
			did not survive	survived	
Step 1	survival 2012	did not survive	5	6	45,5
		survived	1	53	98,1
	Overall Percentage				89,2

a. The cut value is ,500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	debt	-1,061	,419	6,410	1	,011	,346
	equity	,757	,359	4,436	1	,035	2,131
	Age (1)	,461	,234	3,876	1	,049	1,586
	Constant	-2,071	1,758	1,388	1	,239	,126

a. Variable(s) entered on step 1: Age (1).

Correlation Matrix

		Constant	debt	equity	Age (1)
Step 1	Constant	1,000	,035	-,434	-,918
	debt	,035	1,000	-,444	-,131
	equity	-,434	-,444	1,000	,205
	Age (1)	-,918	-,131	,205	1,000

Block 3: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	1,073	1	,300
	Block	1,073	1	,300
	Model	16,408	4	,003

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	42,698[a]	,223	,374

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than ,001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	11,070	7	,136

Contingency Table for Hosmer and Lemeshow Test

		survival 2012		survival 2012		
		Observed	Expected	Observed	Expected	Total
Step 1	1	5	4,772	2	2,228	7
	2	1	2,031	6	4,969	7
	3	1	1,404	6	5,596	7
	4	1	,964	6	6,036	7
	5	3	,672	4	6,328	7
	6	0	,500	7	6,500	7
	7	0	,336	7	6,664	7
	8	0	,220	7	6,780	7
	9	0	,102	9	8,898	9

Classification Table[a]

Observed			Predicted		
			survival 2012		Percentage Correct
			did not survive	survived	
Step 1	survival 2012	did not survive	5	6	45,5
		survived	1	53	98,1
	Overall Percentage				89,2

a. The cut value is ,500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	debt	-,963	,416	5,348	1	,021	,382
	equity	,603	,378	2,544	1	,111	1,828
	Age (1)	,423	,242	3,066	1	,080	1,527
	Size (1)	,146	,141	1,071	1	,301	1,157
	Constant	-2,547	1,860	1,875	1	,171	,078

a. Variable(s) entered on step 1: Size (1).

Correlation Matrix

		Constant	debt	equity	Age (1)	Size (1)
Step 1	Constant	1,000	,000	-,346	-,846	-,241
	debt	,000	1,000	-,427	-,153	,151
	equity	-,346	-,427	1,000	,270	-,341
	Age (1)	-,846	-,153	,270	1,000	-,149
	Size (1)	-,241	,151	-,341	-,149	1,000

4 H2 a and b

Appendix Correlations between variables for the models of growth, models (5,6,7,8)

		Ln(Growth absolute)	Ln(Growth relative)	Size (2)	Age (2)	Debt	Equity
Ln(Growth absolute)	Pearson Correlation	1					
	Sig. (2-tailed)						
	N	59					
Ln(Growth relative)	Pearson Correlation	,276*	1				
	Sig. (2-tailed)	,034					
	N	59	59				
Size (2)	Pearson Correlation	,258*	,084	1			
	Sig. (2-tailed)	,049	,529				
	N	59	59	59			
Age (2)	Pearson Correlation	-,044	-,053	,039	1		
	Sig. (2-tailed)	,743	,693	,769			
	N	59	59	59	59		
Debt	Pearson Correlation	,063	,203	-,046	-,057	1	
	Sig. (2-tailed)	,638	,127	,729	,672		
	N	58	58	58	58	58	
Equity	Pearson Correlation	,026	,132	,129	-,258	,129	1
	Sig. (2-tailed)	,849	,330	,343	,055	,348	
	N	56	56	56	56	55	56

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Base model Regression

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Size (2), Age (2)	.	Enter

a. All requested variables entered.
b. Dependent Variable: Ln(Growth absolute)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,263[a]	,069	,036	,24442

a. Predictors: (Constant), Size (2), Age (2)

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	,249	2	,124	2,082	,134[a]
	Residual	3,345	56	,060		
	Total	3,594	58			

a. Predictors: (Constant), Size (2), Age (2)
b. Dependent Variable: Ln(Growth absolute)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	8,971	,173		52,004	,000					
	Age (2)	-,007	,016	-,054	-,417	,679	-,044	-,056	-,054	,998	1,002
	Size (2)	,039	,019	,260	2,012	,049	,258	,260	,259	,998	1,002

a. Dependent Variable: Ln(Growth absolute)

Coefficient Correlations[a]

