Venture Growth and its Determinants in the German Venture Context

D I S S E R T A T I O N
of the University of St. Gallen,
School of Management,
Economics, Law, Social Sciences
and International Affairs
to obtain the title of
Doctor of Philosophy in Management

submitted by

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from

Germany

Approved on the application of

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Dissertation no. 4764

Difo-Druck GmbH, Bamberg 2018

The University of St. Gallen, School of Management, Economics, Law, Social Sciences and International Affairs hereby consents to the printing of the present dissertation, without hereby expressing any opinion on the views herein expressed.

St. Gallen, May 22, 2018

The President:

Prof. Dr. Thomas Bieger

Acknowledgements

First of all, I want to thank my co-authors Prof. Dr. Thierry Volery and Prof. Dr. Miriam Bird for their continuous support, valuable discussions and for creating a constructive research culture. It were these three elements that gave birth to my research topics, educated me as a scholar as well as guided me through academic complexity. Furthermore, I would like to thank my further doctoral advisors Prof. Dr. Christoph Müller and Prof. Dr. Marc van Essen for serving as reviewers of this thesis.

In addition, I want to express a special thank you to my friends Bastian Hoffmann, Benedikt Rossmann and Markus Rauch for providing their critical opinion on my papers. I know it is challenging to go through paper drafts while successfully managing personal life. I highly appreciate their support and look forward to returning the favor in the future.

Furthermore, I want to thank my girlfriend Leonie Sommer for her warm-hearted support and counterbalance throughout periods of highest highs and lowest lows which are naturally part of a dissertation.

And lastly, I want to thank my parents, Beate und Werner for their unconditional support and affection in every situation paired with well-intentioned advice I should sometimes listen to more often.

Hamburg, Juli 2018 Philipp Eska

Abstract (English)

Founding and growing a successful firm is an art that comes along with countless challenges. Along the entrepreneurial path founders face tremendous uncertainty, often rely on very limited resources and bear the burden of the 'liability of newness'. A focal point of interest within entrepreneurship research therefore is the examination of the growth implications of various entrepreneurial phenomena founders face throughout the lifetime of a venture. Based on the 'KfW/ZEW Start-Up Panel', one of the most detailed longitudinal datasets available on Germany's venture environment, this dissertation comprises three empirical papers, each investigating a separate entrepreneurial phenomenon and its implication on venture growth.

The first paper investigates how entrepreneurial team turnovers in nascent ventures impact new firm growth. By integrating relational embeddedness arguments with entrepreneurial team literature and employing a sample of nascent ventures in Germany over a four-year period, the findings support that entrepreneurial successions have a negative impact on new venture growth, which is more pronounced for teams of three (triads) than for teams of two (dyad). The paper elaborates contributions on entrepreneurial growth, entrepreneurial teams and firms' organizational design.

The second study challenges the female underperformance hypothesis by providing granular empirical results of the effect of gender on new venture growth. Results provide evidence that women entrepreneurs with higher education levels achieve higher growth than their male counterparts. Likewise, women who are driven by motives which can be assigned to the extremes of the opportunity vs. necessity entrepreneurship scale achieve higher growth than their average male counterparts.

Lastly, the third paper investigates the influence of external financing sources on venture growth with an in-depth analysis of the growth impact of venture capital (VC), a financing source deemed especially powerful. Results provide evidence that external financing, especially long-term credits, public subsidies and VC are positively associated with new venture growth, both in terms of sales and employees. Further and contrary to findings focusing on Anglo-Saxon and South European countries, evidence supports the existence of a screening, rather than a value adding effect of venture capital in the German start-up ecosystem.

Abstract (Deutsch)

Der Aufbau eines erfolgreichen Unternehmens ist eine Kunst. Auf dem Weg zum Ziel wird der Gründer bzw. das Gründungsteam dabei immer wieder mit zahlreichen Herausforderungen konfrontiert: hohe Unsicherheit, begrenzte Ressourcen-verfügbarkeit und die Last der „Liability of Newness“. Ein Schwerpunkt der Entrepreneurship-Forschung ist daher die Untersuchung der Wachstumsimplikationen verschiedener unternehmerischer Phänomene, mit denen sich Gründer während der gesamten Lebensdauer des Unternehmens auseinandersetzen müssen. Aufbauend auf dem "KfW/ZEW Start-Up-Panel", einem der detailliertesten Längsschnitt-Datensätze des deutschen Start-Up-Ökosystems, umfasst diese Dissertation drei empirische Arbeiten, die jeweils ein eigenes unternehmerisches Phänomen und dessen Implikationen auf das Start-Up-Wachstum untersuchen.

Die erste Forschungsarbeit untersucht die Frage, wie sich Wechsel an der Spitze von Unternehmerteams auf das Wachstum der Neugründung auswirken. Die Ergebnisse zeigen, dass Nachfolgen an der Unternehmensspitze negative Auswirkungen auf das Wachstum haben. Diese Beobachtung ist noch deutlich ausgeprägter, wenn die Nachfolge bei Teams stattfindet, die aus drei Personen bestehen, als das bei Teams von nur zwei Gründern der Fall ist.

Die zweite Forschungsarbeit stellt die „Underperformance-Hypothese“ von Neugründungen durch Frauen in Frage. Durch detaillierte empirische Analysen wird gezeigt, dass Unternehmerinnen mit höherem Bildungsniveau ein höheres Wachstum erzielen als ihre männlichen Kollegen. Gleichermaßen erreichen Frauen, die von Motiven getrieben werden, die den Extremen der Opportunitäts- und der Notwendigkeits-Skala zuzuordnen sind, ein höheres Wachstum als ihre männlichen Vergleichspersonen.

Schließlich untersucht die dritte Forschungsarbeit den Einfluss von externen Finanzierungsquellen auf das Wachstum von Neugründungen. Dabei wird eine detaillierte Analyse der Wachstumsauswirkungen von Risikokapital vorgenommen. Die Ergebnisse belegen, dass insbesondere langfristige Kredite, öffentliche Zuschüsse und Risikokapital einen positiven Einfluss auf das Unternehmenswachstum haben. Darüber hinaus zeigen die Ergebnisse einen Screening-Effekt, anstatt eines wertschöpfenden Beitrags von Risikokapitalgebern im deutschen Start-up-Ökosystem.

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List of abbreviations

Avg.	average
cf.	confer (compare)
DID	difference-in-differences
e.g.	exempli gratia (for example)
GEM	Global Entrepreneurship Monitor
i.e.	id est (it is; in other words)
ln	logarithm
OLS	Ordinary Least Squares
PhD	Doctor of Philosophy
PSM	Propensity score matching procedure
SD	Standard Deviation
TMT	Top Management Team
VC	Venture Capital
VIF	Variance Inflation Factor
vs.	versus
#	Number

"Our task today is to find singular ways to create new things that will make the future not just different, but better."
(Peter Thiel, Zero to one)

Introduction

In one way or the other every entrepreneur pursues the goal to create something new in the field of his entrepreneurial endeavor. Something new which is not only appealing to him or her but to a broader customer base. As a result, entrepreneurs strive to improve traditional product and service offerings, open up new markets, stimulate competition and most importantly grow their venture to permanently establish it on the market.

Though, founding and growing a successful company is an art that comes along with countless challenges. Along the entrepreneurial path founders face tremendous uncertainty, often rely on very limited resources and bear the burden of the 'liability of newness' (Katlia, Chen, and Piezunka, 2012; Yang and Aldrich, 2017; Stinchcombe, 1965). Therefore, a focal point of interest within entrepreneurship research is the examination of the performance implications of various entrepreneurial phenomena founders face throughout the lifetime of a venture.

In this context, venture growth is a frequently chosen performance metrics. Being able to grow the venture is of high importance for various reasons. Amongst other things, nascent ventures need to grow in order to profit from economies of scale, increase their market power, attract financing and ensure survival of the company (Shane, 1996; Stanworth and Curran, 1976, Zimmerman and Zeitz, 2002). Further venture growth is "one of the most reliable and valid measures of new venture performance" (Delmar, 2006, p. 62), regardless of the initial size of the venture. It is a fundamental element of job and wealth creation of a nation (Casson & Wadeson, 2007, Storey, 1995) and therefore of great interest for policy makers in order to assess the state of the national venture environment. It is therefore not surprising that in times in which the success of US based online start-ups such as Google, Facebook and airbnb become more and more apparent, the wish by European governments emerged to understand the state of their national venture environment.

In the specific case of Germany, transparency on the venture environment was very limited up until 2008 as the systematic collection of cross-sectional data over a continuous number of years had not been performed beforehand. In consequence, it was impossible to assess the state of the German venture environment on a broader basis. Luckily this has been changed with the 'KfW/ZEW Start-Up Panel', which today is one of the most detailed longitudinal datasets available on Germany's venture environment and therefore serves as the basis for this dissertation. The longitudinal database includes roughly 13,000 German start-ups which were founded between the years 2005 and 2011 and are followed since their inception allowing a sound analysis of the new firms' development over time and thorough assessment of the German venture environment.

Such as the data on the German venture environment is our current understanding of many entrepreneurial phenomena: Limited and upgradeable. Therefore, the set goal of this dissertation is twofold. First, to contribute to the entrepreneurial research arena by expanding our understanding of the growth implications of specific entrepreneurial phenomena and second to shed light on Germany's venture environment in order to support a further development of this part of our economy which could hold the future for many of us.

In particular, three different entrepreneurial phenomena and their influence on venture growth are investigated: First, the implication of entrepreneurial team turnover on venture growth, second, the growth success of female founded ventures, and third the influence of external financing on venture growth.

The motivation of the first paper is to fill the scarcity of research investigating how changes in team composition, i.e., entrepreneurial turnover events, influences new venture growth post-turnover. It is generally acknowledged that it is often an entrepreneurial team instead of a single person that is decisive for the success of a venture as a single person rarely has the ability to incorporate all the knowledge and skills needed in order to discover, evaluate and exploit a venture idea. Nonetheless, team formation in the founding context is a dynamic process and maintaining an entrepreneurial team is not always successful and may ultimately lead to a turnover event (i.e., entry and exit of team members) within the entrepreneurial team (Kamm et al., 1990). In particular, two questions are investigated: a) *How do entrepreneurial team turnover events influence new venture growth post-turnover?* and b) *How does initial*

team size (i.e., being a dyadic or triadic team) influence the magnitude of new venture growth post-turnover?

The second article is dedicated to the exploration of a phenomenon which is expanding worldwide but which has been deemed to be less promising in terms of "traditional financial parameters", such as venture growth (Fairlie and Robb, 2009; Gottschalk and Niefert, 2013; Watson, 2002): women entrepreneurship. The majority of studies report that ventures founded by women are on average significantly less successful which led to the establishment of the "female underperformance hypothesis" (Du Rietz and Henrekson, 2000). This claim seems to be overly simplistic and too generalized which is why the set goal of this paper is to show that certain groups of women with specific capabilities do successfully grow their ventures. The study therefore seeks to establish a more differentiated understanding of female entrepreneurs, thereby following new research avenues on female entrepreneurship put forward by Jennings and Brush (2013). Specifically, the following research question is addressed: *Which group of women entrepreneurs manages to grow their business more successfully than the average group of women entrepreneurs?*

The third article is motivated by the insight that start-up performance does not exclusively depend on the quality of the business idea and the performance of the team behind it, but to a high extent on financial resources that enable the development of the product or service (Gartner, Frid, and Alexander, 2012). Further, the insight that a firm's capital structure decision is influenced by its institutional context such as for example the German bank-based economy (Achleitner, Braun, and Kohn, 2011) triggers the question *which financing sources are associated with growth in the German start-up environment?* Following this initial analysis one source of financing which is generally deemed to be especially helpful for venture growth is analyzed in more detail in the German start-up setting: venture capital (VC). As former empirical evidence claims that VC fosters start-up growth in its various forms the question arises if it *has the ascribed positive causal influence on new venture growth in the German context?*

The subsequent section provides the abstracts of the three papers along with the authors, the title as well as the status of the paper in various journal and conference processes. Hereafter the following chapters are dedicated to each of the three dissertation papers. The final chapter revisits the dissertation's most significant contributions, summarizes its limitations, provides suggestions for future research and gives an outlook into the current development of the German venture environment.

Overview of Paper 1-3

Paper 1

Title: Nothing lasts forever: The Influence of Team Members' Entries and Successions on New Venture Growth

Authors: Philipp Eska, Miriam Bird

Abstract: Although the antecedents leading to entrepreneurial team turnovers in nascent ventures have been extensively studied in entrepreneurship research, the impact of such events on new firm growth has scarcely been investigated. Integrating relational embeddedness arguments with entrepreneurial team literature, we investigate how entrepreneurial team entries and successions influence new firm growth post-turnover. Employing a sample of nascent ventures in Germany over a four-year period, we find support that entrepreneurial successions have a negative impact on new venture growth, which is – surprisingly – more pronounced for triadic than for dyadic teams. We discuss contributions for research on entrepreneurial growth, entrepreneurial teams and firms' organizational design.

Status: Accepted and presented at Babson College Entrepreneurship Research Conference 2017. Currently under review for the Annual Meeting of the Academy of Management Conference 2018.

Paper 2

Title: Women Entrepreneurs and Venture Growth – One Size Does Not Fit All

Authors: Philipp Eska, Thierry Volery

Abstract: This study provides a granular analysis of the effect of gender on new venture growth. Our results suggest that the female underperformance hypothesis needs to be nuanced. First, while men outperform women with regard to venture growth on average, women entrepreneurs with higher education levels achieve higher growth than their male counterparts. Second, women entrepreneurs manage to grow their ventures faster than their male counterparts if they are driven by motives which can be added to the extremes of the opportunity vs. necessity entrepreneurship scale. We discuss contributions to the female entrepreneurship and growth literature and highlight future research opportunities.

Status: Currently under review at Journal of Small Business Management for the special issue on High Growth Women's Entrepreneurship.

Paper 3

Title: Venture Capital and the Growth of German Start-Ups – Supportive Partner or Collector of Winners?

Author: Philipp Eska

Abstract: While the financing structure of ventures has been studied in entrepreneurship research, the influence of the various external financing sources on venture growth has not been explored in the German venture context. In particular, the causal growth effect of a financing source deemed especially powerful, venture capital (VC), remains unexplored. Employing one of the largest longitudinal samples on German ventures, results support the view that external financing, especially long-term credits, public subsidies and VC are positively associated with new venture growth, both in terms of sales and employees. Further and contrary to findings focusing on Anglo-Saxon and South European countries, evidence supports the existence of a screening, rather than a value adding effect of venture capital in the German start-up ecosystem.

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Paper 1: Nothing lasts forever: The Influence of Team Members' Entries and Successions on New Venture Growth

Abstract

Although the antecedents leading to entrepreneurial team turnovers in nascent ventures have been extensively studied in entrepreneurship research, the impact of such events on new firm growth has scarcely been investigated. Integrating relational embeddedness arguments with entrepreneurial team literature, we investigate how entrepreneurial team entries and successions influence new firm growth post-turnover. Employing a sample of nascent ventures in Germany over a four-year period, we find support that entrepreneurial successions have a negative impact on new venture growth, which is—surprisingly—more pronounced for triadic than for dyadic teams. We discuss contributions for research on entrepreneurial growth, entrepreneurial teams and firms' organizational design.

Keywords: Entrepreneurial team turnover, entrepreneurial team succession, entrepreneurial team entry, firm growth, cohesion, relational embeddedness, team size

Introduction

Entrepreneurial teams have gained increased attention in entrepreneurship research as the pursuance of entrepreneurial endeavors involves collective action (Gartner *et al*., 1994; Ruef, 2010). In fact, entrepreneurial teams have a strong influence on firm's success (Eisenhardt, 2013) as they actively set the firms' goals and shape the firms' strategy. Therefore, the entrepreneurial team which is involved in founding a venture occupies a towering position in understanding its impact on new firm growth (Eisenhardt and Schoonhoven, 1990). The importance of the entrepreneurial team is enhanced by the fact that the founding context is characterized by high uncertainty and limited resources (Katlia, Chen, and Piezunka, 2012; Yang and Aldrich, 2017). Stinchcombe (1965) termed those challenges associated with the founding context as 'liability of newness', which renders nascent firms particularly prone to failure.

Team formation in the founding context is a dynamic process and maintaining an entrepreneurial team is not always successful and may ultimately lead to a turnover event (i.e., entry and exit of team members) within the entrepreneurial team (Kamm et al., 1990). In contrast to the well-studied antecedents of entrepreneurial team entries and exits (Ucbasaran, *et al.,* 2003; Boeker and Karichalil, 2002; Hellmann and Puri, 2002; Wasserman, 2003), there exists limited research investigating the impact of entrepreneurial team entries and successions on new venture growth post-turnover (despite some exceptions, e.g., Chandler, Honig, and Wiklund, 2005). However, venture growth is one of the most important success parameters of nascent firms (Clarysse, Bruneel, and Wright, 2011; Garnsey, 1998, 2002; Penrose, 1959). Reaching a specific firm size is particularly important for new firms since growth increases market power, and consequently ensures survival (Shane, 1996; Stanworth and Curran, 1976). Further, firm growth among nascent firms is especially important to investigate given that the majority of firms remain small and are rather short-lived (Aldrich and Ruef, 2006).

The scarcity of research investigating how changes in team composition, i.e., entrepreneurial turnover events influencing new venture growth post-turnover, motivates our research questions: a) *How do entrepreneurial team turnover events influence new venture growth post-turnover?* b) *How does initial team size (i.e., being a dyadic or triadic team) influence the magnitude of new venture growth post-turnover?*

In our article, we investigate two specific forms of *entrepreneurial team turnovers*, *(a) entrepreneurial team entry* and *(b) entrepreneurial team succession.* We are particularly interested in those two types of turnover events as they signal the

continuance of the entrepreneurial team (Ruef, 2010). An *entrepreneurial team entry* is defined as the event during which a new member is added to the entrepreneurial team (Ucbasaran *et al*., 2003). An *entrepreneurial succession* is defined as the event during which one of the team members exits while a new member is added to the team in the same year (Wasserman, 2003). Both entrepreneurial turnover types are important events in the history of nascent firms due to their immediate consequences on a founding team's relational composition and therefore impact the way team members work together (Blatt, 2009; Granovetter, 1985; Ruef, 2010).

We argue that an entrepreneurial team entry or an entrepreneurial team succession (Ucbasaran *et al*., 2003) will have a negative impact on firm growth since a turnover event distorts entrepreneurial teams' relational embeddedness, which results in less cooperation, helping and reliability among team members (Blatt, 2009; Carmeli and Azeroual, 2009). We further argue that a turnover event implies a change in team composition and hence influences the often *dyadic* or *triadic* relationships prevalent in entrepreneurial teams (Simmel, 1908; Yoon, Thye, and Lawler, 2013). We propose that the individuality reducing and hence behavioral convergence achieving characteristics of triadic teams help them to better cope with the challenges of integrating a new team member into the existing team leading to a more attenuated negative impact on new venture growth in triadic teams than in dyadic teams (Yoon *et al.*, 2013).

To investigate the impact of entrepreneurial turnover events on new venture growth, we employed a rich database of nascent firms and their founding teams provided by the Centre for European Economic Research (ZEW) and applied the difference-in-differences method on a propensity score matched sample (Arnold and Javorcik, 2009a; Imbens and Wooldridge, 2009; Rosenbaum and Rubin, 1983). The propensity score matching allows us to construct comparable groups between firms experiencing a turnover event (i.e., the treatment group) and firms experiencing no turnover event (i.e., the control group) in the period between 2008 and 2011.

We find that entrepreneurial team successions have a negative impact on new venture growth post-succession while entrepreneurial team entries do not influence new venture growth post-entry. When investigating the initial team size, we find that—in contrast to our hypothesis—these negative growth implications of entrepreneurial team successions are more pronounced in triadic than dyadic teams. This finding is surprising in light of the advantages put forward with regard to triadic teams (Krackhardt, 1999; Simmel, 1908; Yoon *et al*., 2013) and indicates that entrepreneurial team successions

distort the relational composition of triadic teams. Our study provides several theoretical and empirical contributions to entrepreneurship research, specifically the literatures on entrepreneurial teams, entrepreneurial growth and organizational design of nascent ventures.

The findings of our study advance research on entrepreneurial teams (Ruef, 2010; Yang and Aldrich, 2014) by showing that entrepreneurial turnover events constitute important entrepreneurial team dynamics which distort teams' relational embeddedness (Blatt, 2009; Granovetter, 1985) and have negative impact on new venture growth. Further, we incorporate the literature of triads and dyads (Simmel, 1908) into the entrepreneurial team literature and show that team size (Krackhardt, 1999; Ruef, 2010; Simmel, 1908; Yoon *et al*., 2013) is an important factor impacting firm growth post-succession (Simmel, 1908). Moreover, our study contributes to the entrepreneurial growth literature (Delmar, 2006; Lockett *et al.*, 2011) by showing that entrepreneurial growth is contingent on the social interaction within the entrepreneurial team, which may be impacted through an entry or an succession (Lechler, 2001). Finally, we add to the literature of organizational design of new ventures (Charan, Hofer, and Mahon, 1980; Sine, Mitsuhashi, and Kirsch, 2006) by showing that the entrepreneurial team occupies a towering position in influencing new venture performance. Disruptive events such as entrepreneurial team successions—with the aim to professionalize the venture—may not lead to the intended outcomes.

