

**HHL**LEIPZIG
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Dissertation

Risk and Return Management of Venture Capital Companies in the Post-Investment Phase

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Abstract

Risk and return management is one of the core competencies of venture capital companies (VCCs) as they invest in young, innovative firms with a high return potential, but also high risk potential. Due to the liability of smallness, newness and financial constraints young, innovative firms are constantly under the threat of failure. In the scope of this dissertation are four related studies – three empirical studies and one literature review – analyzing the risk and return management of VCCs. In particular, risk assessment and risk management and value adding activities in the post investment phase were examined. In the first article, authors analyze which risks are relevant over the whole venture capital (VC) investment process and show how VCCs assess and documents risks in their deal documents. The second article studies risk management practices of VCCs. We show that the experience and the skills of the corresponding investment manager have a significantly negative impact on the failure risk of a venture. Article three analyzes value creation measures applied by VCCs. The results suggest that VCCs are highly engaged in supporting ventures in financial and human capital issues as well as in establishing strong governance mechanisms. The fourth article also deals with the foregone topic. This paper provides a literature analysis on value adding activity measures in VC investments, synthesizes the variables measuring the main levers of value adding and identifies directions for improvement in terms of data, variables and methods.



Risk and Return Management of Venture Capital Companies in the Post-Investment Phase

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I. List of abbreviations

NTBF – New technology-based firm

PLS – Partial least square

VC – Venture Capital

VCCs – Venture Capital Companies

1. Introduction

“Capital as such is not evil; it is its wrong use that is evil. Capital in some form or other will always be needed.”

- *Mahatma Gandhi* -

Young entrepreneurial firms operating in the high-tech field (NTBFs – new technology based firms) are a relevant driver for the development and commercialization of new technologies, for employment creation, or more generally speaking, for growth and competitiveness of economies (Audretsch, 1995; Colombo, Luukkonen, Mustar, & Wright, 2010). However, NTBFs like all start-ups are associated with several drawbacks compared to their more established counterparts. NTBFs face the challenges of smallness, newness and limited access to capital often engendering a shorter expected life and a greater risk of failure of NTBFs (Ang, 1992; Coleman, 2004). The lack of sufficient resources hinders the development of NTBFs and markedly affects negatively social and economic welfare. A major financing source for NTBFs and other start-ups is VC. Academics, politicians and practitioners agree that VC can mitigate the problems of NTBFs. Hence, it can be highly advantageous for NTBFs. This is especially the case in the early stages of a NTBF's life.

VC is capital provided by VCCs with the purpose of financing young, entrepreneurial ventures with exceptionally high growth expectations. Due to the above mentioned drawbacks of newly established firms and high uncertainties arising from information asymmetries between VCCs and NTBFs' founders, VC investments are ranked as a high risk asset class (Ellis, Sagiv; & Drori, 2014). The investments in NTBFs have a high return, but also high risk potential for VCCs. Risks can be attributed to the information asymmetries between entrepreneurs and VCCs. Therefore, VCCs are actively involved in their portfolio firms to mitigate risk, but to also increase the return performance. Risk and return management varies across the different stages of investment process of VCCs (see Figure 1).

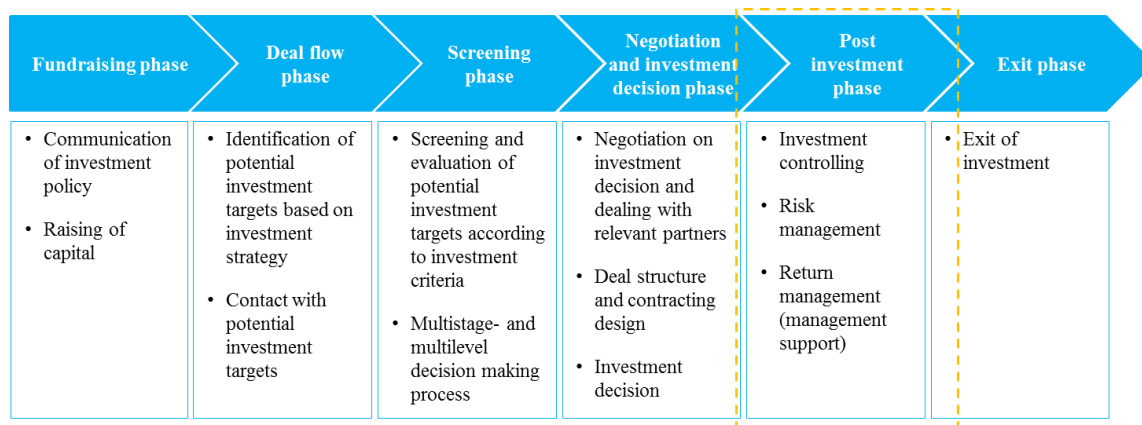


Figure 1: Investment process of venture capital companies

Source: Own illustration, following Schefczyk (2006)

On a portfolio level, VCCs have a certain investment selection strategy in which start-ups to invest. In that course, VCCs follow a portfolio strategy to diversify the risk for their limited partners. The topics of risk diversification and the investment selection strategy were adequately analyzed in academic literature (Achtleitner and Nathusius, 2003; Knill, 2009). In the post-investment phase VCCs pursue risk management and value adding activities to manage the risk and return of portfolio companies. If a portfolio firm does not develop as expected or has a high risk of failure, VCCs conduct several risk assessment and risk management measures reduce or eliminate venture's default risk. VCCs apply various risk management measures such as financial contracts, reporting and controlling or stages financing. To achieve abnormal returns compared to the market, VCCs perform different value creation measures in their portfolio firms, also known as value adding activities. Several empirical studies proved that value adding activities can be an important driver of VC-backed firms' performance (Alperovych & Hübner, 2013; Di Guo & Jiang, 2013). In doing so, VCCs provide financial, operational, strategic, governance, human capital and support with networks (see e.g. Agarwal & Chatterjee, 2007; Cumming et al., 2005; Macmillan et al., 1989). The investment process ends with the divesting phase in which a VCC intends to find the optimal exit decision. Moderate attention has been paid to the risk and return performance and management of venture capital companies (Xu, 2008). Nevertheless, there are already some studies that analyze the risk and return performance and management of VCCs. Bygrave and Tymmons (1992), Moskowitz and Vissing-Jorgenson (2000) and Wright and Robbie (1998) conducted descriptive

statistics. There are also empirical studies examining this topic (see e.g. Cochrane, 2005; Kaplan and Schoar, 2005; Xu, 2004 and 2008).

Due to the sensitivity of internal VC data and restricted publication duties, detailed VC information is rare. Hence, there are a number of crucial aspects of VCC's risk and return management that are under-researched, especially in the field of risk assessment and risk management (Bygrave, 2006; Neergaard & Ulhoi, 2006). For example, risk management, which has received relatively little attention in entrepreneurship literature at the micro-level of VC portfolio firms, has been largely unsystematically analyzed so far, but it is an important research topic (Manigart, Waele Wright, Robbie, Desbrieres, Sapienza & Beekman, 2002; Pinkwart, 2002). Recent studies have already investigated the topic of risk and risk management at the micro-level of VC portfolio firms and offered valuable insights (see e.g. LiPuma & Park, 2014; Lu, Hwang, & Wang, 2006; Smolarski, Verick, Foxen, & Kut, 2005; Tan, Zhang, & Jun, 2008). This study aims to continue the analyses and discussion in academic literature on risk and return management on a micro-level of VC portfolio firms.

Germany belongs to the leading European tech countries and gained importance in the start-up scene over the last years driven by the key regional tech hubs in Berlin, Hamburg and Munich (EY, 2015). The funding volumes in Germany have shown significant growth rates since 2013, many European and global leaders have established branches in Berlin, and German startups reached a new level of valuations reflecting the rising relevance of the start-up market in Germany (EY, 2015). Therefore, it is of interest for research and practice to gain deeper insights into the specialties of the German VC market as previous research primarily focused on the VC market in the United States.

The US and the German VC market are not comparable for several reasons. Recent developments of the European and German VC market can be attributed to differences in financial market development, tax policy, labor market regulations, public spending on research and development as well as technology transfer policies (Black & Gilson, 1998; Bosma & Levi, 2010; Cumming, Schmidt, & Walz, 2010; La Porta, Lopez-de-Silanes, Shleifer, & Vishny, 2000; Lerner & Tåg, 2013). These causes result in several

effects influencing management practices of VCCs in Germany, but also affect deal structure and size in the German VC market. For example, German VCCs are not allowed to be operatively involved with a venture. Even though deal sizes have been on the rise in the last years, deal sizes are not comparable. In the US deal sizes surpass those in Germany by far, implying a different risk aversion, but also availability of capital. Furthermore US VCCs are more professionalized in their management functions across the investment process (Lerner & Tåg, 2013). Hence, risk and return management is of higher relevance for European and German VCCs compared to the US market where exit possibilities are limited and active management support, i.e. active involvement including risk management and value adding activities, is restricted.

Therefore, this dissertation aims to contribute to the literature stream of venture capital by addressing risk assessment and management as well as value adding activities of VCCs based on a rare, longitudinal data set from Germany. The authors' analysis of the current status of existing literature shows that considerable research gaps exist in the field of venture capital due to the lack of in-depth, longitudinal data to study the whole investment process of VCCs, the lack of new data in this field of research as well as data from Germany. The goal of this thesis is to contribute to this literature stream.

The thesis consists of four articles on the topic of risk and return management in venture capital companies during the post-investment phase. An overview of the articles regarding authorship, contribution and publication status is provided in table 1. The first two articles contribute to the topic of risk, risk assessment and risk management analyzing deal documents of German venture capital companies. The second two articles elaborate on the return side, i.e. investigating value adding activities of venture capital companies.

	Chapter 3.1 Risk types and risk assessment in venture capital investments: A content analysis of investors' original documents	Chapter 3.2 Risk management in the venture capital industry: Managing risk in portfolio companies	Chapter 3.4 Value adding activities of venture capital companies: A content analysis of investor's original documents in Germany	Chapter 3.4 Value adding activities in venture capital literature: A review on data, variables and methods
Joint work with	Dorian Proksch Andreas Pinkwart	Dorian Proksch Andreas Pinkwart Michael Schefczyk	Dorian Proksch Nino Röhr Cornelia Ernst Andreas Pinkwart Michael Schefczyk	
Contribution	Shared main authorship with Dorian Proksch Main responsibility for literature analysis Shared responsibility for research design, data analysis, writing and interpretation of results	Author Main responsibility for literature analysis Writing literature review and interpretation of results was collaborative	Shared main authorship with Dorian Proksch Main responsibility for literature analysis Shared responsibility for research design, data analysis, writing and interpretation of results	Author's independent research
Publication status	Forthcoming in: International Journal of Entrepreneurial Venturing (VHB Ranking in 2014: B).	Presented at: Annual Risk Governance Conference in 2015. The later version was published in the Journal of Entrepreneurial Finance, 18 (2016), 2 (VHB Ranking in 2014: C)	Published in: Venture Capital: An International Journal of Entrepreneurial Finance (2016) (VHB Ranking in 2014: C)	Published in: International Review of Entrepreneurship, 14 (2016) 3 (Cra Ranking 2012: Top international journal)

Table 1 Summary of contributions, publications and co-authors of different chapters

As follows, a summary of each article including research gap, the methodology used, the main findings and the contribution of the article are presented:

Article 1: Risk types and risk assessment in venture capital investments: A content analysis of investors' original documents

- *Research gap:* Assessing and managing risk is a major task of venture capital companies. Despite the topic's high practical relevance, there is very little literature in this field. We aim to extend the academic discussion by investigating the risk types and risk assessment in venture capital investments.

- *Methodology:* We analyzed more than 500 deal documents of nine German venture capital companies using content analysis which resulted in 2,452 qualitative quotes.
- *Main findings:* We categorized these quotes into seven risk types, namely financial, market, strategy, technology, production, human capital, and legal risks, implying their relevance during the VC investment process. Market risk and technology risk are mentioned the most in the due diligence and the decision papers. Financial risk with 710 quotes is the most often documented risk considering all venture capital documents.
- *Contribution:* Overall, risk assessment appears to be highly unsystematic and subjective across VCCs. Consequently, we can add to the studies by Moesel, Fiet and Busenitz (2001), Schefczyk (2006), Zellmann, Prengel and Lebschi (2014), who highlight that risk assessment needs further investigation, as well as more structured and comprehensive approaches. We add to the studies by Chen, Yao and Kotha (2009) and Mason and Stark (2004), who likewise analyzed business plans and showed that especially market issues are highly relevant for VCCs in the investment decision making process. Considering the analysis of business plans, we cannot support Chen et al. (2009) and Mason and Stark (2004) that financial risks are of highest importance as market, technology and production risks were mentioned most. However, over the whole investment process financial risks are highly relevant.

Article 2: Risk management in the venture capital industry: Managing risk in portfolio companies

- *Research gap:* Risk management pursued in VC-backed ventures is only moderately researched in academic literature (Tan et al., 2008; Yoshikawa, Phan, & Linton, 2004). Previous studies either focus on single types of risk, e.g. macro-risk (Ning, Wang, & Bo, 2015) or liquidity risk (Cumming, Fleming, & Suchard, 2005) or on specific types of risk management measures, e.g. syndication (Wang, Wuebker, Han, & Ensley, 2012; Hopp, 2010) or financial contracting and incentive mechanisms (Tan et al., 2008). Studies analyzing comprehensive sets of risk management measures applied by VCCs ventures

are limited (see e.g. Kut, Pramborg, & Smorlarski, 2006; Kut, Pramborg, & Smorlarski, 2007; Kut & Smolarski, 2006; Smolarski, Verick, Foxen, & Kut, 2005). However, risk management is one of the core competencies of VCC and therefore a highly relevant topic in practice.

- *Methodology:* We conducted a structured literature review which was the basis for developing five hypotheses concerning measures to decrease failure risk in venture capital-backed ventures. We tested these hypotheses with an empirical data set of 93 venture capital-backed ventures in Germany using original deal data from nine different venture capital funds using a structural equation model.
- *Main findings:* We showed that the experience and the skills of the corresponding investment manager have a significant negative impact on the failure risk of a venture. Investment manager's experience and skills were measured by the working and founding experience, the technology expertise and the network size. Hence, the results emphasize the importance of the selection of the investment manager for risk management in venture capital investments.

Article 3: Value adding activities of venture capital companies: A content analysis of investor's original documents in Germany

- *Research gap:* Value adding activities are a complex, highly diversified topic and moderately analyzed in academic literature foremost due to the lack of publicly available data from VCCs. Furthermore, value adding activities vary across countries due to different legal and tax requirements. Therefore, we aim to provide in-depth details into the practices of VCCs in Germany which is so far an undeveloped field in this literature stream.
- *Methodology:* We qualitatively analyzed value adding activities using a longitudinal data set obtained from nine venture capital companies in Germany. We had access to investor's original documents including business plans, investment committee papers, reporting and annual statements of the investments. This enabled us to create a typology for which value adding services were performed

- *Main findings:* The results suggest that venture capital companies are highly engaged in supporting ventures in financial and human capital issues as well as in establishing strong governance mechanisms to reduce information asymmetries between founders and investors. Further, the provision of relevant contacts through venture capital companies' network is moderately applied. Support in operational issues is of low relevance.
- *Contribution:* We showed that VC can provide a broad portfolio of value adding activities throughout the investment phase. However, the use in practice appears to be rather inhomogeneous and partially structured in terms of documentation. Possibly, founders are not aware which value adding activities can be provided by the respective VCC. Hence, selecting the most suitable and valuable VCC can be an opaque and uncertain decision for founders. For VCC, a systematic application of value adding activities might increase the chance of successful investments. We observed that e.g. governance mechanisms are a common method across VCC since they are applied in nearly all cases in our sample.

Article 4: Value adding activities in venture capital literature: A review on data, variables and methods

- *Research gap:* Established literature has shown that venture capital funds' high returns can be partly attributed to value adding activities performed by the venture capital firms in their portfolio firms. Despite of the topic's importance, to date there is no structured literature review providing possibilities for improvements concerning data and methods. This paper provides a literature analysis on value adding activity measures in venture capital investments, synthesizes the variables measuring the main levers of value adding and identifies directions for improvement in terms of data, variables and methods.
- *Methodology:* Using the approach of a structured literature review, the author studied 37 articles regarding the type of data collection method, methodology, sample region and variables.

- *Main findings:* The analyses showed that data are primarily gathered through databases or surveys which are subject to several limitations. To measure value adding activities great inconsistencies exist regarding the variables used.
- *Contribution:* The author contributes to the literature stream with the following suggestions to improve the data collection and data analyses methods, i.e. using original deal documents rather than surveys or databases, including perspectives from multiple stakeholders in the analysis, improving consistency in variables used to measure a certain value adding activity type, developing and using established scales to measure similar variables, improving consistency in usage of dependent variable and increasing the number of international and comparative studies.

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2. The entire research project

The empirical analyses of the research papers in this dissertation are based on a joint research project of Technical University Dresden and HHL Leipzig Graduate School of Management called “Strategisches Risikomanagement in Frühphasenfonds” (English translation: “Strategic risk management in early-stage financing”). The project was initiated and is led by Prof. Dr. Andreas Pinkwart and Prof. Dr. Michael Schefczyk. The purpose of the project is to analyze the different management areas of early stage German VCCs financing NTBFs. Therefore, the process of capital provision, investment selection, VC networks, management support, risk management and internationalization were investigated.

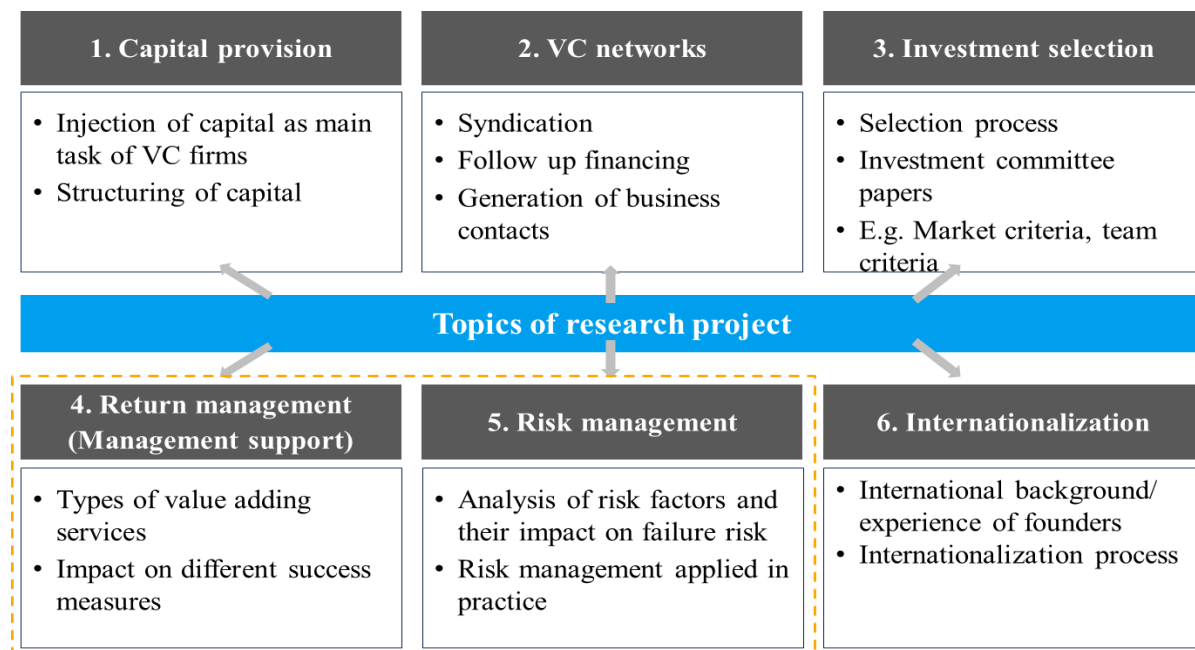


Figure 2: Overview of topics of research project "Strategic risk management in early-stage financing" (own illustration)

The literature stream of venture capital still lacks adequate reliable data and especially in-depth data. The majority of former studies have already provided valuable insights into the practices of VCCs using data bases, surveys and interviews to collect data.

Nevertheless, deal document analysis has been rarely applied so far. Additionally, longitudinal data is a rarity in this literature stream. Hence, this research project aims to close this gap by collecting longitudinal data based on deal documents and a survey from nine VCCs and 128 VC-backed respective investments in Germany. The researchers had access to the anonymized original deal documents including decision files, business plans, due diligence papers, investment committee papers and the continuous reporting like qualitative and quantitative reporting, milestones and board meeting minutes. In addition, a survey with all respective investment managers was conducted covering the main topics of the analysis. By doing so, in-depth, longitudinal qualitative and quantitative data were gathered which cover the entire investment process of VCCs.

A code book was developed in order to use qualitative data for quantitative analyses. Three researchers rated the quantitative quotes based on anchor phrases. As quality measure Krippendorff's alpha was applied based on the principle of investigator triangulation. The feasibility of this approach was tested in pretests with eight NTBFs from three VCCs. In that course, the code book was rarefied in several rounds. The value of Krippendorff's alpha was above 0.8 for all variables which is an acceptable value according to Krippendorff (2004). In total, more than 10.000 quantitative codes were coded.

The sample consists of 128 VC-backed ventures of nine German VCCs. The VCCs invested in NTBFs of which 42 % operated in information technologies, 34 % in life sciences, 14 % in material sciences and 10 % in other industries. The companies in the sample are on average 5.1 years old. The average number of the founder team is three. The VC-backed ventures finished on average two financing rounds. In the first round on average 700.000 Euros were collected and in the second round 1.000.000 Euros. 18 of the VC-backed ventures went bankrupt.

In addition to the articles in this thesis, the following journal articles and dissertations were conducted in the course of this entire research project:

- Fiegler, T. (2016). Venture Capital-Netzwerke. Eine empirische Analyse innerhalb der Frühphasenfinanzierung. Wiesbaden, Germany: Springer Gabler Verlag.

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3. Risk and return management of venture capital companies in the post-investment phase

3.1 Risk types and risk assessment in venture capital investments: A content analysis of investors' original documents

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Abstract

Venture capital is an important resource for new ventures with no access to the capital market. However, venture capital companies' investment decisions could be extremely risky. Assessing and managing risk is therefore a major task of venture capital companies. Despite the topic's high practical relevance, there is very little literature in this field. We aim to extend the academic discussion by investigating the risk types and risk assessment in venture capital investments. We analyzed more than 500 deal documents of nine German venture capital companies, resulting in 2,452 qualitative quotes. We categorized these quotes into seven risk types, namely financial, market, strategy, technology, production, human capital, and legal risks, implying their relevance during the VC investment process. Market risk and technology risk are mentioned the most in the due diligence and the decision papers. Financial risk with 710 quotes is the most often documented risk considering all venture capital documents.