Model			Size (2)	Age (2)
1	Correlations	Size (2)	1,000	-,039
		Age (2)	-,039	1,000
	Covariances	Size (2)	,000	-1,217E-5
		Age (2)	-1,217E-5	,000

a. Dependent Variable: Ln(Growth absolute)

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions		
				(Constant)	Age (2)	Size (2)
1	1	2,898	1,000	,00	,01	,01
	2	,081	5,981	,03	,87	,16
	3	,021	11,811	,97	,12	,84

a. Dependent Variable: Ln(Growth absolute)

Model (5) Debt

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Debt, Size (2), Age (2)	.	Enter

a. All requested variables entered.
b. Dependent Variable: Ln(Growth absolute)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,274[a]	,075	,024	,24813

a. Predictors: (Constant), Debt, Size (2), Age (2)

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	,269	3	,090	1,458	,236[a]
	Residual	3,325	54	,062		
	Total	3,594	57			

a. Predictors: (Constant), Debt, Size (2), Age (2)
b. Dependent Variable: Ln(Growth absolute)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	8,952	,178		50,181	,000		
	Size (2)	,039	,020	,264	2,012	,049	,996	1,004
	Age (2)	-,006	,016	-,052	-,394	,695	,995	1,005
	Debt	,021	,037	,072	,552	,584	,995	1,005

a. Dependent Variable: Ln(Growth absolute)

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions			
				(Constant)	Size (2)	Age (2)	Debt
1	1	3,275	1,000	,00	,00	,01	,03
	2	,623	2,293	,00	,00	,01	,94
	3	,081	6,350	,03	,16	,86	,01
	4	,021	12,585	,97	,83	,12	,02

a. Dependent Variable: Ln(Growth absolute)

Model (6) Equity

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Equity, Size (2), Age (2)	.	Enter

a. All requested variables entered.
b. Dependent Variable: Ln(Growth absolute)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,309[a]	,095	,043	,22623

a. Predictors: (Constant), Equity, Size (2), Age (2)

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	,280	3	,093	1,826	,154[a]
	Residual	2,661	52	,051		
	Total	2,942	55			

a. Predictors: (Constant), Equity, Size (2), Age (2)
b. Dependent Variable: Ln(Growth absolute)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	8,919	,174		51,279	,000		
	Size (2)	,042	,018	,309	2,312	,025	,977	1,023
	Age (2)	,002	,016	,016	,120	,905	,928	1,078
	Equity	-,002	,027	-,010	-,070	,944	,914	1,094

a. Dependent Variable: Ln(Growth absolute)

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions			
				(Constant)	Size (2)	Age (2)	Equity
1	1	3,712	1,000	,00	,00	,01	,01
	2	,206	4,247	,00	,00	,15	,61
	3	,062	7,769	,03	,32	,65	,32
	4	,021	13,434	,96	,67	,19	,06

a. Dependent Variable: Ln(Growth absolute)

Model 7 full

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Size (2), Debt, Age (2), Equity	.	Enter

a. All requested variables entered.
b. Dependent Variable: Ln(Growth absolute)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.332[a]	.110	.039	.22880

a. Predictors: (Constant), Size (2), Debt, Age (2), Equity

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.324	4	.081	1.549	.203[a]
	Residual	2.617	50	.052		
	Total	2.942	54			

a. Predictors: (Constant), Size (2), Debt, Age (2), Equity
b. Dependent Variable: Ln(Growth absolute)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	8.895	.178		50.003	.000					
	Debt	.032	.035	.123	.912	.366	.103	.128	.122	.976	1.025
	Equity	-.005	.028	-.025	-.179	.858	.026	-.025	-.024	.898	1.113
	Age (2)	.003	.017	.023	.164	.871	.033	.023	.022	.920	1.086
	Size (2)	.043	.018	.316	2.336	.024	.308	.314	.312	.972	1.029

a. Dependent Variable: Ln(Growth absolute)

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions				
				(Constant)	Debt	Equity	Age (2)	Size (2)
1	1	4.052	1.000	.00	.02	.01	.01	.00
	2	.659	2.479	.00	.94	.00	.01	.00
	3	.206	4.434	.00	.03	.62	.14	.00
	4	.062	8.106	.03	.00	.31	.65	.33
	5	.021	14.028	.96	.02	.05	.19	.67