Theory and Hypotheses

Following the quintessence of upper echelons theory (Hambrick and Mason, 1984), the group of decision makers referred to as top management team (TMT) in large established organizations (Messersmith et al., 2014) and entrepreneurial team in nascent ventures (Ensley and Hmieleski, 2005; Ensley, Pearson, and Amason, 2002; Ucbasaran et al., 2003) bears a special responsibility: It falls within their responsibility to shape the firms' strategy as well as to set objectives. Hence they have the potential to actively shape firms' performance (Eisenhardt, 2013; Messersmith *et al*., 2014; Ruef, 2010). Thus, the composition of the entrepreneurial team plays a major role for the success (or the lack) of the venture (Eisenhardt, 2013). Given the importance of the entrepreneurial team for new venture success, numerous studies have investigated the impact of entrepreneurial teams' composition on various outcomes such as new product development (Deeds, Decarolis, and Coombs, 2000), firm growth (Eisenhardt, 1989), and seizing new growth opportunities (Kor, 2003), with the last two studies underlining the importance of the entrepreneurial team for new venture growth. With regard to the compositional feature of teams, it has been investigated how human capital within the entrepreneurial team (Cooper, Gimeno-Gascon, and Woo, 1994; Forbes et al., 2006; Ucbasaran et al., 2003), entrepreneurs' growth aspirations (Delmar and Wiklund, 2008), team industry diversity as well as trust within the team (Eisenhardt and Schoonhoven, 1990) foster firm growth. Although this research stream has recognized that team composition plays a fundamental role for firm growth, there exists a scarcity of research investigating how *changes* to the team composition such as team members' entries and successions influence new venture growth.

Team exits and entries in entrepreneurial teams

Entrepreneurial teams are characterized by constant changes in team composition—that is the exits of existing team members and entries of new team members—and therefore team formation can be regarded as a dynamic process (Boyd and Gumpert, 1983; Cooper and Bruno, 1977; Timmons, Smoller, and Dingee, 1985). The antecedents leading to a turnover event have been frequently studied in large, established organizations (Giambatista, Rowe, and Riaz, 2005; (Hambrick and D'Aveni, 1992; Kesner and Dalton, 1994; Messersmith *et al*., 2014; Wiersema and Bantel, 1993). For instance, it has been investigated how firms' environmental dimensions (Wiersema and Bantel, 1993), firm size (Boeker and Karichalil, 2002) and organizations' past performance (Wasserman, 2003) impact turnovers. As regards the impact of turnovers on organizational performance in large, established organizations, the results are ambiguous: while some researchers found a negative impact on firm performance (Hambrick and D'Aveni, 1992; Messersmith et al., 2014), others confirmed a strong positive relationship between turnover events and firm performance (Keck, 1997; Virany, Tushman, and Romanelli, 1992).

However, those research findings may not necessarily hold for entrepreneurial teams in the founding context. A broad range of characteristics differentiates entrepreneurial team turnovers in new ventures from those observed in large, established companies (Gartner, Bird, and Starr, 1992; Katlia *et al*., 2012; Yang and Aldrich, 2017). The differences between large, established corporations and new ventures are rooted in the founding context, which Stinchcombe (1965) termed as 'liability of newness'. Founding conditions are often characterized by high uncertainty and limited resources often requiring fast adaption and augmentation of entrepreneurial teams' competencies (Gartner *et al*., 1992). Further, the founding context is often associated with the absence of established routines within firms (Yang and Aldrich, 2017), which manifests itself in underdeveloped governance and control systems (Ucbasaran *et al*., 2003). Those differences make entrepreneurial team turnovers a distinct phenomenon, which need to be studied independently. With regard to the entrepreneurial team turnover literature, the body of research investigating the antecedents influencing an entrepreneurial team turnover is very rich (e.g., Boeker and Karichalil, 2002; Forbes *et al*., 2006; Rubenson and Gupta, 1996; Ucbasaran *et al*., 2003; Wasserman, 2003) but there exists a scarcity of research investigating the impact of various turnover types on new firm growth (Chandler *et al*., 2005).

Numerous reasons have been put forth why turnover events within nascent firms occur. First, it has been argued that turnovers satisfy evolving organizational needs of the growing venture (Boeker and Karichalil, 2002), and increased need for entrepreneurial team members that can adapt to changing environments (Rubenson and Gupta, 1996). Further, it has also been argued that the type of financing source impacts the frequency of turnover events, with venture-capital-backed companies being more likely to replace founding team members (Hellmann and Puri 2002; Wasserman 2003). With regard to studies on the influence of entrepreneurial team turnover events on nascent firm performance, Chandler *et al.* (2005), have found that team members' entries have a negative effect on firm performance when relying on a self-reported profitability measure of a cross-sectional survey design of Swedish ventures.

Entrepreneurial team's relational embeddedness and cohesion

Entrepreneurial team turnovers—despite providing human capital in terms of adding knowledge and skills (Eisenhardt and Schoonhoven, 1990; Ucbasaran *et al*., 2003)—cause changes to the relational composition of entrepreneurial teams, more precisely to the *relational embeddedness* and *cohesion* among entrepreneurial team members (Blatt, 2009; Ensley et al., 2002). To understand why this is the case, we shortly outline the main ideas of both theoretical perspectives to better understand the impact of turnover events on teams' relational dimension.

Relational *embeddedness*[1] denotes individuals' personal relationships with other individuals, such as members of an entrepreneurial team (Bird and Wennberg, 2016). Relational embeddedness is defined as 'the assets created by and leveraged through relationships' (Nahapiet and Ghoshal, 1998, p. 244). Those assets empower relations to become crucial resources to achieve firm growth (Brinckmann and Hoegl, 2011; Kale, Singh, and Perlmutter, 2000). The three forms of relational embeddedness are trust (Fukuyama, 1995; Putnam, 1993), identity (Håkansson and Shenota, 1995; Merton, 1968) and obligations (Burt, 1993; Granovetter, 1985), which promote firm growth in various forms. Identification is defined as the degree to which founders incorporate the team in their self-concept (Pratt, 1998) and increases cooperation and helping among the entrepreneurial team members (Dutton, Dukerich, and Harquail, 1994). Obligations, defined as team members' commitments to carry out specific activities (Nahapiet and Ghoshal, 1998) create a sense that each team member can be relied on which promotes

[1] Sometimes also referred to as relational capital (e.g., Blatt, 2009).

new venture growth (Blatt, 2009). Finally, trust is defined as 'the willingness of team members to let themselves be vulnerable based on the expectation that others will not abuse that vulnerability' (Blatt, 2009, p. 534) and leads to increased information exchange among team members (Carmeli and Azeroual, 2009). In summary, relational embeddedness within a team results in team members' mutual cooperation, helping and reliability (Blatt, 2009), which enable individuals to jointly pursue economic actions and thereby influence economic outcomes (Granovetter, 1992), such as firm growth (Blatt, 2009). Already Penrose (1959) emphasized that the quality of relationships among entrepreneurial team members has a strong influence on firm growth and that trust and confidence in each other is a necessary prerequisite to grow a firm. Those relational resources help them to exploit the firm's physical and human resources that foster firm growth. With an emphasis on the firm, the resource-based view is therefore very strongly connected to Penrose's theory (Barney, 1991; Kor and Mahoney, 2004).

The second perspective our study draws from is the concept of *cohesion*. Cohesion is defined as 'the degree to which members of the group are attracted to each other' (Shaw, 1981, p. 213) and describes the state of social relationships among a team (Ensley et al., 2002; Piva and Rossi-Lamastra, 2016). Ucbasaran *et al*. (2003) find that cohesion is a key characteristic of well performing entrepreneurial teams. More specifically a team's cohesion impacts firm growth through the following main mechanisms. Team members of cohesive teams depict higher levels of affinity and trust (O'Reilly, Caldwell, and Barnett, 1989) and 'react faster, are more flexible, use superior problem solving techniques, and are more productive and efficient than less integrative teams' (Smith et al., 1994, p. 432). Cohesive teams are further argued to have higher levels of cognitive conflict, which lead to improved decision-making (Ensley *et al*., 2002). Those characteristics of cohesive teams are positively related to new venture growth (Ensley *et al*., 2002).

The importance of team size: Dyadic and triadic teams

Entrepreneurial team turnovers may have a varying effect on the team composition depending on the initial team size of the entrepreneurial team. In the case of an entry, a team member is added to the team which implies that the team size increases while in the case of an entrepreneurial team succession the team size remains the same, however, one team member is replaced through another individual while the number of founding team members decreases (Ruef, 2010). Incorporating the theory on dyads and triads (Simmel, 1908) into the entrepreneurial team literature, this change in the composition of the initial team may have substantial impact on how the team co-operates

Team size or more specifically the fact that the entrepreneurial team consists of two (i.e., constituting a dyad) or three team members (i.e., constituting a triad) influences how teams interact (Simmel, 1908). In Georg Simmel's seminal essay 'Die quantitative Bestimmtheit der Gruppe[2]' (1908), he investigates how the sheer number of team members influence group processes and found that differences in group processes between dyads and triads manifest themselves in *individuality*, *bargaining power* and *conflict characteristics* (Krackhardt, 1999).

First, dyads allow for more *individuality* than triads since no majority must be reached to outvote any individual's opinion, while in triads the interests of the larger group can overrule individual demands. Following Simmel, Coser (1971, p. 187) argues that 'the triad is the simplest structure in which the group as a whole can achieve domination over its component members; it provides a social framework that allows the constraining of individual participants for collective purposes'. Second, the individual *bargaining power* of each member in a dyadic group is bigger compared to the power of each member in a triadic group. This can be exemplified by depicting a situation, in which one member of a dyadic team threatens to leave the group if his or her demand is not met. This threat becomes less important in case the group consists of three (or more) members as the remaining two individuals could still form a group when the disloyal leaves the group (Simmel, 1908). Third, dyadic relationships are qualitatively different from any other team size as the two individuals are directly confronted with one another which also influences how conflicts are resolved between individuals.

Conflict resolution mechanisms are more sophisticated in a triad as the third individual can act as a facilitator between the other two team members. For instance,

[2] An English translation would be 'Quantitative Aspects of the Group'

through rephrasing the sometimes harsh rhetoric and softening firm positions of the involved individuals, the third individual can dampen the otherwise severe consequences on team cohesiveness and direct the conflict towards consensus (Yoon *et al.*, 2013). In consequence, the mechanisms described above result in better group functioning in triads than in dyads at the expense of reduced individuality, increased behavioral convergence and more attenuated conflicts by constraining team members' emotions (Yoon *et al.*, 2013). The effect of a turnover event on new venture growth, given a specific team size, has remained unexplored so far.

Hypotheses

Entrepreneurial team entry and new venture growth

An entrepreneurial team entry implies an addition of a new member to the entrepreneurial team. Numerous studies have argued that this phenomenon is motivated by team desire to enhance team human capital and fill resource needs to better pursue the new ventures' strategic goals (Forbes *et al*., 2006; Ucbasaran *et al*., 2003). Although an entrepreneurial team entry may imply an increase in human capital, there may also be difficulties associated with the integration of a new team member. Entrepreneurial team entries change the way team members interact and influence group functioning (Forbes *et al*., 2006). These changes impact team processes such as conflict solving capacity, team members' interactions and task coordination. Hence, there are substantial 'potential costs associated with the coordination and integration of [new] team members' (Ucbasaran *et al*., 2003, p. 109).

In consequence, the event of adding a new team member is often very disruptive as it interferes with the existing practices established within the entrepreneurial team and hence may distort teams' cohesion (Chandler *et al*., 2005). As Forbes *et al*., 2006 (p. 234) puts it: 'if the contribution of the diverse skills and experiences is negated by a decrease in cohesion, then the net effect of adding a member might be negative'. These difficulties associated with integrating a new team member combined with the already challenging venture environment distort the cohesion among existing team members and may lead to a higher intensity of affective conflicts (Ucbasaran *et al*., 2003).

Looking at entrepreneurial team entry from a relational embeddedness perspective, Blatt (2009, p. 535) argued that 'the greater the novelty a team faces, the more daunting the effort to form and sustain relationships becomes'. Relational embeddedness develops over a track record of interactions requiring reciprocal investments into

relationships (Granovetter, 1992; Beal *et al*., 2003). If an additional team member enters the team, this results in high team-based novelty, which influences the three forms of relational embeddedness among team members (Blatt, 2009).

With regard to identity, the emergence of a joint identity takes time as team members need to incorporate the team into their self-concept. If team members identify with the team, this leads to more coordinated and predictable team behavior (Simon, 1991), even in rapidly changing environments (Blatt, 2009). The lack of the new team member's identity prohibits the successful coordinated decision-making within the entrepreneurial team that fosters firm growth (Blatt, 2009). Further, trust emerges as team members accumulate information about each other over time (Blatt, 2009), thus lower levels of trust within the newly formed team lead to disagreement, conflict and coordination problems during the integration phase of the new team member (Blatt, 2009).

Lastly, the initially unclear situation of how obligations are distributed among team members after an entrepreneurial entry impedes the frictionless functioning of the team (McGrath, Macmillan, and Venkataraman, 1995). For instance, entering team members often have diverging perspectives and agendas from the founding team members who have developed norms and shared expectations of how the business should be operated (Chandler *et al*., 2005). Hence, a newly added team member constitutes a disruption as he or she has not developed the same solid basis of relational embeddedness with the other team members who grew together through shared work experiences. These arguments together lead us to hypothesize that an entrepreneurial team entry has a negative impact on new venture growth.

Hypothesis 1: An entrepreneurial team entry has a negative impact on new venture growth.

Entrepreneurial team succession and new venture growth

With regard to the second turnover phenomenon, entrepreneurial team succession, the event that a team member exits while a new member is added to the team in the same year causes additional complexity to team functioning. Previous studies have associated succession with a situation of 'crisis', since team member succession often disrupts established work routines (Sine *et al*., 2006). Hence, roles within the entrepreneurial team have to be redefined, which changes decision-making and communication within the newly founded organization (Haveman and Khaire, 2004).

Associated with a team succession is that an existing team member exits the organization. Numerous studies found that conflicts arising among team members (e.g., from team members who are poorly integrated into the team) may lead team members to leave the firm (O'Reilly *et al*., 1989; Vanaelst *et al*., 2006). In addition to the arguments developed in the hypothesis above, an entrepreneurial team exit is a sign of an ex ante lower level of embeddedness and cohesion (O'Reilly et al., 1989; Piva and Rossi-Lamastra, 2016). In consequence, entrepreneurial teams experiencing an exit, may have on average lower levels of relational embeddedness than entrepreneurial teams experiencing no team member exit. The lower level of relational embeddedness leads to increased costs of integration and coordination (Ucbasaran *et al*., 2003). In essence, the combination of a leaving team member combined with a new incoming team member constitutes a major challenge influencing firm growth post-succession negatively (Ensley *et al*., 2002). Summarizing the arguments above, we hypothesize that an entrepreneurial team succession has a negative effect on new venture growth.

Hypothesis 2: An entrepreneurial team succession has a negative impact on new venture growth

Dyadic and triadic team and new venture growth post-turnover event

Team size has been argued to affect new firm growth (Ruef, 2010). The entry of new a team member and therewith associated integration and coordination is challenging and may disrupt the quality of relationships among team members. Simmel (1908) argues that the difference between a dyadic and triadic team is fundamental. An entrepreneurial team entry should therefore have a different impact on new firm growth of initial dyadic than triadic teams.

Through a team entry a dyadic team transitions into a triadic team. The relationships between dyadic teams are, however, often very personal and are characterized by high levels of intimacy (Yoon *et al*., 2013). That means that there is a strong interdependency between the two team members and the social structure of the group is already imprinted implying that the entry of a third individual disrupts the already established—often very idiosyncratic—routines between the other two team members (Forbes *et al*., 2006). Hence, a transition to a triadic team reduces such individuality, making relationships less personal between the founding team members. These arguments imply that the full positive potential stemming from teams of three team members (i.e., reduced individuality, increased behavioral convergence and

attenuated conflicts) can only be realized after the full integration of the new team member, which is often a very time-consuming and emotional process (Ucbasaran *et al*., 2003).

If triadic teams transition into a team of four members those are better equipped to integrate the new team member into the existing team than dyadic teams. The reason for this is that the benefits of triadic teams are already present within those teams. Also Simmel (1908) wrote that the group behavior between a triad and a larger team size (such as a team of four) is less substantial than the difference between a dyadic and a triadic team. In fact, relationships are less intimate and emotional in triadic teams than in dyadic teams: 'Triads reduce such intimacy (or its expression) by invoking and making salient an impersonal *supra individual* entity'(Yoon *et al*., 2013, p. 1458). Although a team entry constitutes a disruption to team relational embeddedness, team integration is more likely to take place in triadic teams, which leads to higher quality of information exchange, increased collaboration and quicker decision-making among former triadic teams (Lubatkin et al., 2006). More formally, we posit:

Hypothesis 3: An entrepreneurial team entry has an attenuated negative growth impact in case it occurs for an initially triadic team than for a dyadic team.

We further argue that the initial entrepreneurial team size also influences the magnitude of new firm growth post-succession. In particular, we suggest that triadic teams are better equipped than dyadic teams to cope with an entrepreneurial team succession. Dyadic teams are generally characterized by high interdependence and emotional intensity among team members, implying that a team succession has a stronger negative impact on the cohesion and relational embeddedness of dyadic teams than triadic teams (Yoon *et al.*, 2013).

Second, triadic teams—even in the case of newly formed triadic teams—are better equipped to cope with difficult conflict situations, which may emerge due to team successions (Krackhardt, 1999). As Krackhardt (1999, p. 185) puts it: 'Conflict, is more readily managed and resolved in a triad. In a standard dyadic arrangement, conflicts escalate, and positions harden', which is not the case for triads as the third team member can act as a moderator between the two other individuals. This constellation implies that in triadic teams the third individual acts as a balancing element between the other two, who may facilitate the integration of the newly incoming team member.

Finally, in an association of three, a group continues to exist even in case one of the founding team members exits the team, and hence the 'sense of loss' if one of the founding team members exits is limited since one of the founding team members is still available (Krackhardt, 1999). As Yoon *et al.* (2013, p. 1458) have put it: 'The super-individual property of triads acts as a check on emotional ups and downs likely to occur in a dyad, and reduces the sense of loss if a partner exits because another partner is still available.' These arguments together lead us to set up following hypothesis:

Hypothesis 4: An entrepreneurial team succession has an attenuated negative impact on new venture growth in case it occurs for a triadic than for a dyadic team.

Methods

Data and sample

To investigate our hypotheses, we employed a longitudinal database of nascent ventures in Germany. The database, named 'KfW/ZEW start-up panel', is a joint effort of the Center for European Economic Research (ZEW), the KfW Bankengruppe, a German government-owned development bank, and Creditreform, the largest credit rating agency in Germany. The aim of the data collection is to better understand the development of nascent ventures in Germany over time. The longitudinal database includes German start-ups which were founded between the period 2005 and 2011 and are followed since their inception. To identify the nascent ventures, a random sample of the KfW/ZEW start-up panel is drawn from the database of Creditreform. In each yearly wave, computer-aided telephone interviews (CATI) are conducted with about 6,000 firms and in each of the waves[3], the panel is complemented with additional firms. The interviews are conducted with one of the members of the entrepreneurial founding team, with an interview taking on average 25 minutes.

The longitudinal database provides a comprehensive set of variables on the firm-level such as information on sales, number of employees, and financing structure. At the team level, variables reflecting team dynamics, i.e., if and when an external person was added to the entrepreneurial team of the firm and if an existing member of the entrepreneurial team resigned from his or her position. Further, the database contains information on founders' human capital such as education, start-up experience and

[3] The average response rate for this panel is 20 percent across the years, which is comparable with other surveys.

industry experience. Almost all industry sectors are covered in the database. Approximately half of the firms included in the sample operate in high-technology industries (KfW/ZEW/Creditreform, 2014). Due to the fact that the KfW/ZEW start-up panel included information on team-level entries and exits only for the period between 2008 and 2011, our analysis is based on this period.

Propensity score matching procedure (PSM)

We solved the challenge of constructing comparable samples of firms experiencing a turnover event and firms experiencing no turnover event using PSM[4] (Arnold and Javorcik, 2009a; Imbens and Wooldridge, 2009; Rosenbaum and Rubin, 1983), and employed the nearest neighbor technique. In nearest neighbor matching each firm of the treatment group, (i.e., in our case the firms experiencing a turnover event), is matched with a firm from the control group (i.e., in our case, the firms experiencing no turnover event) that is closest to the treated unit in terms of its propensity score (Li, 2012). Turnover events denote entrepreneurial team successions and entries.