Keywords

Risk, risk assessment, risk management, venture capital, new-technology-based firms,
new ventures

1 Introduction

VC is a financing form for young, entrepreneurial ventures that VCCs provide. VC investments are ranked as a high risk asset class, because VCC invest in ventures with a high return, but also with a high risk potential. An investment decision is made under high uncertainty, due to the information asymmetries between VCCs and start-ups' founders (Ellis, Sagiv, & Drori, 2014). Furthermore, due to their smallness and newness liabilities, the likelihood of failure is high for all new ventures. According to Zacharakis and Meyer (2000), 35 to 55 percent of VC investments fail. Hence, risk assessment and risk management are core and crucial VCC activities to lower the chances of a venture's failure. Comprehensive risk assessment and management throughout the investment process could detect risks earlier, allowing the initiation of countermeasures that could decrease the probability of such a venture failing.

Established literature has shown that VC investments face several risk, for example, agency risk (Bengtsson & Sensoy, 2011; Lu, Hwang, & Wang, 2006; Tan et al., 2008), liquidity or financial risk (Cumming, Fleming, & Schwienbacher, 2005; Kut et al., 2007; Kut et al., 2006; Smolarski, Verick, Foxen, & Kut, 2005), technology or product risk (Kut et al., 2007; Kut et al., 2006; Smolarski et. al., 2005; Wang et al., 2012), market risk (Lu et al., 2006; Wang et al., 2012), human resources risk (Kut et al., 2007; Kut et al., 2006; Smolarski et al., 2005), internationalization risk (LiPuma & Park, 2012), and macroeconomic risk (Kut et al., 2006). Furthermore, prior studies found that VCCs apply types or combinations of risk mitigation measures, for example, syndication (Wang et al., 2012; Hopp, 2010) or financial contracting, and incentive mechanisms (Tan et al., 2008) to overcome certain risk types. In the literature stream on VC investment, selection criteria studies have identified the analyzed criteria and those that are the most relevant. In their work, Chen et al. (2009) and Mason and Stark (2004) focus on business plan analysis. Owing to the sensitivity of deal documents, other VC documents have been rarely analyzed. It is crucial that VCCs do a continuous risk assessment throughout the investment phase, as risks can occur constantly; a venture could, for example, have liquidity issues and need bridge financing, or a founder could leave it. The relevance of different risks could change over time.

Thus, we aim at extending current literature by analyzing the risk types that are relevant in VC investments throughout the VC investment process. Further, we investigate how VCCs assess risks on a portfolio company level during the investment phase. We add to the literature and to practice as follows:

1. We collected a unique data set of in-depth qualitative data from nine public and private VC funds in Germany, as well as data from original deal documents like business plans, investment committee papers, and reporting and annual statements. The majority of prior studies used surveys (e.g. Kut et al., 2006; Lu et al., 2006; Payne, Davis, Moore, & Bell, 2009, Smolarski et al., 2005), or databases (e.g. Cumming et al., 2005; Hopp, 2010; Wang et al., 2012) as data collection method. These studies already led to notable empirical results that contributed to the topic of VC. However, a content analysis of all the deal documents throughout the investment process could provide further and far-reaching information.
2. We identified various risk factors for seven different risk types. We showed that the risks were mainly described in short sentences in the deal documents. Certain VCCs also used scales or charts to illustrate the intensity of the risks. Overall, risk assessment appears to be highly unsystematic and subjective across VCCs. Consequently, we can add to the studies by Moesel et al. (2001), Schefczyk (2006), Zellmann et al.(2014), who highlight that risk assessment needs further investigation, as well as more structured and comprehensive approaches.

We add to the studies by Chen et al. (2009) and Mason and Stark (2004), who likewise analyzed business plans and showed that especially market issues are highly relevant for VCCs in the investment decision making process. Considering the analysis of business plans, we cannot support Chen et al. (2009) and Mason and Stark (2004) that financial risks are of highest importance as market, technology and production risks were mentioned most. However, over the whole investment process financial risks are highly relevant.

2 Theoretical foundations

Risk can be defined as the probability of negative effects (Aven, 2011), and is often associated with uncertainty. To avoid any possible negative influences on companies' performance and development, all types of companies need to undertake a systematic identification, assessment, and treatment of risks (Hain, 2011). Since VC is rated as a high risk asset class, VCCs' are perceived as risk takers by investing in young, entrepreneurial firms. The information asymmetries between investors and start-up founders are a primary driver of VC investment risk (LiPuma & Park, 2013), as is uncertainty regarding the venture's market acceptance and overall development. Hence, VCCs apply certain tools to predict, assess, and evaluate the risks of their portfolio firms. Furthermore, VCCs utilize different types of risk mitigation measures to reduce their investment risk.

The topic of risk assessment and risk management is still a developing topic in the field of entrepreneurship and venture capital. The majority of previous studies discussed risk attitudes and behaviors between entrepreneurs and non-entrepreneurs. Only a few researchers have investigated the topic of risk and risk management on a venture level (LiPuma & Park, 2014; Lu et al., 2006; Smolarski et al., 2005; Tan et al., 2008), and most of these studies use US samples. Only a few studies have been conducted in Europe or Asia. Risk and risk management on a venture level might have been neglected as a topic in academic research due to the lack of in-depth data (Bygrave, 2006; Neergaard & Ulhoi, 2006). VC-backed ventures are private companies and therefore only have minor publication obligations and are, in general, very conservative regarding research projects.

2.1 Risks in VCCs' portfolio companies

2.2.1 Relevant VCC risk types

During the investment process, VCCs face several types of risks and uncertainties (Kaplan & Strömberg, 2004). Prior studies have shown that VCC investments might be subject to agency risk, financial risk, technology risk, market risk, human capital risk, internationalization risk, as well as macro risk. Since each venture has a different

risk and return profile, the extent and combination of different risks vary for each venture. Hence, investment managers have to identify, assess, and manage potential and occurring risks individually for each venture. In the following, we discuss the different risk categories.

Agency risk is one of the most important risks for VCCs due to the information asymmetries and the diverging targets between entrepreneurs and VCCs (Bengtsson & Sensoy, 2011; Gimmon, Benjamin, & Katzenstein, 2010; Lu et al., 2006). Agency theory dates back to the theory of the firm by William Meckling, Eugene Fama, and Michael Jensen, which indicates the conflict of interest between the principal and the agent, in our case the founders or managers of a venture and a VCC (Fama & Jensen, 1983; Jensen & Meckling, 1976). According to Kaplan and Strömberg (2004), there are four types of generic agency problems in the investment process. VCCs are concerned with the entrepreneur or founding team not working as expected to maximize a venture's value (Kaplan & Strömberg, 2004). Assessing the founding team's personal qualities and abilities can be a difficult VCC task. Furthermore, disagreements might develop between the VCC and the entrepreneur or founding team during the investment phase. Fourthly, the founding team might leave the venture before the promised value is generated (Kaplan & Strömberg, 2004). Therefore, VCCs use governance mechanisms like contracting, milestones, the gradual provision of capital, and active board involvement to reduce the agency conflict between them and the founding team (Bengtsson & Sensoy, 2011; Gantenbein & Engelhardt, 2012; Lu et al., 2006; Tan et al., 2008).

There are various different definitions of *financial risk* in academic literature. These definitions include all types of risks associated with the venture's financial situation, for example, running out of liquidity or not reaching the planned profit. If a venture lacks liquidity, the financial risks regarding insolvency are high for the VCC. In contrast, Cumming et al. (2005) define financial risk as the exit risk for a VCC in IPO markets; these authors thus measure the risk of not being able to make a proper exit. Kut et al. (2007), Kut et al. (2006) and Smolarski et al. (2005), offer another perspective. In these authors' studies financial risk was given a twofold classification: on the level of the portfolio and of the macro economy.

Technology risk is often used synonymously in academic literature as a product and development risk. VCCs apply technical or product due diligences to evaluate the technology or product risk before investing in young ventures. Furthermore, syndications and an industry focus are used to overcome the risk associated with technologies and products (see, e.g. Kut et al., 2007; Smolarski et. al., 2005; Wang et al., 2012). This finding is especially relevant to assess the market readiness of high-technology products or services. Kaplan and Strömberg (2004) show that 31% of VCCs in their study rate a product and technology as risky.

Market risk becomes most relevant when new services or products need to be commercialized (Wang et al., 2012). However, market risk is also associated with competition or changes in the market's attractiveness, i.e. decreasing market growth. Founders often lack the marketing capabilities required for a successful market entry (Wang et al., 2012). VCCs apply due diligences as a first step in evaluating the market risk before investing in a venture (Lu et al., 2006). According to Kaplan and Strömberg's study (2004), the major risks related to the market concern the market size and growth, the competition, and entry barriers, as well as the likelihood of customer adoption. Nevertheless, Kaplan and Strömberg's empirical results show that competition, market size, and customer adoption risks were only mentioned at a moderate rate of respectively 40, 31, and 22% in investment documents (Kaplan & Strömberg, 2004).

Strategic risks are becoming increasingly important due to globalization and enduring periods of innovation and finite resources (Cooper & Faseruk, 2011). The existing literature on this topic is fragmented and no agreement on the definition of strategic risk currently exists (Collins & Ruefli, 1992; Cooper & Faseruk, 2011). Strategic risks were only seldom discussed in the context of VC. Chassang and Miguel (2010) defined strategic risk as the risk which occurs when market players do not share the same information about their environment. Contrary, Collins and Ruefli (1992) stated: "strategic risk for an individual firm can be defined in terms of the probability of losing rank position vis a vis the other firms in the reference set". Gates (2006) classified strategic risks into seven major classes, i.e. industry margin squeeze, technology shift, brand erosion, one-kind-of competitor, customer priority shift, new

project failure and market stagnation. Most of these classes rather apply for large corporations. Cooper and Faseruk (2011) identified a negative relationship between a high perception of strategic risks and risk taking behavior. Hence, the results imply that high-risk perceptions encourage low risk-taking behavior (Cooper & Faseruk, 2011).

VC investments suffer from uncertainty regarding the quality, capabilities, and the motivation of the founding team. Hence, VCCs face *human capital or human resources risks*, which, for example, Kut et al. (2007), Kut et al. (2006), and Smolarski et al. (2005) analyze. These authors measure the risk, for example, as a lack of management performance and a lack of management focus. Human resources due diligences are a way of evaluating the risk associated with a venture's management. In the course of such a due diligence, VCCs can verify the management team's track record by using their network (Kut et al., 2007). Kaplan and Strömberg (2004) state that management risks were cited in 61% of their analyses. These authors' analyses mentioned, for example, that the CEO is a "difficult" person, that the management lacks financial planning, that it is unable to focus, and that it is young and inexperienced (Kaplan & Strömberg, 2004). An incomplete management team can be a further human resource risk. Overall, previous studies indicated that risks associated with human capital are highly relevant for VCCs.

Internationalization risk is a rather special risk type for VC-backed firms, as not all ventures pursue an internationalization strategy. LiPuma and Park (2012) study this topic with longitudinal data from 962 invested rounds in 334 VC-backed technology companies. They show that VCCs apply syndication, investment size, and round interval to mitigate internationalization risk. The results suggest that, in domestic investments, VCCs use smaller syndicates, provide less funding, and use fewer frequent investment rounds for portfolio companies that internationalize opportunistically (LiPuma & Park, 2012).

2.2.2 Risk assessment in VC investments

VCCs analyze business plans, meet entrepreneurs in person, and conduct due diligences to evaluate the risks of a VC investment during the investment selection

process (Achtleitner & Nathusius, 2003). The entrepreneurship literature comprehensively analyzed the topic of investment selection criteria by means of qualitative and quantitative methods (see e.g. Riquelme & Rickards, 1992; Shepherd & Zacharakis, 1999; Zacharakis & Meyer, 2000). Some studies, like those of Chen et al. (2009) and Mason and Stark (2004), focus specifically on business plan analysis in this context. The criteria used in the analysis of Mason and Stark (2004) reflect the major risks for VCCs, i.e. the entrepreneur/ management team, strategy, operations, product/service, market, financials, and others. The results indicate that VCCs place the most emphasis on market and financial issues, but also on the entrepreneurs and their team (Mason & Stark, 2004). Furthermore, the study by Chen et al. (2009) shows that the preparedness, the verbal content, and substance of the venture founder's presentation, as well as the business plan quality have a positive relationship with the VC funding decision. All of the above studies pursue a qualitative approach to content analysis in order to identify relevant decision making issues for VCCs. Nevertheless, these studies provide no insights into the question of how VCCs analyze risks and document them. Furthermore, academic literature rarely describes how VCCs assess risks during the investment phase, i.e. analyzing documents in the later stages of the VC investment process like the reporting, decision papers, and board meeting documentations. A few practitioner articles and dissertations discuss how VCCs apply qualitative and quantitative parameters to evaluate a venture's risks and returns (see, e.g. Zellmann et al., 2014). Qualitative factors are especially less analyzed in academic literature (Engel, 2003; Rieg, 2004; Schefczyk, 2006). However, qualitative factors, like the market and management factors, are highly relevant regarding evaluating a venture's return and risk potential (Zellmann et al., 2014). Unsystematic risks and their assessment are strictly dependent on the investment manager's subjective evaluation. Hence, risks evaluation depends on the investment manager's experiences and current evaluation (Zellmann et al., 2014). Overall, the first academic and practitioner-focused studies have shown that evaluating risks during the investment phase is highly subjective and unsystematic. This finding creates opportunities for further research to analyze how VC practices can be improved.

3 Data and method

We collected data of 95 VC-backed firms from nine VC funds in Germany, which included investments from 2005 to 2010. According to the BVK's (Bundesverband Deutscher Kapitalbeteiligungsgesellschaften) German venture capital statistics, we thus covered 21.9% of the seed investments during that time. The analyzed funds included were either public, or a private-public partnership.

The companies included had existed on average for 4.6 years, raised around EUR 750,000 in the seed round, and 1,200,000 Euros in the series A round. In the seed round, they had on average three investors and in the series A round, four (see table 1). The companies operated in the high tech field, including in the information technology and automation (38 %), life science and material science (10%), energy (5 %), communication (4 %), and others industries (9 %).

All VC funds in our sample are early stage funds. Furthermore, they do not have an industry focus, but a diverse portfolio. However, they only invest in technology-based ventures.

Variable	Mean	Median	Std. Dev
Age of portfolio companies (years)	4.59	5	2.09
Number of founding rounds (rounds)	1.98	2	0.89
Investment sum - Seed (Euros)	784,487	600,000	519,577
Investment sum - Series A (Euros)	1,202,948	777,037	1,179,085
Number of investors - Seed	2.55	2	1.98
Number of investors - Series A	3.94	3	2.54

Table 1: Overview of our data set

We had access to the original deal documents, including the business plans, due diligence documents, decision documents, reporting of the ventures to the VC, reporting of the VC to its investors, and board meeting minutes. We used content analysis as a qualitative research method, as it is the classical procedure for analyzing textual material (Flick, 2015). This method enabled us to study the different risk types and risk assessments in VC investments. The method comprises a systematic approach of reading texts, images, tables, and symbols (Krippendorff, 2013). The reasoning

behind this method is that the area of risk management is relatively unexplored. Currently, there is little research on which risk types are relevant and documented, and how the documentation is done.

To structure the data, we utilized the Gioia methodology (Gioia, Corley, & Hamilton, 2012). First, we read the documents several times and three researchers created codes developed from the documents to find repeated patterns of meaning (Braun & Clarke, 2006). In the course of creating codes, we created a coding scheme using Braun and Clarke's (2006) thematic analysis approach. This method is useful to identify, analyze, and report data patterns or categories (Braun & Clarke, 2006). The advantage of this type of analysis is that it organizes and describes the data set in great detail (Braun & Clarke, 2006). These codes were then collected and organized into the first-order categories (Gioia et al., 2012). To refine the developed codes, we separated the categories into subgroups and omitted the less relevant topics (Flick, 2015) to develop the second-order analysis (Gioia et al., 2012). We pursued several cross-checking rounds with three researchers to develop the categories. As a last step, we aggregated the second-order themes into the final dimensions. Seven risk types were identified: financial, market, strategic, technology, production, human capital, and legal risks. We conducted a pre-test with three VCCs to test the feasibility of our approach by collecting data on nine ventures. We used this pre-test to determine which documents are used to document possible risks.

To ensure that our approach was highly reliable, we made use of triangulation by means of three researchers, who coded the data separately and compared the results. We used the achieved Krippendorff's alpha — above 0.9 for all our risk types (see table 2) — as an intercoder reliability measures. This is a good value (Krippendorff, 2004).

Risk type	Average pair wise agreement	Krippendorff's alpha
Financial risk	98.9	0.986
Market risk	98.7	0.958
Strategic risk	95.4	0.910
Technology risk	99.5	0.993
Production risk	99.4	0.992
Human capital risk	96.5	0.955
Legal risk	98.4	0.979

Table 2: Intercoder reliability for the assessment of the different risk types

To ensure the anonymity of the VCCs and companies, we substituted their names with general terms, indicating this by making use of square brackets. All the quotations were translated from German into English.

4. Results

In total, we identified 2,452 cases of risks in the analyzed documents. Decision papers (41 percent) and reporting of the venture (35 percent) are the two most important documents for the evaluation of risk, given the number of cases. The other documents are responsible for a rather small proportion of the mentioned overall risks. Examining at risk, we found that market risk and technology risk are mentioned the most in the due diligence and the decision papers. In the VC's and the venture's reporting, as well as in the board meetings, financial risks were mentioned most often. Table 2 summarizes the risks described in specific documents.

Risk type	Business Plan	Due diligence	Decision paper	Venture reporting	VC reporting	Board meeting minutes	Total	Percentage
Financial risk	24	6	163	438	27	52	710	29
Market risk	36	70	194	93	0	9	402	16
Strategic risk	17	30	145	18	2	4	216	9
Technology risk	44	90	211	68	2	11	426	18
Production risk	32	15	98	67	4	11	227	9
Human capital risk	12	18	111	68	4	15	228	9
Legal risk	21	23	78	99	12	10	243	10
Total	186	252	1000	851	51	112	2452	100
Percentage	8	10	41	35	2	4	100	

Table 3: Mentioning of specific risk types in different venture capital documents

4.1 Risk types

Following the Gioia methodology, we identified seven areas of risk in the documents: financial, market, strategic, technological, production, human capital, and legal risks.

Financial risks are risks subject to the portfolio companies' liquidity situation. The risk of not gaining new investors is also included, as this would lead to a future liquidity gap. Similarly, not reaching revenue targets might increase the risk of bankruptcy.

Market risks summarize the risk that the portfolio company unable to successfully sell its product on the market. Reasons for such a failure can be bad market conditions, no demand for the portfolio company's solution, or the portfolio company's lack of selling abilities.

Strategic risks encompass risks tailored to bad strategic choices. These choices might affect the market entry strategy, or the creation of a unique selling proposition.

Technology risks describe the risks that the technology might not work as expected, or might not be developed on time, which would mean that the product cannot be built, or only at higher costs.

Production risks encompass all the risks that the product cannot be produced under the planned conditions, which include, for example, production delays and issues with suppliers.

Human capital risks describe the risks that the human resources required to succeed are not available or might no longer be available for the portfolio company.

Legal risks describe all the risks dealing with the law and regulatory frameworks. These risks include intellectual property rights, contracting, tax, and other governmental regulations.

Each risk type in the separate areas is described in the following.

4.1.1 Financial risk

With 710 identified quotes, financial risk is the most mentioned risk in the VC documents.

New ventures are in general only financed for a short period of time. Therefore, liquidity plays a major role, which we also identified in our documents. 41 percent of all of the quotes in the area of financial risks dealt with assessing the liquidity risk. Most of the quotes dealt with the current liquidity risks, which the following examples show:

“Status of liquidity: yellow: The first customer was obtained. Nevertheless, more customers are needed to reach the revenue goals in 2010.”

“Despite the positive revenue and cost development, the liquidity situation of [company] is tense due to the customers’ payment overruns. Specifically, the final payment of [customer 1] of EUR 375 thousand could fail ([customer 1] is in trouble).”

If liquidity is a continuous issue, ventures might face a high risk of going bankrupt, which the following phrases show:

“Based on the current ratio of costs and earnings, as well as the current order situation, we estimate that the company will be insolvent in [date].”

“It is clear that the company will be insolvent in [date1] if the money to reach the first milestone is not paid before [date 2].”

Besides the liquidity and bankruptcy risks, ventures usually need several financial rounds to reach the break-even point. Failing to obtain follow-up financing is a severe risk for ventures, which the following quote shows:

“As already stated in the ad-hoc information of [date], [investor 1] unexpectedly cancelled the negotiations for a follow-up financing.”

VCCs set certain milestones for ventures to ensure they achieve their revenue goals. In our documents, we identified the risk of not reaching the expected revenues in 127 quotations, as illustrated in the following:

“The order situation is weaker than expected, therefore it’s not clear whether the revenue goals of [company] can be reached. There are no signed orders, but promising inquiries (see sales pipeline).”

“The planned revenues were missed by 24 percent (a detailed analysis will follow).”

4.1.2 Market risk

We identified 402 mentions of market risk in the deal documents, which implies the high relevance of this risk type for VCCs. Market risks are diverse, since they cover various fields, for example, the market entry, market acceptance, market potential, and marketing and sales issues.

VCCs wrote the following about market entry:

“There is still a possibility that the market entry is going to be hindered by competitors in this segment. Owing to the diversification of the customer structure and the proprietary product, this risk is ranked as moderately high.”

“The market entry carries risks, because of the dependence on cooperation partners regarding the development of the products and the resulting licensing contracts.”

For young ventures, the risk associated with market acceptance is highly important, as they enter a new market with a new product or service, meaning the market is not familiar with them. To overcome the problem of newness and market acceptance,

reference customers provide the market with a positive signal. In the deal documents, a high risk due to a lack of market acceptance was described as follows:

“Moderate customer acceptance.”

“Physicians do not sufficiently accept MR-guided procedures in minimally invasive interventions.”

Marketing, i.e. product, pricing, placement, and promotion risks, comprised 10% of the market risks. VCCs documented the following:

“Long marketing cycles to achieve customers’ trust”

“Currently there are deficits in the marketing and sales”

“Decreasing prices for products in this segment. However, material costs are also decreasing.”

Risks due to a lack of sales activities and sales competencies, resulting in shortcomings in terms of the revenue, is a further issue for VCCs:

“Sales are currently stagnating. The venture is not developing as expected. In the future, we have to ensure that sales increase, possibly by hiring new employees. The current orders do not match the venture’s core offerings.”

“We see that the sales cycle is slower than planned and expected. Hence, the venture has not generated any substantial revenue so far.”

4.1.3 Strategic risk

We identified 216 mentions of strategic risks in the deal documents. The predominant risk in this category is competition, which was responsible for 54.6% of the strategic risks. Further risks are, for example, market entry barriers, market positioning, and market structure.