Model (8) Independent variables

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Equity, Debt	.	Enter

a. All requested variables entered.
b. Dependent Variable: Ln(Growth absolute)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.104[a]	.011	-.027	.23656

a. Predictors: (Constant), Equity, Debt

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.032	2	.016	.283	.754[a]
	Residual	2.910	52	.056		
	Total	2.942	54			

a. Predictors: (Constant), Equity, Debt
b. Dependent Variable: Ln(Growth absolute)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	9.223	.070		130.873	.000					
	Debt	.026	.036	.101	.729	.470	.103	.101	.100	.983	1.017
	Equity	.003	.028	.013	.094	.926	.026	.013	.013	.983	1.017

a. Dependent Variable: Ln(Growth absolute)

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions		
				(Constant)	Debt	Equity
1	1	2.316	1.000	.03	.07	.03
	2	.573	2.011	.04	.92	.05
	3	.112	4.549	.92	.00	.92

a. Dependent Variable: Ln(Growth absolute)

5 H3 Influence of VC on growth in sales

Correlations

		Ln(Growth absolute)	Ln(Growth relative)	Size (2)	Age (2)	Debt	VC
Ln(Growth absolute)	Pearson Correlation	1					
	Sig. (2-tailed)						
	N	59					
Ln(Growth relative)	Pearson Correlation	,276*	1				
	Sig. (2-tailed)	,034					
	N	59	59				
Size (2)	Pearson Correlation	,258*	,084	1			
	Sig. (2-tailed)	,049	,529				
	N	59	59	59			
Age (2)	Pearson Correlation	-,044	-,053	,039	1		
	Sig. (2-tailed)	,743	,693	,769			
	N	59	59	59	59		
Debt	Pearson Correlation	,063	,203	-,046	-,057	1	
	Sig. (2-tailed)	,638	,127	,729	,672		
	N	58	58	58	58	58	
VC	Pearson Correlation	,390**	,227	,283*	-,126	,268*	1
	Sig. (2-tailed)	,002	,083	,030	,342	,042	
	N	59	59	59	59	58	59

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Model 9

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Age (2), Size (2), VC	.	Enter

a. All requested variables entered. b. Dependent Variable: Ln(Growth absolute)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.419[a]	.176	.131	.23206

a. Predictors: (Constant), Age (2), Size (2), VC

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.632	3	.211	3.914	.013[a]
	Residual	2.962	55	.054		
	Total	3.594	58			

a. Predictors: (Constant), Age (2), Size (2), VC b. Dependent Variable: Ln(Growth absolute)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	9.011	.164		54.792	.000					
	VC	.062	.023	.344	2.669	.010	.390	.339	.327	.901	1.110
	Size (2)	.024	.019	.160	1.253	.216	.258	.167	.153	.914	1.094
	Age (2)	-.001	.015	-.007	-.053	.958	-.044	-.007	-.006	.978	1.022

a. Dependent Variable: Ln(Growth absolute)

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions			
				(Constant)	VC	Size (2)	Age (2)
1	1	3.144	1.000	.00	.02	.00	.01
	2	.761	2.033	.00	.86	.00	.01
	3	.075	6.484	.04	.08	.15	.89
	4	.020	12.494	.95	.03	.85	.09

a. Dependent Variable: Ln(Growth absolute)

Model 10

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Size (2), VC	.	Enter

a. All requested variables entered.
b. Dependent Variable: Ln(Growth absolute)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.419[a]	.176	.146	.22998

a. Predictors: (Constant), Size (2), VC

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.632	2	.316	5.976	.004[a]
	Residual	2.962	56	.053		
	Total	3.594	58			

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Size (2), VC	.	Enter

a. Predictors: (Constant), Size (2), VC

b. Dependent Variable: Ln(Growth absolute)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	9.007	.143		62.878	.000					
	VC	.062	.023	.345	2.729	.008	.390	.343	.331	.920	1.087
	Size (2)	.024	.019	.160	1.264	.212	.258	.167	.153	.920	1.087

a. Dependent Variable: Ln(Growth absolute)

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions		
				(Constant)	VC	Size (2)
1	1	2.287	1.000	.01	.06	.01
	2	.691	1.819	.01	.88	.00
	3	.022	10.301	.99	.06	.99

a. Dependent Variable: Ln(Growth absolute)

Model 11 Regression (Full model)

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Age (2), Size (2), Debt, VC	.	Enter

a. All requested variables entered.