We used PSM to control for differences in firm characteristics between firms experiencing a turnover event and firms experiencing no turnover event to address a potential selection bias (Rosenbaum and Rubin, 1983) (i.e., endogeneity bias). Depending on the entrepreneurial team turnover event the treatment group comprises firms that have experienced either an (a) *entrepreneurial team entry or* (b) *entrepreneurial team succession.* Firm observations were coded as 1 if they experience one of the turnover events during the period of observation. Firms experiencing no turnover event were coded as 0.

In order to calculate the propensity score[5], we employed four distinct firm characteristics that are expected to influence the likelihood of a firm experiencing a turnover event, namely: *Sales*. Is measured in absolute terms on a yearly basis, reflects past performance and hence is a proof of concept stage of the business model of the venture that may affect the stability of both the entrepreneurial team (Boeker and Karichalil, 2002). *Number of employees*. This variable reflects firm size and indicates the formalization of the nascent venture (Reichenstein and Dahl, 2004).

[4] STATA command: 'psmatch2' (Leuven and Sianesi, 2015).
[5] The propensity score can be interpreted as the 'conditional probability of assignment to a particular treatment given a vector of observed covariates. Both large and small sample theory show that adjustment for the scalar propensity score is sufficient to remove bias due to all observed covariates' (Rosenbaum and Rubin, 1983, p. 41)

Firm age. Is measured in number of years since founding, and captures any age related patterns with regard to founder transitions with younger firms being particularly prone to turnover events (Boeker and Karichalil, 2002). *Team size*. Is measured as the number of team members who are active in management and have an ownership stake in the company (Ruef, 2010) as former studies have shown that entrepreneurial team size influences the likelihood of an entrepreneurial team turnover (Boeker and Karichalil, 2002).

We then stratified the propensity score into different strata and tested the balance for each stratum (using Stata command 'pscore'), concluding that the balancing property was satisfied (Li, 2012). Finally, we checked the means of the covariates used in the PSM (using Stata command 'pstest') and concluded that through the matching procedure, differences in means between the control and treatment group became insignificant and resulted in a bias reduction compared to the unmatched sample. In a second step, we employed the *difference-in-differences method* on the propensity score matched sample to compare sales growth of the treated versus growth of the untreated group after the turnover event.

Analytical procedure

After constructing the propensity-score matched sample, we employed the difference-in-differences (DID) method to investigate growth differences of firms having experienced a turnover event compared with firms experiencing no turnover event. The effect of a turnover event on sales growth is defined as the difference between the outcome of the firm with a turnover event and the outcome that the firm would have reached without a turnover event (Lechner, 2010). The impact of the turnover event is therefore measured by variation in *sales growth* which is attributable to the turnover event only. However, assessing it requires knowledge of what the outcome would have been if the firm had not experienced a turnover event. Therefore, the DID method compares the difference in the outcome before and after the turnover for a target firm to the difference in the outcome before and after this event for a control group having experienced no turnover event

The coefficient of interest represents the *interaction term* between the variable *treated* and *after*. The variable *after* is created to differentiate the time periods before and after the treatment (i.e., the entrepreneurial team turnover) as we need to distinguish between the growth before and after the entrepreneurial team transition. This variable is

coded as 1 if the observation was made *after* the treatment and 0 if it was made before the treatment or in the year of the treatment. The variable *treated* takes the value 1 if the firm belonged to the treatment group (i.e., firms experiencing a turnover event) and 0 if the firm belonged to the control group (i.e., firms experiencing no turnover event). To understand the effect of the interaction term on sales growth, we employed ordinary least squares (OLS) regression models (similar to Wennberg, Wiklund, Hellerstedt, and Nordqvist, 2011).

Measures

The dependent variable was measured at time *t*, and unless stated otherwise, we lagged the control variables at t-1 to avoid simultaneity bias.

Dependent variable

As our dependent variable, we used *sales growth*, (Brush and Vanderwaf, 1992; Chandler and Hanks, 1993; Delmar, 2006; Eisenhardt and Schoonhoven, 1990), which is frequently used in studies assessing performance of nascent firms (Ensley, Pearson, and Amason, 2002; Zimmerman and Zeitz, 2002). Growth in sales is important for nascent ventures since 'economics of scale typically are too small for them to continue without increasing their scale of operations' (Zimmerman and Zeitz, 2002, p. 417). We defined sales growth as the logarithmic change, which is computed as the total sales at $year_t$ divided by total sales in $year_{t-1}$ (Brush, Bromiley, and Hendrickx, 2000; Colombo and Grilli, 2005). We took the logarithm of the yearly sales growth variable to correct for the skewed distribution (Delmar, 2006)[6], following formula reflects the computation of the sales growth variable:

$$\text{Sales growth} = \ln \frac{\text{Sales}_t}{\text{Sales}_{t-1}}$$

[6] The logarithm of the dependent variable is often an option for obtaining both a higher fit and a better use of the data' (Delmar, 2006, p. 69).

Turnover events

Our study investigates two basic forms of entrepreneurial team turnovers, (a) entrepreneurial entry and (b) entrepreneurial succession. We define an entrepreneurial team entry as the event during which a new member is added to the entrepreneurial team. An entrepreneurial team succession is characterized by the fact that one of the entrepreneurial team members exits while a new member is added to the team in the same year.

Control variables

We further included a set of control variables in our models. *Firm size*. Firm size is strongly associated with firm growth (Delmar, Davidsson, and Gartner, 2003). This variable was computed as the number of full-time employees. *Entrepreneurial team size*. This variable was measured as the number of entrepreneurial team members who are active in management and have an ownership stake in the firm. A higher number of team members is associated with higher firm growth (Ruef, 2010). *Firm age*. Firm age was measured as the number of years a firm has existed since its inception. *Education within the entrepreneurial team*. The availability of general human capital within the entrepreneurial team is believed to increase entrepreneurial teams' cognitive skills impacting firm growth positively (Colombo and Grilli, 2005). Education was measured using two dummy variables. One was coded as 1 if at least one of the entrepreneurial team members possessed university education and the other one was coded as 1 if at least one of the entrepreneurial team members possessed upper secondary education. Primary education and lower secondary education served as a reference category. *Founding experience within the entrepreneurial team.* This variable is computed as 1 if at least one of the founders has previous founding experience and 0 otherwise. Founding experience enhances individual's ability to transfer relevant knowledge from prior founding experience to a new entrepreneurial venture (Toft-Kehler, Wennberg, and Kim, 2014). *Industry experience*. We further included a dummy variable to control for industry-specific work experience. This variable is coded 1 if at least one of the team members had more than three years of industry experience in the same industry (Eisenhardt and Schoonhoven, 1990). *High technology industry*. This variable is coded as dummy variable 1 if the venture belongs to a high-technology industry and 0

otherwise since nascent ventures in the high-technology sector and in non-high-tech industries are likely to differ in terms of sales growth (Carmeli and Azeroual, 2009).

Results

Before presenting our models, we would like to elaborate on some descriptive results. Our data reveals 167 entrepreneurial team entries and 65 entrepreneurial team successions[7]. These numbers imply that 2.1 percent of all firms experience one type of entrepreneurial team turnover during the four-year time period between 2008 and 2011.

Table 1: Entrepreneurial team turnover events by year

Number entrepreneurial team transitions	2008	2009	2010	2011	Total
Entrepreneurial team entry	49	32	37	49	167
Entrepreneurial team succession	10	20	20	15	65

Table 2 displays the descriptive statistics and the correlations, indicating only moderate correlations. Variance inflation factors (VIFs) are all below 2.5 suggesting that multicollinearity is not a major concern.

Table 2: Means, standard deviations and correlations of variables

		Mean	S.D.	VIF	1	2	3	4	5	6	7	8
1	Sales growth (log)	0.367	1.040	n.a.								
2	Firm size	3.796	8.053	1.04	-0.038							
3	Team size	1.964	1.024	1.08	0.019	0.088*						
4	Firm age	1.600	1.362	1.19	-0.285*	0.051	0.024					
5	Team university education (0/1)	0.596	0.491	1.53	0.058*	0.025	0.217*	-0.026				
6	Team upper sec. education (0/1)	0.170	0.375	1.49	-0.024	0.030	-0.167*	-0.003	-0.549*			
7	Team founding experience (0/1)	0.517	0.500	1.08	0.059*	0.070*	0.199*	0.005	0.124*	-0.177*		
8	Team industry experience (0/1)	0.981	0.136	1.02	-0.044	0.029	0.001	0.109*	-0.035	0.051*	0.048*	
9	High-technology industry (0/1)	0.568	0.495	1.06	0.010	-0.076*	0.098*	0.078*	0.201*	-0.099*	0.073*	0.018

Note: All correlations marked with * are significant at the 5% level or lower.

[7] We excluded entrepreneurial exits as we are primarily interested in team continuance the rather than in team dissolution (Piva and Rossi-Lamastra, 2016). Further, our data only entails few observations for entrepreneurial team exists. After excluding observations with missing values and employing the propensity score matching procedure, we are left with too few observations to gain robust insights into the effect entrepreneurial team exits on sales growth.

Table 3 shows the difference-in-differences regression results for the six models (1) entrepreneurial team entry, (2) entrepreneurial team succession, (3) entrepreneurial team entry for dyads, (4) entrepreneurial team entry for triads, (5) entrepreneurial team succession for dyadic teams and (6) entrepreneurial team succession for triadic teams.

The relevant variable to assess the impact of an entrepreneurial turnover on venture growth after the turnover is the *interaction* term. It indicates the positive or negative growth impact of the specific turnover type in comparison to the matched sample of firms experiencing no turnover event.

Hypothesis 1 argued that an entrepreneurial team entry has a negative impact on new venture growth. This hypothesis is not supported by our results in model 1 (0.063, $p > 0.1$). Hypothesis 2 suggested that an entrepreneurial team succession has a negative impact on new venture growth. This hypothesis finds support in our results (see model 2) as the interaction term is negative and significant (-0.586, $p < 0.01$). Hypothesis 3 proposed that an entrepreneurial team entry has an attenuated negative growth impact when it occurs for an initially triadic team than for a dyadic team. Our results do not support Hypothesis 3 as both interaction coefficients in model 3 (0.086, $p > 0.1$) and model 4 (-0.321, $p > 0.1$) are insignificant. Lastly, Hypothesis 4 proposed that an entrepreneurial team succession has an attenuated negative impact on new venture growth when it occurs for an initially triadic entrepreneurial team than for a dyadic entrepreneurial team. Model 5 on entrepreneurial team succession for dyadic teams reports a negative and significant interaction term (-0.578, $p < 0.05$). Model 6 on entrepreneurial team successions in triadic teams also reports a significant and negative interaction term (-1.099, $p < 0.01$), which is stronger than for dyadic teams. The suest test statistic (5.51, $p < 0.05$) confirms a significant difference in how entrepreneurial team successions influence teams composed of two and three members. These findings imply that the negative effect of entrepreneurial team succession is stronger for triadic than for dyadic teams indicating that initial team size is of importance when assessing the magnitude of entrepreneurial team succession.

Table 3: OLS regressions on firm growth

Model	(1) Entry	(2) Succession	(3) Entry for dyads	(4) Entry for triads	(5) Succession for dyads	(6) Succession for triads
After	-0.105	0.095	-0.218	0.127	0.271+	0.166
	(0.093)	(0.114)	(0.134)	(0.177)	(0.149)	(0.209)
Treated	0.066	0.217	-0.142	0.176	0.147	0.698*
	(0.098)	(0.133)	(0.148)	(0.215)	(0.168)	(0.336)
Interaction (Treated x After)	**0.063**	**-0.586****	**0.086**	**-0.321**	**-0.578***	**-1.099****
	(0.162)	**(0.219)**	**(0.223)**	**(0.326)**	**(0.281)**	**(0.395)**
Firm size	-0.009*	0.028**	-0.011*	0.019*	0.022**	0.071*
	(0.004)	(0.010)	(0.005)	(0.009)	(0.008)	(0.034)
Team size	0.013	-0.069	-0.050	-0.048	-0.132+	-0.316+
	(0.037)	(0.048)	(0.073)	(0.083)	(0.078)	(0.165)
Firm age	-0.198***	-0.171***	-0.219***	-0.251***	-0.197***	-0.197**
	(0.028)	(0.036)	(0.041)	(0.051)	(0.046)	(0.069)
Team university education (0/1)	0.114	-0.050	0.045	0.388*	0.171	-0.392
	(0.086)	(0.117)	(0.125)	(0.195)	(0.152)	(0.285)
Team upper sec. education (0/1)	0.008	-0.042	-0.140	-0.107	0.053	-0.600
	(0.105)	(0.162)	(0.164)	(0.350)	(0.191)	(0.410)
Team founding experience (0/1)	0.052	0.139	-0.144	-0.211	0.162	0.216
	(0.071)	(0.095)	(0.103)	(0.143)	(0.120)	(0.201)
Team industry experience (0/1)	-0.323	0.098	-0.234	-0.330	-0.038	0.164
	(0.358)	(0.349)	(0.456)	(0.611)	(0.526)	(0.539)
High-technology industry (0/1)	0.009	0.147	0.151	0.037	0.133	0.218
	(0.072)	(0.091)	(0.102)	(0.154)	(0.117)	(0.174)
Constant	0.950*	0.414	1.325**	0.935	0.523	1.084
	(0.370)	(0.378)	(0.497)	(0.659)	(0.588)	(0.670)
Observations	857	283	346	164	171	77
R-squared	0.094	0.168	0.174	0.195	0.219	0.288

Note: Robust standard errors in parentheses. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$

Robustness tests

We conducted a number of robustness tests to determine the reliability of our results. First, we re-estimated our models using fixed effects panel models (STATA command *xtreg*). We obtained very similar results with significance levels remaining the same. Further, we also re-ran our analysis using employment growth as the dependent variable, which was computed similar to the growth variable used in our main analysis (Brush *et al*., 2000). We find no significant effect of entrepreneurial team turnover on ventures' employment growth post-transition. This finding is consistent with previous studies finding modest correlation between various growth measures (Achtenhagen, Naldi, and Melin, 2010; Delmar *et al.,* 2003). Further, we employed a more fine-grained operationalization of industry as our data allows us to control for different industry types[8] by incorporating a set of industry dummies into our OLS regressions. Again, our results remained very similar. Lastly, we tested if there is any difference (using t-tests) in sales growth between firms experiencing a turnover event, for which the turnover leads to an increase in human capital within the entrepreneurial team (i.e., that is the turnover event increases the level of education within the entrepreneurial team) with firms for which the turnover event constitutes no increase in human capital within the entrepreneurial team. We did not find significant differences in sales growth between those two types of firms indicating that the increase in human capital does not lead to higher sales venture growth post-turnover.

Discussion

We built on the cohesion and relational embeddedness perspectives to theorize how two different types of entrepreneurial team turnovers, i.e., entrepreneurial team entry and entrepreneurial team succession, influence new venture growth. We found empirical evidence that entrepreneurial team successions have a negative impact on firm growth as they constitute a disruption of established work routines (Haveman and Khaire, 2004), making the integration of new team members a time consuming and costly process (O'Reilly *et al*., 1989; Ucbasaran *et al*., 2003).

[8] The industry classifications are as follows: wholesale/retail, cutting-edge technology manufacturing, high-technology manufacturing, technology-intensive services, software, non-high-tech manufacturing, skill-intensive services, other business-orientated services, consumer-orientated services and construction.

The second turnover event, i.e. entrepreneurial team entry, has an insignificant effect on new firm growth post-entry. One reason for this finding could be that teams' relational embeddedness of the founding team members is only marginally (if not at all) affected by the addition of a new team member. In particular, the entrepreneurial team maintains sound relationships, unimpaired by the entry of a new member (Forbes *et al*., 2006).

Finally, we employed Simmel's theory (1908) on dyadic and triadic teams to hypothesize how entrepreneurial teams consisting of three team members are better equipped to cope with the challenges caused by entrepreneurial team turnovers than dyadic teams, ultimately leading to an attenuated negative growth impact for triadic teams. We found that—in contrast to our hypothesis—entrepreneurial team successions for triadic teams have a stronger negative effect on firm growth than for dyadic teams. We assume that triadic teams experiencing a succession do not profit from the stabilizing, behavioral convergence increasing, attenuated conflict characteristics from which triadic teams profit in an established team setting (Yoon *et al*., 2013). With regard to dyadic teams it can be argued that the founding team member is highly dependent on the new team member as he or she would otherwise be managing the venture on his or her own (Krackhardt, 1999). We assume that due to the strong dependence on the new team member, the founding team member therefore tries to avoid personal conflict to the best of his or her ability (Ensley *et al*., 2002).

Contributions to literature on entrepreneurial growth

Our study contributes to the entrepreneurial growth literature (Clarysse *et al.*, 2011; Delmar, 2006; Penrose, 1959; Wright and Stigliani, 2013) by providing evidence for the central role of the team for new venture growth (Eisenhardt, 2013). More specifically, research has shown that mutual trust (Eisenhardt and Schoonhoven, 1990), confidence and knowledge of each other (Penrose, 1959), human capital resources (Colombo and Grilli, 2005), team heterogeneity (Ensley, Carland, and Carland, 1998), as well as teamwork and relational capabilities (Brinckmann and Hoegl, 2011) impact new firm growth. What these studies have missed is that venture growth is also influenced by changes to the team composition (Hellmann and Puri, 2002; Wasserman, 2003) which is frequently subject to changes (Chandler *et al*., 2005).

Following recent calls for research on the impact of team composition on firm growth (Wright and Stigliani, 2013), we showed that venture growth is strongly dependent on the entrepreneurial team. More precisely, our findings demonstrate that entrepreneurial team successions have a negative influence on new venture growth while team entries have no significant effect on new firm growth. These findings underline that turnovers do not impact growth per se, but that it depends on the type of turnover event. We present further nuanced insights by showing that the negative growth effect on firms experiencing a succession is more pronounced for triadic teams than for dyadic teams, thereby shedding further light on the importance of team size for new venture growth (Ruef, 2010). To our knowledge, it is the first study to show that entrepreneurial team successions have a negative impact on new venture growth.

Contributions to literature on entrepreneurial teams

Since early findings postulated the importance of the entrepreneurial team for strategic decisions, a vast number of studies examined the relationship between team composition and new firm growth (Brinckmann and Hoegl, 2011; Eisenhardt and Schoonhoven, 1990). Our study contributes to this stream of literature by showing that also changes to the team composition have strong implications for new firm growth. In studies investigating the antecedents of entrepreneurial turnover events, a prevalent explanation for why such turnovers occur in the venture context is to augment the level of human capital (Ucbasaran *et al*., 2003). What these studies have missed is the fact that the successful utilization of team knowledge base in turnover situations is dependent on the relational embeddedness and cohesion within the venture team (Forbes et al., 2006; Piva and Rossi-Lamastra, 2016) and the size of the entrepreneurial team (Ruef, 2010). Our study therefore contributes to the research on team relational embeddedness (Blatt, 2009; Granovetter, 1985) by showing that changes in entrepreneurial team composition has a negative growth effect in case of succession events, and no significant effect in case of a team entry. We also compared entrepreneurial team successions, in which the turnover event led to an augmentation of human capital within the entrepreneurial team with team successions that led to no increase in human capital within the team and found that there was no significant growth difference between those two groups. This finding lends further support that the rise in human capital resources does not necessarily lead to firm growth.

We further contribute to the entrepreneurial team literature by showing that turnover events in teams of two versus teams of three (Krackhardt, 1999; Ruef, 2010; Simmel, 1908; Yoon *et al*., 2013) have a differing growth effect, namely that succession events in triadic teams have a stronger negative impact on firm growth than successions in dyadic teams. To our knowledge, this is the first study that provides evidence for the importance of team size in succession events. This is a particularly interesting finding since triads have been argued to be favorable for team processes (Simmel, 1908). We contribute to the entrepreneurial team literature by showing that team size related advantages of triads might not be effective in case of entrepreneurial team successions.

Contributions to organizational design of nascent organizations

Lastly our study contributes to the research area of organizational design of nascent organizations. We add to previous research stating the organizational structure is important when professionalizing the growing organization (Charan *et al*., 1980; Sine *et al*., 2006). One essential part of professionalization concerns the entrepreneurial team and therewith associated turnover events such as successions (Hellmann and Puri, 2002; Wasserman, 2003). We showed that team composition—especially changes to the composition of the entrepreneurial team—constitutes one of the most important areas of organizational design in nascent organizations as it has immediate consequences for new firm growth (Chandler et al., 2005; Terpstra and Olson, 1993). Although antecedents and consequences of turnover events (Chandler *et al*., 2005; Ucbasaran *et al*., 2003; Wasserman, 2003) have been extensively examined in large established organizations, there exists a scarcity of research investigating the impact of turnover events on new firm growth.