Competition appears to be a crucial risk for VCCs. VCCs mainly described the current competitive situation and competition intensity in the core market. If competition is high, VCCs documented the following:

“Increasing competition in the Asian market due to research projects and spin-offs.”

“Increasing pressure due to competition: There is a risk that potential customers may imitate the venture’s offerings, but the market development appears to be positive.”

“In the coming month, further competitors might enter the market.”

Market entry barriers are a major threat for ventures. If market entry barriers are high, ventures’ market entry might become a tedious process often requiring more resources than expected. Especially technology-based ventures frequently need certifications or approvals to sell their products. Hence, VCCs reported the following:

“There are high market entry barriers for followers.”

“The market entry barriers for this system are extremely high.”

“The market entry is regulated therefore entering the market is often delayed and might become a lengthy process.”

Market positioning reflects the venture’s current or targeted strategic position in the target market, which changes often in the early stage. This regular change is reflected in the following quotations:

“The investment manager perceives the market positioning of the venture as weak, which is not surprising in the pre-clinical phase.”

“The investment manager highlights that competitors crowd the target markets, therefore a different market positioning should be considered.”

4.1.4 Technology risk

Technology risk was documented 426 times in our sample. This risk is particularly relevant in the pre-founding phase, in which founders develop the technology into a viable product. Especially in technology-based firms, the product development process might last several years, often implying a high degree of uncertainty and requiring large financial resources.

VCCs often documented the general status of risk associated with technology.

“General technology risks are not observable.”

“The common technology risks are present. However, they are of minor relevance.”

In their deal documents, VCCs reported the success and failure of prototypes and tests of the venture's technology. VCCs mentioned, for example, whether the tests were done on time, their results, and whether prototypes already existed.

"The third system has been assembled. The evaluation project for a new hardware supplier has been started. The first tests are expected to be completed in [month, year] at the supplier's site and afterwards at the venture."

"While developing the first prototypes [founder 1] and [founder 2] identified several technical problems. This means the systems are not running smoothly."

Furthermore, we observed that some VCCs use external partners to evaluate technology. In the course of such an evaluation, technical due diligences are often conducted.

"The result of the technical due diligence is negative. The evaluator identified several bugs and gaps in the system security. He recommends switching to other software immediately, or eliminating the bugs in the existing software."

VCCs set milestones for the development of technology for portfolio companies and track their achievement:

"Technology development: As reported in June 2011, (the venture) will not reach the technical milestones."

4.1.5 Production risk

A total of 227 quotations dealt with production risks. We were able to identify the three main areas in which risks occurred. The first area was the production's proof of concept. At 42 percent, this risk type was the most addressed area, as described in the following quotation:

"Low production risk as the production plant is already running."

The second category focuses on delays in producing the goods:

"There are long delays in production, as renting a new production space has been impossible to date."

“Proof of quality as assessed by a third party is missing. Readiness for series production not achieved.”

The last area comprises risks in working with suppliers, which the following quotations show:

“We couldn’t deliver our systems, because the [product parts] were missing. We assume that we can resolve the issues with our suppliers on [date].”

“[Supplier] has problems with delivering the goods and can’t supply [company] with enough [product] within the next two years.”

4.1.6 Human capital risk

We identified two major areas of human capital risks by analyzing the documents: Risks concerning the management team and risks concerning the workforce. 39 percent of our 228 identified quotations dealt with risks concerning the management team. In a new venture, the founders are the most crucial human resources, which the following quotations show:

“The company development still relies strongly on the original management team.”

“High dependence, especially in the early stage, on the chief developer (one of the shareholders).”

If one of the founders leaves the company, the company might face severe risks, as described in some cases:

“[Founder 1] says that he will quit his job as CEO with immediate effect, due to personal reasons.”

“The CEO is seriously ill and has been in hospital for two weeks.”

Further, in many cases, the management team was not complete, which required the recruitment of a new manager to fill the gap, which the following quotes show:

“Management team gaps: It is necessary to recruit a vice president of operations for an optimal management team performance. We need him to have enough impact and control on the day-to-day operational side.”

“In the short term, the management team should be extended with a sales director with software experience.”

46 percent of HR risk quotes dealt with the workforce. A major risk is that the team is unable to handle the work, as in the following quotes:

“There are bottlenecks in the IT and not all tasks can be completed. A new developer should be hired.”

“A sales person is urgently needed.”

However, ventures sometimes have problems recruiting qualified employees, as the following quotes show:

“Working on finding new employees (employment agency, temporary employment agency, direct addressing, personal network) has had unsatisfactory results. The job market is empty. There is no engineer with construction experience on the market.”

“Owing to the specialization required, it is unexpectedly difficult to find the required software developer. Other applicants have been interviewed and it seems that there might be qualified candidates.”

4.1.7 Legal risk

Examining the legal risks, we identified intellectual property risks as the most relevant category. 47 percent of all cases of legal risks dealt with intellectual property. The question of patenting opportunities is of especially high relevance for VCCs, which the following quote shows:

“Unlike in the US, genes and their mutations are not patentable in Germany and Europe. Scientific publications can access information on genetic changes and their possible consequence free of charge. Consequently, the tests are not patentable and could be imitated.”

Furthermore, there is a risk due to possible patent infringements, as the following quote shows:

“The patent due diligence has been conducted. The finding is that the US market cannot be accessed due to the patent situation, but no others interferences are expected from other patents.”

If a patent is approved, companies have a competitive advantage. However, a patent filing is not always successful, given the following quote on the risk of imitations:

“Objection to a [company] patent arrived. The management team, with the support of the patent lawyer [patent lawyer], will now investigate this.”

A further risk includes governmental regulations, which were documented in 14 percent of all the legal risk mentions. Therefore, current and future regulations are analyzed:

“A change in the scientific framework (legal framework of working with genetics) could hinder an important part of the business model of [company]. Stronger security guidelines could lead to higher R&D and production costs, and therefore reduce the cost advantage of [product].”

“In the long run, there is a risk of the discontinuation of governmental subsidies for [industry]. At the moment, there is no political statement indicating this development.”

Certification of products can be crucial for entering a market. Hence, if a venture fails to receive certification, this can lead to high risks:

“The company has successfully filed for [certification]. All legal conditions to sell on the European market have been fulfilled.”

Further, legal risks due to problems with the contracts wording:

“The contract has several weaknesses and we therefore recommend removing these in the next financial round.”

Table 4 summarizes our results. The table also includes identified subcategories not previously described, because we focused on the areas most described in the documents. Table 4 provides a holistic view of all the subcategories.

Risk types	Identified subcategories
Financial risk	Liquidity, solvency, revenue development, follow-up financing, bridge financing, financial planning, governmental sponsorships, credits
Market risk	Market assessment, market attractiveness including potential and development, market acceptance, founder's market know-how, marketing and sales, product portfolio, pricing, regulation, customer awareness and behavior
Strategy risk	Competition, market positioning, market structure, market entry barriers, unique selling proposition
Technology risk	Prototypes and tests, proof of concept, marketability studies, certification and patents, quality issues regarding technology, supplier products, competitive positioning of technology, implementation of technology, market acceptance of technology, know-how regarding technology
Production risk	Production delays, supplier issues, increase in prices of raw materials, quality issues after producing the product, changes in production facilities
Human capital risk	Management team, stock of employees, salary issues, parental leave, hiring of external consultants to complement the managing team
Legal risk	Intellectual property, governmental regulations, contracting, tax issues, insurances, legal conflicts with former founders, consultations of lawyers

Table 4: Summary of the different risks reported in the VC documents

4.2 Risk assessment methods

Our second research question aims at answering how VCCs assess and record risks in their deal documents. We found that, in our sample, risk assessment and documentation were done mostly descriptively and highly unsystematically. 94% of the risk mentions were of a qualitative nature, i.e. in the document, investment managers described the existence of a certain risk type in a venture. In most cases, the extent of the risk was outlined. Furthermore, risk management measures were sometimes described. In addition to description of risks, VCCs also used graphical or quantitative risk assessment methods, for example, traffic lights and bar charts. These types of assessment techniques were used in only 6% of all quotes.

We observed two types of traffic lights systems to evaluate the degree of the risks. First, some VCCs assessed risks by means of green, yellow, and red. Other VCCs used a framework differentiating between five evaluations of risk, i.e. green, yellow,

orange, red, and ad hoc. Sometimes VCCs also used colors in their descriptions of risk to illustrate the extent of a certain risk.

In addition, VCCs utilized bar charts with different scales to illustrate whether an issue has a high or low risk for the investment. Our analysis showed that the VCCs primarily applied scales from -3 to +3 or from 0 to 100 percent. We observed that some VCCs used these scales systematically to evaluate common types of risks for ventures, for example, various market and technical risks resulting in a total assessment of the venture.

5 Discussion and conclusion

Our results firstly showed that VCCs documented seven risk types, namely financial, market, strategy, technology, production, human capital, and legal risks, implying their relevance during the VC investment process. Contrary to prior literature, agency (Bengtsson & Sensoy, 2011; Gimmon et al., 2010; Lu et al., 2006) and internationalization (LiPuma & Park, 2012) were not documented in our sample, which may be due to the following two reasons: First, agency risk is a rather theoretical term. However, we assume that agency risk is not a common term in practice and that VCCs included descriptions in other risk types, for example, human capital or financial risks. These risk types might include the motivation of the founder's team or the information asymmetries between the entrepreneurs and the VCCs. In addition, because they are handled implicitly, agency risks might not be documented. Instead, phone calls or personal meetings might be used to address agency risks. On examining internationalization risk, we observed that the ventures in our sample have a rather low tendency to internationalize. Hence, this issue is of less relevance for the VCCs in our data set. Surprisingly, the analysis showed that legal risks were mentioned more than 200 times in the deal documents. To date, this risk type is only found very rarely in the entrepreneurship literature, as most of the prior studies analyzed other types of risk, such as agency risk (Bengtsson & Sensoy, 2011), market risk (Kaplan & Strömberg, 2004; Lu et al., 2006; Wang et al., 2012), and HR/founding team risk (Kaplan & Strömberg, 2004; Kut et al., 2007; Kut et al., 2006; Smolarski et al., 2005). VC contracts and patents were the focus of previous research on legal issues. Our study provides insights into more legal issues, like governmental

regulations, tax issues, insurances, legal conflicts with former founders, and consultations with lawyers.

Our results add to the work done by Chen et al. (2009) and Mason and Stark (2004), as we can confirm that market issues are specifically highly relevant for VCCs in the investment decision making process. However, we cannot support financial risks being the only other important area. Our results further suggest that technology and production issues were documented more often in the pre-investment phase, which contradicts Chen et al.'s and Mason and Stark's results. This finding might be due to our sample's focus on technology-based firms, for which a profound technical analysis is highly relevant before an investment decision is made. VCCs hire industry experts and consultants to conduct technical due diligences and provide their opinions on the technology to evaluate the risk associated with a venture's technology.

Furthermore, we observed variations in the documentation of the risks in different documents, indicating that the relevance of certain risk types changes over time and differs between addressees of specific documents. Financial risks are a major issue in venture reporting, as well as in the board meeting minutes. This implies that VCCs primarily require financial information in a venture's regular reporting. In addition, since the board represents the venture owners, its major focus appears to be the venture's financial development. With regard to decision papers, the market was primarily documented, but also technological and financial issues.

The results regarding the risk assessment topic suggest that VCCs record and assess risks unsystematically and subjectively. Only 6 percent of the VCCs used structured forms like traffic light systems and bar charts to describe risks and their extent. We can thus confirm the results of Moesel et al. (2001), Schefczyk (2006), and Zellmann et al. (2014), who all emphasized the irregularity of risk reporting in VC investments. In addition, this study provides information on qualitative risks, for example, HR, market, and legal risks, which Engel (2003), Rieg (2004), and Schefczyk (2006) identified as a relevant research topic. Qualitative risk factors are primarily described in sentences and merely evaluated by means of traffic light systems or bar charts. Nevertheless, when a firm uses traffic light systems or bar charts, qualitative risks, like quantitative risks, are classified by means of these structured forms.

6. Limitations, implications, and further ideas for research

6.1 Limitations

Risk management is a sensitive topic, which means that some risks might be omitted in the documents. From interviews with expert we knew that strong risks are often only reported as the last possibility. Furthermore, prior literature has shown that decision making in VC investments is often highly subjective (Moesel et al., 2001) and that various factors influence it. Hence, VCCs might not report all risks in their deal documents, which would support the study by Manigart et al. (2002), who show that risk analysis is largely unsystematic and cannot be easily differentiated. However, we think that the variety of documents and the high number of quotations in our study enabled us to create a holistic view of risks in VC investment, although we are aware of the limitations of content analysis.

In addition, our method only allowed us to observe documented risks. For example, agency risk certainly plays a role, as the VCCs in our data set also used reporting, incentives, and vesting or drag-along clauses. These mechanisms help reduce agency risk. However, VCCs did not document agency risks issues directly in the deal documents in our sample. Interviewing VCC investment managers might allow us to gain further insight into how VCCs perceive agency risk and how they deal with this issue.

Furthermore, the sample was only collected from VCCs in Germany; consequently, our results should be transferred to other countries very carefully. The legal requirements for VC funds and VCCs in Germany differ from those of the US where, for example, VCCs are not allowed to be involved operatively with a venture. Deal sizes are smaller in Germany, which means that German VCCs have a different risk aversion. In addition, US VCCs are more professionalized and we can assume that their risk assessment is also more developed.

Further, there might be a possible bias in our findings, due to our sample including VC investments from 2005-2010, i.e. during the financial crisis. The risks were probably rated higher during this period, due to the economic downturn and restricted capital situation.

Our data set consists of a higher share of public and public private partnerships funds. This might create a bias, because public funds can have other investment goals than private funds. Public funds also tend to have a higher risk aversion than private funds. Hence, public funds' documentation and consideration of risks might be more intense and of higher relevance.

Our sample covers early stage VC funds investing in technology based ventures, therefore transferring the results to later stage VC funds or other industry investments, like e-commerce, should be done cautiously.

6.2 Implications and further ideas for research

Our research has several implications for the literature and practice.

In terms of the literature, the analysis has shown that the literature stream is rather underdeveloped, but nevertheless of great practical importance, for VCCs. We aim to encourage discussions on and analyses of this field of research to shed more light on VCC risk management practices. We observed that legal risks were less studied, therefore it might be interesting to analyze the importance and different aspects of legal risks in future studies. A possible research question could be the relevance and peculiarities of legal risks in VC investments in different legal systems. We also identified the importance of a precise specification of a certain risk type, as different interpretations might otherwise arise. This is especially important when creating a survey as a data collection method, because the results might otherwise not be comparable. A further direction for research might be a cross-country analysis of the risks and a risk assessment, as there are several differences between European and US VCCs (see section 6.1 limitations). A mixed method approach including, for example, interviews, verbal protocol analysis, and content analysis might be favorable to explore aspects of formal and informal risk assessment in VC investments. Furthermore, since our sample is limited to early stage VC funds investing in technology-based firms, further investigations into different fund stages and sector specializations might be of interest to explore the differences.

In terms of practice, we showed that the documentation of risks is highly diverse. Broad topics, like financial risk, are often assessed and documented from a high

perspective level by using a single item like a value on a bar chart. Furthermore, asking investment managers to rate financial risks from -3 to +3 might not lead to comparable results, as they would interpret risks differently. A high financial risk might mean not reaching a multiple of five when selling the investment for one investment manager, while, it might mean a strong danger of the portfolio company being lost due to bankruptcy. This difference makes it difficult to compare investment cases within a portfolio. Using a structured assessment of all the risks might ensure comparability and a better assessment of the overall risks. VCCs could thus use a risk matrix to track risks better, which would also make it possible to track and visualize changes in the risk profile. Finally, we observed that risks were mainly described in short sentences. Using visualizations like traffic lights or bar charts might make it easier for investment managers and board members to interpret the current risk status.

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3.2 Risk management in the venture capital industry: Managing risk in portfolio companies

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Abstract

Managing risk is one of the main activities of venture capital companies. Despite the fact that this topic is of high practical relevance, only little research was published on risk management performed by venture capital companies in their ventures. Hence, we conducted a structured literature review which was the basis for developing five hypotheses concerning measures to decrease failure risk in venture capital-backed ventures. We tested these hypotheses with an empirical data set of 93 venture capital-backed ventures in Germany using original deal data from nine different venture capital funds using a structural equation model. We showed that the experience and the skills of the corresponding investment manager have a significant negative impact on the failure risk of a venture. Investment manager's experience and skills were measured by the working and founding experience, the technology expertise and the network size. Hence, the results emphasize the importance of the selection of the investment manager for risk management in venture capital investments.

Keywords

Risk management, failure risk, venture capital, new-technology-based firm

1 Introduction

Risk management can add value and is necessary in all types of companies to secure long-term stability (Frooth, Scharfstein, & Stein, 1993; Mackay & Moeller, 2007). Nevertheless, the topic of risk management is still in its infancy as articles are mainly published in finance and accounting, but less in management or entrepreneurship journals (Bromiley, McShane, Nair, & Rustambekov, 2015). Especially VC investments are well known as high risk investments since VCCs invest in ventures with a high growth but also high risk potential (LiPuma & Park, 2014). Young entrepreneurial firms face the challenge of “liability of newness” resulting in particular difficulties, e.g. shorter expected life, and a greater risk of failure (Ang, 1992; Coleman, 2004). In the investment decision making process, VCCs are often faced with uncertainty about the future performance of the venture and the adverse selection problem. The reason for that is that VCCs have to rely on information about the venture supplied by the entrepreneur (Tourani-Rad & England, 2003). A comparative study by Zacharakis and Meyer (2000) showed that VC investments fail at a rate of 35 to 55 per cent. Young and entrepreneurial firms are an essential part of the German economy and an important source for innovation in order to stay competitive on a global basis. Hence, research on comprehensive risk management for the VC industry is of great practical importance to improve the practices how German VCCs pursue risk management which might reduce the risk of failure of their ventures.

Risk management pursued in VC-backed ventures is only moderately researched in academic literature (Tan et al., 2008; Yoshikawa et al., 2004). Previous studies either focus on single types of risk, e.g. macro-risk (Ning et al., 2015) or liquidity risk (Cumming et al., 2005) or on specific types of risk management measures, e.g. syndication (Wang et al., 2012; Hopp, 2010) or financial contracting and incentive mechanisms (Tan et al., 2008). Studies analyzing comprehensive sets of risk management measures applied by VCCs ventures are limited (see e.g. Kut et al., 2006; Kut et al., 2007; Kut & Smolarski, 2006; Smolarski et al., 2005). These studies used comparable methods and similar samples leading to a lack of new findings (Dimov & Murray, 2008; Milavo & Fernhaber, 2009). However, risk management is one of the core competencies of VCC and therefore a highly relevant topic in practice. One

reason for the limited amount of studies in this field might be the lack of reliable data. VC-backed ventures are private companies and only limited subject to the duty of publishing company data and financial statements (Bygrave, 2006; Neergaard & Ulhoi, 2006).

To analyze risk management measures and their impact on the failure risk of VC-backed ventures we pursued the following research strategy: We conducted a structured literature review to develop five hypotheses on risk management measures applied by VCC in ventures, i.e. the assessment and evaluation of new ventures, contracts, investment manager's experience and skills, governance mechanisms and management support. These hypotheses were tested with a structural equation model using an empirical data set of 93 VC-backed ventures in Germany from nine different VC funds.

As risk management received relatively little attention in entrepreneurship literature (Pinkwart, 2002) and is an important research topic, but largely unsystematic and not easy to diversify (Manigart et al., 2002), we add to literature and practice as follows:

1. We used a rare data set with in-depth quantitative and qualitative data from nine public and private VC funds combining data obtained from a survey with investment managers and original deal documents like business plans, investment committee papers, reporting and annual statements.
2. We provide an analysis of the Germany VC market which was rather moderately studied in literature before. Thereby, we shed light into the risk management practices of German VC funds.
3. The results from our structural equation model imply that particularly investment manager's experience and skills have a statistically significant impact to reduce failure risk in VC-backed ventures. This finding supports Hopp and Lukas (2014) who were among the first showing that investment managers can have technological, industry, financial and managerial experience and leadership skills which might be crucial for the success and failure ventures. Furthermore, governance mechanisms, e.g. milestones and reporting, were heavily applied by all VCC. However, contrary to other studies like Bengtsson and Sensoy (2011) and Tan et al. (2008) we cannot show that

governance mechanisms have a significant effect on reducing the risk of venture's failure.

2 Literature review and hypothesis development

Risk can be defined as the probability and severity of adverse effects (Aven, 2011). Therefore, risk management is crucial to manage the uncertainty of risks. A sound risk management is characterized as proactive, aligned and economic including the identification, estimation, evaluation, treatment and monitoring of possible negative influences on performance (Hain, 2011). VCC are financial intermediaries investing foremost in ventures bridging the gap created by the shortage of appropriate financing for small and entrepreneurial firms (LiPuma & Park, 2014; Okpala, 2012). By investing in ventures VCC bear high risk due to information asymmetries between the investor and entrepreneur known as the principal agent problem (LiPuma & Park, 2014). Hence, VCC apply different types of risk management measures to reduce the risk of the investment. Risk management in VC-backed ventures was sparsely analyzed in academic literature (Tan et al., 2008; Yoshikawa et al., 2004). The studies of Kut et al. (2006), Kut et al. (2007), Smolarski et al. (2005) investigated how buy-out and VC funds in Europe overall, in India, UK, France and Germany manage risk in the pre-screening phase of the investment, in existing ventures, the portfolio risk and macro risk considering a comprehensive set of risk management measures. These studies showed first attempts to analyze a set of risk management measures. Nevertheless, the studies are subject to several limitations especially due to partially small samples.

We conducted a structured literature review to study the current state of academic literature on the topic of risk management in VC-backed ventures. First, we analyzed all entrepreneurship journals ranked in the 55th edition of the Journal Quality List edited by Prof. Anne-Wil Harzing from 2005 to 2015 regarding the keywords "risk", "risk management", "venture capital" and "failure". We identified thirteen relevant studies. Second, we searched in the EBSCOhost Online Research Databases for the abovementioned keywords in the titles and abstracts of all types of academic journals from 2005 to 2015. Overall, we identified 17 relevant papers (see Appendix 1). The

samples of the different studies vary greatly in size and data collection method. A considerable number of studies are of explorative nature due to partly small sample sizes. This implies that this field of research is relatively unexplored offering room for further research. The majority of papers used data from the US and in some cases parts of Europe or Asia. Only few studies were conducted in Germany.

2.1 Risk types in VC-backed ventures

VC investments are subject to several risks. Our structured literature review showed that academic scholars investigated agency risk, financial or liquidity risk, technology risk, market risk, human resources risk, internationalization risk and macro risk. In the following, the different types of risks are described.

