FGF Studies in Small Business and Entrepreneurship

Alexandra Moritz
Joern H. Block
Stephan Golla
Arndt Werner *Editors*

Contemporary Developments in Entrepreneurial Finance

An Academic and Policy Lens on the Status-Quo, Challenges and Trends

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Preface

Increased regulations, new technologies, and new methods of communication have significantly changed the financing landscape for entrepreneurial ventures and small- to medium-sized companies (SMEs) in recent years. In the past, fast-growing innovative start-ups were heavily dependent on a limited number of finance sources: family and friends, bootstrapping, or investments by an angel followed by venture capital. For many entrepreneurs, acquiring external finance was the major challenge in the development and growth of their ventures—even though they had good future business prospects. If they were lucky, they were able to obtain support from government funding. SMEs could address their local banks or their suppliers, trying to secure the financing required. Other sources of financing were not available—not like today. However, the entrepreneurial finance landscape has changed dramatically in the past decades. Nowadays, the capital can be acquired from many new sources reflecting the different needs in different financial situations of modern SMEs. Large corporations and even some smaller ones, for example, have created their own accelerator funds to provide equity financing for innovative start-ups. Corporate venture capital is going through its sixth cycle, creating an unprecedented boom. A number of different fund types have emerged, such as venture debt funds or social venture funds, which not only try to reduce the financing gap of small innovative firms but also follow nonfinancial goals and support good causes, and, ultimately, the Internet, with its platforms and crowd-based investment opportunities providing debt financing, equity, or just rewards which have created a totally new environment of entrepreneurial finance. In fact, not only have the financing opportunities of start-ups and small businesses changed in a way that multiple sources of external finance are available both on national and international levels. The whole industries are facing disruption by aggressive young fintechs. The editors of this edited volume believe that it is time to issue a series of articles addressing these latest trends and provide an overview of the current and future developments. This book tries to provide a comprehensive understanding of these new trends in financial decision-making and supply of capital by new players. This book is therefore a starting point comprising studies with focus on SMEs as well as young and growing firms.

In the first part, this book focusses on the status quo of SME financing, trends in market regulation, and governmental initiatives and their consequences for SME financing. First, Masiak, Moritz, and Lang investigate SME financing by using cluster analysis. They develop a useful empirical taxonomy of SME financing patterns in Europe. Werner, Menk, and Neitzert are focussing on the context of SME financing. They contribute to another long-term discussion and analyze the access to capital markets for SMEs in the European Union. While politicians try to open the path to international capital markets, the authors highlight the importance of local banks and their contribution to money supply. In the next chapter, Zimmermann discusses the use of funds for either innovation activities or investments. Interestingly, the author shows that all innovations are heavily dependent on internal sources of finance, while investments are backed by bank loans plus internal funding. Finally, Raimi and Uzodinma investigate SME financing in Nigeria and provide a comprehensive overview of the trends in Nigerian financing programs.

In a contemporary book about entrepreneurial finance, investigations of trends in venture capital and business angel financing are indispensable. Hence, the second part of our book focusses on these financing sources. First, Granz, Henn, and Lutz show that venture capitalists and business angels differ in regard to their investment criteria. A central problem in starting a new firm is the availability of financial resources because of the high degree of uncertainty due to the newness and/or innovativeness of entrepreneurial ventures. In this context, the authors develop a conceptual framework grounded on agency theory for the investment criteria that VCs and BAs use for their funding decisions. Following this, Diegel et al. introduce a venture capital sentiment index in Europe to better understand the current and future investment climate of VC investors. The next two chapters by Signore, Masiak, Fisch, and Block discuss activities in the venture capital market. First, Signore investigates the relationship between innovations and their related value using a large venture capital database. Afterward, Masiak, Fisch, and Block analyze the distribution of the different types of venture capital investments in 402 German regions and provide implications for high-tech firms and regional policy initiatives.

In addition to classical VC funds, corporate venture capital is currently reaching the pinnacle of start-up investments. Roehm and Kuckertz apply rigid scientific methodology to assess typical corporate venture capital-related circumstances. In particular, they focus on their dependency on the corporate world while doing business with start-ups, which are embedded in a different ecosystem.

In the third part, this book focusses on the current trends in entrepreneurial finance. First, Hirschmann and Moritz investigate social ventures and their funding opportunities. Finding funding for start-ups is always challenging—but these difficulties are even more pronounced for social ventures where financial returns are often subordinated to social returns. Grants have been considered as an important financing source for these types of start-ups. The authors investigate the requirements for social ventures to receive grants and highlight that grants also increase the likelihood to receive follow-up financing.

Afterwards, this book looks at the financing opportunities enabled by the Internet and the participation of the crowd. For quite a while, crowdfunding was considered

the silver bullet of start-up financing. In the context of this new trend, a new instrument based on cryptocurrencies and the block chain has emerged—initial coin offerings (ICOs). This new and highly innovative financing source completes the portfolio of disruptive innovations in the financial sector. Ackermann, Bock, and Bürger compare the main characteristics of crowdfunding and ICOs and provide insights both on motivational factors of investors and success factors for their campaigns. Finally, Daldrup, Krahl, and Bürger investigate the suitability of crowdfunding to support public research. Their article provides different approaches how Public Research Organizations (PROs) and universities can successfully acquire financing through the crowd.

In sum, we expect that this book provides an excellent contemporary overview of the current trends in entrepreneurial finance and outlines expected future developments. With their thematic diversity and different methodologies, the chapters included offer a multifaceted picture of the current and future entrepreneurial finance landscape. We strongly believe that this book can be considered as a timely reference and essential reading material for students, academics, practitioners and political decision makers.