Our research showed that entrepreneurial team successions do not have the intended outcomes, namely to increase firm growth. These findings may be due to the increased role ambiguity that can be found within the entrepreneurial teams (Sine *et al*., 2006). Newly formed entrepreneurial teams may not have established agreements on task division (Forbes *et al*., 2006) and this may be particularly harmful in case of an entrepreneurial team succession (Sine *et al*., 2006). We therefore suggest that in situations, in which an entrepreneurial team succession is inevitable, clear responsibilities and team roles should be defined as to avoid role ambiguity among entrepreneurial team members (Sine *et al*., 2006).

Limitations and avenues for future research

As in all research, our study has limitations, which present important avenues for future research. First, our database reports data over a period of four years, prohibiting the assessment of the long-term consequences of entrepreneurial team turnovers which would be interesting to study as the long-term growth implications could be different for both turnover events studied in this article. Second, we did not study the implications of entrepreneurial team exits (i.e., team members exiting the nascent venture) as our primary aim was to investigate the effects of entrepreneurial team entries and successions and on new firm growth. Future research should further investigate which circumstances lead to entrepreneurial team exits and how this can lead to team dissolution (Piva and Rossi-Lamastra, 2016). Third, team's cohesion and relational embeddedness were indirectly measured through the turnover events, which is commonly done in studies on relational embeddedness (Barden and Mitchell, 2007). Future research should investigate how identity, trust and obligations in entrepreneurial team succession influence team group processes, for instance by using case study methodology. Fourth, we invite future research to investigate why the postulated benefits of triadic teams (Yoon *et al*., 2013) were not effective to better understand the role of team size in case of entrepreneurial team successions. Further, with our research we showed which effect an entrepreneurial entry and succession has on new firm growth. However, additional research is needed to understand under which circumstances an entrepreneurial entry or succession can also be positive for firm growth. Specifically we suggest to examine how different transition types such as voluntary or forced transition (Wasserman, 2012) or the prevalence of family ties within the team (Brannon, Wiklund, and Haynie, 2013; Wennberg et al., 2011) influence new venture growth. Finally, as our study was based in the German context, future research should replicate our study in other cultural contexts to understand the generalizability of our findings.

Conclusion

In this study, we aimed to provide nuanced insights on the growth implications of entrepreneurial team successions and entries. Our paper provides a new perspective to explain why entrepreneurial team successions have a negative impact on venture growth by employing arguments from relational embeddedness literature. Our study sheds light on the importance of entrepreneurial team size in turnover situations by showing that triadic teams experience a more pronounced negative growth effect than dyadic teams. We hope this study encourages other scholars to investigate the underlying mechanisms of turnover events as to contribute to a better understanding of how to design an entrepreneurial entry or succession.

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Paper 2: Women Entrepreneurs and Venture Growth – One Size does Not Fit All

Abstract

This study provides a granular analysis of the effect of gender on new venture growth. Our results suggest that the female underperformance hypothesis needs to be nuanced. First, while men outperform women with regard to venture growth on average, women entrepreneurs with higher education levels achieve higher growth than their male counterparts. Second, women entrepreneurs manage to grow their ventures faster than their male counterparts if they are driven by motives which can be added to the extremes of the opportunity vs. necessity entrepreneurship scale. We discuss contributions to the female entrepreneurship and growth literature and highlight future research opportunities.

Keywords: Entrepreneurship, female entrepreneurship, gender, growth

Introduction

Women entrepreneurs are an essential driver of economic growth. Notably, the Global Entrepreneurship Monitor (GEM) Report on Women's Entrepreneurship concludes that female entrepreneurship is an expanding phenomenon worldwide: in 2016, an estimated 163 million women were starting or running new businesses in 74 economies around the world (Kelley, Ali, et al., 2017). In addition, over 111 million were running established businesses. Drawing on GEM data, Micozzi and Lucarelli (2016) found that women make up about one-third of all nascent entrepreneurs between 2001 and 2012.

The female entrepreneurship phenomenon has spurred abundant research which examined differences in firm size, growth and other performance rates between male and women entrepreneurs (Ahl, 2006; Henry et al., 2016). A majority of studies report that ventures founded by women are on average significantly less successful in terms of "traditional financial parameters", such as venture growth (Fairlie and Robb, 2009; Gottschalk and Niefert, 2013; Watson, 2002), which led to the formation of the "female underperformance hypothesis" (Du Rietz and Henrekson, 2000).

This stream of research has been criticized because of methodological flaws. Many studies relied on cross-sectional surveys with purposive and convenience sampling methods, poor response rates, and only descriptive statistics (Ahl, 2006). In addition, recent studies suggest that the female underperformance hypothesis needs to be rejected when relative performance measures, such as return on equity, return on assets, or Sharpe ratio are compared between women and male founded ventures (Robb and Watson, 2012; Watson, 2002).

In contrast to past research on female entrepreneurship in terms of classical performance measures, our aim is to show that the underperformance claim is too generic and needs to be rejected for certain groups of women with specific capabilities. This study therefore is not a mere comparison between men and women but rather a differentiation between women entrepreneurs themselves, thereby following new research avenues on female entrepreneurship put forward by Jennings and Brush (2013). Specifically, we address the following research question: *Which group of women entrepreneurs manages to grow their business more successfully than the average group of women entrepreneurs?* In this sense, we answer James' (2012) call for research to focus on women entrepreneur success factors, in contrast to numerous past

contributions which primarily focused on the problems experienced by women entrepreneurs.

We argue that the general claim that female entrepreneurs perform worse than their male counterparts is misleading as it does not distinguish between groups of female entrepreneurs who not only perform better than the majority of women entrepreneurs but even outperform their male entrepreneurs. Based on human capital theory and founding motivation (opportunity vs. necessity), we hypothesize that certain groups of women are more successful than others. Specifically, we investigate the impact of knowledge and founding motivation on the growth of start-ups launched by women entrepreneurs with a population averaged regression model. Our study draws on start-up panel which includes 1,435 ventures founded solely by women between 2005 and 2011.

Theory and Hypotheses

As women entrepreneurs and the characteristics of their ventures are significantly different from that of men (Ahl, 2006), a stream of gender dedicated entrepreneurship research evolved (Cabrera and Mauricio, 2017). Amongst others, it constantly reveals two things: first, women have a lower propensity to start businesses (Gottschalk and Niefert, 2013; Koellinger, Minniti and Schade, 2013; Wagner and Sternberg, 2004), and second, women entrepreneurs perform worse than their male counterparts in terms of various indicators such as firm survival (Boden and Nucci, 2000; Robb, 2002) and financial performance (Du Rietz and Henrekson, 2000; Fairlie and Robb, 2009; Gottschalk and Niefert, 2013; Rosa et al., 1996; Watson, 2002).

Boden and Nucci (2000) report 4-6% higher survival rates for single male owned firms compared to single woman owned firms for two U.S. samples. This finding is confirmed by Robb (2002) who reports a survival rate which is 2% lower for women owned businesses, with a 5% higher likelihood for women owned businesses to close down. These results were obtained from a sample of 45,000 firms after controlling for size, industry, legal form, organizational form and location.

Rosa et al. (1996) find that woman owned businesses have amongst other attributes less employees, capital assets and sales turnover than those of their male counterparts. A study on a large random sample of 4,200 Swedish ventures (Du Rietz and Henrekson, 2000) finds a general female underperformance in terms of sales growth

even after controlling for structural factors such as firm size or industry. Further, they do not find significant differences in terms of profitability growth, employment growth and order growth.

Another study based on the 1992 CBO data reports that women-owned ventures have on average 80% lower revenues and are 52% less likely to have profits above US$10,000 than male owned start-ups (Fairlie and Robb, 2009). The authors find that these differences stem from the fact that female-owned businesses have less start-up capital, less prior industry specific work experience and less prior family business work experience.

In the context of Germany, Gottschalk and Niefert (2013) analyze a sample of 4,000 start-ups and show significant underperformance of female-owned ventures for sales, employment growth and return on sales. They explain these gaps by differences in education levels, work experience, team size, necessity-based intentions and industry sectors.

However, a stream of research has challenged the female underperformance hypothesis by showing that it vanishes when relative performance measures which compare input to output factors are used to examine gender related performance differences (Robb and Watson, 2012; Watson, 2002) For example, Watson (2002) reports significantly lower income and profits for female-owned firms compared to male-owned firms on a large Australian sample. Nonetheless, after comparing inputs to outputs, employing measures such as ROA, ROE and total income to total assets, he concludes that there are no significant differences between the two groups.

A study of more than 4,000 business ventures drawn from the Kauffman Firm Survey (KFS) microdata for the period 2004–2008 (Robb and Watson, 2012) reports that the likelihood of survival for female-owned start-ups is just as high as for male-owned ventures. Further, female-owned ventures achieve similar levels ROA as their male counterparts.

Yet to our knowledge there is no study presenting evidence that the female underperformance hypothesis needs to be rejected for the most important performance measure for newly established ventures —sales growth— for certain groups of women entrepreneurs.

The role of knowledge

There exist two major schools of thought —the liberal feminism perspective and the social feminism perspective— in the female entrepreneurship literature. The liberal feminism theory sees men and women as essentially similar and equally capable. Therefore, the cause for underperformance of female ventures is often traced to external factors such as discrimination by lenders or structural differences such lower education prevalence (Robb and Watson, 2012). The social feminism theory suggests that men and women are seen to be, or have become, essentially different (Ahl, 2006) and that these differences matter when it comes to the way men and women operate their business venture and performance outcomes (Robb and Watson, 2012). The most common differences identified for women entrepreneurs include a higher risk aversion (Kepler and Shane, 2007; J. Watson and Robinson, 2003), the importance of balancing family and work aspects (Buttner and Moore, 1997; Jennings and McDougald, 2007; Kepler and Shane, 2007)**,** and a tendency to grow the business venture at a slower and sustainable pace (Morris et al., 2006; Orser and Hogarth-Scott, 2009).

In line with the social feminist perspective, we argue that some women entrepreneurs who possess a specific knowledge base or are driven by particular founding intentions grow their businesses faster than other women entrepreneurs or the average male founder.

Penrose's (1959) theory of firm growth suggests that knowledge is necessary for exploiting the firm's underutilized resources, understanding the competitive environment and building unique capabilities, which foster the growth of the firm. These arguments are in line with previous research that has argued that innovation and consequently firm growth is mainly driven by the commercial use of knowledge and human capital (Davidsson and Honig, 2003; Wiklund and Shepherd, 2003).

Previous studies identified the educational level, industry specific work experience and founding experience of women entrepreneurs as key individual competencies which positively influence venture growth (Mitchelmore and Rowley, 2013). These knowledge vectors are broadly distinguished between explicit (or declarative) and implicit (or procedural) knowledge. The former refers to factual knowledge and information that a person knows: it is gained through formal education and training. The latter relates to knowing how to perform certain activities and is acquired by learning on the job.

In regards to educational attainment —the highest degree obtained through formal education— we argue that the knowledge base built in the early years provides the female entrepreneur with the skills necessary to pursue growth opportunities within the venture context (Lerner and Almor, 2002; Micozzi and Lucarelli, 2016). Educational attainment can also serve as a signaling tool e.g. towards external investors or potential employees. Lastly, it serves as a characteristic to sort "people by level of ambition and assertiveness" (Micozzi and Lucarelli, 2016, p. 179), all positively influencing venture growth.

In addition to educational attainment, technological knowledge has increasingly been identified as a distinct form of explicit knowledge necessary to succeed in today's knowledge economy (Hitt, Ireland, and Lee, 2000). Technological knowledge is the knowledge, skills and abilities needed to perform specific tasks. This type of knowledge is practical and often relates to mechanical, information technology, mathematical, or scientific tasks. Some examples include knowledge of programming languages, mechanical equipment or tools. Technological knowledge can help young founders in seizing founding opportunities and avoid common mistakes (Micozzi and Lucarelli, 2016). It can also enhance the entrepreneur's ability to effectively exploit an opportunity by, for example, determining the product's optimal design to optimize functionality, cost, and reliability (Wiklund and Shepherd, 2003). This knowledge and skills can be acquired both through university degrees and dedicated short courses offered by professional organizations for instance.

From the above we argue that education attainment and technological knowledge, taken together, represent important explicit knowledge-based resources which can have a positive influence on venture growth. Thus, we propose

Hypothesis 1: Women entrepreneur's explicit knowledge has a positive impact on new venture growth.

Implicit knowledge (or know-how) matters for venture growth, too. Industry specific work experience in particular is argued to reduce challenges associated with the founding context (Cooper et al., 1994), often summarized as the "liability of newness". Industry related experience ranges from "tacit knowledge of the products, processes, and technology to specific human capital investment in relationships and goodwill with specific customers, suppliers, or stakeholders" (Cooper et al., 1994, p. 379). It takes time to accumulate and cannot be transferred. Thus women entrepreneurs

with industry specific experience are expected to navigate the challenging founding context more successfully than founders without or only little relevant previous work experience.

Founding experience constitutes another type of highly relevant implicit knowledge in entrepreneurship. Experience translates into expertise in that the positive experience–performance relationship only appears to serial entrepreneurs, while novice entrepreneurs may actually perform increasingly worse because of their inability to generalize their experiential knowledge accurately into new ventures (Toft-Kehler et al., 2014). In addition, industry experience is associated with more accurate and less biased entrepreneur expectations (Cassar, 2014). We therefore argue that single women entrepreneurs with previous founding experience are better equipped to grow their ventures.

Hypothesis 2: Women entrepreneur's implicit knowledge has a positive impact on new venture growth

Founding motivation

Past research suggests that female and male founded ventures are different with regard to founding motivations (Cabrera and Mauricio, 2017). Generally, a distinction is made between positive factors that 'pull' and negative situational factors that 'push' people into entrepreneurship (Shapero and Sokol, 1982). A broad range of studies have traditionally captured the distinction between push and pull motivation by introducing the concept of opportunity and necessity entrepreneurship. Opportunity entrepreneurs are viewed as entrepreneurs who start a business in order to pursue an opportunity in the market, whilst necessity entrepreneurs are pushed by unemployment situations or dissatisfaction with their previous jobs. Whereas opportunity entrepreneurs pursue a business opportunity for personal interest, an entrepreneur driven by necessity perceives entrepreneurship as the 'best (or unique) option available for employment' (Micozzi and Lucarelli, 2016, p. 181), but not necessarily the preferred, occupation.

These are important drivers for female entrepreneurship (Micozzi and Lucarelli, 2016; Orhan and Scott, 2001; Rey-Martí, Tur Porcar, and Mas-Tur, 2015) and the growth of the venture (Gundry and Welsch, 2001; Morris et al., 2006). There is a broad agreement in the literature that, in comparison with necessity entrepreneurs, opportunity

entrepreneurs have usually prepared their entry into self-employment on a more solid basis and they start their businesses in an area of their particular expertise. These factors lead to a longer survival rate and higher business growth in the case of opportunity entrepreneurs (Wennekers et al., 2005).

However, empirical evidence about motivational differences between men and women entrepreneurs remains inconclusive. Some authors suggest that men's motivation involves necessity, while woman's involves opportunity. "This difference derives from men with medium-level incomes acting as breadwinners for family. Women, who experience less social pressure in this sense, can seek opportunities to boost family income." (Rey-Martí, Tur Porcar, and Mas-Tur, 2015, p. 811). Conversely, other authors find that "across the countries, women start a business venture more often out of necessity than men do" (Micozzi and Lucarelli, 2016, p. 177).

As the purpose of this paper is to isolate groups of single women entrepreneurs who successfully grow their ventures we included both types of founding motivations into our model while taking founding motivations which cannot be clearly added to any of the two archetypes as a reference group. In line with past literature, we hypothesize that it is the opportunity driven female entrepreneur which is capable to outperform its female and male peers.

Hypothesis 3a: Women entrepreneur's opportunity driven motivation has a positive impact on new venture growth.

Hypothesis 3b: Women entrepreneur's necessity driven motivation has a negative impact on new venture growth.

Method

In this study, we draw on a longitudinal database of nascent ventures from Germany, the 'KfW/ZEW start-up panel'. This database is the largest representative sample of start-ups which were founded in Germany between 2005 and 2011 and which are followed since their inception. The data was gathered with approximately 6,000 new firms from all industries via computer-aided telephone interviews conducted once a year. The longitudinal database includes a wide range of firm-level and individual level data. We focus on ventures founded by a single person as we want to be able to relate the growth of the venture to the knowledge base and motivational characteristics of a single individual. The sample for this study includes a total of 13,347 start-ups founded

between 2005 and 2011, and for which sales growth information was available for at least three years. Of these, 1,435 start-ups were founded by women entrepreneurs.

We model a population-averaged panel regression to determine the influence of women entrepreneurs' motivation and knowledge on firm growth. Population-averaged models are frequently used for population studies in which the difference in the population-averaged response between groups with different covariates is important, rather than the change of a single individual (Beckman and Burton, 2008; Zeger, Liang, and Albert, 1988). By specifying a population-averaged model, we can interpret the results to be valid for the whole population; in this case the group of women entrepreneurs, rather the single individual (Zeger et al., 1988). This method delivers "consistent estimators of the regression coefficients under only weak assumptions about the actual correlation among a subject's observations" (Liang and Zeger, 1986, p. 122).

Dependent variable

Our dependent variable *sales growth* has been frequently used in studies assessing performance of nascent firms (Delmar, 2006; Ensley, Pearson, and Amason, 2002; Zimmerman and Zeitz, 2002). An important argument why sales growth is one of the most important performance measures for new ventures lies in the economies to scale argument. Typically economies of scale "are too small for them to continue without increasing their scale of operations" (Zimmerman and Zeitz, 2002, p. 417). We defined sales growth as the logarithmic change, which is computed as the total sales at $year_t$ divided by total sales in $year_{t-1}$ (Brush, Bromiley, and Hendrickx, 2000; Colombo and Grilli, 2005). We took the logarithm of the yearly sales growth variable to correct for the skewed distribution (Delmar, 2006). The following formula reflects the computation of the sales growth variable:

$$\text{Sales growth} = \ln \frac{\text{Sales}_t}{\text{Sales}_{t-1}}$$

Independent variables

We include three different categories of independent variables in our models: (1) the gender of the founder, (2) founder's knowledge and (3) founder's founding motivation. The *gender of the founder* is coded 1 if the founder is a woman and zero in case of a

male founder. As multiple studies present evidence for an on average female underperformance we test for this hypothesis first before we differentiate within the group of women entrepreneurs.

Founder knowledge is measured with a series of five variables capturing the different levels of implicit and explicit founder knowledge into our analysis. *Education attainment* was measured using two dummy variables: tertiary education, which was coded as 1 if the founder of the venture completed university education, and upper secondary education, which was coded as 1 if the founder of the venture completed upper secondary education only. Primary education and lower secondary education served as a reference category. *Technological knowledge* is a dummy variable coded as 1 if the founder was educated within at least one the three fields of engineering, natural sciences or technical profession. All other types of education serve as the reference group.

We further include a dummy variable to control for *industry experience* at it has been hypothesized to have a positive impact on venture growth (Achtenhagen et al., 2010; Eesley and Roberts, 2012). This variable is coded 1 if the founder had more than three years of industry experience in the same industry as the venture. *Founding experience* was computed as 1 if the founder has previous founding experience and 0 otherwise. Founding experience is believed to benefit individual's ability to apply crucial knowledge from prior founding experiences within the new founding situation (Toft-Kehler et al., 2014).

Lastly, we include two variables which capture the *founding motivation* of the entrepreneur. A broad range of former studies identified opportunity and necessity-related motivational factors (Jennings and Brush, 2013; Shapero and Sokol, 1982) as important drivers for female entrepreneurship (Micozzi and Lucarelli, 2016; Orhan and Scott, 2001; Rey-Martí, Tur Porcar, and Mas-Tur, 2015). Accordingly, we categorized founding motivation as either *opportunity driven* or *necessity driven*. The variable opportunity driven founding motivation was coded 1 if the founder declared that his primary founding motivation was the realization of a certain business idea. The necessity driven founding motivation variable was coded 1 if the founder declared that his or her primary founding motivation was the goal to escape from unemployment. All other founding motivations (e.g., self-determined working, encouragement by former employer, tax incentives, higher income opportunities, improper employment

opportunities) broadly fit between these two extreme realizations and serve as the control group.

Control variables

We further included a set of control variables in our models to control for any structural difference between the group of single female and single male founders. *Nationality of the founder* has been found to have an influence on performance which is which why we control for it (Watson, Kumar, and Michaelsen, 1993). This variable is coded as 1 if the founder is German and 0 if the founder is of foreign nationality. Since nascent ventures in a *high-technology industry* might differ in terms of sales growth (Carmeli and Azeroual, 2009) we include this variable. The variable is coded as 1 if the venture belongs to a high-technology industry and 0 otherwise. *Number of employees* is measured in number of full time employees of the venture in the specific year. This variable reflects firm size and indicates the formalization of the nascent venture (Reichenstein and Dahl, 2004). *Firm age* is measured in number of years since founding, and captures any age related growth pattern with older firms traditionally featuring less rapid growth (Barron, West, and Hannan, 1994; Delmar, Davidsson, and Gartner, 2003). We include three variables indicating the *employment situation before founding*. The variable *self-employed* is coded as 1 if the person was self-employed before founding the current start-up. The same logic applies to the variables *unemployed* and *not gainfully employed.* The group of founders which was employed before founding his or her start-up serves as a reference group and is coded 0.