Agency risk is often stated as the major risk for VCC due potential problems of adverse selection and moral hazard between entrepreneurs and VCC (Bengtsson & Sensoy, 2011; Lu et al., 2006; Tan et al., 2008). The theory was developed by William Meckling, Eugene Fama and Michael Jensen depicting the conflict of interest between the principal and the agent, in the case of VC founders or managers of the venture and the VCC (Fama & Jensen, 1983; Jensen & Meckling, 1976). Mechanisms like financial contracting, milestones, gradual provision of capital and active involvement in the board are applied by venture capitalists to overcome the information asymmetry between the VCCs and the entrepreneur (Bengtsson & Sensoy, 2011; Lu et al., 2006; Tan et al., 2008).

Liquidity or financial risks are partially used as synonyms in academic literature. Kut et al. (2006), Kut et al. (2007), Smolarski et al. (2005) classified financial risk in their analysis on the level of the portfolio and macro economy. Contrary, liquidity risk was analyzed by Cumming et al. (2005) indicating that VCC adjust their investment decisions according to liquidity risk. Liquidity risk refers according to Cumming et al. (2005) to the exit risk for the VCC in IPO markets describing the risk of not being able to reach an exit in a proper way. The study showed that VCC prefer to invest in high-tech and early stage ventures to defer the exit and increases the syndication size (Cumming et al., 2005). In our analysis, we define liquidity or financial risk as the risk of the venture to become illiquid or even bankrupt.

Technology risk is often used synonymously as product risk, technological risk or technical risk in academic literature. Assessing the technology or product risk is crucial risk for VCC before investing in ventures due to the fact that technologies and products are often not market-ready. Technology due diligences, syndication and the opinions of investment managers with industry experience are used to overcome the risk associated with technologies and products (Kut et al., 2006; Kut et al., 2007; Smolarski et. al., 2005; Wang et al., 2012).

Market risk is mainly related to the commercialization of a new technology (Wang et al., 2012). Ventures often lack the marketing capabilities necessary to take the technology to market (Wang et al., 2012). VCC apply due diligences to assess the market risk as a central part of the investment decision process (Lu et al., 2006). Furthermore, VCC utilize their network and skills to foster the market introduction. According to Kaplan and Strömberg (2002) major market risks are market size and growth, competition and barriers to entry and the likelihood of customer adoption. However, the results indicated that competition, market size and customer adoption risks mentioned at a moderate rate of 40, 31 and 22 per cent in the investment documents (Kaplan & Strömberg, 2002).

Human resources risks are risks associated with the quality and capabilities of the management of the venture. This was analyzed by the studies of Kut et al. (2006), Kut et al. (2007) and Smolarski et al. (2005). In these studies human resources risk was measured by the lack of management performance and the lack of management focus. To mitigate the risk related to the management, VCC can verify the track record of the management team and can invest in management teams which are previously known (Kut et al., 2007). Kaplan and Strömberg (2002) showed that risks associated with the management were mentioned in 61% of the analyses. It was documented that the CEO is a “difficult” person, that the management lacks in financial planning, the management is not able to focus or that the management is young and inexperienced (Kaplan & Strömberg, 2002). In addition, a further risky issue for VCC is an incomplete management team (Kaplan & Strömberg, 2002). Overall, the results indicate that risks associated with human capital are of high relevance for VCC.

LiPuma and Park studied the special topic of *internationalization risk* using longitudinal data of 962 invested rounds in 334 VC-backed ventures (LiPuma & Park, 2014). Variables for risk management were round size, round interval and round syndication. Compared to solely domestic ventures, VCC use smaller syndicates and provide smaller and less frequent rounds of capital for ventures which internationalize opportunistically (LiPuma & Park, 2014).

Volatility and macroeconomic drivers, namely *macro risk*, affect VC investments by the total amount, by the number of deals, and by the average amount per deal (Ning et al., 2015). Types of macro risk can be inflation risk, business-cycle risk, interest rate risk and foreign exchange rate risk (Kut et al., 2006). Therefore, in times of high macro risk VCC adapt their risk preferences and investment strategies by investing in fewer deals with a smaller average amount per deal, raising their investments in later investment stages and injecting a lower percent of cash in the first several financing sequences (Ning et al., 2015).

Failure risk as one of the most severe risks for VCC was not contained in the results of our structured literature review. In a further search we explored that only very few researchers studied this topic empirically (Dimov & De Clercq, 2006). Therefore, we focused in our analysis on this type of risk since failure risk consists partially of the above mentioned risk types according to insolvency literature (Carter & van Auken, 2006; Davila, Foster, & Gupta, 2003; Headd, 2003; Pinkwart, Kolb, & Heinemann, 2015; Pleschak, Ossenkopf, & Wolf, 2002; Schilling, 2002), namely liquidity risk, market risk, human resources risk and technology risk. Therefore we include these risk factors as variables in our model to describe failure risk.

2.2 Risk management in VC-backed firms

The literature review has shown that VCC apply the following risk management measures: 1) assessment and evaluation of new ventures (Kut et al., 2007; Lu et al., 2006), 2) governance (Bengtsson & Sensoy, 2011; Tan et al., 2008) and 3) contracting (Bengtsson & Sensoy, 2011; Kut et al., 2007; Tan et al., 2008). In the course of the interviews with practitioners we identified two further influencing factors to reduce risk in VC investments, investment manager's experience and skills as well as

management support. There might be some interactions between the different risk management measures, e.g. governance mechanisms and management support. In the context of support functions of VCC governance mechanisms are a part of the support functions. However, in this context we separated governance mechanisms from management support due to the fact that governance mechanisms belong to the most important risk management measures in VC deals.

Assessing and evaluating potential new investments are the first steps of risk management VCC can apply in the investment process. Kut et al. (2007) showed that risk management in evaluating new investments is a well-developed area in practice in the VC industry (Kut et al., 2007). VCC have a variety of tools to assess and evaluate potential investment targets regarding risk and return, e.g. performing different types of due diligences like financial, product, market, customer, legal, competitor analysis internally and externally and analyzing audited financial statements (Kut et al., 2007; Kut & Smolarski, 2006; Lu et al., 2006; Smolarski et al., 2005). Information asymmetries can for example be resolved through the overall coherence of the business plan and the VCC's own due diligence report according to Tourani-Rad and England (2003). VCC can also check the risk associated with the management by verifying the track record of the management team and board members and performing criminal background checks (Kut et al., 2007; Kut & Smolarski, 2006; Smolarski et al., 2005). Further measures to be conducted before an investment decision is made can be the consideration of synergies with existing ventures and the risk preferences of the investors of the fund (Kut et al., 2007; Kut & Smolarski, 2006; Smolarski et al., 2005). We assume that a better assessment of the risk before investing might lead to a lower failure rate of VC-backed venture.

Hypotheses 1: *A high effort in assessing and evaluating the investment is negatively related to failure risk of VC-backed ventures.*

Financial contracting can be used by VCC as a protection against downside risk (Bengtsson & Sensoy, 2011; Kut et al., 2007; Tan et al., 2008), but also to generate value in portfolio companies by mitigating the agency problem with financial contracts (Kaplan & Strömberg, 2002). Financial contracting is one measure next to active

involvement (Kut et al. 2007) and direct monitoring to reduce information asymmetry, motivational and financial problems (Bengtsson & Sensoy, 2011). VCC apply financial contracting mechanisms like liquidation preference, anti-dilution rights, cumulative dividends, redemption rights, participation rights and pay-to-play provisions according to Bengtsson and Sensoy (2011) and Tan et al. (2008). Syndication is a common measure in the VC industry to team up for assessing and investing collaboratively ventures to share the risk (Hopp, 2010; Hopp & Lukas, 2014; Smolarski et al., 2005; Wang et al., 2012). Staged financing is a useful control mechanism for VCC to gather information and monitor the progress of the venture having the option to inject further capital when milestones are reached and periodically abandon the venture (Kut & Smolarski, 2006; Tan et al., 2008). Adding to this, Bengtsson and Sensoy (2011) identified that good governance abilities can be a substitute for measures of financial contracting. Therefore, we state that a high use of contracting mechanisms might lower the risk of failure of VC-backed firms:

Hypothesis 2: An extensive use of contracting mechanisms is negatively related to the failure risk of VC-backed ventures.

VCC are known as active investors in their ventures. Risk management mechanisms related to governance like milestones, reporting and an active involvement in the board are applied by VCC to reduce agency risk. This risk type describes the interest conflict in the relationship between the investor and the entrepreneur. A considerable amount of studies investigated how VCC use control and incentive mechanisms to enhance the firm's performance and receive higher returns. Contrary, only a few studies focused on this topic to reduce downside or failure risk (Bengtsson & Sensoy, 2011; Tan et al., 2008). According to Tan et al. (2008) governance risk management measures can be distinguished in either control mechanisms like monitoring (e.g. reporting, frequency of interaction, convertible securities), staged investments, which we allocated to financial contracting, and the allocation of ownership and control rights or incentive mechanisms (Tan et al., 2008). Shares of stock rights of the entrepreneur and employee stock options are incentive mechanisms to reduce agency risk. The greater VCC's monitoring abilities, the more effective is the monitoring at constraining the

entrepreneur's behavior (Bengtsson & Sensoy, 2011). From practice, we know that all VCC use control mechanism, hence we assume:

Hypothesis 3: The extensive use of governance mechanisms are negatively related to the failure risk of VC-backed ventures.

Investment managers are responsible for assessing new ventures and investment decisions in the pre-investment phase as well as the management of existing ventures in the post-investment phase, i.e. communication, meetings, controlling and supporting the venture. Investment managers can have technological, industry, financial and managerial experience and leadership skills which might be crucial for the success and failure ventures (Hopp & Lukas, 2014). According to Hopp and Lukas (2014) more experienced investment managers control their investments less often than less experienced investors. Furthermore, more industry experience allows less frequent and intense evaluation (Hopp & Lukas, 2014). Yazdipour and Constand (2010) argued that researchers cannot ignore the human/managerial/decision-making side in failure prediction. Hence, they suggest in human decisions about the making or breaking of a private company a shift from the commerce/operational (effect) side of failure analysis to the human/managerial/decision making (cause) side of it (Yazdipour & Constand, 2010). We assume that an experienced investment manager can be better in assessing risk and using countermeasures which can lead to a lower failure risk of VC-backed firms:

Hypothesis 4: The degree of investment manager's experience is negatively related to the failure risk of VC-backed ventures.

A variety of studies proved that VCC add value to their portfolio companies (Alperovych & Hübner, 2013; Manigart et al., 2002; Sapienza, 1992; Sapienza, Manigart, & Vermeir, 1996) by applying different types of value added services like financials, governance, strategy, operational improvements and human capital improvements (Bottazzi, Da Rin, van Ours, & Berglöf, 2002; Cumming et al., 2005; Guo & Jiang, 2013; Tang, Zhang, & Jun, 2014; Timmons & Bygrave, 1986). We transferred the positive effects from management support to the literature of risk

management in the VC industry. Hence, we assume that management support can have an impact on the failure risk of VCC's portfolio companies:

***Hypothesis 5:** The extensive use of management support provided by VCC is negatively related to the failure risk of VCC's portfolio companies.*

3 Data and method

3.1 Sample

Our sample consists of 93 VC-backed firms collected from nine different public and private public partnership VC funds in Germany. Considering the statistics of the Bundesverband Deutscher Kapitalbeteiligungsgesellschaften, which recorded 433 seed investments in Germany from 2005 to 2010, our sample covers 21.5% of the seed investments in this time frame in Germany. We conducted a survey with the corresponding investment managers. In addition, we had access to the original deal documents including the business plans, investment committee papers, reporting and annual statements of the investments. That enabled us to collect in-depth quantitative and qualitative data.

Considering our data set, the VC-backed firms are on average 4.6 years old at the time of data collection. In the seed round the firms received on average 784,487 Euros as investment and in the series A round 1,202,948 Euros (see table 2). The firms in our data set are technology-based firms as they operate in the industries information technology and automation (39 %), life science (34%), material science (9 %), energy (5 %), communication (4 %) and others (9 %).

Variable	Mean	Median	Std. Dev
Age of ventures	4.59 years	5	2.09
Size of founders team	2.85 founders	3	1.13
Number of founding rounds	1.98 rounds		0.89
Investment sum Seed	784,487 Euros	644,109 Euros	519,577
Investment sum Series A	1,202,948 Euros	816,287 Euros	1,179,085
Number of investors Seed	2.55	2	1.98
Number of investors Series A	3.94	3	2.54

Table 1 Overview of our data set

3.2 Measures and variables

We used a structural equation model approach to build and test our model because failure risk can hardly be measured directly. Hence, we used a set of proxy variables. We built a partial least squares (PLS) model because of its suitability for proxy variables and the lack of existing scales in this field of research (Ainudding, Beamish, Hulland, & Rouse, 2007; Henseler, Ringle, & Sinkovics, 2009). Furthermore, the fit of PLS models compared to covariance based methods for sample sizes smaller than 100 also attributed to our choice (Fornell & Bookstein, 1982). Not all of our items follow normal distribution. Hence, they would have been omitted once using a covariance based approach. In PLS models items do not have to follow a certain distribution (Hulland, 1999). In addition, we use variables measured with a 5-point Likert scale in our model. PLS models support the use of nominal, ordinal and interval scaled data (Fornell & Bookstein, 1982, Nitzl, 2010; see also Brinckmann, McShane, Nair, & Rustambekov, 2011; Menzar & Nigh, 1995). We decided to use a reflective measurement model for the outer constructs of the risk management measures, the control variables and the construct of business failure as well as for the inner construct for two reasons. Reflective measurement models have defined reliability test criteria and are well researched (Roy & Tarafdar, 2012). Further, our indicator variables strongly correlate within our construct.

3.2.1 Dependent variables

Measuring failure risk of a company is difficult. Therefore, we measure failure risk by proxy variables, namely human resource risk, technology risk, financial risk and market risk based on the literature of bankruptcy and insolvency (Pinkwart, Proksch, Schefczyk, Fieger, & Ernst, 2015). Pinkwart et al. (2005) showed that 80 per cent of the reasons for failure include a lack of management companies or management companies. Other studies confirmed human resources as an important reason for business failure (Carter & van Auken, 2006; Headd, 2003). A further cause of failure is risk related to the technology of a venture (Schilling, 2002). These companies are dependent on developing their technology to a working and marked-proved product. If ventures do not succeed in reaching the market readiness in a timely manner development costs can grow in outstanding way which ventures often cannot afford (Pleschak et al., 2002). Difficulties in getting a follow-up financing, miscalculation for the capital need and bad planning are among the most common reasons for business failure, namely financial risk (Davila et al., 2003; Headd, 2003; Pleschak et al., 2002; Thornhill & Amit, 2003). New ventures often need too long to break even or even fail because of the lack of financial resources. A further reason for the failure of companies can be found in the area of the market. Problems with the market entry or in marketing and sales are among the most common reasons of failure (Dowling & Drumm, 2002; Pleschak, 2002; Wagner, 1994). This can be explained by a lack of experience in marketing and sales as well as an overoptimistic planning (Hall, 1992; Thornhill & Amit, 2003). In addition, new companies often rely on a few key clients leading to a strong dependency from these customers (Brüderl, Preisendörfer, & Ziegler, 1996; Guggemoos, 2012). We measured the five above mentioned risk types by the assessment of the supervising investment managers on a scale from 1 to 5 (1: very low risk, 5: very high risk).

3.2.2 Independent variables

As mentioned in chapter 2.3.3 we identified five groups of risk management measures applied by VCC, i.e. assessment and evaluation of new ventures, contracting, governance, investment managers' experience and skills and management support.

Each group was measured by different items since VCC use several risk management measures for each group comprehensively in practice.

We used different items to measure the degree of assessment. We first looked if an external assessment of the company was done. From the VCC documents we knew that often external companies are hired to evaluate e.g. technology, market and legal risks. Further, we looked at the intellectual property protection. If the technology is protected by e.g. patents or registered designs the market and technology risks might be lower. In addition, we measured if the VCC relied on their network in assessing the technology and the competencies of the founders.

Contracts handle different aspects of risks between the entrepreneur and the VCC. An important item is liquidation preference. A high liquidation preference lowers the risk of VCC as it minimizes possible losses. We analyzed how strongly a liquidation preference was used. Further, we measured the number of syndication partners. Syndication is a possibility to share risk with other investors. Further, we looked at the investment sum. If the investment sum is lower it might increase the risk of failure in terms of liquidity. In addition we intended to measure if staged financing was used. However, due to the fact that this was the case for all our cases we did not include this item in our model.

Governance mechanisms like reporting and milestones are useful to assess risks continuously. To measure governance we included five proxy variables in our model. At first we looked if milestones were used and monitored. VCC often use milestones to bind founders to certain goals. If milestones are reached, founders receive the full investment sum. In addition, we looked at reporting. From expert interviews we knew that successful companies report regularly. If the company does not perform as expected, reporting rates might decrease. We therefore measured how heavily VCC rely on reporting. Furthermore, we included personal exchange in our model as it indicates a high interaction between founders and investment managers. Fourthly, we included the variable information through network in our model. According to principal agent theory a conflict exists between founders and VCC due to information asymmetry. Therefore, if VCC use their network to lower information asymmetries

risks might be reduced. Lastly, we investigated at the shares of the founders. If the founders still have a high share of equity they might be more motivated financially and incentivized even if they lost decision rights due to the contract with the VCC.

Investment manager's experience and skills might have a significant influence on the failure risk of ventures. We described the experience and skills of the investment manager by five variables. First, we looked at the working experience. More working experience might make it easier to deal in business environment. Second, we assessed the founding experience. Third, we analyzed the expertise with the field of technology. Forth, we assessed the business skills of the investment manager. An investment manager has to have a profound understanding of business to be able to evaluate the development of the ventures. Lastly, we analyzed the network size. With a superior network, the investment manager has more possibilities to get additional knowledge and support for areas he is not an expert on.

We measured the degree of management support by six variables. Firstly, we looked at the support by the VCC using own competencies. Bringing in their experience in the company might lead to better development of the portfolio company. Further, we looked at sales support. Young companies often fail because of a lack of sales activities. A support in the area could possibly lead to a lower risk of failure. Thirdly, we analyzed support with technology. For new ventures technology is a crucial success factor. Fourthly, we examined strategic support. A strong strategy is often an indicator for successful firms. In addition, we looked at support in follow-up financing. For new ventures it is critical to raise additional financing in a timely manner to avoid illiquidity and bankruptcy. Lastly, we measured the use of network in general to lower the risk of the venture after the investment took place. Networks might be useful to get new customers or consultants for solving issues.

3.2.3 Control variables

We controlled for age and industry. The risk of failure might be higher when companies are younger. Albach (1987) suggested that for most companies the highly probable chance of failure ends after five years. In addition, some industries might have higher failure rate than others.

4. Results

4.1 Descriptive statistics

The results of the descriptive statistics are presented in Appendix 2. The failure risk was measured on a 5-point Likert scale (1: very low, 5 very high). The statistics show that liquidity risk has the highest value of 3.652 at the lowest standard deviation of 1.152. Technology risk was rated on average at 2.711 depicting the lowest failure of risk measures, but at the highest standard deviation of 1.455.

The descriptive statistics for the five groups of risk management present that governance mechanisms like milestones (mean = 4.247) or reporting (mean= 4.355) at a standard deviation of below 0.8 were deployed consistently high by the VCC in our sample. The same applies for risk management like obtaining references of founders (mean=4.086), liquidation preference (mean= 4.096) or support in follow up financing (mean= 4.065).

4.2 Results of structural equation model

The resulting path model is shown in table 2. The degree of assessment and evaluating new ventures has no significant influence on the failure risk. The t-statistic is not significant on a 95 per cent level for this construct. Therefore, we rejected H1.

Looking at contracting, we found no significance due to low t-statistics. Hence, we rejected H2.

Governance is not significant considering the low t-statistics. Therefore, we rejected H3.

Our results show a high impact of investment manager's experience and skills on failure risk of VC-backed firms. This is indicated by the high factor loading as well as the high value of the t-statistics. The connotation of the loading is negative stating that a high experience leads to low risk. Thus, we accepted H4.

Construct	Loadings	t-Statistics	Cronbach's alpha	Composite reliability	AVE	f ²	q ²
Assessment and evaluation of new ventures	0.157	1.559	1	1	1	0.030	0.012
Contracting	0.194	1.239	1	1	1	0.039	0.006
Investment Manager's experience and skills	-0.273	2.046**	0.682	0.806	0.511	0.088	0.014
Governance mechanisms	-0.224	1.300	0.705	0.818	0.604	0.037	0.012
Management support	0.451	3.219**	1	1	1	0.241	0.053
Failure risk	-	-	0.715	0.823	0.540		

Tables 2: Reliability measure of the PLS model

Significance of * 90 % level, ** 95 % level, *** 99 % level

The control variables, age and industry, had no significant effect. We therefore removed them from the final model.

4.3 Results of inner models

In the following, we looked at the indicator variables of the single constructs. The indicator loadings and t-statistics are shown in table 4. Looking at the construct assessment and evaluating ventures the only significant variable was expert assessment. IP protection, references for technology and references for founders are not significant. Analyzing the construct contracting only liquidation preference is significant. We omitted the items syndication partner, investment sum and shares of investors. All items except of business skills were relevant when we looked at the construct investment manager's experience and skills. In the construct governance mechanisms all variables were significant.

Looking at the construct business failure all variables were significant and had a high factor loading. The factor loading was above 0.6 for all our variables which is an acceptable value (Hair, Ringle, & Sarstedt, 2013). This showed the validity of our approach to measure failure risk by using the four most important risks of bankruptcy.

Item	Loadings	t-Statistics	Item	Loadings	t-Statistics
Assessment and evaluation of new ventures			Management support		
Evaluation	1	-	Use of Contacts	1	-
Contracting			Failure		
Liquidation	1	-	HR risk	0.624	3.695**
Investment Manager's experience and skills			Liquidity risk	0.775	9.426**
Working experience	0.797	2.258**	Market risk	0.701	5.126**
Founding experience	0.705	2.957**	Technology risk	0.823	7.904**
Network size	0.623	1.976**			
Technology expertise	0.722	2.066**			
Governance mechanisms					
Milestones	0.883	2.926**			
Information through network	0.663	2.231**			
Reporting	0.770	2.828**			

Table 3: Loadings and t-statistics of the items

*Significance of * 90 % level, ** 95 % level, *** 99 % level*

4.4 Reliability measures

We followed the framework of Hair et al. (2013) to assess the reliability of the PLS model. We therefore looked separately at the structural model and the measurement model.