b. Dependent Variable: Ln(Growth absolute)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.421[a]	.178	.116	.23615

a. Predictors: (Constant), Age (2), Size (2), Debt, VC

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.639	4	.160	2.863	.032[a]
	Residual	2.956	53	.056		
	Total	3.594	57			

a. Predictors: (Constant), Age (2), Size (2), Debt, VC

b. Dependent Variable: Ln(Growth absolute)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	9.017	.172		52.535	.000					
	VC	.063	.025	.352	2.573	.013	.391	.333	.320	.828	1.207
	Debt	-.007	.037	-.024	-.187	.853	.063	-.026	-.023	.912	1.096
	Size (2)	.024	.020	.159	1.208	.232	.258	.164	.150	.900	1.112
	Age (2)	-.001	.016	-.010	-.079	.938	-.044	-.011	-.010	.978	1.022

a. Dependent Variable: Ln(Growth absolute)

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions				
				(Constant)	VC	Debt	Size (2)	Age (2)
1	1	3.555	1.000	.00	.02	.02	.00	.01
	2	.810	2.095	.00	.51	.13	.00	.01
	3	.540	2.567	.00	.35	.81	.00	.00
	4	.076	6.847	.04	.07	.00	.14	.89
	5	.020	13.439	.95	.05	.04	.85	.08

a. Dependent Variable: Ln(Growth absolute)

Model 12 Regression (VC, Debt, Size(2))

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Size (2), Debt, VC	.	Enter

a. All requested variables entered. b. Dependent Variable: Ln(Growth absolute)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.421[a]	.178	.132	.23396

a. Predictors: (Constant), Size (2), Debt, VC

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.638	3	.213	3.886	.014[a]
	Residual	2.956	54	.055		
	Total	3.594	57			

a. Predictors: (Constant), Size (2), Debt, VC b. Dependent Variable: Ln(Growth absolute)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	9.011	.151		59.846	.000					
	VC	.064	.024	.354	2.629	.011	.391	.337	.324	.842	1.187
	Debt	-.007	.037	-.024	-.187	.852	.063	-.025	-.023	.912	1.096
	Size (2)	.024	.019	.158	1.217	.229	.258	.163	.150	.905	1.105

a. Dependent Variable: Ln(Growth absolute)

Model 13 Regression (VC and Debt on growth)

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Debt, VC	.	Enter

a. All requested variables entered. b. Dependent Variable: Ln(Growth absolute)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.394[a]	.155	.124	.23498

a. Predictors: (Constant), Debt, VC

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.557	2	.279	5.045	.010[a]
	Residual	3.037	55	.055		
	Total	3.594	57			

a. Predictors: (Constant), Debt, VC b. Dependent Variable: Ln(Growth absolute)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	9.188	.038		239.564	.000					
	VC	.073	.023	.403	3.136	.003	.391	.389	.389	.928	1.077
	Debt	-.013	.037	-.045	-.349	.729	.063	-.047	-.043	.928	1.077

a. Dependent Variable: Ln(Growth absolute)

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions		
				(Constant)	VC	Debt
1	1	1.953	1.000	.12	.11	.12
	2	.606	1.796	.18	.88	.13
	3	.442	2.103	.70	.00	.75

a. Dependent Variable: Ln(Growth absolute)

6 Conclusion

Hvilken kommersialiseringsaktør (KA) er du tilknyttet, eller har du vært tilknyttet? Kryss av for den aktøren som har vært viktigst. * survival 2012 Crosstabulation (Count)

		survival 2012		
		did not survive	survived	Total
Hvilken kommersialiseringsaktør (KA) er du tilknyttet, eller har du vært tilknyttet? Kryss av for den aktøren som har vært viktigst.	0	0	2	2
	Bergen teknologioverføring	0	2	2
	Bioparken	0	2	2
	Birkeland innovasjon	1	5	6
	Campus Kjeller	2	10	12
	Coventure (Sørlandet Teknologisenter)	1	4	5
	Forskningsparken AS	0	3	3
	Leiv Eirikson Nyskaping	1	7	8
	Norinnova & TTO Nord	4	4	8
	NTNU technology transfer	1	8	9
	Prekubator	1	4	5
	Sinvent	0	2	2
	Forinnova	0	3	3
	Biomedisinsk Innovasjon	0	2	2
Total		11	58	69

Age (1) * survival 2012 Crosstabulation

		survival 2012		
		did not survive	survived	Total
Age (1)	3.00	1	0	1
	4.00	2	2	4
	5.00	1	5	6
	6.00	1	12	13
	7.00	2	13	15
	8.00	4	6	10
	9.00	0	6	6
	10.00	0	7	7
	11.00	0	7	7
Total		11	58	69