Interactions

In order to differentiate the various groups of female entrepreneurs, we include the following set of interaction variables: *women entrepreneur with university education*, *women entrepreneur with upper secondary education*, *women entrepreneur with technological knowledge*, *women entrepreneur with founding experience*, *women entrepreneur with an opportunity-driven motivation*, *women entrepreneur with a necessity-driven motivation*, *women start-up in high-technology industry*, *women entrepreneur self-employed before founding*, *women entrepreneur unemployed before founding*, *women entrepreneur not gainfully employed before founding*. All these variables are coded 1 if the condition is met and 0 otherwise.

Results

Table 1 displays the descriptive statistics and correlations for single founders, indicating only moderate correlations.

Table 2 depicts the results for the mean-comparison test between single female and single male founders. In line with previous studies single women entrepreneurs have significantly slower sales growth than their male counterparts on the most aggregated level without controlling for any structural differences between these groups.

In addition, women entrepreneurs exhibit lower values for all knowledge related variables. Only 26 percent of all women entrepreneurs have a university education compared to 31 percent of male entrepreneurs. An even bigger gap of around 10 percentage points can be observed between men and women with upper secondary education. Further, only 19 percent of women entrepreneurs in our study were educated in a technological knowledge-related subject, in contrast to 63 percent of all male founders. Smaller differences exist in respect to previous work experience in the industry of the venture: 84 percent of all women entrepreneurs have more than three years of work experience in the industry of the venture compared to 91 percent of all men. Lastly, only 19 percent of the females in our sample reported to possess previous founding experience, a figure which is 9 percentage points smaller than that of their male counterparts.

In contrast to these significant differences with regard to the knowledge related variables, we do not find any gender related differences with regard to the founding motivation. Around 27-28 percent of all single founders report that their founding motivation was opportunity related while necessity related motivations range between 11-12 percent for the two groups.

No difference could be found regarding the nationality of the founders. In both groups 91-92 percent of the entrepreneurs are German citizen. As expected, a significantly higher proportion of male founders (41 percent) pursue business in the high-technology sector in comparison to women (19 percent). Further, female start-ups are smaller in terms of employees (1.01 employees for women versus 1.26 employees for men) and also younger (1.08 years for women versus 1.15 years for men). Lastly, our results indicate no difference with regard to the employment situation before founding for the group of the unemployed (both around 18-19%), albeit we found there

are significant differences for the self-employed (12 percent for women versus 16 percent for men) and not gainfully employed group (12 percent for women versus 7 percent for men). To summarize, the mean comparison analysis shows significant differences between male and women entrepreneurs for venture growth and for the majority of our input variables, with the notable exception of the founding motivation variables. These findings are in line with former studies finding structural differences between women and men to be significant (Du Rietz and Henrekson, 2000; Gottschalk and Niefert, 2013)

Table 3 shows the results for the four population-averaged panel regression models on venture growth. We include our independent variables stepwise to be able to observe the changing influences on the outcome variable. Model (1) includes all control variables, as well as the gender of the founder variable. Model (2) further includes the full set of knowledge variables. In Model (3) the founding motivation variables are added. Lastly Model (4), the full model, includes all single women entrepreneur related interaction variables.

Table 1: Means, standard deviations and correlations of variables

		Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	**Sales growth (log)**	0.417	1.155															
2	**Woman (1/0)**	0.145	0.352	-0.020*														
3	**University education (1/0)**	0.313	0.464	0.001	-0.030*													
4	**Upper sec. education (1/0)**	0.297	0.457	0.007	-0.081*	-0.438*												
5	**Technological knowledge (1/0)**	0.577	0.494	0.013	-0.295*	-0.011	0.154*											
6	**Industry experience (1/0)**	0.852	0.355	-0.082*	-0.113*	-0.002	0.128*	0.111*										
7	**Founding experience (1/0)**	0.258	0.438	0.003	-0.070*	0.115*	-0.090*	-0.050*	0.023*									
8	**Opportunity founding motivation (1/0)**	0.273	0.445	0.014	0.001	0.085*	-0.045*	-0.052*	-0.049*	0.091*								
9	**Necessity founding motivation (1/0)**	0.111	0.314	-0.009	0.026*	-0.069*	-0.001	0.062*	-0.004	-0.064*	-0.216*							
10	**German (1/0)**	0.923	0.267	-0.011	0.021*	-0.004	0.058*	0.046*	0.047*	-0.028*	-0.046*	-0.026*						
11	**High-technology industry (1/0)**	0.383	0.486	-0.005	-0.158*	0.207*	-0.059*	0.101*	0.060*	0.081*	0.042*	-0.020*	0.036*					
12	**Number of employees**	1.134	3.271	-0.034*	-0.019*	0.048*	0.031*	-0.019*	0.058*	0.048*	0.055*	-0.059*	0.009	-0.034*				
13	**Firm age**	1.142	1.276	-0.261*	-0.019*	0.023*	0.009	0.031*	0.228*	-0.022*	-0.038*	0.026*	0.022*	0.013	0.089*			
14	**Self-employed (1/0)**	0.145	0.352	0.002	-0.035*	0.124*	-0.066*	-0.059*	0.016*	0.517*	0.116*	-0.109*	-0.011	0.067*	0.080*	-0.038*		
15	**Unemployed (1/0)**	0.188	0.391	0.015	0.015*	-0.068*	0.013*	0.052*	-0.034*	-0.100*	-0.111*	0.296*	-0.004	-0.053*	-0.103*	0.032*	-0.198*	
16	**Not gainfully employed (1/0)**	0.072	0.258	0.010	0.066*	0.014*	-0.059*	-0.066*	-0.157*	-0.058*	0.014*	-0.061*	0.007	0.024*	-0.043*	-0.009	-0.115*	-0.134*

Note: All correlations marked with * are significant at the 5% level or lower.

Table 2: Results for the mean-comparison test (t-test) between female and male founders

		Woman founder Mean (Std. Dev.)		N	Man founder Mean (Std. Dev.)		N
Dependent variable							
	Sales growth (log)	0.35	*	1280	0.43	*	9637
		(1.11)			(1.16)		
Independent variables							
Explicit knowledge	University education (1/0)	0.26	***	1435	0.31	***	8005
		(0.44)			(0.46)		
	Upper sec. education (1/0)	0.20	***	1435	0.30	***	8005
		(0.40)			(0.46)		
	Technological knowledge (1/0)	0.19	***	1435	0.63	***	8005
		(0.40)			(0.48)		
Implicit knowledge	Industry experience (1/0)	0.84	***	1435	0.91	***	8005
		(0.37)			(0.28)		
	Founding experience (1/0)	0.19	***	1435	0.28	***	8005
		(0.39)			(0.45)		
Founding motivation	Opportunity founding motivation (1/0)	0.27		1372	0.28		7657
		(0.45)			(0.45)		
	Necessity founding motivation (1/0)	0.12		1372	0.11		7657
		(0.32)			(0.31)		
Structural control variables	German (1/0)	0.92		1431	0.91		8000
		(0.27)			(0.28)		
	High-technology industry (1/0)	0.19	***	1232	0.41	***	6774
		(0.39)			(0.49)		
	Number of employees	1.01	***	1466	1.26	***	8974
		(2.77)			(3.52)		
	Firm age	1.08	*	1449	1.15	*	9893
		(1.24)			(1.28)		
Control variable: employment before founding	Self-employed (1/0)	0.12	***	1428	0.16	***	7984
		(0.33)			(0.37)		
	Unemployed (1/0)	0.19		1428	0.18		7984
		(0.38)			(0.39)		
	Not gainfully employed (1/0)	0.12	***	1428	0.07	***	7984
		(0.32)			(0.25)		

Note: Robust standard errors in parentheses. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$

Table 3: Population-averaged panel regression models

	Model	1	2	3	4
Gender of founder	**Woman (1/0)**	**-0.0776****	**-0.0699*****	**-0.0720*****	**-0.0937**
		(0.0252)	**(0.0262)**	**(0.0274)**	**(0.207)**
Explicit knowledge	University education (1/0)		-0.0124	0.00287	-0.0179
			(0.0190)	(0.0201)	(0.0213)
	Upper sec. education (1/0)		0.0189	0.0300	0.0159
			(0.0194)	(0.0206)	(0.0217)
	Technological knowledge (1/0)		**0.0361****	**0.0372****	**0.0346***
			(0.0164)	**(0.0175)**	**(0.0182)**
Implicit knowledge	Industry experience (1/0)		**-0.147*****	**-0.139*****	**-0.132*****
			(0.0360)	**(0.0369)**	**(0.0402)**
	Founding experience (1/0)		-0.0156	-0.0176	-0.0201
			(0.0208)	(0.0224)	(0.0234)
Founding motivation	Opportunity founding motivation (1/0)			-0.00749	-0.0246
				(0.0198)	(0.0210)
	Necessity founding motivation (1/0)			-0.0381	**-0.0573****
				(0.0271)	**(0.0290)**
Women entrepreneurs	Woman * University education (1/0)				**0.195*****
					(0.0692)
	Woman * Upper sec. education (1/0)				0.110
					(0.0699)
	Woman * Technological knowledge (1/0)				-0.0292
					(0.0669)
	Woman * Industry experience (1/0)				0.0121
					(0.102)
	Woman * Founding experience (1/0)				0.0274
					(0.0815)
	Woman * Opportunity founding motivation (1/0)				**0.157****
					(0.0644)
	Woman * Necessity founding motivation (1/0)				**0.150***
					(0.0840)
	Woman * German (1/0)				-0.147
					(0.182)
	Woman * High-technology industry (1/0)				-0.0620
					(0.0691)
	Woman * Number of employees (1/0)				0.00321
					(0.0260)
	Woman * Firm age (1/0)				-0.00685
					(0.00820)
	Woman * Self-employed (1/0)				0.0716
					(0.0977)
	Woman * Unemployed (1/0)				0.0484
					(0.0718)

	Woman * Not gainfully employed person (1/0)				0.0153
					(0.110)
Structural control variables	German (1/0)	-0.0370	-0.0407	-0.0462	-0.0407
		(0.0333)	(0.0333)	(0.0371)	(0.0378)
	High-technology industry (1/0)	-0.00937	-0.00416	-0.00272	0.000741
		(0.0159)	(0.0163)	(0.0173)	(0.0179)
	Number of employees	0.00294	0.00326	0.00286	0.00343
		(0.00245)	(0.00245)	(0.00257)	(0.00272)
	Firm age	**-0.188*** **	**-0.181*** **	**-0.183*** **	**-0.184*** **
		(0.00738)	**(0.00756)**	**(0.00783)**	**(0.00827)**
Employment before founding control variables	Self-employed (1/0)	-0.0210	-0.00485	-0.00310	-0.0136
		(0.0239)	(0.0274)	(0.0299)	(0.0316)
	Unemployed (1/0)	**0.0713*** **	**0.0624*** **	**0.0724*** **	**0.0621*** **
		(0.0194)	**(0.0194)**	**(0.0215)**	**(0.0227)**
	Not gainfully employed (1/0)	**0.0640***	0.0519	0.0469	0.0406
		(0.0316)	(0.0319)	(0.0343)	(0.0363)
	Constant	0.651***	0.755***	0.749***	0.760***
		(0.0361)	(0.0479)	(0.0517)	(0.0543)
	Observations	9,538	9,538	9,107	9,107
	Number of ventures	4,419	4,419	4,222	4,222

Note: Robust standard errors in parentheses. *** p < 0.001, ** p < 0.01, * p < 0.05, + p < 0.1

In line with previous studies we find that women entrepreneurs perform significantly worse (-0.0776, $p < 0.01$) than their male counterparts when compared on the most aggregated level, i.e. without differentiating within the group of women entrepreneurs (c.f. Model (1)). Further, the control variables firm age and unemployed before founding depict highly significant ($p > 0.001$) relationships with firm growth throughout all models. Firm age depicts the expected negative (-0.188 – - 0.184) and being unemployed before founding. a positive relationship (0.0713 – 0.0621). After including the knowledge parameters (c.f. Model (2) – Model (4)) we find that technological knowledge has a significantly positive influence on venture growth (0.0361 – 0.0346, $p < 0.01$ – $p < 0.05$). In contrast to our expectations our results depict a highly negative influence of industry specific work experience (-0.147 – -0.0132, $p < 0.001$) on venture growth. Model (3) further includes results on the influence of the founding motivation on venture growth both depicting negative but not significant coefficients.

Lastly, Model (4), including all interaction terms, reveals the most important insights. In contrast to Model (1) – (3) the negative growth impact of the gender variable renders insignificant while three interaction terms depict significantly positive values. First, women's university education has a highly positive impact on venture growth (0.195, $p < 0.001$). Second, single female founders driven by opportunity-founding motivations clearly outperform their male counterpart (0.157, $p < 0.01$). Lastly, it is not only the group of single women entrepreneurs driven by opportunity intentions but also the group driven by necessity motives which depicts stronger venture growth, although on a slightly lower level (0.150, $p < 0.05$). All other interaction terms are non-significant. Other things being equal, the results indicate that women entrepreneurs who belong to one of the groups mentioned above outperform a randomly picked male entrepreneur in our sample with regard to venture growth.

For the group of women entrepreneurs, results resemble those of the panel-regression results in Table 3 with regard to the positive or negative influence and significance level of the coefficients. In addition, the upper secondary education coefficient is significantly positive (0.203, $p < 0.001$), underlining the importance of explicit knowledge for the growth of single female founded ventures. The growth of business ventures founded by male entrepreneurs is not influenced by the level of explicit knowledge but rather by the knowledge type, i.e. technological knowledge is more important to predict the growth of ventures as indicated by the positive coefficient

(0.037, $p < 0.05$). Another important result which differentiates male from female founded ventures is the fact that necessity driven motivation negatively influences venture growth for male founded ventures (-0.0584, $p < 0.05$), in contrast to the positive effect observed for women entrepreneurs.

Table 4: Population-averaged panel regression analysis on venture growth for woman founder vs. man founder

Category	Name	Woman founder	Man founder
	University education (1/0)	**0.194*** **	-0.0109
		(0.0532)	(0.0223)
Explicit knowledge	Upper sec. education (1/0)	**0.203*** **	0.0200
		(0.0443)	(0.0227)
	Technological knowledge (1/0)	0.0291	0.0370*
		(0.0532)	(0.0191)
	Industry experience (1/0)	**-0.239** **	**-0.130*** **
Implicit knowledge		**(0.0841)**	**(0.0409)**
	Founding experience (1/0)	0.0125	-0.0171
		(0.0673)	(0.0244)
	Opportunity founding motivation (1/0)	**0.274*** **	-0.0169
Founding motivation		**(0.0399)**	(0.0218)
	Necessity founding motivation (1/0)	**0.166*** **	**-0.0584***
		(0.0459)	**(0.0305)**
	German (1/0)	-0.157	-0.0389
		(0.161)	(0.0394)
	High-technology industry (1/0)	-0.0470	0.000575
Structural controls		(0.0515)	(0.0188)
	Number of employees	0.00232	0.00276
		(0.00667)	(0.00281)
	Firm age	**-0.188*** **	**-0.187*** **
		(0.0217)	**(0.00844)**
	Self-employed (1/0)	0.0398	-0.0128
		(0.0575)	(0.0329)
Employment situation before founding controls	Unemployed (1/0)	**0.171*** **	**0.0630*** **
		(0.0428)	**(0.0238)**
	Not gainfully employed (1/0)	0.0506	0.0360
		(0.0971)	(0.0380)
	Constant	**0.631*** **	**0.752*** **
		(0.183)	**(0.0558)**
	Observations	1,085	8,022
	Number of ventures	511	3,711

Note: Robust standard errors in parentheses. *** p < 0.001, ** p < 0.01, * p < 0.05, + p < 0.1

The evidence presented above suggests that the cross-the-board female underperformance hypothesis does not hold true, even for traditional financial performance parameters as venture growth. The results further underscore the positive relationship of explicit knowledge and venture growth (Unger et al., 2011), especially for female founded start-ups. We thereby add to and partly reject previous research which reported a positive but weaker influence of school and university education on the performance of self-employed females compared to males (Robinson and Sexton, 1994).

Further, the negative relationship of industry experience and start-up growth for both female and male founded firms is surprising as previous studies reported a positive influence of this knowledge parameter on venture growth (Unger et al., 2011). It might partly be explained by the insight that it's not the mere number of years of industry experience (i.e. human capital investments), but rather the appropriated knowledge (i.e. outcomes of human capital investments) which causes the performance differences (Unger et al., 2011). This insight is supported by our finding that technological knowledge positively contributes to the growth of male founded start-ups of which a large portion operate in the high-technology sector.

In line with previous findings in industrialized countries, we find a higher share of opportunity-based female entrepreneurship than necessity-based entrepreneurship (Cabrera and Mauricio, 2017). In contrast to these consistent insights, we find that there is no gender based difference between the share of opportunity and necessity driven founding intentions (Cabrera and Mauricio, 2017). Nonetheless, a sharp differentiation between the two sexes emerges when we evaluate the influence of founding motivation on venture growth. Both necessity and opportunity driven motivation, positively influence growth of female start-ups throughout all models in our analysis. The results in Table 4 nevertheless show that the impact of an opportunity driven motivation is significantly higher (0.274) than the one of necessity driven motivation (0.166). Conversely, the growth of male-founded ventures is not or negatively influenced by founding motivation of the entrepreneur.

An interpretation of the positive impact of both necessity and opportunity motivation on venture growth is that female entrepreneurs might simply be more motivated, independently of the type of business idea pursued. But the coding of opportunity and necessity motivation may matter too. The necessity vs. opportunity motivations to launch a start-up can be plotted on a scale ranging from pure necessity

driven reasons, as for example “way to escape unemployment”, to pure opportunity driven founding motivations, as for example “the realization of a business idea”. Everything in between those two extremes can be accounted to one of both sides, but is not as clearly a manifestation of necessity or opportunity driven motivations as the two extremes are. We thus conclude that it is not the mere existence of any founding motivation, but the existence of a specific, either unequivocal necessity or opportunity based, founding motivation which makes female entrepreneurs highly successful. Both for the necessity driven female entrepreneur for whom founding is the “best (or unique) option available for employment” (Micozzi and Lucarelli, 2016, p. 181) or the opportunity driven female entrepreneur for whom founding is the voluntary activity of taking part in an entrepreneurial endeavor in order to realize their business idea, can launch high-growth start-ups.

Conclusion

This study analyzes women’s entrepreneurial venture growth performance. In contrast to numerous past contributions which either find support for the female underperformance hypothesis (Du Rietz and Henrekson, 2000) based on classical financial measures such as sales growth (Fairlie and Robb, 2009; Gottschalk and Niefert, 2013; Rosa et al., 1996) or reject it based on relative performance measures (Robb and Watson, 2012), we argue that certain groups of women entrepreneurs with a specific founding motivation and knowledge are not only capable of growing their ventures equally fast as their male counterparts, but can outperform them.

Our results therefore provide a more nuanced view about female underperformance as specific groups of women entrepreneurs clearly outperform the average male founder. In particular, two characteristics are decisive for the growth success of female-run ventures. First, the explicit knowledge of women entrepreneurs, specifically tertiary education attainment of women entrepreneurs, positively influences the growth prospects of their ventures. Second, both women entrepreneurs motivated by opportunity and necessity clearly outperform their male counterparts. When differentiating within the group of women entrepreneurs, our results reveal that those women entrepreneurs with university and upper secondary education outperform the average women entrepreneur, thereby underscoring the importance of explicit knowledge-based resources on the success of female founders.

The study contributes to the female entrepreneurship literature by demonstrating that the diverse group of women entrepreneurs includes females which are not only capable of matching the performance of their male counterparts, but clearly outperform them. Further, our study adds to the knowledge-based view and founding motivation literature by stressing the importance of educational and motivational aspects for business ventures launched by women entrepreneurs. Lastly our study adds to the growth literature by adding to prior findings on venture growth (Delmar & Shane, 2006; Toft-Kehler, Wennberg, & Kim, 2014) which give guidance for growth models for women entrepreneurs.

This study has several limitations, which can serve as inspiration for future research. First, our results are based on a dataset of a single country and are therefore not necessarily applicable to other countries with different characteristics, such as level of industrialization. Further, the structure of our data allows the thorough analysis of only single female founded ventures. Despite the fact that this group is the single biggest cohort within the group of ventures with female participation, it would be worthwhile to understand the growth dynamics of female lead ventures which have been founded by teams of entrepreneurs as well. Another fruitful research avenue would be to draw on a repertoire of innovative and qualitative methodologies to gain a richer, more holistic insight about the women entrepreneurs at the helm of high-growth ventures. There remains much to be done to match “the now expected post-structural feminist approach” (Henry et al., 2015) in entrepreneurship.