4.4.1 Reliability measures of structural model

The R^2 of our model was 0.282 which is an acceptable value (Huber, Herrmann, Meyer, Vogel, & Vollhardt, 2007; Nitzl, 2010). The Q^2 value was greater than zero and therefore indicates a predictive relevance of the model (Henseler et al., 2009). The effect size of the constructs contracting, investment manager's experience and skills, governance and support were above 0.02 showing a weak effect. The effect size of the construct assessment and evaluation of new ventures was below 0.02. This is not surprising as the t-test is not significant and the factor loading is below 0.2. The

predictive relevance for the construct investment manager's experience and skills is weak stated by a value above 0.02. The value for predictive relevance for the constructs is below 0.02 indicating a low predictive relevance. We choose to include the constructs in the model due to the explorative nature of the study.

4.4.2 Reliability measures of structural model

Indicators with a loading below 0.4 were stepwise removed so that only indicators with a standardized indicator loading above this value were included in the model. This is an acceptable approach according to Henseler et al. (2009) and Hair et al. (2013). All indicators are significant on a 95 per cent level determined by the t-statistics. The internal consistency reliability was measured by Cronbach's alpha and composite reliability. The value for Cronbach's alpha was above 0.6, which is permissible (Nunnally & Bernstein, 1994). The composite reliability was above 0.7 for all the constructs (see table 1), which is an acceptable value (Henseler et al., 2009; Hair et al., 2013). The average variance accepted (AVE) was used to measure the convergent validity. This approach is widely accepted in literature (Fornell & Larcker, 1981; Hair et al., 2013). All the measures were above 0.5 showing an excellent value. We used Fornell-Larcker criterion results, cross loadings and heterotrait-monotrait ratio of correlations (HTMT) to test for discriminant validity (Fornell & Larcker, 1981; Ringle, Wende, & Becker, 2015). The model passed all three tests as described in the appendix (A2).

5 Discussion and conclusion

Based on a structured literature review, the analysis of qualitative data of nine VC funds and an empirical analysis using a structural equation model we studied five groups of risk management measures VCCs can partake in their ventures to reduce failure risk. We empirically tested the relevance for each group of risk management measures. As a result, we show which risk management measures have an influence on business failure of VC-backed ventures.

First, the assessment of the investment prior the decision had no significant influence to reduce the failure risk in VCC's ventures in the model. Therefore, we cannot

support the studies of Kut et al. (2007), Kut and Smolarski (2006), Lu et al. (2006), Smolarski et al. (2005) and Tourani-Rad and England (2003) showing the significant relevance of assessment and evaluation in the pre-investment phase. One reason might be that this is often seen as the most important part in the investment decision process. The usage of different assessment methods was high for all cases in the sample (see descriptive statistics in A1), which confirm Kut et al. (2007) that risk management in evaluating new investments is a well-developed area in practice in the VC industry. However, the difference between the usages within the ventures might not be very high resulting in no significant influence.

Second, the construct contracting is not significant. Hence, we cannot support the results of Bengtsson and Sensoy (2011), Kut et al. (2007) and Tan et al. (2008) that financial contracting can be used by VCC as a protection against downside risk. A reason for that could be that VCC use similar formats of contracting, which also can be seen in the descriptive statistics (A1). In addition, all VCC used staged financing, syndication and milestone with each venture. This implies no significant differences across the cases in the sample.

Third, the results show that governance mechanisms are not significant to reduce failure risk in the model. The descriptive statistics showed that governance mechanisms are extensively used in all ventures supporting no significance of the statistical results (see A1). Considering this result, we cannot support Bengtsson and Sensoy (2011) and Tan et al. (2008) who found significant evidence for the importance of governance mechanisms in VC risk management.

The construct investment manager's experience and skills as a risk management measure in VC-backed ventures are significant, which was rarely discussed in literature before. This finding continuous the discussion of Hopp and Lukas (2014) who were among the first showing that investment managers have various competencies, skills and experiences which might be crucial for the success and failure ventures. Also the study of Yazdipour and Constand (2010) highlighted the importance of human capital in failure prediction of private firms. If the investment manager is more experienced the VC-backed ventures have less failure risk as the investment

manager might be able to uncover possible problematic issues earlier and use the right countermeasures. In addition, we found that also VC-backed ventures supported by investment managers with founding experience have a lesser risk of failure.

Last, we found that management support is significant. Counter-intuitively, the connotation is negative. The extensive use of management support leads to a higher risk. This might be a chicken-and-egg problem. Possibly, investors only extensively support their portfolio companies when risk is already high which might be too late to save the company. To test this assumption we created a PLS model to analyze the influence of business failure on the degree of management support. We found that a high chance of business failure has a positive impact on the degree of management support as described by the use of VCC's network and bringing external consultants into the portfolio company. Therefore, we can assume that this result might be explained by a chicken-egg problem. Considering this problem in the study, we recommend further investigation on the use of the risk management measures in the VC industry. It would be interesting to analyze if risk mitigation measures are only used when a risk occurred or also in a preemptive way.

6. Limitations and implications

6.1 Limitations

Like most empirical studies the research is subject to several limitations. First, we could not assess all risk management measures identified in literature. A holistic model including further risk management measures could lead to additional results.

Secondly, we used a self-assessment of the investment managers for their experience in a survey. This might introduce a possible bias. However, the survey covered a variety of different areas of VC financing wherefore it was not clear for the investment managers that a connection between their experience and the risk was made.

Thirdly, we focused on German technology start-ups from public and private VC funds. It is unclear if the results can be generalized to other countries and all types of new ventures. Therefore, similar studies, e.g. using data in the US or Asia, might

uncover similarities and differences between risk management measures across countries.

The data set consists of a higher share of public as well as public private partnership funds which also could include a possible bias as public funds might pursue a different investment and risk management strategy as private funds.

The quantitative approach does not allow to further study changes in the perceived failure risk over time. A qualitative approach to explicitly study the development of the risks in different investment stages could further yield to new results.

In addition, the use of PLS does not allow to control for endogeneity effects which is also discussed in current literature (Henseler, Dijkstra, & Sarstedt, 2014, Ronkko & Evermann, 2013).

The results might be partially biased due to the fact that our sample includes VC investments from 2005-2010, i.e. during the financial crisis. It might be possible that risks were higher during that time because of the economic downturn and the restricted capital situation.

6.2 Implications

Our research has several implications for the literature and practice.

In terms of the literature, the analysis has shown that the research stream of risk management in VC investments is rather underdeveloped, but nevertheless of great practical importance, for VCCs. We tested the effectiveness of different risk management measures on lowering the risk of business failure in new ventures. Thereby, we showed the importance of risk management on the probability of failure. With this article we aim to encourage discussions on and analyses of this field of literature to shed more light on VCC risk management practices. The results indicate the relevance of the investment manager in risk management in VC investments. Continuing this discussion, a possible research question could be which experiences, skills and knowledge as well as what kind of interaction between founders lowers venture's failure risk. Another research direction might be a cross-country analysis as

there are several differences, e.g. legal, between European and US VCCs. The German law for asset management companies like VCC prohibits active involvement of the VCC in the portfolio firm. VCC are only allowed to provide advice which also impacts their risk management practices. Further one, a mixed method approach including, for example, surveys, verbal protocol analysis, and content analysis might be favorable to explore aspects of formal and informal risk assessment in VC investments. Furthermore, since our sample is limited to early stage VC funds, further investigations into different fund stages might be of interest to explore the differences across investment stages.

In terms of practice, we showed that all VCC in our sample pursue comparable risk management measures for the assessment and evaluation of new ventures, in contracting as well as in governance issues. Looking at the descriptive statistics we observed that particularly governance mechanisms, liquidation preferences and partially assessment and evaluation measures are extensively applied by VCC in their ventures in our data set. Nevertheless, their mechanisms do not show a significant influence on failure risk, which might be explained by the fact that they act like hygiene factors. Our study provides empirical evidence for the great importance of investment manager's experience and skills which could be understood as the motivator of the analyzed risk management. Considering our empirical results, LPs and VC funds should therefore rely on highly experienced employees managing ventures. The results suggest that VCC have to invest in their human capital to improve the skills and knowledge of their investment managers as well as the working environment and conditions to hire the best investment managers. In that course, an exchange between more experienced and younger investment managers triggered by the VCC might be a possibility to achieve a knowledge transfer.

Appendix A1: Overview of academic work on risk management in VC-backed ventures from 2005-2015

Reference	Sample	Data collection method	Data analysis method
Bamford & Douthett (2013)	Initial public offerings (IPO) n = 545	Investors Daily Digest and Barron's	Descriptive statistics Logistic regression OLS estimation
Bengtsson & Sensoy (2010)	Private partnership VCs n = 646 Start-up companies n = 1,266 Investment rounds n = 1,534	Private Consulting firm VCExperts	Descriptive statistics Correlations Kruskal-Wallis test Probit regression OLS regression Heckman-Sorensen Index
Cumming et al. (2005)	Investment rounds n = 18,774	VentureExpert	Descriptive statistics Logit regression Poisson regression Comparison of proportions and means tests Correlations
Hopp (2010)	Capital contributions n = 2,373 (961 ventures and 437 VCCs)	Thomson Venture Economics	Descriptive statistics Correlations Logistic regression
Hopp & Lukas (2014)	VC investments n= 2,373 in Germany	Public sources and Thomson Venture Economics	Descriptive statistics Correlation matrix Weibull duration model Heckman type selection model
Kut et al. (2007)	Venture capital and buy-out funds n = 142	Survey	Descriptive statistics Mann-Whitney test Pearson chi-square test
Kut et al. (2006)	Venture capital and buy-out funds n = 142	Survey	Descriptive statistics Mann-Whitney test Pearson chi-square test Logit regression OLS regression
Kut & Smolarski (2006)	Private equity funds n = 33 from Germany and France n = 21 from India	Survey	Descriptive statistics Mann Whitney test Pearson Chi-square test

LiPuma & Park (2014)	Invested rounds n = 962 VC-backed technology companies n = 334	InfoUSA's CorpTech data	Descriptive statistics Pearson Correlations GLS regression Poisson regression
Lu et al. (2006)	VC firms n = 34	Questionnaire survey EDB and AVCJ	Descriptive statistics Mann-Whitney-Wilcoxon Correlations Two-sided Pearson chi-square Hierarchical regression
Maula, Autio, & Murray (2009)	Technology-based firms n = 91	Venture Economics Database Survey	Descriptive statistics Correlations Standardized factor loadings Goodness of fit statistics
Ning et al. (2015)	Venture investments and deals n = 68	Money Tree Report from PriceWaterhouseCoopers/ National Venture Capital Association using data from Thomson Reuters	Descriptive statistics Correlations Multiple regression models
Payne, Davis, Moore, & Bell (2009)	VC firms n = 26 VC investors n = 52	Survey	Descriptive statistics Varimax Rotated Factor Loadings Correlations GLS regression Multivariate regression
Pbrimah & Prakash (2010)	VC firms n = 584	Jay Ritter's VentureXpert	Descriptive statistics Tobit regression OLS regression Variance-covariance matrix
Smolarski et al. (2005)	Private equity funds n = 32 from UK n = 21 from India	Survey	Descriptive statistics Mann-Whitney test Pearson chi-square test
Tan et al. (2008)	VC firms n = 53	Survey	Descriptive statistics
Wang et al. (2012)	VC-backed companies n = 1,757 (772 reporting sales information) Financing rounds	VentureXpert Alliances database	Descriptive statistics Correlations Regression analysis (OLS, negative binomial model)

	n = 5,896 (1,757 VC-backed companies)		
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Table 4: Overview of academic work on risk management in VC-backed ventures from 2005-2015

Appendix 2: Descriptive data of dependent and independent variables

	Mean	Std. Dev	Scale	Data Source
Failure risk				
HR risk	3.200	1.317	Rating from 1 to 5	Survey with investment managers
Liquidity risk	3.652	1.152	Rating from 1 to 5	Survey with investment managers
Market risk	3.311	1.304	Rating from 1 to 5	Survey with investment managers
Technology risk	2.711	1.455	Rating from 1 to 5	Survey with investment managers
Assessment and evaluation				
Expert assessment	3.795	0.915	Rating from 1 to 5	Survey with investment managers
IP protection	3.435	1.424	Rating from 1 to 5	Survey with investment managers
References of technology	3.806	1.002	Rating from 1 to 5	Survey with investment managers
References of founders	4.086	0.686	Rating from 1 to 5	Survey with investment managers
Contracting				
Liquidation preference	4.096	0.990	Rating from 1 to 5	Survey with investment managers
Number of syndication partners	2.568	1.975	Metric	Term sheet
Investment sum	436,169	206,874	Metric (Euros)	Investment committee papers
Investment manager experience and skills				
Working experience	3.311	0.932	Rating from 1 to 5	Survey with investment managers
Founding experience	3.237	0.993	Rating from 1 to 5	Survey with investment managers
Technology expertise	3.355	0.842	Rating from 1 to 5	Survey with investment managers
Business skills	3.946	0.578	Rating from 1 to 5	Survey with investment managers
Network size	3.720	0.851	Rating from 1 to 5	Survey with investment managers
Governance				
Milestones	4.247	0.789	Rating from 1 to 5	Survey with investment managers
Information through network	4.323	0.710	Rating from 1 to 5	Survey with investment managers
Reporting	4.355	0.653	Rating from 1 to 5	Survey with investment managers
Shares of Founder	83.30	8.830	Per cent	Term sheet
Personal exchange	4.323	0.710	Rating from 1 to 5	Survey with investment managers
Management support				
Support with competence	3.554	0.881	Rating from 1 to 5	Survey with investment managers

Support with sales	2.681	0.987	Rating from 1 to 5	Survey with investment managers
Support with technology	2.304	1.117	Rating from 1 to 5	Survey with investment managers
Support with strategy	3.839	0.664	Rating from 1 to 5	Survey with investment managers
Support with follow-up financing	4.065	1.046	Rating from 1 to 5	Survey with investment managers
Use of network	3.785	0.900	Rating from 1 to 5	Survey with investment managers
Control				
Age	4.598	2.086	Metric	Business Plan
Industry – IT	0.385	0.473	Binary	Investment committee papers
Industry – Life Science	0.344	0.463	Binary	Investment committee papers
Industry – Material Science	0.098	0.177	Binary	Investment committee papers
Industry – Energy	0.057	0.108	Binary	Investment committee papers
Industry – Telecommunication	0.041	0.079	Binary	Investment committee papers
Industry – Other	0.090	0.164	Binary	Investment committee papers

Table 5: Descriptive statistics

Appendix A3: Discriminant validity

In table 6, the Fornell-Lacker criterion is shown. The table shows the latent variable correlation. In the diagonal the square root of the AVE can be found. This value should be higher than all values below and left in the table to pass the discriminant validity. This is the case for our model.

	Failure risk	Assessment and evaluation	Contracting	Investment manager experience and skills	Governance	Management support
Failure risk	0.735					
Assessment and evaluation	0.225	1.000				
Contracting	0.361	0.214	1.000			
Investment manager experience and skills	-0.183	0.130	-0.158	0.715		
Governance	0.201	0.298	0.435	-0.050	0.777	
Management support	0.383	0.304	-0.416	0.197	0.641	1.000

Table 6: Fornell-Lacker Criterion

In table 7, the cross loadings of each item in our PLS model are shown. Each variable should load highest on its corresponding construct. Then, the discriminant validity test is passed. This is the case in our model.

	Failure risk	Assessment and evaluation	Contracting	Investment manager experience and skills	Governance	Management support
Failure risk						
HR risk	0.624	0.006	0.019	-0.199	-0.126	0.046
Liquidity risk	0.775	0.105	0.338	-0.222	0.184	0.245
Market risk	0.701	0.297	0.353	0.071	0.241	0.339
Technology risk	0.823	0.212	0.259	-0.202	0.187	0.380
Assessment and						

evaluation						
Evaluation	0.234	1.000	0.214	0.130	0.298	0.304
Contracting						
Liquidation	0.361	0.214	1.000	-0.158	0.435	0.416
Investment manager experience and skills						
Working experience	-0.137	0.177	-0.080	0.797	0.127	0.290
Founding experience	-0.159	0.078	-0.256	0.705	-0.292	-0.174
Network size	-0.110	-0.018	0.007	0.623	0.096	0.291
Technology expertise	-0.106	0.123	-0.068	0.722	-0.001	0.261
Governance						
Milestones	0.227	0.161	0.414	-0.056	0.883	0.476
Information through network	0.098	0.349	0.181	0.015	0.663	0.577
Reporting	0.114	0.304	0.366	-0.055	0.770	0.541
Management support						
Use of network	0.383	0.304	0.416	0.197	0.641	1.000

Table 7: Cross-Loadings

In table 8, the heterotrait-monotrait ratio of correlations (HTMT) is shown. If the HTMT is below 0.900 discriminant validity has been established between two constructs. This is the case for all of our items.

	Failure risk	Assessment and evaluation	Contracting	Investment manager experience and skills	Governance	Management support
Failure risk						
Assessment and evaluation	0.249					
Contracting	0.390	0.214				
Investment manager experience and skills	0.332	0.168	0.174			
Governance	0.342	0.407	0.481	0.271		
Management support	0.407	0.304	0.416	0.430	0.797	

Table 8: Heterortrait-Monotrait Ratio Criterion

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3.3. Value adding activities of venture capital companies: A content analysis of investor's original documents in Germany

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Value-adding activities of German venture capital companies: A content analysis of investors' original documents

As many studies have shown, venture capital companies pursue value-adding activities for their portfolio firms to achieve abnormal returns compared to the market. Value-adding activities are complex and highly diverse, but also are very relevant to practice. Hence, the topic has been considerably analyzed in academic literature. However, in-depth knowledge is still lacking owing to the sensitivity and scarcity of publicly available data from venture capital companies. We provide in-depth details into the practices of venture capital companies. Using a longitudinal data set obtained from nine venture capital companies in Germany, we qualitatively analyzed the companies' value-adding activities. Drawing on investors' original documents, including business plans, investment committee papers, reports and annual statements of the investments, we created a typology of which value-adding services were performed. Results suggest that, consistent with prior studies, venture capital companies are highly engaged in supporting ventures with respect to financial and human capital issues as well as in establishing strong governance mechanisms to reduce information asymmetries between founders and investors. Further, support through venture capital companies' network of relevant contacts is moderately applied. Support for operational issues is of low relevance.

Keywords: venture capital; non-financial value-added; non-financial contributions; value creation; new venture

Introduction

New technology-based firms are an important accelerator for innovation activity and growth in economies. However, a major bottleneck for the evolution and growth of start-ups is the availability of capital. Fortunately, venture capital (VC) is an especially widespread and developed form for financing new and innovative businesses. This financing type for start-ups bridges the gap created by the scarcity of long-term favorable financing that is considered appropriate for small firms (Okpala 2012). VC investments are high-return investments in small, high-risk firms (Lam 1991). A variety of empirical studies showed that VC-backed firms perform better than non-VC-backed firms (Barry and Mihov 2013; Bessler and Seim 2012; Chiampou and Kallett 1989; Dagogo and Ollor 2009; Di Guo and Jiang 2013; Robinson 1987; Rosenbusch, Brinckmann, and Müller 2013), that VC IPOs generate positive returns after the IPO (Bessler and Seim 2012), and that VC backing is associated with efficiency gains and successful exits (Chemmanur, Krishnan, and Nandy 2011; Nahata 2008).

The main purpose of venture capital companies (VCCs) is the provision of capital for young, entrepreneurial ventures. However, VCCs earn abnormal returns compared to the market – a phenomenon that cannot be explained solely by the capital provision. Empirical studies have shown that VCCs provide supporting functions for innovative start-ups and have mechanisms to overcome the problem of information asymmetries (Alperovych and Hübner 2013; Di Guo and Jiang 2013; Fleming 2004; Sapienza 1992, 1996). High returns are influenced by screening and value-adding effects (Di Guo and Jiang 2013), and value-adding activities can be an important driver of VC-backed firms' performance (Alperovych and Hübner 2013). Two studies have identified that high involvement of VCCs has a positive correlation with positive returns (Sapienza 1992, 1996).

Despite prior studies that led to notable empirical results and contributed to the topic of VC, in-depth knowledge is still lacking as to how and to what extent VCCs in different countries conduct value-adding activities. Germany has besides the UK and

France the most relevant and largest VC market in Europe and is a hub for high-tech start-ups. However, owing to varying legal systems, entrepreneurial cultures, risk aversion, and degrees of professionalization, VC markets' characteristics differ across countries. The German legal and tax systems for VCCs and VC funds differ from those in the US and the UK, and deal sizes in Germany are smaller and VCCs are not as professionalized as US VCCs. UK and US VCCs are the most involved in their ventures and add the most value compared to other European countries (Sapienza et al. 1996). Thus, a reasonable assumption is that value-adding activities might be performed differently in Germany.

In our study, we analyze VCCs' value-adding activities to create a holistic typology considering the specifics of the German market. In that effort, using content analysis to study investors' original documents we qualitatively assessed various types of value-adding activities applied by German VCCs. However, we do not investigate how VCCs' involvement affects the new venture's performance. The paper makes four contributions:

- (1) The study provides in-depth insights into the question of what kinds of value-adding activities VCCs apply in their ventures.
- (2) The study reflects rare access to detailed VC information in that we obtained a unique, longitudinal data set from nine public and private VCCs in Germany that encompassed data of 95 VC-backed ventures. This data set led to 587 qualitative quotations on the topic of value-adding activities.
- (3) We created a typology of value-adding activities enabling a holistic view of what activities VCCs perform, continuing the research theme initiated by Gorman and Sahlman (1989) and Sapienza et al. (1996).
- (4) The results confirm prior studies stating that VCCs support in the areas of financial, strategic, governance, and operational improvements and through networks, as well as in human capital issues. However, VCCs mainly apply financial, governance and human capital value-adding activities (Sapienza et al. 1996). In contradiction to established literature (Gorman and Sahlman 1989;

MacMillan et al. 1989; MacMillan et al. 1989; Maula, Autio, and Murray 2005), operational improvements are of low relevance in this study.

Literature analysis

VCCs exercise strong fundamental skills in selecting and monitoring their portfolio companies, setting the foundation for their superior investment performance (Achleitner, Engel, and Reiner 2013), and the value-creation measures or value-adding activities applied by VCCs have received increasing attention in academic literature.

Academic scholars have investigated whether VCCs apply different types or comprehensive sets of value-adding activities in their portfolio companies. Agarwal and Chatterjee (2007) showed that VC-backed firms are more successful owing to VCCs' entrepreneurial skills, motivations, and strategy. Cumming, Fleming, and Suchard (2005) identified that VCCs pursue financial, administrative, marketing, and strategic/management value-adding activities. Large and Muegge (2008) showed that operating, outreach, consulting, mentoring, and recruiting are the most influential categories for creating value in VC-backed firms. The results of MacMillan et al. (1989) suggested four distinct areas of involvement: development and operations, management selection, personnel management, and financial participation.

Prior studies have shown that some value-adding activities are commonly applied across VCCs with respect to financial, strategic, governance, operational, network, and human capital improvements. Therefore, we focus on these value-creation levers in our analysis.

Financial improvements

The main sources for return generation in VC-backed firms are financial improvements such as capital infusion and helping to raise further capital to overcome financial constraints (Alperovych and Hübner 2013). VC is effective in helping young, innovative firms to overcome credit constraints (Bottazzi et al. 2002), and the involvement of VCCs in start-ups leads to raising more capital (Chang 2004; Gorman and Sahlman 1989).

Strategic improvements

The topic of strategic value-adding activities has so far been moderately discussed by academic scholars in the context of VCC activities. According to Gorman and Sahlman (1989), one of the activities most frequently performed by portfolio companies is to assist in creating strategic analyses. Owing to active involvement of the board, VCCs support strategy formulation and revision in their portfolio firms (Rosenstein 1988). In fact, VCCs' strategic involvement is their most important role (Sapienza, Manigart, and Verme 1996). Prior work has found that VCCs help to improve new ventures' strategy when daily pressures on the management of the start-up lead to postponement of this task (Timmons and Bygrave 1986), although other research did not find statistically significant support for strategic information provided by VCCs (Busenitz, Fiet, and Moesel 2004).

Governance improvements

VCCs are active investors and add value to their portfolio companies owing to their active involvement (Alperovych and Hübner 2013). VCCs apply mechanisms like milestones, gradual provision of capital, and active involvement in the board to overcome the information asymmetry between investors and founders. The level of monitoring and control depends on the percentage of equity VCCs hold, as well as the percentage of seats on a new firm's board of directors held by VCC (Barney et al. 1989). Studies have shown that VCCs monitor, control, and actively manage their investments (Alperovych and Hübner 2013). When risk is higher, VCCs are more likely to try to structure the deal in a way to exercise close monitoring and control over the new venture (Barney et al. 1989). Reporting requirements are eclectic, but a shift seems to be occurring toward greater use of quarterly reporting and portfolio valuation as well as more frequent direct contact between VCCs and their limited partners (Robbie, Wright, and Chiplin 1997).

An important way in which VCCs add value non-monetarily is by serving as a director on the board (Rosenstein et al. 1993). In VC-backed firms, the board is typically small and controlled by outsiders, and the presence of the VCC increases the frequency of

independent board members (Brunninge and Nordqvist 2004). As some of the outside members often have a high degree of experience and a close relationship with the management (Rosenstein 1988), the VCC can significantly improve the professionalism and independence of the board of directors (Tang et al. 2014). One study showed that the level of monitoring and control depends on the level of business and agency risk associated with investing in a new firm (Barney et al. 1989).

Operational improvements

Academic literature shows that VCCs' activism has an influence on growth, profitability, efficiency, employment, and innovation activity of the entrepreneurial firm. Examples of operational value-adding services are giving advice regarding the technology (Maula, Autio, and Murray 2005), formulating marketing plans (MacMillan et al. 1989), developing production or service techniques (MacMillan et al. 1989), and operational planning (Gorman and Sahlman 1989). VC-backed firms are able to extract more interest from optimization of the operating cycle (Alperovych and Hübner 2013). VCCs' involvement supports the effects of technology commercialization on the performance of new ventures (Chen 2009), which might be due to VCCs' entrepreneurial experience, manpower, and creativity (Chen and Chang 2013). VC-funded firms have a higher number of patent applications (Engel and Keilbach 2007), and they can push toward building absorptive capacity and more permanent in-house R&D efforts (Prelicean and Boscoianu 2008).

Support through networks

The provision of networks is one of the most value-adding activities of VCCs since venture capitalists exploit their networks to find potential partners, clients, and suppliers (Alperovych and Hübner 2013). The impact of networks on success has been demonstrated empirically (Bellavitis, Filatotchev, and Kamuriwo 2014; Hochberg et al. 2007). Furthermore, networking through contacts to other firms and professionals has been rated as an important success driver in venture capital-backed firms (Sapienza, Manigart, and Verme 1996). However, networking is not as important as financial and strategic support. VCCs also improve governance by using their

networks to recruit specialized independent directors with industry experience (Suchard 2009).

Support in human capital issues

One of the most frequently performed activities for VC-backed firms is management recruiting (Gorman and Sahlman 1989) and, related, the overall improvement of human capital of new firms (Hellmann and Puri 2002). VCCs support their portfolio companies in finding key management team members (Timmons and Bygrave 1986) or replacing the founder with an outside CEO (Hellmann and Puri 2002). Furthermore, as VCCs have significant experience in investment, industry, consulting, and entrepreneurship (Alperovych and Hübner 2013), these skills can be transferred to the portfolio companies to further develop venture managers' skills. Entrepreneurial experience, manpower, and creativity have a positive impact on the new venture's performance in terms of profitability and patent creation (Chen and Chang 2013), and the coaching function is important to drive growth in portfolio companies (Colombo and Grilli 2009). Interpersonal roles such as the mentor role add value in VCCs' portfolio companies (Sapienza, Manigart, and Verme 1996).

Regardless of value-adding activities' great importance and positive effects on a new venture's performance, some studies have shown that venture capital investments do not outperform the market (Achleitner, Engel, and Reiner 2013; Becsky-Nagy, Balázs, and Fazekas, 2014; Brau, Brown, and Osteryoung 2004; Florou 2005; Kirkulak 2008). This finding might be partially explained by the negative effects of VCCs' involvement, especially with the governance mechanism, which requires a lot of time for the founder and reduces the founder's resources for focusing on the core activities to develop the venture. Furthermore, VCCs are often not experts in the industry or the technology the venture is operating in. Hence, their involvement and suggestions can be counterproductive for the venture.

Data and method

Our sample consists of 95 VC-backed firms, and the data were collected from nine public and private VC funds in Germany. The companies were financed between 2005

and 2010. Our sample covers 21.9% of the seed investments in Germany in this time frame according to the statistics of the Bundesverband Deutscher Kapitalbeteiligungsgesellschaften (the German venture capital association), which recorded 433 seed investments in Germany from 2005–2010. We had direct access to investors' original documents, such as business plans, investment committee papers, and regular reporting and annual statements of the investments. This access enabled us to collect in-depth qualitative data regarding the value-added activities as well as general quantitative data about the investments, such as the investment sums and number of investors.

The VC-backed firms in our data set were on average 4.6 years old at the time of data collection. In the seed round, the firms received on average €784,487 as investment from 2.55 investors and in the Series A round €1,202,948 from 3.94 investors (Table 1). Firms in our data set are technology-based firms as they operate in the industries of information technology and automation (38 %), life science (34 %) and material science (10%), energy (5 %), communication (4 %) and others (9 %). Descriptive statistics of our data set appear in Table 1.

---Please insert Table 1 about here---

We relied on content analysis to determine what kind of value-adding activities VCCs use to create value in their portfolio firms. This method entails a systematic approach to reading a body of texts, images, tables and symbols, not essentially from an author's or user's perspective (Krippendorff 2013). We decided to employ this data collection approach because we observed that the majority of studies in this research stream used surveys, interviews, or databases to collect data (e.g., Bellavitis, Filatotchev, and Kamuriwo 2014; Fried and Hisrich 1995; Knyphausen-Aufseß 2005; Saetre 2003; Steier and Greenwood 1995). However, these types of data collection are subject to several limitations. In most cases, the response rate of surveys or interviews is rather low, which reduces the relevance of the study because it represents only a small share of the whole population. In addition, survey or interview responses are subject to several biases, such as being socially desirable answers or not measurable by

standardized scales. Databases are limited in their degree of detail because they are primarily based on publicly available data and thus do not offer data on internal practices of VCCs. However, collecting data is consistently difficult in VC research. This is especially the case for value-adding activities, the VC investment selection process, and performance data since they are among the most sensitive data of VCCs. In addition, start-ups are less obliged to publish company data than large corporations, which also increases the difficulty of gathering data on VC deals.

As mentioned above, we analyzed the original deal documents of the VCCs in our sample. To ensure a high reliability of our approach we used investigator triangulation (Krippendorff 2004). In total, we analyzed more than 500 documents. In multiple encoding rounds, we discussed our results and removed any quotations that could not be directly tied to value-adding activities.

To organize and structure the data, we used the Gioia methodology (Gioia et al., 2012). In the first step, we read the documents multiple times. Three researchers developed codes based on the documents' content to find reiterated patterns of meaning. While creating codes, we educed a coding scheme that relied on thematic analysis (Braun and Clarke 2006), which is useful to identify, analyze, and report data patterns or categories. The main benefit of this analysis is that it structures and describes the data set in great detail. The identified codes were then collected and organized into the first-order categories (Gioia et al., 2012), which we separated into subcategories. We deleted the less relevant topics to refine the codes once more (Flick, 2015), which resulted in the second-order analysis (Gioia et al., 2012). Last, we aggregated the second-order themes into the final dimensions.

We conducted a pre-test with three VCCs, collecting data for nine ventures. We used this pre-test to find out which documents to use to document possible value-adding activities and created a coding scheme. To ensure the anonymity of the ventures in our sample, we substituted the names of the ventures and persons with general terms and indicated that by using square brackets. Quotations were translated from German to English.

Results

In total, we identified 587 mentions of value-adding activities in the documents. Of all the mentions, 35% referred to the decision paper and 32% referred to the reporting of the venture. In addition, in 28% of VCCs reported their value-adding activities in the board meetings. Other documents account for only a small proportion of the overall mentions. Table 2 summarizes which risks are described in which documents. In the following discussion, the findings in each category of value adding activities are described.

---Please insert Table 2 about here---

Financial improvements

While analyzing financial improvements we were able to identify 108 relevant quotes in the documents. The support in follow-up financing belongs to one of the most mentioned categories of value-adding activities in the documents. As the following quotes show, VCCs are highly involved in the preparation, organization, and negotiation of follow-up financing.

Preliminary talk with the management about a follow up financing. The [investment manager] made clear that the precondition for a further financing round is reaching a revenue target (e.g., 10 million Euros).

The investors are in final negotiations with a [business angel]. The fund management expects the closing of the next financing round with [business angel] on [date].

We saw that often portfolio companies were not able to find follow-up financing in the predefined time frame. Therefore, bridge financing was provided to ensure the survival of the company.

Because of the low liquidity, investors except [investor 1] and [investor 2] decided to conduct a bridge financing although the company failed to reach the last milestone.

We pay the urgent bill of [venture] (2nd warning) in advance of our next payment; therefore an agreement with [venture] will be made today. From now on, weekly visits of [venture] are necessary to check liabilities and resolve conflicts.

Further, VCCs were highly involved in the preparation of a possible exit. To that end, VCCs helped in identifying and evaluating potential exit channels.

A meeting with the management of [potential exit partner] will be held on [date]. An agenda should be created together with [investment manager] and [investment manager] should join the [management] (for the meeting).

Visit of [potential exit partner] to evaluate an exit option. Result: Investment manager and management think that they should position the company as exclusive partner.

In addition, VCCs assisted ventures in creating realistic financial planning and budgets.'

Possible goals and strategies for next year were discussed with [manager 1] and [manager 2]. [manager 1] will think about it and create a budget plan [for new strategic partner].

Strategic improvements

In the deal documents, we identified 177 mentions of strategic improvements induced by VCCs. VCCs supported their ventures primarily in the overall business as well as through sales strategy. The forums for this type of support were usually strategy meetings. A meeting's results were often presented and discussed in the board meetings. Afterwards, the board approved the strategy, provided further ideas for strategic directions, or highlighted deficits of the venture's strategic development.

In considering the overall business strategy, VCCs discussed potential strategic directions of the venture, such as cost leadership or niche and mass strategies. VCCs used scenario analysis to evaluate potential strategic growth directions together with

the management of the venture. In addition, the deal documents identified value drivers for the investment.

The investment manager supports the targeted strategy establishing the brand as cost leader in the respective market.

[Manager 1] and [Manager 2] informed the audience regarding potential growth scenarios which can be found in the presentation. The management is going to develop these scenarios further and plans to present the outcome at the shareholder's meeting.

Since sales strategy was mentioned relatively often in the deal documents it can be assumed that this is an important issue for VCCs and that they regularly intervene. The analysis has shown that new ventures developed the sales concept in cooperation with the VCCs. VCCs also gave advice if sales processes could be optimized, if a sales department needed to be restructured, or if sales partnerships should be intensified or even closed.

The existing sales partnership should be reviewed, adapted and cancelled if necessary.

Due to the low sales performance the venture has to restructure the sales department in [year].

We found mentions that in some cases, VCCs recommended buy and build strategies. They discussed with the venture's management team whether a buy and build strategy was a worthwhile direction for the venture, and searched with the venture for potential targets, evaluating these with respect to opportunities and threats. VCCs also supported the checking of purchase contracts with respect to critical terms.

The idea of a buy and build strategy was analyzed in cooperation with [investment manager]. The management of [venture] and [investment manager] are currently not finding any potential targets. They agreed to keep this idea in mind.

The analyses indicate that VCCs sometimes supported their ventures regarding their market entry strategy. This can be the case for either the overall market entry or the market entry in new countries. VCCs recommended whether, when, and how a market entry was sensible for the venture. In this regard, the respective sales strategy was also part of the discussion.

The investment committee evaluates the market entry in other countries without any personal presence as critically due to the restricted financial budget for this industry.

Governance improvements

With 124 relevant codings, governance-related involvement of VCCs belongs to the most often mentioned value-adding activities in the documents. VCCs in our sample used contracting to ensure their governance rights. Seats on the board and regular information about the status of the company are defined in contracts.

[VCC1] and [VCC 2] have the right to place a board member and also to send a guest.

Referring to §5 of the constitution of [venture] the operating plan has to be approved by the supervisory board.

Our results showed that VCCs used milestones to control their portfolio companies and to ensure a positive development of the venture. A milestone agreement can take the following form:

Milestones are: 1. 243,233 Euros at the signing of the contract and registering the shared capital increase in the trade register, 2. 121,617 with gaining at least 12 customers with signed contracts by [date 1]. 135,150 with gaining at least 18 customers with signed contract by [date 2] or earning a cumulated revenue of at least 500,000 Euros by [date 3].

However, we observed that in practice, milestones were frequently not reached. As a consequence, VCCs often had to change the deadline or even cancel the milestone to ensure the venture's survival.

The milestone was postponed in agreement with the board and [VCC 1] and [VCC 2] as hiring a chief financial officer was not possible in time.

The milestone for [company] is not reachable anymore. [VCC 1] and [VCC 2] nevertheless decided to further support [company]. The support of the other investors, however, is a must. Discussions will start soon.

We identified that the quality of ventures' reporting was critical, and was not sufficient in several cases. Hence, VCCs forced ventures to improve their reporting.

The reporting is working only slowly and we strongly advice to send it in time. The new reporting guidelines should be implemented in the following month.'

The management only provides very little information. We strongly advise to work closer together.

Operational improvements

We found 11 quotations in the area of operational improvements. Sometimes operational issues were discussed in board meetings. VCCs seemed to actively engage in the venture only if a critical issue was apparent or if the venture was close to bankruptcy. Even in these situations, it was not uncommon to hire external advisors.

The management of [venture] has declared temporary bankruptcy. The fund management is discussing countermeasures with the management of [venture] to ensure its survival.

The situation of [venture] is very difficult and the management of [VCC 1] has hired a [consultant] to support the venture.

In rare cases, we found recommendations that were operational:

The investment committee suggests integrating a customer satisfaction form into the ordering process.

A new design of the website is discussed as project for the future. [Investment manager] recommends giving the redesign of website, flyers and letterheads to one agency to ensure a consistent design with recognition value. [Investment

manager] suggests contacting [company] – we had good experience in the past in designing a corporate identity with this agency.

In addition, we saw that VCCs provided support in the creation of contracts and legal issues. However, in this case VCCs relied primarily on external partners.

Call of investment manager with [patent layer] to discuss the possible license contract with [potential seller of products].

Support through networks

For support through networks, we found 39 mentions in our sample. VCCs often have large networks of consultants, advisors, coaches and industry experts that the venture can draw on.

Our results suggest that VCCs exploited their network to find further co-investors for follow-up financing. In this context, VCCs contacted potential investors and conducted negotiations for the venture. Furthermore, VCCs recommended which investor might be the best choice for the venture.

[VCC 1] is going to provide [the venture] further useful contacts to financial and strategic investors.

We identified that some VCCs made contacts to potential new customers for the venture. Owing to a VCC's reputation, the business deal might be more likely for a start-up that is unknown and new at the market. This finding is especially relevant for the market entry to find first reference customers.

Existing market contacts were intensified finding first strategic partners to bring the software into the market.

We are going to make the following reference calls for the venture.

In our sample, a few VCCs used their networks to find potential original equipment managers or distributors for their ventures. First, VCCs recommended which companies might be potential sales partners and made contact with them. Second, they supported the negotiations and cooperation with the sales partners. In addition, we observed that VCCs helped to develop provisional models for sales partners.

[VCC 1] recommends searching for a new distributor at the US east coast. Furthermore, [investment partner] suggests getting in contact with an industry expert to evaluate the sales problems, but also the potential in the US.

[Investment partner] is going to contact [company 1], [company 2] and [company 3] in order to support the sales initiatives of [venture].

A small number of VCCs recommended the engagement of a merger and acquisition advisory, sometimes suggesting which advisory would be a suitable partner for the venture.

From the point of view of the investors involving an M&A advisor preferably in the US seems to be sensible to increase the probability of success.

VCCs rarely established contacts between portfolio firms. In that case, the VCC tried to identify synergies between the ventures and looked for potential customers or cooperation partners.

The VCC is looking for another portfolio firm which might be a potential customer for the venture.

Support in human capital issues

In the coding process, we identified 110 relevant mentions in our sample of value-adding activities concerning the human capital of VC-backed ventures.

VCCs pointed out which job positions should be filled and developed job profiles together with the portfolio firm. Furthermore, VCCs were sometimes involved in the interview process or recommended potential candidates. Recruiting issues were often part of milestones. When a milestone was reached, a certain vacancy could be filled. Additionally, staffing a position could be a milestone target.

After filling the sales back-office the target is to find a further sales employee. The managing partner has advertised the vacancy. This task is supported by [investment manager].

Investors and managers agree that after closing the next financing round a full-time CFO position should be established and filled.

Our analysis suggests that among the VCCs in our sample, the use of external or internal coaches seems to be an established method for supporting their portfolio firms. Some VCCs systematically utilized coaches with special industry or functional experience to develop the ventures further. Sometimes these coaches temporarily filled critical vacancies in the start-up. VCCs proposed several potential candidates as coaches, from which the venture chose. In addition, VCCs intervened if a coach did not work out as intended.

It is planned to establish a coach as well as a supervisory board.

Currently no coach works together with the start-up. Both investors are searching for potential candidates to support in business development, sales and investment decisions.

Some VCCs in our sample advised their portfolio firms to hire consultancies to get advice for special projects, such as the development of better organizational processes or the creation of a marketing strategy. VCCs often recommended certain consultancies with profound expertise for the respective project.

The development of the organization with lean and fast processes is conducted by the [venture] in cooperation with [consultancy].

We observed that a few VCCs supported ventures in terms of salaries. For example, the VCC might determine changes in salaries and bonuses of the management team or recommend the establishment and configuration of employee participation models. In addition, we found in some cases that VCC determined cuttings in wages if the venture is in an unsecure financial situation.

For important employees of the venture a virtual employee participation model should be established in [year] with approval of all investors. Therefore, maximum 5% of the capital stock is available. The allocation is up to shareholders and investors.

Salaries of employees were realigned. Salaries of already existing employees are related to prior salaries. However, these employees are willing to give up

parts of their salaries (founders -15%, non-founders -10%). These voluntary salary cuts were incentivized through exit profit participation.

Some VCC induced layoffs of employees and in the management team. We observed that this was the case due to trimmings of the organization or insufficient suitability and incompetency of the respective employee or manager.

Today we do not have any arguments arguing against the dismissal. Hence, we are going to support the layoff of the CEO at the end of [date].

Summary of our results

Analyzing the documents confirms that value adding activities take place in the six areas of finance, strategy, governance, operations, networks and human capital. Each area consists of a variety of value adding activities. These activities are summarized in table 3.

---Please insert Table 3 about here---

Discussion

The results showed what kind of value-adding activities VCCs in Germany undertake to support their ventures during the investment phase. Our investigation disclosed a great variety of value-adding activities, some of which support the findings of previous studies (e.g., Fried and Hisrich 1995; Gomez-Mejia, Balkin, and Welbourne 1990; MacMillan, Kulow, and Khoylian 1989; Sapienza et al. 1996), but also add to literature.

The degree of support varies greatly across ventures and VCCs. For one investment case the VCCs documented 25 value-adding activities, whereas for three ventures no value-adding activities at all were mentioned in the document. One reason for no mention of activities could be that the founders were so experienced they required no value-adding activities. Another reason could be that the investment manager was inexperienced and therefore not able to offer activities. A third reason might be that value-adding activities occurred, but were not documented.

Several explanations, such as different country settings, different strategies of VCCs, or VCCs' experience, account for why some VCCs either are more involved in their portfolio firms or report more activities than other VCCs. The legal requirements for VC funds and VCCs in Germany differ from those in the US where, for example, VCCs are not allowed to be involved operatively with a venture. Furthermore, VCCs in the US are more professionalized and are more actively involved in their portfolio firms (Sapienza et al. 1996). A further reason for the different levels of VCCs' involvement might be the strategy of the VCCs. Some VCCs perceive themselves as strategic partners and company builders for their portfolio firms, whereas other VCCs might act solely as financial investors. A third explanation for varying VCC involvement stems from VCCs' business and industry experience: VCs with operating experience in the venture's focal industry can add significantly more value than those with less industry-specific experience (Sapienza et al. 1996).

Our analyses indicated that VCCs are highly involved in governance issues in their portfolio firms and that governance mechanisms are a widespread form of value-adding activities. The data collection methods may reflect mainly the perspective of VCCs, which require a lot of reporting from their portfolio firms. As our study chiefly reflects VCCs' perspective and not the perspective of the founder, our study might overstate the importance of governance mechanisms. However, the relevance of governance improvement is also supported by prior published literature showing that governance mechanisms – such as active involvement through the board, reporting, milestones, and contracting – are commonly applied in VC practice (e.g., Alperovych and Hübner 2013; Barney et al. 1989; Brunninge and Nordqvist 2004; Robbie, Wright, and Chiplin 1997; Rosenstein 1988; Tang et al. 2014). As VCCs can only roughly estimate the founding team's motivation and performance, governance mechanisms can be useful in overcoming the problem of information asymmetries between founders and investors. However, since we observed that governance improvements are a distributed practice across VCCs, they might not be the value-adding lever for standing apart from the competition and developing the venture into a high-flying investment.

Our analysis shows that, consistent with the findings of Hellmann and Puri (2002), VCCs often perform value-adding activities in the area of human capital. The support ranges from recruiting, salary and remuneration, and promotion to dismissal issues, as was also shown by prior studies (Gomez-Mejia, Balkin, and Welbourne 1990; MacMillan, Kulow, and Khoylian 1989; Saetre 2003). Human capital is the one of main resources of a new venture. However, VCCs prefer that founding teams are complete in terms of experience and competencies in the investment selection process – possibly so as to lessen the effort human capital issues require during the investment phase.