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Paper 3: Venture Capital and the Growth of German Start-Ups: Supportive Partner or Collector Of Winners?

Abstract

While the financing structure of ventures has been studied in entrepreneurship research, the influence of the various external financing sources on venture growth has not been explored in the German venture context. In particular, the causal growth effect of a financing source deemed especially powerful, venture capital (VC), remains unexplored. Employing one of the largest longitudinal samples on German ventures, results support the view that external financing, especially long-term credits, public subsidies and VC are positively associated with new venture growth, both in terms of sales and employees. Further and contrary to findings focusing on Anglo-Saxon and South European countries, evidence supports the existence of a screening, rather than a value adding effect of venture capital in the German start-up ecosystem.

Keywords: *Venture financing, sales growth, employee growth, causal effect, venture capital, screening effect*

Introduction

While start-up financing is still a vividly discussed topic, both in research and practice, its central position for the success of the venture is beyond a doubt (Cassar, 2004). It follows that the start-up performance not exclusively depends on the quality of the business idea and the performance of the team behind it, but to a high extent on financial resources that enable the development of the product or service (Gartner et al., 2012). Funding sources range from personal equity capital of the founder, debt capital financing by banks or external equity capital by venture capital funds (Achleitner et al., 2011). While research examining the financing structure of new ventures has been increasing (c.f. Achleitner et al., 2011; Cassar, 2004), academia still seeks to improve its understanding of the influence of external financing on start-up growth, especially the causal effect of venture capital financing (c.f. Balboa, Martí, and Zieling, 2006; Bertoni, Colombo, and Grilli, 2011; Colombo and Grilli, 2010; Croce, Martí, and Murtinu, 2013).

Former studies on venture financing highlighted that 'a firm's capital structure decisions are obviously influenced by its institutional context, i.e., by national economic environments and institutions such as the tax system or typical borrower-lender relationships' (Achleitner et al., 2011, p. 264) and that the start-ups in Germany therefore operate in a predominantly bank-based economy. Based on these structural preconditions of the German financing economy the aim of this study is to clarify: *which financing sources are associated with growth in the German start-up environment?* This question is especially important to answer within the German context as it is comparatively more difficult to attract external financing compared to other start-up meccas such as the Silicon Valley in the US and Tel Aviv in Israel (Achleitner et al., 2011; McKinsey&Company, 2013), which is one of the often cited reasons why Germany is lagging behind in the overall success of its ventures when compared at the international level (McKinsey&Company, 2013).

Second, this study explores venture capital financing in more detail and answers the question: *does it have the ascribed positive causal influence on new venture growth in the German context?*

Why does this matter? Venture capital is often regarded as more than equity capital and rather as 'smart money' (Sørensen, 2007), thereby referring to the supportive resources as knowledge and network which venture capital firms are expected to bring along with their equity investments (Croce et al., 2013; Lindsey, 2008). Empirical evidence shows that VC fosters start-up growth post investment in its various forms,

notably sales and employee growth (Balboa et al., 2006; Bertoni et al., 2011; Colombo and Grilli, 2010), productivity growth (Croce et al., 2013) and professionalization of the firm (Hellmann and Puri, 2002).

As most studies focus on the UK, US and Southern European countries (with the notable exception of Engel, 2002) it is not clear if these findings also hold in the German context. The relationship between VC capital and growth might be different in Germany as previous studies provide evidence for the lower appeal of Germany compared to the US for PEs and VCs (Groh, Lieser, and Biesinger, 2015), along with a lower availability of venture capital for start-ups in particular (Achleitner et al., 2011; Schiereck et al., 2013).

This paper asserts that external financing in general and venture capital in particular are positively associated with venture growth, both in terms of sales and employees. First, it claims that it is the group of ventures which employ external financing sources beyond the funds of the founder and family and friends i.e. short- to long-term credits, public subsidies and venture capital which achieve superior venture growth. Second, a screening effect i.e. picking the winners instead of a value adding effect of venture capital is hypothesized.

An obstacle of previous studies on new ventures was the relative lack of available data. This challenge is solved by employing the KfW/ZEW Start-up Panel provided by the Centre for European Economic Research (ZEW). It includes 11,639 observations between 2008 to 2011 and represents one of the largest existing longitudinal panel data sets on German ventures.

Fixed effect regression analysis and the difference-in-differences method on a propensity score matched sample (Chang et al., 2013) are employed. These methods allow measurement of the dependency of external financing and venture growth in general, and further allow for differentiation of the causal effect of VC capital (Croce et al., 2013) while controlling for important characteristics of the start-up (e.g. gender, nationality, team size, industry, number of employees etc.).

Results show that on average only 34% of the investments and 16% of the operating costs were financed using external capital, between 2008 to 2011. These figures are well below the 41% of outside financing reported by Nofsinger and Wang (2011) for the 27 countries[9] included in the Global Entrepreneurship Monitor database

[9] 'The final sample involves 27 countries (regions) including Australia, Belgium, Brazil, Canada, Chile, China (Mainland), Denmark, Finland, France, Germany, Greece, Hong Kong (China), Ireland, Italy, Japan,

and the 40% of outside financing[10] reported by Cassar (2004) for an Australian sample. Further, the expected positive relationship between the share of external financing sources and venture growth is confirmed. In particular, long-term credits, public subsidies and VC are positively associated with venture growth. Most importantly, results suggest the existence of a *screening* rather than *value-added effect* for VC-financed firms. This means that is rather the ability of VC financiers to invest into start-ups which grow strongly throughout their existence (i.e. winners) and not a boost in growth after the VC invested.

The paper contributes to current research in various ways. First, it adds to the start-up financing theory by examining the influence of all financing sources in concert and shows that it is especially long-term credits, public subsidies and venture capital which are positively associated with new venture growth. Second, the paper adds to the venture capital theory by reporting a selection effect with regard to the growth influence of venture capital in Germany. Lastly, the paper has a political implication by suggesting a further opportunity for the external equity industry to profit from improved wealth creation achieved by these operators in other developed countries.

Theory and Hypotheses

A limited operating history and scale of ventures for start-ups are the factors that make the funding with external capital difficult (Huyghebaert and Van de Gucht, 2007). First, the short time in existence results in the fact that 'start-ups are arguably the most informationally opaque firms in the economy'(Cassar, 2004, p. 264). This impedes to assess the viability of the business model based on previous periods, thereby increasing the risk of an investment. Second, the product or service the start-up is offering is at least partly and often completely new and cannot be compared to any existing offer in the market. This elevates the perceived and often actual risk and uncertainty of the business model, famously summarized as the 'liability of newness' (Stinchcombe, 1965). Third, the in relative terms higher screening costs per start-up result in on average higher capital costs as well as a smaller volume in provided capital (Berger and Udell, 1998; Cassar, 2004; Huyghebaert and Van de Gucht, 2007). Confronted with these challenges ventures often heavily rely on internal capital (Achleitner et al., 2011; Kohn

Netherlands, New Zealand, Norway, Singapore, Slovenia, South Africa, Spain, Sweden, Switzerland, United Kingdom, United States, and Venezuela'(Nofsinger and Wang, 2011, p. 2285)

[10] 'Outside financing was operationalized by including all finance sourced from unrelated individuals and businesses, trade credit, venture capitalists, and banks'(Cassar, 2004, p. 271)

and Spengler, 2008). Nonetheless, at some point the application and uptake of external financial capital becomes inevitable as it is of great importance for the venture success (Alsos, Isaksen, and Ljunggren, 2006; Becchetti and Trovato, 2002; Carpenter and Petersen, 2002).

External financing and new venture growth

Newly founded firms are characterized as highly-risky endeavors offering the chance to achieve extensive growth (Delmar, Davidsson, and Gartner, 2003) through product or process innovations which often require substantial outside financing to cover the significant cost positions in the early stage.

Attracting these external funds is frequently mentioned as one of the dominant problems for young firms (Terpstra and Olson, 1993), caused by the riskiness and informational opacity of ventures (Berger and Udell, 1998). Therefore, the majority of the financial needs of ventures are financed through 'bootstrapping', i.e. self-funded by resources of the founder or family and friends (Achleitner et al., 2011; Blanchflower and Oswald, 1998). These funding sources are nonetheless limited and often insufficient to cover the growing capital needs. Previous research provides evidence for this argument reporting that 'growth of most small firms is constrained by the availability of internal finance' (Carpenter and Petersen, 2002, p. 298). Following this insight there are multiple reasons to assume that high availability of external financing is positively associated with new venture growth.

First, attracting external funds eases the often very limited financial situation with regard to further investments. A vast range of empirical research provides evidence for the restricting influence of the limited availability of financial means on entrepreneurial development (Carpenter and Petersen, 2002; Cooper et al., 1994; Evans and Jovanovic, 1989; Holtz-Eakin, Joulfaian, and Rosen, 1994). Second, being able to attract external capital may serve as a positive signal to other outside stakeholders and increases the 'company's credibility with potential suppliers and customers' (Astebro and Bernhardt, 2003, p. 308). Third, receiving outside financing can at least partially be regarded as a proxy for the proved quality of the firm, its team and its business model thereby providing information which is often not observable for third parties (Astebro and Bernhardt, 2003). Following these arguments this paper asserts that higher shares of external capital are positively associated with higher growth rates.

Hypothesis 1: Higher shares of external capital are positively associated with venture growth.

External financing sources and new venture growth

The question is, are all external financing sources are equally positively associated with venture growth? First, it needs to be noted that the range of financing sources a founder can apply for is broad. Five major financing sources are generally differentiated: funds of family and friends, short- and long-term credits, public subsidies as well as venture capital (Achleitner et al., 2011). These external financing resources differ in terms of granting counterpart, issuing process, debt or equity characteristic, average amount and repayment terms. Four of five financing sources[11] (short-term and long-term credits, public subsidies, venture capital) are hypothesized to positively influence new venture growth.

The most important external financing source in the German start-up ecosystem are *credits with short, middle and long-term maturities* granted by both commercial banks and state-owned public funding bodies (Achleitner et al., 2011). The important characteristic of credit financing is that the founder does not need to give away shares of the company and therefore often prefers this financing source. On the other hand, a failure to serve the scheduled repayment or the breach of contractual covenants may put the venture into bankruptcy. The necessary transparency and professionality needed during the application process along with a constant monitoring throughout the live time of the loan can both be regarded as a proxy for the quality of the start-up idea and an amplification of resources to invest into the growth of the start-up. These arguments together lead to the hypothesis that the existence of short- and/ or long-term credits in the financing mix of a venture is positively associated with venture growth.

[11] *Funds of family and friend.* Due to the highly unpredictable economic prospect of each venture, the associated risks and the tedious application process for external capital from third parties founders frequently rely on capital from family and friends. Other than financing granted from third parties with an official application process, funds of family and friends are a poorer proxy for the viability of the business idea. On the one side, it may be the case that the special group of family and friends has better knowledge on both the founder and the business idea due to the long-standing relationship between them and is given this superior information willing to commit personal funds. On the other hand, it might be the case that the business idea of the founder is not credible enough to receive external financing from a professional source, therefore a reach out to family and friends is the next logical step. Further, financing with funds of family and friends might be regarded as a sign of limited commitment and willingness to bear the financial risks awaiting if the business idea fails to excel. In sum, neither a positive nor a negative association of funds provided by family and friends and venture growth is expected and therefore no hypothesis is postulated.

Hypothesis 2: Short- and long-term credits are positively associated with venture growth.

A further financing source included in this investigation are *public subsidies.* These funds are provided by the Federal Employment Agency in form of start-up allowances (e.g.'Gründungszuschuss' or 'Überbrückungsgeld') (Achleitner et al., 2011). As reported in former studies there exists considerable public support for newly founded ventures in Germany (Witt and Hack, 2008) which is well tailored for the needs of the ventures (Brixy, Hundt, and Sternberg, 2010). Considering the prominent position of public support in the financing structure of German ventures (Kohn and Spengler, 2008) it is expected to play an important role for the growth of the newly established firm.

Hypothesis 3: Public subsidies are positively associated with venture growth

Lastly, and arguably the most prominent financing source, considering its mystical image, is *venture capital.* As elaborated in detail in the next section VC firms are regarded to have a superior selection process and are often argued to provide operational and strategic support, thereby fostering the success of the portfolio company, which is why this paper contends that venture capital financing is positively associated with new venture growth.

Hypothesis 4: Venture capital is positively associated with venture growth

Venture capital and new venture growth

Venture capital financing is widely considered 'the most suitable financing mode for entrepreneurial firms' (Croce et al., 2013, p. 490), especially due to the frequently documented superior venture performance of VC-backed companies. Results show that VC-backed firms grow faster in terms of sales and employees (Balboa et al., 2006; Bertoni et al., 2011; Colombo and Grilli, 2010), issue more patents, are more productive (Croce et al., 2013) and perform better after IPO (Barry and Mihov, 2015). The question arises, to which activity performed by the venture capital firm this effect can be attributed to?

Two schools of thought exist. The first group describes the VC as a partner who through supportive activities creates a *value adding effect* at the portfolio firm. The second group describes the VC firm as a highly skilled collector of winners; i.e.

attributes the superior performance of the VC-backed firm to the existence of a *selection effect*.

In more detail the *value adding* explanation holds that VCs foster the professionalization of the firm (Hellmann and Puri, 2002), help with advice on topics such as recruitment and remuneration of employees, as well as the development of the strategy of the young firm (Sapienza, Manigart, and Vermeir, 1996; Sørensen, 2007). Further, it is argued that VCs provide 'coaching, mentoring and access to investment banks' (Croce et al., 2013, p. 490), regularly monitor their portfolio companies (Kaplan and Strömberg, 2003) and support through granting access to their network (Hsu, 2006; Lindsey, 2008). All these activities are argued to become precious resources to the venture (Shepherd, Ettenson, and Crouch, 2000) resulting in superior growth of VC-backed start-ups. A range of previous research provides evidence that the superior growth of VC-backed firms is attributable to the *value added* by VCs (e.g. Balboa, Martí, and Zieling, 2006; Bertoni, Colombo, and Grilli, 2011; Colombo and Grilli, 2010; Croce, Martí, and Murtinu, 2013),

The *selection effect* explanation opposes the *value adding* explanation. It attributes the strong growth of VC-backed companies to the capability of the VC to 'pick winning firms' (Baum and Silverman, 2004) i.e. firms 'that have promising future business opportunities, which are hidden to other investors' (Croce et al., 2013, p. 491). The superior screening capabilities (Fried and Hisrich, 1994; Kaplan and Strömberg, 2001) entailing the continuous analysis of the market, the individual venture and the peculiarities of the investment structure, allow VCs to better tackle the opaque information situation which is naturally part of the character of young unlisted firms (Amit, Brander, and Zott, 1998). Consequently, the assumed superior performance of VC-backed ventures could be the result of superior screening abilities allowing VCs to identify highly promising business opportunities. In other words, it could be the ability of VC investors to pick and invest into successful business models rather than the above mentioned supportive activities which drive the observed growth. This is a view frequently supported in previous literature (c.f. Baum and Silverman, 2004; Chemmanur et al., 2011).

Before postulating the hypothesis, a further characteristic of VC needs to be considered. In contrast to credit financing, the dissemination of VC is generally very limited. In a report to the president, Reynolds and Curtin (2009) find that in the US in 2005 around $69 billion of personal funds were invested by founders into their start-ups

while in the same period the sum of invested venture capital was only $0.8 billion, i.e. 86 times less. Previous research on German ventures suggest a similar unfavorable relationship (Achleitner et al., 2011). Furthermore, according to the VC/PE attractiveness index 2011 (Groh, von Liechtenstein, and Lieser, 2010), Germany is ranked on the 10th position beyond other neighboring countries such as the Netherlands (9th) and Switzerland (5th). The ranking is led by the US. The report shows that Germany is a seemingly less attractive country for VC investors. These insights are supported by studies reporting an underdeveloped German external equity market (Schiereck et al., 2013). Two questions emerge. First, do VC financed ventures in Germany experience higher growth rates than non-VC financed firms? If yes, is the higher growth of VC-backed firms a causal effect of venture capital financing i.e. attributable to a *value adding effect*, or the result of the superior selection capabilities of VCs, i.e. attributable to a *selection effect*? Following the arguments above this paper hypothesizes that ventures backed by VCs feature higher growth rates.

Hypothesis 5: VC-backed ventures in Germany feature higher growth rates than non-VC-backed firms.

Further, this paper hypothesizes that the potential superior performance of VC-backed ventures is attributable to a selection effect, rather than a value adding effect. The hypothesis is derived from the mentioned evidence of an underdeveloped external equity market in Germany (Groh et al., 2015; McKinsey&Company, 2013; Schiereck et al., 2013) and the resulting expected behavior of existing players. As the need for external capital is significantly higher than the supply offered by the relatively small VC community (Metzger and Bauer, 2015), these financiers only face limited to no competition on each deal and therefore do not have to offer active support throughout the investment period in order to be allowed to invest into selected ventures.

Hypothesis 6: Initial selection explains the superior growth of VC-backed start-ups in Germany.

Methods

Data and sample

The analysis is based on the 'KfW/ZEW start-up panel', a longitudinal database which includes German start-ups founded between the period 2008 and 2011 and are followed since their inception. This database is the product of a collaboration of three German

institutions, namely the Center for European Economic Research (ZEW); the KfW Bankengruppe, a German government-owned development bank; and Creditreform, the largest credit rating agency in Germany. Its main goal is to expand the knowledge about the German start-up ecosystem, especially its development over time. In order to establish this database a random sample from the Creditreform database was drawn in order to identify nascent ventures. In a next step computer-aided telephone interviews (CATI) were conducted with about 6,000 of these ventures. These two steps were repeated on a yearly basis, thereby complementing the panel data. Each interview was conducted with the founder of the venture and had an average length of 25 minutes. Both firm-level and individual level data was collected, for example information on sales, number of employees, industry and age of the venture; as well as founders' nationality, gender, educational knowledge, industry and venture experience. The majority of industry sectors are covered, with an oversampling[12] for the high-technology industries (KfW/ZEW/Creditreform, 2014).

Method

In a first step, the fixed effects regression specification is chosen in order to infer the effect of venture financing on venture growth. The fixed effects method allows not confounding the influence of differences between venture opportunities, and the financing approach taken by the founder on new venture growth (Delmar and Shane, 2003). Comparing venture financing and new venture growth at various points in time, while controlling for unobserved characteristics about the venture allows to partial out 'the effect of venture-level factors, such as the quality of the venture opportunity, and allows for an unbiased estimate of the relationship between venture financing and venture growth' (Delmar and Shane, 2003, p. 1171). Fixed effect models therefore provide 'consistent estimators of the regression coefficients under only weak assumptions about the actual correlation among a subject's observations' (Liang and Zeger, 1986, p. 122).

Propensity score matching procedure (PSM). In a second step and in order to solve the challenge to construct two comparable samples of firms with and without VC investment, the PSM[13] method (Arnold and Javorcik, 2009b; Imbens and Wooldridge,

[12] Approximately half of the firms included in the sample.
[13] STATA command: 'psmatch2' (Leuven and Sianesi, 2015).

2009; Rosenbaum and Rubin, 1983) is employed, applying the nearest neighbor specification. This specification implies that each firm of the treatment group (i.e. in this case firms with VC investment) is matched with a venture of the control group (i.e. in this case firms without VC investment) with the closest propensity score (Brau, Brown, and Osteryoung, 2004; Chemmanur et al., 2011; Croce et al., 2013; Engel and Keilbach, 2007; Jain and Kini, 1995; Li, 2012; Megginson and Weiss, 1991; Puri and Zarutskie, 2012). The advantage of PSM matched samples is that it allows to control for a defined set of venture characteristics, thereby addressing a potential selection bias (Croce et al., 2013; Rosenbaum and Rubin, 1983) resulting from the fact that 'VC financing cannot be plausibly interpreted as the result of a random process' (Croce et al., 2013, p. 495) as it becomes clear in the hypothesis section.

The propensity score was calculated on the basis of four distinct firm characteristics which are expected to influence the likelihood of a firm receiving venture funding. First, sales measured in absolute terms on a yearly basis is included. The absolute sales volume per year can be regarded as a proxy for growth performance (Delmar, 2006) and thereby sheds light on the viability and sales generating ability of the business idea, that influences the likelihood to receive VC funds. A second proxy for the viability, maturity and formalization of the business idea is the number of employees (Reichenstein and Dahl, 2004). Thirdly, firm age is included, capturing age dependent growth patterns along the existence of ventures (Delmar et al., 2003). Lastly, team size measured in number of actively managing team members with an ownership stake in the company (Ruef, 2010) is included as former studies showed that the likelihood to receive venture financing is higher for entrepreneurial teams than single founders (Achleitner *et al*., 2011).

In a next step the propensity score results were stratified and checked if all stratums were balanced (employing the 'pscore' Stata command). Results confirmed that the aim of balanced samples was reached (Li, 2012). Lastly tested was whether the differences in the means of the variables employed in the matching procedure between both groups, control and treated group, are insignificant in order to achieve any potential bias reduction compared to the unmatched sample.