Our results show that financial improvements, in addition to governance and human capital improvements, belong to the most recorded value-adding activities in the documents. This finding is not surprising since financing the venture is one of the core activities of VCCs. VCC support in gaining follow-up financing often takes the form of bridge financing in the case of liquidity issues, and VCCs also offer support in preparing the exit and in financial planning. Prior studies have shown comparable results (e.g., Ehrlich et al. 1994; Fried and Hisrich 1995; Gabrielsson and Huse 2002).

Strategic improvements of the venture were moderately mentioned by VCCs. Investment managers often have experience in starting a business or in consulting or banking, allowing ventures to benefit from these experiences. This knowledge might be especially useful for founders with other backgrounds or experiences, like natural science. The study showed that several VCCs provided support in various strategic issues, ranging from business, market entry, buy and build, or expansion strategies. The majority of prior studies showed in general that VCCs support their ventures strategically (e.g., Busenitz, Fiet, and Moesel 2004; Knyphausen-Aufseß 2005). However, the results of our study offer in-depth information as to the areas of strategy and the extent to which VCCs support their ventures in strategic issues.

The results indicated that support through contacts was documented only moderately often, which somehow contradicts former publications since various studies have shown that VCCs open their network for their ventures. However, the extent to which

VCCs make contacts for their portfolio firms in prior studies is not clear (e.g., Fried and Hisrich 1995; Gabrielsson and Huse 2002; Gorman and Sahlman 1989; Saetre 2003; Sapienza 1992; Timmons and Bygrave 1986). Our results showed that VCCs made contact for their ventures with a wide range of people or institutions, including potential customers, advisors, and marketing agencies.

Operational value-adding activities were rarely performed in this sample, which might be explained by a variety of reasons. VCCs may not have the capacities to provide operational assistance to all ventures since investment managers often supervise five to ten investments at the same time. Furthermore, the German legal system prohibits asset-managing companies like VCCs from operationally engaging with their ventures. As VCCs are only allowed to give advice, their operational involvement in the deal documents could violate the law. Nevertheless, operational value-adding activities might occur without documentation. Furthermore, European VCCs are less involved in their ventures than US or UK VCCs, also in terms of operations (Sapienza et al. 1996). VCCs tend to hire coaches or external consultants.

Overall, owing to the data collection method operational improvements might be underestimated in this study. In contrast to this study's results, a considerable number of other studies showed that VCCs affect operations and the operating performance of ventures through various forms of involvement, such as operational planning and monitoring, operating activities, or cost and quality control measures (e.g., Ehrlich et al. 1994; Fried and Hisrich 1995; Gabrielson and Huse 2002; Gorman and Sahlman 1989; MacMillan, Kulow, and Khoylian 1989; Saetre 2003) .

Implications and limitations

Implications

We have shown that VC can provide a broad portfolio of value-adding activities throughout the investment phase. However, what VCCs intend and document regarding their involvement in their portfolio firms appears to be rather inhomogeneous and only partly structured in terms of documentation. Possibly, founders are not aware of which value-adding activities can be provided by the

respective VCC. Hence, selecting the most suitable and valuable VCC can be a murky and uncertain decision for founders. In addition, VCCs may inform the founder during the investment decision-making process what kind of value-adding activities they can offer. Nevertheless, as our results indicated that some ventures were not supported formally at all, some VCCs may not apply value-adding activities for their ventures.

For VCCs, a systematic application of value-adding activities might increase the chance of successful investments. We observed, for example, that governance mechanisms are a common method across VCCs since they are applied in nearly all cases in our sample. Other activities are offered irregularly, perhaps depending on a venture's need. A continuous analysis of which value-adding activities are relevant for which ventures might be sensible to ensure that all ventures receive the support necessary to become a successful investment for the VCC.

However, a strategic question arises: Should value-adding activities be performed to make successful investments more successful or to minimize risk in low-performing ventures? Further, some researchers provide evidence that VC investments do not outperform the market (e.g., Achleitner et al. 2013; Becsky-Nagy, Balázs, and Fazekas 2014; Kirkulak 2008). A reason might be the focus on only financial support.

Limitations

As content analysis was used as the research method, the study is subject to several limitations. In addition, the study has some further limitations owing to the peculiarities of the sample.

First, since content analysis is a purely descriptive research method, the study could only assess what was written and intended by the VCCs in the documents. That is, only what is described can be analyzed. As a result, informal support in particular is not part of the analysis. The findings reflect more the perspective of the VCCs than that of the founder, who might have a diverging view on the VCCs' involvement. Furthermore, we cannot check on whether the VCCs kept their promises as to what they intended and document regarding their involvement and how this might affect the

venture's performance. However, we believe that most value-added activities are documented as this provides evidence of their existence to other stakeholders.

Second, the content analysis might not be objective since it depends on the writer's point of view as well as the interpretation of the researchers.

Further, the sample has a focus on technology-based ventures. Hence, whether these results can be generalized to other industries is unclear. Technology-based ventures may need more support in business issues, as their founders often have a technical background instead of a business background.

In addition, the sample contains only German VCCs and German VC investments. Transferring the results to other countries could be problematic, especially in light of different legal systems as in the case of operational value-adding activities. A cross-country comparison might provide further insights into this issue.

Lastly, the data set consists of a greater share of public than private VCCs, which could create a bias as public VCCs might have other investment goals and strategies than private VCCs.

Conclusion

This study provides content analysis evidence for a wide range of value-adding activities among 95 VC-backed investments in Germany. We classified value-adding activities into six categories that we identified in a pre-test and created a typology. The findings suggest that most VCCs are formally involved in their ventures. However, the extent of involvement differs greatly. Our results show that financial, governance, and human capital improvements are of highest relevance, which is consistent with prior literature. Thereby, VCCs support their ventures in various issues. Operational value-adding activities play a minor role owing to legal requirements of asset-managing companies in Germany.

Overall, the findings indicate that applying value-adding activities in VC investments is common for VCCs in Germany. However, the great variance suggests that there is no structured application of value-adding activities. This circumstance opens up

several avenues for future research, including analysis of the strategy and motives behind value-adding services of VCCs. Our main suggestion is that future research pursues the question of whether deviance from intention for VCCs' involvement is prevalent and how this might affect ventures' performance.

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Table 1. Descriptive statistics for the data set.

Variable	Mean	Std. Dev
Age of portfolio companies (years)	4.59	2.09
Size of founders' team (founders)	2.85	1.13
Number of founding rounds (rounds)	1.98	0.89
Investment sum seed (Euros)	784,487	519,577
Investment sum Series A (Euros)	1,202,948	1,179,085
Number of investors seed	2.55	1.98
Number of investors Series A	3.94	2.54

Table 2. Mentions of different types of value-adding in venture capital documents.

Type of value adding	Business plan	Due diligence	Decision paper	Venture reporting	VC reporting	Board meeting minutes	Total
Human capital	0	0	59	27	4	20	110
Network	0	0	15	16	0	8	39
Strategy	0	0	15	15	6	11	47
Strategy (board)	2	0	24	32	7	65	130
Governance	0	0	44	52	3	25	124
Financial	1	0	40	34	3	30	108
Operational	0	0	5	3	1	2	11
Others	0	0	6	10	0	2	18
Total	3	0	208	189	24	163	587
Percentage	0.51%	0.00%	35.43%	32.20%	4.09%	27.77%	100.00%

Table 3. Summary of the different value-adding activities reported in the VC documents.

Value adding lever	Identified sub categories
Financial improvements	Follow-up financing, bridge financing, preparation of exit, financial planning
Strategic improvements	Business strategy, sales strategy, buy and build strategy, market entry strategy, engagement of consultancies, strategic partners, business plan
Governance improvements	Contracting, milestones, reporting
Operational improvements	Operational recommendations (e.g., process or organizational optimization, support in cost-cutting, support in marketing, support in legal issues)
Support through networks	New investors (e.g., other VCC, business angels or strategic investors), potential customers, sales partners, M&A advisors, portfolio firms of the VCC, appraisers, marketing agencies, recruiting firms
Support in human capital issues	Recruiting, coaching, consulting, salaries and remuneration, layoffs, replacement of CEO, promotions

3.4 Value adding activities in venture capital literature: A review on data, variables and methods

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Abstract

Established literature has shown that venture capital funds' high returns can be partly attributed to value adding activities performed by the venture capital firms in their portfolio firms. Despite of the topic's importance, to date there is no structured literature review providing possibilities for improvements concerning data and methods. This paper provides a literature analysis on value adding activity measures in venture capital investments, synthesizes the variables measuring the main levers of value adding and identifies directions for improvement in terms of data, variables and methods. Hence, I studied 37 articles regarding the type of data collection method, methodology, sample region and variables. The analyses showed that data are primarily gathered through databases or surveys which are subject to several limitations. To measure value adding activities great inconsistencies exist regarding the variables used. Therefore, to assure a better comparability of studies in this research stream, this paper calls for other data collection methods and the development of established variables and scales.

Keywords

New venture, venture growth, venture capital, value adding, value creation

Introduction

During the last three decades there is a growing interest in academia in the topic of value adding activities applied by VC (venture capital) firms to their portfolio companies to increase the chance of successfully exiting the investment. A number of studies showed that VC-backed firms achieve higher returns than non VC-backed firms (Barry and Mihov, 2013; Bessler & Seim, 2012; Chiampou & Kallett, 1989; Dagogo & Ollor, 2009; Guo & Jiang, 2013; Robinson, 1987). Empirical work has been done to investigate how VC firms add value to their portfolio companies in the last thirty years (see Figure 1). Considering prior studies it can be observed that venture capital firms add value to their portfolio firms through financial, strategic, governance, operational, human capital and network improvements (Achleitner et al., 2013; Agarwal and Chatterjee, 2007; Cumming et al., 2005; Macmillan et al., 1989). For example, governance improvements can be achieved due to milestones, reporting mechanisms and employee involvement (Barnes, 2004; Schertler, 2003).

This previous work offers valuable insights into the critical role of venture capital firms for their portfolio companies. However, these studies also highlight the need for further thorough and comprehensive analyses of value adding activities. In spite of the rising attention for this research topic, there remains a lack of systematic approaches measuring and analyzing value adding activities to assure a comparability of studies. Hence, the aim of this paper is to provide an overview of the literature regarding various types of value adding activities. To this end 37 studies were reviewed. Information on data collection method, research method, sample size and region as well as variables measuring value adding activities were synthesized. Based on this, gaps, deficiencies and ideas for improvements in terms of data, variables and methods were identified for this research field.

In venture capital literature, terms such as “value adding measures”, “value adding activities” and “value creation measures” are often used interchangeably. Equally, “value adding” and “value creation” are used synonymously. To assure clarity in terms of terminology this study uses the following synonyms: value adding and value adding

activities. The paper follows the following structure. The next section introduces the methodology used to pursue the literature review. This is followed by an analysis of various studies related to value adding activities based on data, variables and methods. Afterwards, gaps, deficiencies and ideas for improvements in the reviewed literature are highlighted. Finally, the paper closes with a conclusion.

Method

To receive the relevant literature on value adding activities in the venture capital industry I used the following strategy. First, I searched in the EBSCOhost (Business Source Complete) and ScienceDirect for combinations of keywords such as “venture capital”, “value”, “value creation” or “value adding” and “return” in the title and abstract of articles. In this course in total 124 articles were identified. Thereby, I only included publications like academic journal articles and conference papers based on any type of empirical analysis. Some of the studies were existent in more than one database. Hence, this amount of studies should not be taken as mutually exclusive. I studied the abstracts, data and results section of each article. Those articles not in the research stream of value adding activities in the venture capital industry were eliminated. Most of the excluded studies dealt with the question whether venture capital firms create value at all, but not how. Furthermore, I eliminated all articles which were not based on empirical research since the present study analyzes data, variables and methods of studies. In 37 out of 124 articles value adding activities in the venture capital industry were the dominant addressed topic (see Figure 1).

(Figure 1 near here)

This searching strategy of identifying relevant literature is subject to a limitation since important works that have not used the selected key words but analyzed a comparable subject might be neglected. To reduce this problem, I searched for further articles in the references of the selected articles. Nevertheless, this review may not have identified every study published in this field of research. Due to this systematic

approach I believe that the overview is comprehensive enough to provide a broad overview of research in this subject.

Literature on value adding measures by venture capital firms

The literature stream of value adding activities of venture capital firms started to grow in the 1980s. Considering our selected articles this review shows that the number of studies increased over the last three decades. The rise of studies especially in the 2000s reflects the growing importance of value adding activities of venture capital firms. Especially in times of money as a commodity (Rosenstein et al., 1993) value adding activities become even more important to attract the most promising ventures and higher the chance of a successful exit of the investment. Research in this field mainly focuses on different types of value creation measures and their impact on different success indicators of the venture, i.e. performance (Sapienza, 1992), sales growth (Macmillan et al., 1989), returns (Cumming et al., 2005; Macmillan et al., 1989), exit success (Bellavitis et al., 2014; Bottazzi and Da Rin., 2002; Busenitz et al., 2004; Checkley et al., 2010; Cumming et al., 2005; Hochberg et al., 2007; Siepel, 2016), initial public offering (Chang, 2004; Checkley et al., 2010; Cumming, 2005) and internal rate of return (Cumming et al., 2005; Manigart et al., 2002).

Samples, data collection and data analysis methods of previous studies

The selected studies were analyzed under various viewpoints considering data, variables and methods (see table 1): Sample size, observed object, data collection method, data analysis method and region. The samples range in terms of size heavily depending on the type of data collection method and data analysis method. As it can be expected samples collected from databases have rather large sample sizes, surveys and interviews middle size samples and case studies small samples. Furthermore, it is not observable that sample sizes grew over time. A great diversity exists in terms of which person or object was analyzed in the samples. First, a distinction can be made between different types of people like entrepreneurs (e.g. see Ehrlich et al., 1994), CEOs of VC-backed firms (e.g. see Sapienza, 1992) and venture managers or partners (e.g. see

Robbie et al., 1997) and secondly between institutions like VC-backed firms (e.g. see Timmons and Bygrave, 1986; Barney et al., 1989), VC firms (e.g. see MacMillan et al., 1989; Gorman and Sahlmann, 1989), VC funds (e.g. see Sweeting, 1997), corporate VC firms (e.g. see Knyphausen-Aufseß, 2005) as well as VC deals or transactions (Bellavitis et al., 2014; Cumming, 2005). When it comes to data collection method this review shows that mainly databases, surveys and interviews were used to gather relevant data. However, only one study is based on the original deal documents (Steier and Greenwood, 1995). Over time a tendency towards multiple data collection approaches becomes apparent and the usage of databases increases. In more than 50% of the studies data was analyzed mainly from the United States and/or overall North America. Especially in the 1980s and 1990s studies were foremost conducted in the United States which can be explained by the fact that the VC market in the United States as well as research is further developed in the United States compared to other regions. There are some studies from Europe (e.g. Lehmann, 2006), from Asia (e.g. Pruthi et. al., 2003), from Australia (Cumming et al., 2005) and Africa (Dagogo and Ollor, 2009). Only 16% of researchers collected their samples in different countries. Furthermore, the comparison of similarities and differences across countries is even less researched (e.g. Sapienza et al., 1996). The types of sampling and data collection method have implications for the research method as well as the interpretation of the results since the applied techniques are diverse and subject to several limitations.

(Insert table 1 near here)

Research methods used in previous studies

In the reviewed studies mainly three types of research methods were applied, namely empirical studies, qualitative analyses and case study approaches. In order to test the impact of various value adding activities on different success measures, studies used different statistical analysis techniques, such as correlations, multivariate regression, Granger causality, network analysis, negative binomial estimation, hazard model etc. In studies with an explorative nature data was foremost collected by semi-structured interviews (e.g. Fried and Hisrich, 1995; Knyphausen-Aufseß, 2005; Saetre, 2003;

Steier and Greenwood, 1995). A moderate amount of studies used secondary or third resources, e.g. company data or surveys, to combine different analysis methods (e.g. Bellavitis et al., 2014; Fujiwara and Kimura, 2012). In the reviewed studies the majority of respondents or interview partners were chief executive officer, entrepreneurs or venture managers. Some studies utilized also mixed respondents, i.e. VC-backed and non VC-backed firms (Dagogo and Ollor, 2009) or managers of ventures and VC firms (Gabrielsson and Huse, 2002; Rosenstein et al., 1993; Sapienza et al., 1996). The approach of mixed respondents is firstly useful to lessen the problems of common method bias and secondly provides results from different perspectives of different stakeholders. As shown in table 1, statistical methods used to test the impact of value adding activities on success of VC-backed investments developed over time. Early studies foremost used descriptive statistics, multiple regression or qualitative methods. In more recent studies techniques like Granger causality, Cox and Heckman regressions or cross-sectional econometrics were applied. Studies of explorative nature included also tables, figures, and matrices to illustrate results.

Measuring value adding activities in previous studies

The second aim of the review is the analysis of variables used in the selected studies to measure value adding activities. Thereby, it was also targeted to compare how different studies measure the same or comparable variables, e.g. the variable advisory board was measured in six different ways (see table 3). The majority of studies used the number of seats on board like Campbell and Frye (2009), Gabrielsson and Huse (2002), Gorman and Sahlmann (1989), Rosenstein et al. (1993) and Sapienza et al. (1996). Fujiwara and Kimura (2012) measured this variable on a 4 point scale, whereas Fried et al. (1998) used a 7 point scale. Furthermore, Bottazii et al. (2008) and Robbie et al. (1997) controlled if the VC firm has at least a seat on board and Barney et al. (1989) measured the percentage of seats the VC firm has on the venture board.

For all types of value adding activities which were identified in the literature, i.e. financial, governance, strategic, operational, network and human capital

improvements, various variables were used to measure their impact on venture's success. Variables measuring governance value adding activities were found in the majority of the selected studies (see table 3). Furthermore, to measure governance value adding activities the highest numbers of variables was used (compared to the other five types of value adding activities). This might reflect the importance of governance improvements in VC-backed firms since VC firms are active investors and use several governance mechanisms to control and monitor the venture firm. In terms of the number of studies analyzing different types of improvements it is also apparent that also financial and network value adding activities are of high relevance (see tables 2 and 6). To the contrary, strategic, operational and human capital value adding activities are relatively moderately researched (see tables 4, 5 and 7). Nevertheless, studies proved that strategic, operational and human capital value adding activities impact the success of VC-backed investments (Guo and Jiang, 2013; Gorman and Sahlman, 1989; Sapienza et al., 1996).

Analyzing how the great variety of variables was measured it is obvious that there are some variables, e.g. follow-up financing, advisory boards, monitoring or development of business strategy, which were used very often in studies. Nevertheless, there is also a considerable amount of variables which I found only once in the selected studies, e.g. organizational development, contacts for follow up financing and exit or development of competencies of management team. Furthermore, when it comes to the point how variables are measured great inconsistencies are apparent as well. This can be explained by the variety of data collection methods used in studies. Secondly, several studies have an explorative character in which no established scales existed since this research stream is rather young.

(Insert table 2-8 here)

Gaps and deficiencies in literature

The literature analysis showed that the research stream on value adding activities in VC investments received a growing attention over the past 30 years. For the review I

studied qualitative as well as quantitative studies including surveys, interviews and case studies. The majority of studies is of quantitative nature. Based on this review I suggest six directions to improve the literature stream on VC value adding:

- Use original deal documents rather than surveys or databases

Value adding activities are among the most sensitive tasks for many VC firms. Hence, collecting data is consistently difficult. Furthermore, young, entrepreneurial ventures are not subject to publication duties of company data like large corporations. To represent the population adequately researchers have to collect data from as many observations as possible. However, the number of companies willing to take part in these studies is very limited. Therefore, researchers often rely on surveys or databases to collect data. Using surveys or databases data is subject to several limitations. The response rate of surveys is often relatively low which limits the meaningfulness of the study since it presents only a low percentage of the whole population. Furthermore, survey responses also underlie biases, e.g. socially desirable answers or the subjectivity of scales, especially when these are not standardized. Considering databases, the deepness and wideness of these data is rather limited since they are often based on publicly available data. Therefore, it is difficult to gather data on internal practices of VC firms. As recommendation for further research, it would be meaningful if future studies base their data analysis on real deal documents, e.g. decision templates, reporting and investment committee papers of VC firms. However, it is known that it is of great difficulty to get access to this kind of data.

- Include perspectives from multiple stakeholders in the analysis

In the selected studies researchers preferentially relied on single respondents. Thereby, foremost VC firms or the entrepreneur/ manager of the venture have been taken into account in the analysis. Only very few studies like Gabrielsson and Huse (2002) analyzed both perspectives which is useful to enrich the quality of the results. Studying different stakeholders would offer different perceptions. Furthermore, this has the advantage of validating the results.

- Improve consistency in variables used to measure a certain value adding activity type

Established literature has shown that six different types or groups of value adding activities were studied in literature before, i.e. financial, strategic, governance, operational, human capital and network improvements. Additionally, for each of the value adding activity types various measures can be pursued by VC firms to improve the venture. For example to advance a venture from a financial perspective, researchers analyzed the measures support in follow up financing/ fundraising, receiving financial expertise, convertibles, preferred stocks, give a sense of economic safety, debt and syndication. In the selected studies foremost two to three variables were used to investigate financial improvements. Hence, a great diversity exists among studies how a certain value adding activity type was analyzed. Therefore it is again complicated to compare the results of different studies. However, it offers more in-depth implications for practitioners which measure or sets of value adding activities measures can be useful.

- Develop and use established scales to measure similar variables

The need for developing established scales of certain variables is one of the core suggestions of this paper since I observed that the way how variables are measured is highly inconsistent across studies. Established scales have the advantages of easy understanding, but also of reliability and validity. Furthermore, they assure that is measured what is intended. Some studies try to use comparable measures or prior published studies to overcome the problem of non-comparability. Nevertheless, the variations are high for nearly all variables.

- Improve consistency in usage of dependent variable

Considering the dependent variable “value added”, in the selected studies it can be observed that also in this respect a great variety exists among studies (see table 8). This might be partially explained by the fact that value added or success is difficult to measure. Measuring the success of new ventures is not trivial due to the lack of

historical data and the accessibility of data (Brush and Vanderwerf 1992; Gartner and Shane 1995). This problem might be reduced by using sets of different success indicators and multiple sources according to Brush and Vanderwerf (1992) and Murphy et al. (1996). Studies like Cumming et al. (2005) and Hochberg et al., (2007) used at least three different success measures. Nevertheless, which value added measure was used and how it was measured varied a lot, e.g. returns was measured in dollar value (Cumming et al., 2005) and at a five point scale (Macmillan et al., 1989). Moreover, exit success was measured as value 1 if the venture was acquired or merged, or listed in an initial public offering (Bellavitis et al., 2014), as value 1 if the venture was acquired or listed in an initial public offering and 0 if otherwise (Bottazzi and Da Rin, 2002), as exit rate (Busenitz et al., 2004), as number of successful exits (Checkley et al., 2010) and as proportion of investments exited (Cumming et al., 2005). Due to this great variety of value added measures it is again difficult to compare the results of the different studies. On the other hand, the use of different target variables shows that different value adding activity measures influence certain success measures differently. This offers greater implications for practitioners which value adding activity is more effective for certain goals.

- Increase number of international or comparative studies

The majority of studies were conducted based on a sample analyzing VC firms or VC-backed ventures from the United States. During the 1990s the first studies were published analyzing different regions or countries regarding value adding activities of VC firms. Nevertheless, the number of studies from other countries is currently rather moderate. Furthermore, only very few studies undertook comparative studies like Sapienza et al. (1996) and Manigart et al. (2002). Therefore, a lack of research is existent analyzing commonalities as well as differences in value adding activities across countries which can be expected due to cultural differences.

Conclusion and future research

During the last thirty years a growing and noteworthy amount of research offering useful findings for practitioners and researchers was published in the research stream of value adding activities of VC firms. The most often discussed topics were the two questions if and how VC firms affect VC-backed venture's performance. Researchers have shown that VC firms apply diverse sets of tools to increase the likelihood of investment's success.

The growing number of studies in this area encouraged this review. I hope that this review is informative and somewhat provoking and that it shows researchers how data, variables and methods can be improved. Both qualitative and quantitative studies showed rich evidence on the critical role of value adding activities by VC firms. Nevertheless, there are a number of gaps and deficiencies in this research topic highlighting the need for better data quality and variables. Considering these gaps and deficiencies, I identified some important considerations for future research. Firstly, original deal documents would higher the quality of data immensely since most of the studies use surveys or databases as data collection method. Secondly, to validate the findings and extend the perspective on value adding activities of VC firms, future studies considering both the perspective of the VC firm and the VC-backed venture would enrich this literature stream. Lastly, there is a great variety regarding which variables are analyzed in studies and how they are measured. This holds true for dependent as well as independent variables. Therefore, the development and use of established scales as in other literature streams like psychology or marketing would improve the comparability of studies.

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Diagrams, tables and illustrations

Figure 3 Selection strategy and overview of articles from EBSCOhost and ScienceDirect

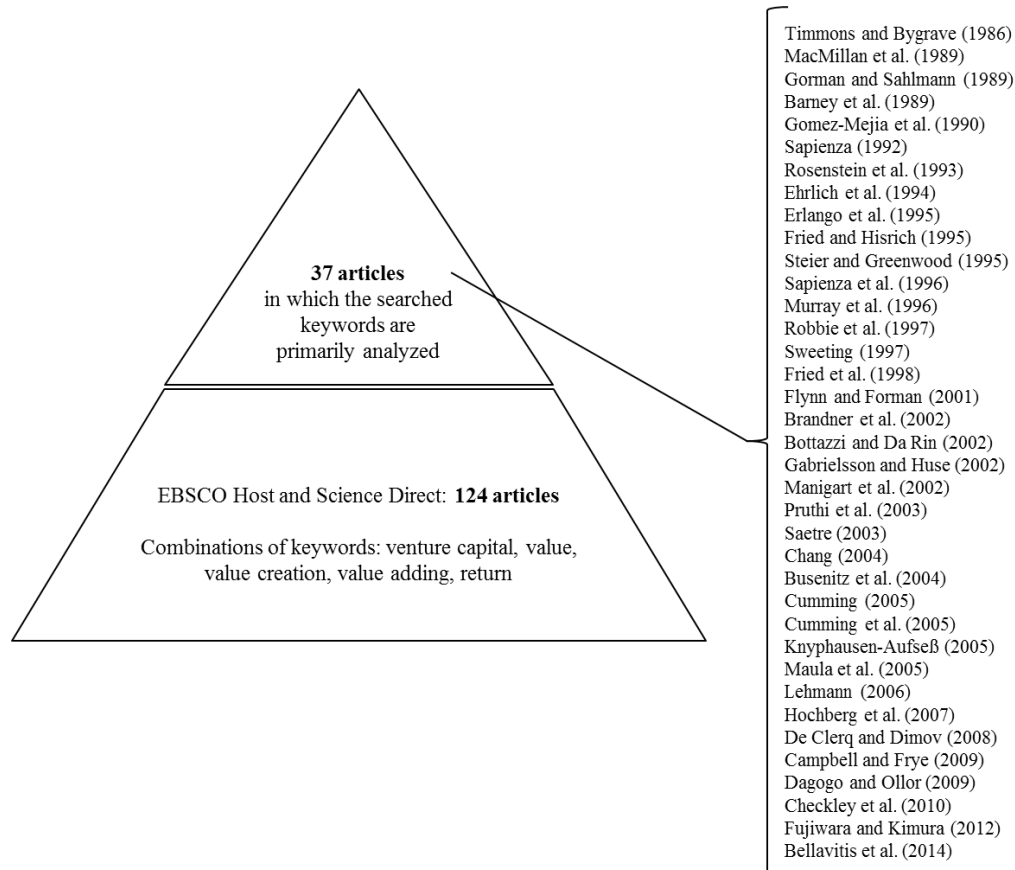


Table 2 Overview of selected studies for review with respect to data, data collection and data analysis method (n=37)

Authors	Sample/ respondents	Data collection method	Data analysis method	Region
Timmons and Bygrave (1986)	n= 1,501 VC-backed firms	Venture Economics database, interviews	Descriptive statistics, cluster analysis	North America
MacMillan et al. (1989)	n= 62 VC firms	Survey	Descriptive statistics, cluster analysis, regression analysis	North America
Gorman and Sahlmann (1989)	n= 49 VC firms	Survey	Descriptive statistics	North America
Barney et al. (1989)	n= 54 VC-backed firms	Interviews, American Electronics Association membership directory and announcements in the venture capital journal	OLS regression	North America
Gomez-Mejia et al. (1990)	n= 20 VC firms and CEOs of VC-backed ventures	Interviews and participant-observation methods	Qualitative analysis	North America
Sapienza (1992)	n= 51 CEOs of VC-backed firms and lead VC investor	Survey	Descriptive statistics, correlations, regression analysis	North America
Rosenstein et al. (1993)	n= 198 CEOs of VC-backed firms in survey, n= 98 CEOs of VC-backed firms in telephone interview	Survey, telephone interviews	Descriptive statistics	North America
Ehrlich et al. (1994)	n= 47 Entrepreneurs	Survey	Descriptive statistics, ANOVA, cross tabulations	North America
Elango et al. (1995)	n= 149 VC firms	E-Mail survey	Descriptive statistics	North America

Fried and Hisrich (1995)	n= 14 VC-financed firms	Interviews	Qualitative analysis	North America
Steier and Greenwood (1995)	n= 1 VC-backed firm	Interviews, site visits and archival material	Case study analysis	North America
Sapienza et al. (1996)	n= 51 VC firms and CEO of venture	Survey	Descriptive statistics, regression analysis	North America and Europe
Murray (1996)	n= 6 VC-backed firms	Survey	Case study analysis	Europe
Sweeting (1997)	n= 3 VC funds	Interviews and published statistics	Descriptive statistics, qualitative analysis	UK
Fried et al. (1998)	n= 68 VC firms	E-Mail survey	Descriptive statistics	North America
Robbie et al. (1997)	n= 25 individuals from VC firms, n= 108 VC firms	Interviews based on structured questionnaire, mailed survey	Descriptive statistics	UK
Flynn and Forman (2001)	n= 87 VC firms	Survey	Descriptive statistics, correlations	Worldwide
Manigart et al. (2002)	n= 209 VC firms	Survey	Descriptive statistics, correlations, LDV regression	North America and Europe
Brandner et al. (2002)	n= 284 VC-backed exits	Dataset collected by Macdonald & Associates	Descriptive statistics, regression analysis	North America
Gabrielsson and Huse (2002)	n= 135 small technology based entrepreneurial firms, n= 65 CEOs of VC firms	Multiple data collection approach	Descriptive analysis, correlations, regression analysis	Sweden
Pruthi et. al. (2003)	n= 37 venture capitalists	Survey, interviews	Descriptives statistics, ANOVA, correlations, regression	Asia

Saetre (2003)	n= 4 VC-backed firms	Interviews	Multiple case study analysis	Norway
Chang (2004)	n= 1,106 VC-backed firms	Venture Economics database and Joint Venture/ Strategic Alliance Database of the SDC	Descriptive statistics, correlations, hazard model	Worldwide
Busenitz et al. (2004)	n= 183 VC-backed firms	E-Mail survey	Descriptive statistics, correlations, bivariate analysis, Cox regression	North America
Cumming et al. (2005)	n= 806 VC-backed entrepreneurial firms	Australian Bureau of Statistics Venture Capital Survey	Descriptive statistics, cross-sectional econometrics	Australia
Cumming (2005)	n= 3083 transactions	Dataset collected by Macdonald & Associates	Descriptive statistics, Panel data, correlations, logit regression	North America
Knyphausen-Aufseß (2005)	n= 4 Corporate venture capitalists	Website information, press releases, company presentations and ten personal interviews with executives and investment managers of the companies	Multiple case study analysis	Worldwide
Maula et al. (2005)	n= 91 CEOs and founders of CVC financed firms	Survey	Descriptive statistics, univariate tests, regression analysis, ANOVA	North America
Lehmann (2006)	n= 108 VC-backed firms	Hand collected data set from German Neuer Markt, German Patent Office, Deutsche Börse AG, Datastream, OnVista	Descriptive statistics, OLS estimation, probit and negative binomial estimation	Germany
Hochberg et al. (2007)	n= 3,469 VC funds	Thomson Financial's Venture Economics Database	Descriptive statistics, network analysis, regression analysis	North America

De Clercq and Dimov (2008)	n= 200 VC firms, n= 8,162 initial investments	Thomson Financial's VentureXpert database	Descriptive statistics, correlations, logit regression	North America
Bottazzi and Da Rin (2002)	n= 119 venture firms, n=503 venture partners, n=1,652 portfolio companies	Survey, Amadeus, Worldscope, Venture Expert, national venture capital associations, Thomson Financial, SDC	Descriptive statistics, univariate tests, probit regression	Europe
Campbell and Frye (2009)	n= 444 ventures	Initial public offering prospectus database developed by R. R. Donnelley Financial and initial public offering Crossroads	Descriptive statistics, instrumental variables regression, Heckman regression	North America
Dagogo and Ollor (2009)	n= 120 (VC-backed and non VC-backed firms)	Selection under SMEEIS	Descriptive statistics, multiple regression analysis	Nigeria
Checkley et al. (2010)	n= 39 VC firms, observed over 11 years	Hand collected data set from a commercial database developed by IE Consulting and supplementary data from British Venture Capital Association's Directory of Members and VC firm's websites	Descriptive statistics, correlations, Granger causality	UK
Fujiwara and Kimura (2012)	n= 32 VC firms	Combination of primary data collected in an internet-based survey and secondary data from public databases, i.e. Dow Jones Galante's Venture Capital & Private Equity Directory	Descriptive statistics, OLS regression, correlations, probit regression	North America
Bellavitis et al. (2014)	n= 1,264 VC-backed companies with n=5,344 VC deals	Qualitative interviews, Thomson One Banker database	Descriptive statistics, correlations, random-effect panel logistic regression	North America

Table 3 Overview of variables and measurements of financial value adding activities

	Follow up financing/ fundraising	Receiving financial expertise	Convertible	Preferred stocks	Give sense of economic safety	Debt	Strategic alliances/ syndication
Gorman and Sahlmann (1989)	Ranking						
Cumming et al., (2005)		Proportion of investments receiving financial expertise					
Chang (2004)							Counts of articles written
Hochberg, et al., (2007)							Binary
Cumming (2005)			Proportion	Proportion		Proportion	
MacMillan et al., (1989)	4 point scale					4 point scale	
Rosenstein et al., (1993)	Rating of top five					Rating of top three	
Elango et al., (1995)	5 point scale						
Brandner et al., (2002)							If syndication occurs = 1, not= 0
De Clercq and Dimov (2008)							Number of syndication partners

Checkley et al., (2010)							Not available
Fujiwara and Kimura (2012)							7 point likert scale
Lehmann (2006)							Number of VC firms provided equity to investors
Pruthi et al., (2003)	5 point likert scale						
Bottazzi and Da Rin, (2002)	value 1 if VC firm helped to obtain additional financing, 0 otherwise						value 1 indicates if company is financed by single investor, 0 otherwise
Gomez-Mejia et al. (1990)	Mentioned in interviews	Mentioned in interviews					
Ehrlich et al. (1994)	Ranking						
Fried and Hisrich (1995)	Mentioned in interviews						
Gabrielsson and Huse (2002)	Five point scale	Five point scale			Five point scale		Participation in syndicates
Maula et al. (2005)	Multi item scale measuring satisfaction						

Table 3 Overview of variables and measurements of governance value adding activities

	Advisory board	Independent directors at board	Contracts	Monitoring	Milestones	Reporting	Personal exchange/ interaction	Resolve compensation issues	Preferred Stock	Dilution	Equity based compensation	Help form and manage board
Sapienza (1992)							Frequency of interaction per week					
Gorman and Sahlmann (1989)	Number of seats in board						% of total working hour spending with monitoring and assisting portfolio companies	Ranking and frequency				Ranking and frequency
Cumming et al., (2005)							Average days per month with investee company					
Sapienza et al. (1996)	Number of directors serving on board	Number of independent directors and VC firm members in board					7 point scale (frequency of face to face interaction)					

Fujiwara and Kimura (2012)	4 point scale								4 point scale	4 point scale		
Manigart et al., (2002)				Percentage of lead investments / number of investments per VC firm								
MacMillan et al., (1989)				4 point scale								
Fried et al. (1998)	7 point scale											
Rosenstein et al. (1993)	Number of directors serving on board			Rating of top three								
Elango et al. (1995)								5 point scale				5 point scale
Robbie et al., (1997)	Has seat on board			4 point scale/ Amount of monitoring information and actions required	Number of performance targets	Increased amount and/or frequency of reporting	More frequent presentation/ visit					

Campbell and Frye (2009)	Number of directors serving on board	Number of independent directors and VC firm members in board									Percentage of management compensation that is equity based	
Dagogo and Ollor (2009)				n/a								
Pruthi et al., (2003)			5 point scale	5 point scale		5 point scale		5 point scale				
Barney et al., (1989)	% of seats in board of VC firm											
Bottazzi and Da Rin, (2002)	value 1 indicates if VC firms is a board member		value 1 indicates if instruments like straight debt, preferred equity or convertible debt are used				value 1 if monthly or weekly contact between VC firm and venture					
Gomez-Mejia et al. (1990)						Mentioned in interviews		Mentioned in interviews				
Ehrlich et al. (1994)				Ranking			Five point scale					

Fried and Hisrich (1995)							Mentioned in interviews					
Gabrielsson and Huse (2002)	Number of directors serving on board	Number of outside directors		Nine point scale			Total amount of time spend					

Table 4 Overview of variables and measurements of strategic value adding activities

	Development of business strategy	Review business plan	Analysis if competitors	Strategic support IM	Evaluate acquisitions	Sounding board
Gorman and Sahlmann (1989)				Ranking and frequency		
Cumming et al., (2005)				Proportion of investments receiving strategic/ management support		
Sapienza et al., (1996)				Ratings of importance and effectiveness		Ratings of importance and effectiveness
MacMillan et al. (1989)	4 point scale					4 point scale
Fried et al. (1998)	7 point scale					
Rosenstein et al., (1993)	Rating of top three					
Dagogo and Ollor (2009)	not available			not available		
Pruthi et al. (2003)	5 point scale			5 point scale	5 point scale	5 point scale
Gomez-Mejia et al. (1990)	Mentioned in interviews	Mentioned in interviews				
Ehrlich et al. (1994)	Ranking					Ranking
Fried and Hisrich (1995)						Mentioned in interviews

Gabrielsson and Huse (2002)	Five point of scale					Five point scale
Maula et al. (2005)			Multi item scale measuring satisfaction			

Table 5 Overview of variables and measurements of operational value adding activities

	Development of technology	Organizational development	Operational planning	Assist with marketing and sales	Engineering, production, operations	Receiving marketing expertise	Receiving administrative expertise
Gorman and Sahlmann (1989)			Ranking and frequency				
Cumming et al., (2005)						Proportion of investments receiving marketing support	Proportion of investments receiving administration support
MacMillan et al. (1989)	4 point scale					4 point scale	
Elango et al., (1995)			5 point scale				
Dagogo and Ollor (2009)					n/a		
Pruthi et al., (2003)			5 point scale	5 point scale			
Ehrlich et al. (1994)	Ranking			Ranking			
Gabrielsson and Huse (2002)	Five point of scale				Five point of scale	Five point of scale	
Maula et al. (2005)	Multi item scale measuring satisfaction	Multi item scale measuring satisfaction					

Table 6 Overview of variables and measurements of network value adding activities

	Contacts to customers and suppliers	Use of network contacts	Contact for follow up financing and exit	Professional contacts	Making external contacts easier	Introduction to potential service providers	Intra-industry network	Extra-industry network	Network	Business linkages and networks
Gorman and Sahlmann (1989)	Ranking and frequency									
Sapienza et al. (1996)	Ratings of importance and effectiveness		Ratings of importance and effectiveness	Ratings of importance and effectiveness						
Hochberg, et al., (2007)									Binary	
MacMillan et al., (1989)	4 point scale									
Rosenstein et al., (1993)	5 point scale					5 point scale				
Elango et al., (1995)	5 point scale									
Dagogo and Ollor (2009)										n/a
Pruthi et al., (2003)	5 point scale					5 point scale				
Gomez-Mejia et al. (1990)	Mentioned in interviews									

Ehrlich et al. (1994)	Ranking									
Fried and Hisrich (1995)		Mentioned in interviews								
Gabrielsson and Huse (2002)		Five point of scale			Five point of scale					
Maula et al. (2005)	Multi item scale measuring satisfaction									
Bellavitis et al., (2014)							Self- developed matrix	Self- developed matrix		

Table 7 Overview of variables and measurements of human capital value adding activities

	Contacts to consultants and new personal	Coach/ Mentor	Development of competencies of management team	Recruiting	Hiring outside investors	Manage crises and problems	Motivation
Gorman and Sahlmann (1989)	Ranking and frequency						
Sapienza et al., (1996)		Ratings of importance and effectiveness		Ratings of importance and effectiveness			
MacMillan et al., (1989)	4 point scale			4 point scale		4 point scale	4 point scale
Rosenstein et al., (1993)	Rating of top three			Rating of top three		Rating of top three	
Elango et al., (1995)	5 point scale			5 point scale			
Pruthi et al., (2003)	5 point scale					5 point scale	5 point scale
Bottazzi and Da Rin, (2002)				value 1 if VC firm recruited for venture, 0 otherwise	value 1 if VC firm involved in hiring outside director, 0 otherwise		
Gomez-Mejia et al. (1990)		Mentioned in interviews		Mentioned in interviews			
Ehrlich et al. (1994)			Ranking	Ranking		Ranking	Ranking
Gabrielsson and Huse (2002)		Five point of scale		Five point of scale			

Maula et al. (2005)				Multi item scale measuring satisfaction			
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Table 8 Overview of dependent variables

	Sales growth	Employment growth	Performance	Returns	Market share	Exit success	ROA	IPO	IRR
MacMillan et al. (1989)	Five point scale			Five point scale	Five point scale				
Barney et al. (1989)				\$ value					
Sapienza (1992)			Multi-criterion measure						
Bottazzi and Da Rin (2002)							In Percent	If IPO took place	
Manigart et al. (2002)									Seven category criterion in %
Brandner et al. (2002)		Measured by the number of employees							
Chang (2004)								IPO success rates	
Busenitz et al. (2004)						Exit rate			
Cumming et al. (2005)						Proportion of investment exited			\$ value
Hochberg et al. (2007)						Exit rate, \$ exit rate		IPO rate, \$ IPO rate	
Checkley et al.						Number of			

(2010)						successful exits			
Bellavitis et al. (2014)						1 if venture was acquired, merged or IPO; 0 if otherwise			
Paglia and Harjoto (2014)	Percentage change of Sales	Percentage change of employment							

4. Further research in the venture capital field

Articles published

- Stranz, W., Lahmann, A. D. F., & Velamuri, V. (2016). Value creation in SME private equity buy-outs. *Qualitative Research in Financial Market* (Forthcoming).

Articles in review process

- Proksch, D., Stranz, W., & Pinkwart, A. (2016). German entrepreneurs in the high-tech field: In whom should a venture capital company invest? *International Journal of Entrepreneurship and Small Business* (Second review round).

Conference articles

- Proksch, D., Stranz, W., & Pinkwart, A. (2016, October). Risikomanagement in Venture Capital Finanzierungen: Eine qualitative Inhaltsanalyse von Geschäftsdokumenten. Paper presented at the 4th Annual Conference on Risk Governance, University of Siegen; Siegen, Germany, October 12-13.
- Stranz, W., Lahmann, A. & Velamuri, V. (2016). Value Creation in SME Private Equity Buy-outs. Paper presented at the 20th Interdisciplinary Annual Conference on Entrepreneurship, Innovation and SME, G-Forum; Leipzig, Germany, October 5-7.
- Lahmann, A., Proksch, D., & Stranz, W. (2016, October). Optimal use of milestones in venture capital financing — A barrier option model. Paper presented at the 20th Interdisciplinary Annual Conference on Entrepreneurship, Innovation and SME, G-Forum; Leipzig, Germany, October 5-7.
- Proksch, D., Stranz, W., & Pinkwart, A. (2016, October). The internationalization process of new technology and research-based ventures: Similarities and Differences. Paper presented at the 20th Interdisciplinary Annual Conference on Entrepreneurship, Innovation and SME, G-Forum; Leipzig, Germany, October 5-7.
- Proksch, D., Stranz, W., & Pinkwart, A. (2016, September). The internationalization process of new technology and research-based ventures: Similarities and Differences. Paper presented at the TIE Conference, DTU Copenhagen, September 8-9.

- Proksch, D., Pinkwart, A., & Stranz, W. (2015, October). Risk management in venture capital companies: the use of risk reducing measures for successful and less successful German high-technology companies. Paper presented at the 19th Interdisciplinary Annual Conference on Entrepreneurship, Innovation and SME, G-Forum; Kassel, Germany, October 8–9.
- Stranz, W. (2015, October). Value creation measures in the VC industry. Paper presented at the Doctoral Colloquium at the 19th Interdisciplinary Annual Conference on Entrepreneurship, Innovation and SME, G-Forum; Kassel, Germany, October 8–9.



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