Analytical procedure. The final step after constructing the two propensity-score matched samples was to run the differences-in-differences (DID) model in order to examine sales and employee growth differences of firms having VC financing to firms which did not receive VC financing during the observation period. The effect of VC

financing on sales and employee growth is defined as the difference between the outcome of the firm with VC financing and the outcome that the firm would have reached without VC financing (Lechner, 2010). This way it is possible to determine which part of the variation in growth can be attributed to VC financing. In order to assess this variation, it needs to be known what the growth would have been for ventures which did not experience VC financing. The DID method, therefore, enables us to compare the differences in both sales and employee growth before and after the VC invested into the venture, to the differences before and after VC investments for firms which were not financed by venture capital firms.

The focal point of interest is the *interaction* variable, which represents the multiplication between the variable *treatment* and *post-treatment.* The variable *treatment* takes the value 1 if the firm belonged to the group of firms which received VC financing at any point in time during the observation period, and 0 if the firm belonged to the control group i.e., firms which did not receive VC financing. The variable *post-treatment* allows to distinguish between the periods before and after a VC invested into the venture. This is a necessary prerequisite as otherwise an examination of the growth before and after the VC investment took place would not be possible. Two *post-treatment* variables were coded. The first one is coded 1 in the year in which a VC invested into the company and all years after. It is coded 0 if the observation was made before the VC investment. The models entailing the variable coded this way are denoted as t=0 in Table 5a-b. The second *post-treatment* variable is coded as 1 if the observation was made after the VC investment and 0 if it was made before the VC investment or in the year of VC investment.

Measures. The dependent variable was measured at time *t*, and unless stated otherwise, the control variables were lagged at t-1 to avoid simultaneity bias.

Dependent variable. Two growth measures, sales and employee growth, are employed in order to assess the growth performance of the ventures. Both, sales (Brush and Vanderwaf, 1992; Chandler and Hanks, 1993; Delmar, 2006; Eisenhardt and Schoonhoven, 1990) and employee growth (Balboa et al., 2006; Bertoni et al., 2011; Colombo and Grilli, 2007) are widely recognized measures to assess the performance of new ventures (Ensley et al., 2002; Zimmerman and Zeitz, 2002) as they best reflect the market acceptance of the products or service of a young firm (Bertoni et al., 2011; Colombo and Grilli, 2005; Feeser and Willard, 1990). Growth is defined as the logarithmic change, which is computed as the total sales or employees at $year_t$ divided

by total sales or employees in year$_{t-1}$ (Brush, Bromiley, and Hendrickx, 2000; Colombo and Grilli, 2005). The logarithm of the yearly growth variables was used to correct for the skewed distribution (Delmar, 2006)[14]. The following formula reflects the computation of the two growth variables:

$$\text{Sales growth} = \ln \frac{\text{Sales}_t}{\text{Sales}_{t-1}}$$

$$\text{Employee growth} = \ln \frac{\text{Employees}_t}{\text{Employees}_{t-1}}$$

Independent variables. As outlined above three separate analysis steps are performed, for each of which a separate set of independent variables is employed to shed light on the relationship between venture financing and venture growth.

Share of external financing. The first set of independent variables explains the share of external financing of *investments* and *operating costs* in percent. In order to test for a lagged effect of the share of external financing on growth the influence of both independent variables on venture growth was tested for three different points in time (t=0, t-1, t-2). To exemplify this logic, the t-1 model tests the influence of the share external financing of *investments* and *operating costs* of last year on today's venture growth. This logic applies to all results shown in Table 3a-4b.

External financing sources. The second set of independent variables included in the analysis describes if a specific financing source was used to cover the external financing needs. The availability of specific sources of financing is believed to impact firm growth positively. Therefore, five financing sources are distinguished (Achleitner et al., 2011). *Short-term credits.* This category is coded as 1 if overdraft and credit card credits were employed to cover financing needs and 0 otherwise. *Long-term credits.* Besides middle- and long-term credits, promotional loans by KfW Bankengruppe (Germany's federal promotional bank) and promotional loans by state-owned public funding bodies ('Landesfinanzinstitute') are included in this variable. It is coded as 1 if any of these financing sources were employed to cover the financing needs of the venture and 0 otherwise. *Funds of family and friends.* This variable is coded as 1 if the venture was to any extend financed through grants and money donations by relatives and friends and 0 otherwise. *Public subsidies.* This variable describes the influence of money provided by the Federal Employment Agency ('Bundesagentur für Arbeit') in

[14] The logarithm of the dependent variable is often an option for obtaining both a higher fit and a better use of the data' (Delmar, 2006, p. 69).

the form of start-up allowances (e.g. 'Gründungszuschuss' or 'Überbrückungsgeld'). It is coded as 1 if the venture was to any extent financed by these resources and 0 otherwise. *Venture capital.* Lastly the influence of venture capital financing is captured. This variable is coded as 1 if any external equity was provided by venture capital firms or if the venture received mezzanine capital (e.g. subordinated debt, participation rights, silent partnerships). As for the share of external financing variables the lagged influence of venture financing sources on venture growth was tested for through lagging the independent variables by up to two periods (t=0, t-1, t-2). For example, the t-2 model tests the influence of the availability of a specific financing source on today's venture growth.

Difference-in-differences variables. The third and last set of independent variables included in the analysis belongs to the difference-in-differences investigation. Three variables are necessary to perform this analysis. *Treatment.* The variable treatment is coded 1 if the firm was VC financed at any point in time during the observation period and 0 otherwise. *Post-treatment.* This variable distinguishes the observations before and after venture capital investments. Two *post-treatment* variables were coded in order to be able to examine both; an immediate effect of VC financing and a by one year lagged effect of VC financing. *Post-treatment* (t=0) captures the immediate effect and is coded 1 in the year in which a VC invested into the company and in all years afterwards. It is coded 0 if the observation was made before the VC investment. *Post-treatment* (t-1) captures the lagged effect and is coded as 1 if the observation was made at least one year after the VC investment and 0 if it was made before the VC investment or in the year of VC investment. *Interaction.* This variable is the multiplication between the variable treatment and post-treatment. It attains the value 1 for all firm year observations which fulfill the two above mentioned conditions. First, the venture is financed by a VC and second, the firm year observation was made after the VC investment.

Controls. Furthermore, a set of six control variables is included in the analysis. *Team.* This variable indicates if the venture was founded by a single founder or if it was a team effort. The variable is coded 1 if it was a team founded start-up and 0 for single founders. *Gender.* This variable is coded 1 if the single founder or at least one of the founding team members was female and 0 otherwise. *Nationality.* This variable is coded 1 if the single founder or all founders of a founding team were of German nationality. If at least one person of the founding team or the single founder was not German the variable was coded 0. As the nationality of the founders can influence the performance

of the venture it is included in the analysis (Watson et al., 1993). *High-technology industry*. This variable is coded as 1 if the venture belongs to a high-technology industry and 0 otherwise. Nascent ventures differ in their growth pattern depending on the sector they belong to which is why it should be controlled for (Carmeli and Azeroual, 2009). *Number of employees*. Is measured in number of full time employees of the venture in the specific year. This variable reflects firm size and indicates the formalization of the nascent venture (Reichenstein and Dahl, 2004). *Firm age*. Is measured in number of years since founding, and captures any age related growth pattern with older firms traditionally featuring less rapid growth (Barron, West, and Hannan, 1994; Delmar, Davidsson, and Gartner, 2003).

Results and Implications

On average only 33,5% of the investments and 15,5% of the operating costs are financed using external funds. The additional funds are drawn from a variety of external financing sources (Table 1). The amount of 47% of all financing needs is covered by long-term credits, followed by 26% financed through short-term credits. It was found that 11% of all financing needs are covered by funds of family and friends, followed by 9% from public subsidies and lastly 6% covered by venture capital.

Table 1: Share of external financing and share by source of total external financing between 2008-2011

		Share of external		**Share by source of total external financing**					
		Invest-ments	Operating costs	Short-term credits	Long-term credits	Funds of family/ friends	Public subsidies	Venture capital	Others
All	08-11	16%	8%	26%	47%	11%	9%	6%	2%
Team (1/0)	Team (1)	17%	9%	27%	46%	7%	5%	12%	2%
	Single founder (0)	17%	7%	27%	48%	12%	9%	3%	2%
Gender (1/0)	Male (1)	17%	8%	26%	48%	10%	8%	6%	2%
	Mixed or female (0)	19%	8%	30%	45%	10%	8%	5%	2%
Nationality (1/0)	German (1)	18%	9%	27%	49%	11%	9%	3%	1%
	Mixed or foreigner (0)	16%	7%	27%	45%	9%	6%	11%	2%
High-technology industry (1/0)	High-tech (1)	12%	7%	28%	40%	10%	7%	13%	3%
	Low-tech (0)	19%	8%	28%	51%	10%	7%	3%	1%

Regarding the distribution of venture capital involvement in the German start-up environment, a couple of peculiarities need to be highlighted. First, the share of VC financing of ventures founded by teams is four times as high as for single founded

companies (12% vs. 3%). Second, the share of venture capital financing in teams with mixed or foreign nationalities is roughly four times as high, as for teams of Germany nationality only (11% vs. 3%). Third, the share venture capital funds of firms operating in the high-technology sector is considerably higher (13%) than for firms in the low-tech sector (3%). Table 2 displays the descriptive statistics, indicating only moderate correlations.

In order to understand the influence of the share of external financing on venture growth, both sales and employee growth, a set of fixed effect regression analysis is performed. In a first step, it is examined how the current (t=0) share of external financing influences the current growth rate of the venture. The results can be found in the columns denoted as (1) in Table 3a and 3b. In a second step, the same regression analysis is performed with the only difference being that the external investment share is lagged by one year (t-1) in order to capture if there is a delayed influence of external financing on venture growth. The results for these models can be found in the second result column (2). In a last step, the external financing share is lagged by two periods (t-2) in order to test if the timely delay of external financing on venture growth is bigger than one year.

As can be seen from the result tables both the current share of external financing of investments and share of external financing of operating costs have no immediate influence on sales growth. In contrast, the share of external financing of investments has a positive and highly significant influence on employee growth (0.00151, $p<0.001$). The results of the by one year lagged investment shares on sales growth in contrast depict a significant influence of both external financing variables. Surprisingly the investment coefficient is negative (-0.000829) and significant on the 5%-level. On the other hand, the coefficient for the operating costs depicts a positive relationship (0.00801) highly significant on the 0.1%-level. The negative relationship between sales growth and investment share becomes significantly ($p<0.05$) positive (0.00218) in the by two periods (t-2) lagged model. Results in Table 3b indicate that there is no lagged influence of the share of outside financing on employee growth as none of the two financing coefficients has a significant influence.

Table 2: Means, standard deviations and correlations of variables

		Mean	**S.D.**	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Sales growth (log)	0.37	1.09														
2	Employee growth (log)	0.15	0.54	0.218*													
3	Investments (share in %)	33.48	34.71	0.077*	0.041*												
4	Operating costs (share in %)	15.55	25.72	0.030*	-0.005	0.518*											
5	Short-term credits (1/0)	0.37	0.48	-0.044*	-0.023	-0.088*	-0.072*										
6	Long-term credits (1/0)	0.39	0.49	0.038*	0.061*	0.101*	-0.101*	0.157*									
7	Funds of family/ friends (1/0)	0.15	0.35	-0.003	-0.047*	-0.024*	0.040*	0.082*	-0.044*								
8	Public subsidies (1/0)	0.16	0.37	0.101*	0.041	0.054*	0.030*	-0.010	0.148*	0.024*							
9	Venture capital (1/0)	0.07	0.25	0.056*	0.056*	0.056*	0.139*	-0.021*	-0.014	0.005	-0.022*						
10	Team (1/0)	0.30	0.46	0.034*	0.082*	0.025*	0.050*	-0.028*	-0.008	-0.09*	-0.071*	0.172*					
11	Gender (1/0)	0.21	0.44	-0.002	-0.052*	0.042*	0.017*	0.014	-0.013	0.011	0.004	-0.007	0.224*				
12	Nationality (1/0)	0.64	0.48	-0.032*	-0.075*	-0.032*	-0.059*	0.027*	0.024*	0.057*	0.066*	-0.163*	-0.888*	-0.192*			
13	High-technology industry (1/0)	0.43	0.50	0.003	0.043*	-0.074*	0.017*	-0.089*	-0.147*	-0.051*	-0.069*	0.120*	0.130*	-0.123*	-0.102*		
14	Number of employees	1.71	4.74	-0.033*	-0.174*	0.064*	-0.002	0.053*	0.094*	-0.072*	0.043*	0.119*	0.137*	-0.001	-0.119*	-0.010	
15	Firm age	1.38	1.34	-0.270*	-0.091*	-0.132*	-0.119*	0.116*	0.030*	-0.017	-0.118*	-0.017	-0.015*	-0.021*	0.020*	0.012	0.064*

Note: All correlations marked with * are significant at the 5% level or lower.

Table 3a: Regression analysis on new venture sales growth

	Model	(1)	(2)	(3)
	Sales growth (log)	t=0	t-1	t-2
Share of external financing	Investments (share in %)	-0.000359	**-0.000829***	**0.00218***
		(0.000676)	(0.000420)	(0.000915)
	Operating costs (share in %)	0.000662	**0.00801*****	0.00195
		(0.00108)	(0.000579)	(0.00132)
Structural controls	Team (1/0)	-0.111	0.118	0.0446
		(0.129)	(0.113)	(0.190)
	Gender (1/0)	-0.00353	**0.0663****	-0.0586
		(0.0543)	(0.0246)	(0.0729)
	Nationality (1/0)	-0.167	0.0502	-0.0283
		(0.125)	(0.112)	(0.185)
	High-technology industry (1/0)	-0.0672	**-0.0798*****	**0.109**+
		(0.0427)	(0.0210)	(0.0604)
	Number of employees	-0.00497	**-0.00478**+	0.00185
		(0.00325)	(0.00271)	(0.00520)
	Firm age	**-0.216*****	**-0.182*****	-0.0219
		(0.0155)	(0.00806)	(0.0234)
	Constant	0.922***	0.589***	0.0702
		(0.127)	(0.112)	(0.194)
	Observations	2,448	2,619	1,168
	Number of ventures	1,899	2,217	1,049

Note: Robust standard errors in parentheses. *** p < 0.001, ** p < 0.01, * p < 0.05, + p < 0.1

Table 3b: Regression analysis on new venture employee growth

	Model	(1)	(2)	(3)
	Employee growth (log)	t=0	t-1	t-2
Share of external financing	Investments (share in %)	**0.00151*****	-0.000340	-0.000343
		(0.000419)	(0.000426)	(0.000587)
	Operating costs (share in %)	-0.000334	0.000858	-2.36e-05
		(0.000587)	(0.000584)	(0.000783)
Structural controls	Team (1/0)	0.103	**0.159***	0.170
		(0.0814)	(0.0797)	(0.119)
	Gender (1/0)	**-0.106****	**-0.0965****	**-0.109***
		(0.0323)	(0.0338)	(0.0445)
	Nationality (1/0)	-0.0502	0.0446	0.0755
		(0.0798)	(0.0781)	(0.117)
	High-technology industry (1/0)	0.0159	-0.0289	0.0610
		(0.0275)	(0.0287)	(0.0386)
	Number of employees	**-0.0181*****	**-0.0109*****	-0.00404
		(0.00165)	(0.00194)	(0.00266)
	Firm age	**-0.0381*****	**-0.0417*****	-0.00546
		(0.00990)	(0.00980)	(0.0148)
	Constant	0.313***	0.228**	0.0825
		(0.0807)	(0.0798)	(0.126)
	Observations	1,432	1,385	634
	Number of ventures	1,097	1,156	562

In sum, results depict a generally positive influence of external financing on venture growth for both growth metrics. While the positive influence of external capital on employee growth is immediate, the positive influence on sales growth follows swiftly with a lag of one year for external financing of operating costs and a lag of two years for external financing of investments. The negative relationship between investment share and sales growth in the model lagged by one year is 2.6 times lower in order of magnitude than the coefficient in the model lagged by two years and therefore overcompensated in the year following it. Based on the findings above Hypothesis 1, arguing that the share of external financing is positively associated with new venture growth, is confirmed.

Hypothesis 2-4 suggest that it is not only the mere availability of external financing which influences venture growth but rather the source of financing employed. The analysis starts by investigating the influence of the current (t=0) composition of external financing sources on venture growth. In a second step the lagged effects are examined.

The results for Model (1) in Table 4a and 4b depict significant positive growth influences for three specific external financing sources. One of the highest positive and significant influences on venture growth, both sales (0.217, $p<0.01$) and employee growth (0.0919, $p<0.05$) can be found for ventures with VC. The second financing source positively and significantly influencing both metrics of venture growth are long-term credits. The long-term credits regression coefficient is 0.0721 ($p<0.1$) in the revenue growth model and 0.0841 ($p<0.001$) in the employee growth model. Lastly, public subsidies positively influence sales growth (0.233, $p<0.01$) while funds of family and friends negatively influence employee growth (-0.0852, $p<0.05$).

Model (2) in Table 4a and 4b depict the influence of the external financing sources on venture growth lagged by one year (t-1), in order to capture delayed growth influences. Short-term credits are found to have a significantly negative influence (-0.105, $p<0.01$) on venture growth, while the positive influence of public subsidies remains with comparable strength (0.201) on a higher significance level ($p<0.001$). Both, the positive influence of long-term credits and VC disappear. The positive influence of public subsidies is also found in the employee growth model (0.0618, $p<0.1$), while all other positive and negative effects found in the regression of the present financing structure (t=0) on venture growth disappear. Regarding the Models in column (3) which entail the external financing source variables lagged by two years, no significant influence on venture growth can be found. Based on the results of Model (1)

and (2) Hypothesis 2, claiming a positive influence of credits on venture growth is confirmed for long-term credits and rejected for short-term credits. Further, Hypothesis 3 is confirmed due to the positive influence of public subsidies on both sales and employee growth. Lastly, Hypothesis 4 is confirmed due to the significantly positive VC coefficients in Model (1) for sales and venture growth.

In a next step the growth performance of VC-backed ventures vs. non-VC backed ventures and the causal effect of VC investment on growth is analyzed. As can be seen from the regression results in Table 5a Model (1) the treatment variable is significant and positive (0.292, $p<0.05$). Similar results are found for Model (2) (0.199, $p<0.05$) in which a lagged influence of VC financing on venture growth is tested. Hypothesis 5, asserting that that VC-backed ventures feature higher growth rates than non-VC-backed firms, is therefore confirmed.

Lastly Hypothesis 6 claims that initial selection explains the superior growth of VC-backed start-ups in Germany. This implies the treatment coefficient to be significantly positive, as confirmed with the confirmation of Hypothesis 5 and interaction term to be non-significant. As can be seen for all model specifications the interaction term is not significant on any conventional level. These findings imply a non-significant influence of venture capital investors on venture growth after the VC involvement. In sum, these results suggest the existence of a *screening effect* and not a *value-added effect* of VC financing in Germany, i.e. that it is rather the ability of VC financiers to invest into start-ups which grow strongly throughout their existence which explains the higher growth rates found for VC-backed ventures.

Table 4a: Regression analysis of external financing sources on new venture revenue growth

	Model	(1)	(2)	(3)
	Revenue growth (log)	t=0	t-1	t-2
External financing sources	Short-term credits (1/0)	-0.0436	**-0.105****	-0.0749
		(0.0369)	(0.0394)	(0.0544)
	Long-term credits (1/0)	**0.0721**+	0.0228	0.0689
		(0.0385)	(0.0388)	(0.0543)
	Funds of family/ friends (1/0)	0.00890	-0.00731	0.0962
		(0.0521)	(0.0543)	(0.0776)
	Public subsidies (1/0)	**0.223****	**0.201*****	-0.0722
		(0.0700)	(0.0521)	(0.0757)
	Venture capital (1/0)	**0.217****	0.0772	0.0430
		(0.0778)	(0.0793)	(0.109)
Structural controls	Team (1/0)	-0.0258	0.123	-0.00269
		(0.101)	(0.108)	(0.152)
	Gender (1/0)	-0.0182	-0.0193	-0.0174
		(0.0443)	(0.0464)	(0.0609)
	Nationality (1/0)	-0.0889	0.0778	-0.0869
		(0.0976)	(0.104)	(0.147)
	High-technology industry (1/0)	-0.0453	-0.00589	**0.105***
		(0.0373)	(0.0392)	(0.0527)
	Number of employees	**-0.00545**+	**-0.00921****	0.00430
		(0.00309)	(0.00337)	(0.00453)
	Firm age	**-0.223*****	**-0.208*****	**-0.0417***
		(0.0135)	(0.0138)	(0.0208)
	Constant	0.752***	0.700***	0.255
		(0.100)	(0.105)	(0.157)
	Observations	3,444	3,338	1,582
	Number of ventures	2,529	2,667	1,359

Note: Robust standard errors in parentheses. *** p < 0.001, ** p < 0.01, * p < 0.05, + p < 0.1

Table 4b: Regression analysis of external financing sources on new venture employee growth

	Model	(1)	(2)	(3)
	Employee growth (log)	t=0	t-1	t-2
External financing sources	Short-term credits (1/0)	-0.0137	-0.0363	-0.00908
		(0.0226)	(0.0242)	(0.0317)
	Long-term credits (1/0)	**0.0841*****	0.0283	-0.00699
		(0.0232)	(0.0242)	(0.0319)
	Funds of family/ friends (1/0)	**-0.0852***	-0.0493	-0.0338
		(0.0375)	(0.0384)	(0.0515)
	Public subsidies (1/0)	0.0560	**0.0618**+	-0.0433
		(0.0396)	(0.0341)	(0.0454)
	Venture capital (1/0)	**0.0919***	0.0325	0.0230
		(0.0385)	(0.0400)	(0.0536)
Structural controls	Team (1/0)	0.0788	**0.152***	0.119
		(0.0613)	(0.0657)	(0.0976)
	Gender (1/0)	**-0.127*****	**-0.106*****	**-0.123*****
		(0.0261)	(0.0274)	(0.0355)
	Nationality (1/0)	-0.0445	0.0562	0.0357
		(0.0597)	(0.0640)	(0.0956)
	High-technology industry (1/0)	0.0162	-0.0206	0.0376
		(0.0234)	(0.0248)	(0.0326)
	Number of employees	**-0.0177*****	**-0.0106*****	**-0.00430***
		(0.00150)	(0.00177)	(0.00216)
	Firm age	**-0.0367*****	**-0.0370*****	**-0.0212**+
		(0.00844)	(0.00849)	(0.0122)
	Constant	0.292***	0.196**	0.160
		(0.0617)	(0.0671)	(0.104)
	Observations	1,977	1,839	889
	Number of ventures	1,433	1,449	760

Table 5a: Regression analysis of VC financing on new venture revenue growth

	Model	(1)	(2)
	Revenue growth (log)	t=0	t-1
Difference-in-differences	Treatment	**0.292***	**0.199***
		(0.130)	(0.0785)
	Post-treatment	**0.205***	0.0983
		(0.0883)	(0.0643)
	Interaction	-0.145	-0.0425
		(0.148)	(0.110)
Structural controls	Team (1/0)	-0.0695	-0.0720
		(0.121)	(0.122)
	Gender (1/0)	-0.0156	-0.0154
		(0.0429)	(0.0431)
	Nationality (1/0)	-0.147	-0.155
		(0.121)	(0.122)
	High-technology industry (1/0)	-0.0454	-0.0461
		(0.0420)	(0.0421)
	Number of employees	0.00389	0.00406
		(0.00309)	(0.00309)
	Firm age	**-0.167*****	**-0.171*****
		(0.0172)	(0.0176)
	Constant	0.484**	0.605***
		(0.148)	(0.134)
	Observations	1,372	1,372
	Number of ventures	651	651

Note: Robust standard errors in parentheses. *** p < 0.001, ** p < 0.01, * p < 0.05, + p < 0.1

Table 5b: Regression analysis of VC financing on new venture employee growth

	Model	(1)	(2)
	Employee growth (log)	t=0	t-1
Difference-in-differences	Treatment	-0.0163	0.0218
		(0.0891)	(0.0527)
	Post-treatment	-0.0123	-0.0606
		(0.0638)	(0.0438)
	Interaction	0.0695	0.0304
		(0.0972)	(0.0689)
Structural controls	Team (1/0)	**0.280****	**0.272****
		(0.101)	(0.101)
	Gender (1/0)	**-0.0559+**	**-0.0559+**
		(0.0300)	(0.0302)
	Nationality (1/0)	**0.194+**	**0.191+**
		(0.101)	(0.102)
	High-technology industry (1/0)	-0.0407	-0.0388
		(0.0315)	(0.0316)
	Number of employees	**-0.00992*****	**-0.00984*****
		(0.00187)	(0.00187)
	Firm age	**-0.0286***	**-0.0245***
		(0.0116)	(0.0118)
	Constant	0.0886	0.114
		(0.117)	(0.105)
	Observations	1,022	1,022
	Number of ventures	501	501

In a next step the growth performance of VC-backed ventures vs. non-VC backed ventures and the causal effect of VC investment on growth is analyzed. As can be seen from the regression results in Table 5a Model (1) the treatment variable is significant and positive (0.292, $p<0.05$). Similar results are found for Model (2) (0.199, $p<0.05$) in which a lagged influence of VC financing on venture growth is tested. Hypothesis 5, asserting that that VC-backed ventures feature higher growth rates than non-VC-backed firms, is therefore confirmed.

Lastly Hypothesis 6 claims that initial selection explains the superior growth of VC-backed start-ups in Germany. This implies the treatment coefficient to be significantly positive, as confirmed with the confirmation of Hypothesis 5 and interaction term to be non-significant. As can be seen for all model specifications the interaction term is not significant on any conventional level. These findings imply a non-significant influence of venture capital investors on venture growth after the VC involvement. In sum, these results suggest the existence of a *screening effect* and not a *value-added effect* of VC financing in Germany, i.e. that it is rather the ability of VC financiers to invest into start-ups which grow strongly throughout their existence which explains the higher growth rates found for VC-backed ventures.

Robustness tests

In order to ensure the robustness of the results numerous robustness tests were conducted. First, a re-estimation of model results using simple OLS regression (STATA command reg) was performed. Results are highly comparable with significance levels remaining broadly the same. Further, the analysis was re-run employing a largely extended set of control variables. The analysis comprised three *founder knowledge* variables (education of the founder(s), technological knowledge of the founder(s), industry experience, founding experience), three variables indicating the *employment situation immediately before founding* (self-employed, unemployed, not gainfully employed) and two variables indicating the *founding motivation* (opportunity driven vs. necessity driven founding motivation). All models were re-run using the stepwise regression approach for both OLS and fixed effect panel regression models. Again, results remained very similar.

Conclusion

This article theorized that the share of external financing and the sources employed to satisfy the external financing needs influence venture growth. Further, the causal relationship between venture financing and venture growth was assessed.

Empirical results depict an immediate positive effect of the share of investments on employee growth and a lagged positive influence of the share of external financing of investments and operating costs on sales growth. A possible explanation for this finding is that further top-line growth can only be realized after certain investments into the product development or infrastructure are conducted. The observed lag between the share of external financing and sales growth supports these arguments as financial funds need to acquired and invested first as well as people hired before the entrepreneur can harvest the results of the investment effort.

Further, long-term credits, public subsidies and venture capital were found to be positively associated with venture growth. In addition to the explanation above, all three external financing sources require an official application in one way or the other. The signaling effect of receiving external financing after a successful application then works as a proxy for the potential and creditability of the business idea. Therefore more and more customers and suppliers start trusting the company and enter commercial exchange (Astebro and Bernhardt, 2003) .

Lastly, evidence proves a superior growth for VC-backed companies which this paper claims is attributable to the superior screening abilities of VC firms. A possible explanation for the observed pattern of no significant growth effect after VC investment could be the low availability of VC in the German market (Metzger and Bauer, 2015), enabling those VCs which are already present to pick proven winners rather than fostering growth through supportive activities.

Contributions

This article investigates the growth influence of capital structure around business start-up in German ventures, followed by an assessment of the causal effects of VC financing. This investigation thereby contributes to current research in various ways.

First, due to the limited availability of data, former studies frequently examined the isolated effect of a specific financing type on venture growth, thereby ignoring that the interplay of specific financing sources might be important to explain the observed

growth effect. By including all financing sources employed by the venture this study answers the call for further research of Croce, Martí, and Murtinu (2013) in which they prompt future investigations to consider the influence of all other types of financing (e.g. debt capital, public funds, etc.) when investigating the influence of VC capital. Almost all former VC focused research papers suffer from this drawback.

Second, current literature is often based on samples drawn from the US, UK, or Southern European countries. By employing the KfW/ZEW Start-Up Panel, the insights are based on one of the most detailed longitudinal datasets available for Europe's economically most powerful country. This study thereby goes beyond merely relating financing sources to growth for one specific point in time, and investigates dependencies of financial sources on growth over time. It contributes to the discussion on start-up financing in general, and venture financing in Germany in particular, which is frequently a central argument to explain why the German start-up environment has not yet catch up with other international start-up hubs.

Lastly, the study has important policy implications. The econometric estimates indicated that VC firms in Germany operate very differently compared to their counterparts in other countries. The observed superior growth of their portfolio firms seems to be explained by their selection skills and not by their contribution to start-up growth through financial injection and supportive actions. This evidence suggests that if Germany would succeed in making the investment environment more attractive for external equity providers (Schiereck et al., 2013) it could profit from an improved wealth creation (Bertoni et al., 2011). In sum, the provided evidence supports that the development of a well-functioning VC sector should be on top of the agenda of future politicians, despite the already improved supply of external equity (Brixy et al., 2010).

Limitations

As all research, this study has limitations which hopefully serve as inspiration for future investigations.

First, the database reports data over a period of four years, prohibiting the assessment of the long-term consequences of VC-backing on new venture growth. It might be the case that German VCs actually offer the support described under the value adding argument above but that the beneficial consequences are only realized in the long-term.

Second, the study aimed to investigate the causal effects of VC financing on new firm growth and did not cover the causal implications of all external investment sources using the DID approach. Future research should further investigate which financing sources foster venture growth after receiving external capital applying the DID approach. Following this path would help to shed further light on the uncovered positive growth associations of public subsidies and long-term credits.

Third, the exact details of VC investment were not recorded and could therefore not be analyzed. Future research should investigate how the exact terms of each deal, for instance ‘voting rights received’, impact the supportive involvement of VC firms. It could be the case that only after a certain threshold has been passed formerly passive VC firms become more active and offer support beyond financial funding.

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Conclusion

The goal of this dissertation was to establish an improved understanding of the current state of Germany's venture environment and an effort to provide new insights on frequently observed phenomena in the venture context.

In essence, it addresses the research question, *how entrepreneurial phenomena influence new venture growth.* The main findings of the articles are summarized below.

Paper 1 provides empirical results which suggest that entrepreneurial team successions have a negative impact on new venture growth post-succession while entrepreneurial team entries do not influence new venture growth post-entry. Further, the negative growth implications of entrepreneurial team successions are more pronounced in triadic than dyadic teams. In light of the advantages put forward with regard to triadic teams (Krackhardt, 1999; Simmel, 1908; Yoon *et al*., 2013) this finding is surprising and indicates that entrepreneurial team successions distort the relational composition of triadic teams. The findings contribute to research on entrepreneurial teams (Ruef, 2010; Yang and Aldrich, 2014) by showing that entrepreneurial turnover events constitute important entrepreneurial team dynamics which distort teams' relational embeddedness (Blatt, 2009; Granovetter, 1985) and have a negative impact on new venture growth. Additionally, by incorporating the literature of triads and dyads (Simmel, 1908) into the entrepreneurial team literature it can be shown that team size (Krackhardt, 1999; Ruef, 2010; Simmel, 1908; Yoon *et al*., 2013) is an important factor impacting firm growth post-succession (Simmel, 1908). Moreover, the study contributes to the entrepreneurial growth literature (Delmar, 2006; Lockett *et al.*, 2011) by showing that entrepreneurial growth is contingent on the social interaction within the entrepreneurial team, which may be impacted through an entry or a succession (Lechler, 2001). Finally, we add to the literature of organizational design of new ventures (Charan, Hofer, and Mahon, 1980; Sine, Mitsuhashi, and Kirsch, 2006) by showing that the entrepreneurial team occupies a towering position in influencing new venture performance. Consequently disruptive events such as entrepreneurial team successions – with the aim to professionalize the venture – may not lead to the intended outcomes.

Paper 2 provides a new perspective on female entrepreneurship. In contrast to numerous past contributions which support the female underperformance hypothesis (Du Rietz and Henrekson, 2000), the paper argues that certain groups of women entrepreneurs are not only capable of growing their ventures equally fast as their male counterparts, but can outperform them. In particular, two characteristics were found to

be decisive for the growth success of female-run ventures. First, the explicit knowledge of women entrepreneurs, specifically tertiary education attainment of women entrepreneurs, positively influences the growth prospects of their ventures. Second, both women entrepreneurs motivated by opportunity and necessity clearly outperform their male counterparts. The insights imply that the existing findings of female entrepreneurs with regard to financial growth performance need to be questioned.

The study contributes to the female entrepreneurship literature by demonstrating that the diverse group of women entrepreneurs includes females which are not only capable of matching the performance of their male counterparts, but clearly outperform them. Further, the study adds to the knowledge-based view and founding motivation literature by stressing the importance of educational and motivational aspects for business ventures launched by women entrepreneurs. Lastly, the study contributes to the growth literature by adding to prior findings on venture growth (Delmar & Shane, 2006; Toft-Kehler, Wennberg, & Kim, 2014) which give guidance for growth models for women entrepreneurs.

Paper 3 investigates the growth implications of the share and source of external financing on venture growth. The share of external financing of investments shows an immediate positive effect on employee growth and a lagged positive influence on sales growth. A possible explanation for this finding is that further top-line growth can only be realized after certain investments into the product development or infrastructure are conducted. The observed lag between the share of external financing and sales growth supports these arguments as financial funds need to be acquired and invested first as well as people hired before the entrepreneur can harvest the results of the investment effort.

When investigating different sources of external financing, results show that long-term credits, public subsidies and venture capital are positively associated with venture growth. A possible explanation for this observation could be that all three external financing sources require an official application in one way or the other. The signaling effect of receiving external financing after a successful application then works as a proxy for the potential and credibility of the business idea. Therefore, more and more customers and suppliers start trusting the company and enter commercial exchange (Astebro and Bernhardt, 2003).

Lastly, evidence proves superior growth for VC-backed companies which this paper claims is attributable to the superior screening abilities of VC firms, in contrast to the frequently testified value adding effect of VC firms found in other studies.

The contributions of these findings to current research are threefold. First, they add to the start-up financing theory by showing that especially long-term credits, public subsidies and venture capital in Germany are positively associated with new venture growth. Second, the paper adds to the venture capital theory by reporting a selection effect with regard to the growth influence of venture capital in Germany. Lastly, the paper has a political implication for Germany by suggesting that the VC industry could contribute to an increased wealth creation if more competition in these markets could be achieved.

Limitations and future research

As in all research, this dissertation has limitations, which present important avenues for future research. First, the database, which covers a period of four years, prohibits the assessment of the long-term consequences of all studied phenomena which would be interesting to study as the long-term growth implications could be different in each case. Another fruitful research avenue would be to apply qualitative research methods to the same set of questions to gain richer, more holistic insights. Lastly, the focus of the data on the German context also forms its weakness. This implies that a cross-border comparison of the results generated by the application of the same methods and equal sampling method would help to understand if national differences exist.

In addition, each of the papers holds specific limitations which are outlined in more detail in the corresponding sections of the papers. A short summary of the limitations per paper shall be given below:

Paper 1 does not cover the implications of entrepreneurial team exits (i.e., team members exiting the nascent venture) as well as the circumstances that lead to entrepreneurial team exits as data limitations did not allow to cover these cases.

In Paper 2 data limitations only allowed an analysis of single female founded ventures. However, it would be worthwhile to understand the growth dynamics of female led ventures which have been founded by teams of entrepreneurs as well. Another fruitful research avenue would be to draw on a repertoire of innovative and qualitative methodologies to gain a richer, more holistic insight about the women entrepreneurs at the helm of high-growth ventures.

Lastly, Paper 3 aims to investigate the causal effects of VC financing on new firm growth and does not cover the causal implications of all external financing sources available to finance a venture. Future research should therefore investigate which financing sources foster venture growth after receiving external capital. Additionally, the exact details of VC investment were not recorded and could therefore not be analyzed. Research on exact terms of each deal, for instance 'voting rights received', could provide insights on how the supportive involvement of VC firms is impacted.

Outlook

Besides the substantially increased understanding of the German venture environment it has to be acknowledged that the subject of investigation in this dissertation is a rapidly changing one. Today, the German start-up environment already looks very different than it did when the investigation period covered in this dissertation ends. Luckily, things seem to change for the better which is why headlines in major German newspapers provide cause for celebration: "The European start-up landscape is healthier than ever" (Frankfurter Allgemeine Zeitung, 17.12.2017). Spoken in numbers, European start-ups received more financial funds than ever before (19.1 billion Euro) of which 4.3 billion Euro could be attracted by German ventures. An increase of roughly 90% compared to the previous year.

It appears that we are on track to make ventures an ever more important part of our economy, even though our understanding of what drives venture growth is still very limited. But as the German venture environment progresses so will hopefully progress our understanding of it based on contributions of the following generations of academic scholars.

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Date of Birth	24. September 1988 in Ulm
Nationality	German

Education

Since 10/2015 — **University of St. Gallen (HSG)** — **St. Gallen, Switzerland**
PhD Candidate at Swiss Research Institute of Small Business and Entrepreneurship Ø 5,55/ 6
Subject area: *"Venture Growth and its Determinants in the German Venture Context"*

09/2012 – 06/2013 — **HEC Paris** — **Paris, France**
Master of Science in International Finance Ø 3,78/ 4
Specialisation in Corporate Finance

09/2008 – 09/2011 — **University of St. Gallen (HSG)** — **St. Gallen, Switzerland**
Bachelor of Arts in Economics Ø 5,26/ 6

07/2010 – 01/2011 — **Universidad de San Andrés** — **Buenos Aires, Argentina**
Exchange student Ø 5,54/ 6

09/2005 – 07/2008 — **Wirtschaftsgymnasium Wangen** — **Wangen, Germany**
Secondary School Abitur Ø 1,3

Work & Internships

Entrepreneurial Experience

Since 01/2018 — **ZahnEins** — **Hamburg, Germany**
First employee, focus on Acquisitions and Business Development

- Goal of ZahnEins is to build Germany's leading dental group offering high quality dentistry services throughout Germany

Venture Experience

02/2017 – 07/2017 — **PrediLive** — **Munich/Berlin, Germany**
Founding team member

- Goal of PrediLive (=predictive livestock) was to improve the productivity and animal welfare of laying hens through digital analytics of farm data
- Team consisted of three McKinsey colleagues, one veterinarian who serves 25% of all laying hen farmers in Germany and TU Munich Professor Heinz Bernhardt who served as a mentor
- Project received the EXIST Business Start-up Grant, a grant of the German Federal Ministry for Economic Affairs and Energy, worth EUR 130.000

Consulting Experience

11/2013 – 12/2017 — **McKinsey & Company** — **Munich, Germany**
Fellow Senior Associate with first Junior Engagement Manager experiences
(On educational leave since November 2015)

- Coordinated the integration planning of 20 functions together with seven clients in a cross-continental EUR 2.5 bn merger in the High-Tech Industry

- Developed a connected car strategy for a German commercial vehicle player including the organizational and financial set-up of a new business unit
- Created a product portfolio strategy for a US OEM-supplier supported by a complex market sizing model for current and future product services
- Trained 150+ new hires as a faculty member during week-long capability building seminars
- Recruited 20+ new consultants as faculty member of McKinsey recruiting flagship events ("Spuren hinterlassen", "CEO of the Future", "HSG Recruiting Team")

02/2012 – 04/2012 **Roland Berger Strategy Consulting** **Zurich, Switzerland**
Intern in Financial Services Team

- Estimated revenue potential of specific customer groups for a Swiss bank along with competitor analysis in a specific business segment to identify gaps in current product offering

Asset Management Experience

10/2011 – 12/2011 **Union Investment**
Frankfurt, Germany *Intern in Fund Management Team*

- Conducted market, company and financial statement analysis (Form 10-K) for a broad range of small and midsized US investment targets
- Presented in depth company profile and market analysis for Canadian target and gave specific investment recommendations to the fund management team
- Prepared and participated in company meetings with CFOs and CEOs of major international companies (Roche, Nestlé, ThyssenKrupp, Fresenius, Pirelli, Continental etc.)

Additional information

Languages	German (mother tongue), English (C1), Spanish (B2)
IT skills	MsOffice (very good), Stata (good), R (good)
Awards	- Winner of McKinsey & Company, Porsche, Bayer, Bertelsmann, ThyssenKrupp and Vodafone "CEO of the Future" – Competition 2013 (2000+ participants) - Scholarship holder of EXIST Business Start-up Grant of EUR 130.000
Extracurricular activities	
	- Two-year Entrepreneurship Education at University of St. Gallen - Ski instructor and ski camp leader at Deutschen Alpenverein Ulm - President of the ski club at the University of St. Gallen
Sports	Skiing, mountain biking, paragliding, golf, triathlon and marathon (New York 2016; Paris 2013; Zurich 2010),
Financial markets	Managing own portfolio of ETFs, stocks, certificates, options, currencies, commodities and cryptocurrencies since 10+ years
Travelling	Paddled through the Yukon Territory and British Columbia, backpacked through Asia and Africa, explored Scandinavia and New Zealand with a camper van