The editors and authors are grateful and acknowledge the long-standing and ongoing support of our Arbeitskreis “Gründungs- und Mittelstandsfinanzierung” by “Wissenschaftsförderung der Sparkassen-Finanzgruppe e.V.”.

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Part I
Status Quo in SME Financing and Financial Market Regulation

European SME Financing: An Empirical Taxonomy

Christian Masiak, Alexandra Moritz, and Frank Lang

Abstract This study investigates financing patterns of European SMEs by looking at a large number of different financing instruments and their complementary and substitutive effects, using the SAFE dataset collected in 2015. We develop an empirical taxonomy of SME financing patterns in Europe to analyse SME financing, applying cluster analyses. Our cluster analysis identifies seven distinct SME financing types based on the financing instruments used: mixed-financed SMEs with focus on other loans, mixed-financed SMEs with focus on retained earnings or sale of assets, state-subsidised SMEs, debt-financed SMEs, trade-financed SMEs, asset-based financed SMEs and internally financed SMEs. Moreover, the SME financing types can not only be profiled according to their firm-, product-, industry- and country-specific characteristics but also to macroeconomic variables. Our findings can support policy makers in assessing the impact of changes in policy measures for SME financing.

Keywords European SME financing · Financing patterns · Empirical taxonomy · Cluster analysis

A prior version of this chapter has been part of the EIF Working Paper series: Masiak, C., Moritz, A. and Lang, F. (2017): Financing Patterns of European SMEs Revisited: An Updated Empirical Taxonomy and Determinants of SME Financing Clusters, EIF Working Paper 2017/40 and the doctoral dissertation of Christian Masiak "Financing SMEs and Entrepreneurial Opportunities: Firm- and Regional-Level Investigations from Europe" awarded by Trier University (Germany) in 2018. In contrast to the working paper and dissertation, this version is shortened significantly and focusses on macroeconomic differences.

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1 Introduction

Small- and medium-sized enterprises (SMEs) are a significant driver of the European economy, as approximately 99.8% of all European nonfinancial enterprises are SMEs, generating around EUR 3.9 trillion value added per year (European Commission 2016). Nevertheless, SMEs are often confronted with financing constraints due to high information asymmetries, insufficient collateral, agency risks and high transaction costs for capital providers (e.g. Artola and Genre 2011; Berger and Udell 1998; Chong et al. 2013; Ryan et al. 2014).

Although research in SME financing has increased over the last years (e.g. Casey and O'Toole 2014; Lawless et al. 2015; Moritz et al. 2016), little is known about the substitutive or complementary usage of several financing instruments and cross-country differences in Europe. Moritz et al. (2016) found that country differences seem to have the strongest impact on differences in SME financing patterns. However, the authors did not further investigate the reasons for these differences. In our study, we complement this research by including macroeconomic variables (e.g. Beck et al. 2008; Camara 2012; Demirgüç-Kunt and Maksimovic 1999; Hernández-Cánovas and Koëter-Kant 2011). Furthermore, we analyse the status quo of the financing patterns of European SMEs and consequently check for the stability of the clusters identified by Moritz et al. (2016).

We use the "Survey on the access to finance of enterprises (SAFE survey)", which is conducted on behalf of the European Central Bank (ECB) and the European Commission (EC). The SAFE survey contains information on about 17,950 firms in 39 countries (wave 2015H1). Since the majority of firms in the SAFE survey are SMEs (approximately 90%), the survey is ideally suited for our research question. Moreover, the SAFE survey contains information about a large number of different financing instruments, as well as firm-, product-, industry- and country-specific information. We use the different financing instruments as active variables in our cluster analysis to identify financing patterns of SMEs in Europe. To profile the different financing patterns, we use the firm-, product-, industry- and country-specific characteristics provided in the SAFE survey.[1] In this article, however, we focus solely on country-specific and in particular macroeconomic variables. To complement these profiles, we added a number of relevant macroeconomic variables to our dataset such as GDP per capita, inflation rate and volatility, unemployment rate or property rights.

Our findings contribute to the literature on SME financing in different ways (e.g. Beck et al. 2008; Casey and O'Toole 2014; Lawless et al. 2015; Moritz et al. 2016). To date, little is known about the complementary and substitutive use of

[1]For an entire analysis of all passive variables, such as firm-, product- and industry-specific characteristics, please refer to the following EIF Working Paper: Masiak, C., Moritz, A., and Lang, F. (2017): Financing Patterns of European SMEs Revisited: An Updated Empirical Taxonomy and Determinants of SME Financing Clusters, EIF Working Paper. Available at: http://www.eif.org/news_centre/publications/EIF_Working_Paper_2017_40.htm. Accessed 01 October 2018.

different financing instruments (Beck et al. 2008; Casey and O'Toole 2014). Our findings suggest that the identified financing patterns by Moritz et al. (2016) are relatively stable over time and various financing instruments are used as complements and substitutes by European SMEs. Furthermore, we contribute to the literature by investigating the influence of country characteristics on small firms' financing (e.g. Beck et al. 2008; Camara 2012; Mokhova and Zinecker 2014).

The remainder of the study proceeds as follows: Section 2 provides a literature review focused on macroeconomic variables influencing SME financing. Section 3 explains the dataset (SAFE survey), the method applied and the description of the variables used in the empirical analysis. In Sect. 4 we provide the results of the cluster analysis and the determinants of the financing patterns. Section 5 summarises the results, discusses limitations and suggests further research areas.

2 Literature Review

Prior research identified a significant effect of country-, firm- and industry-specific factors on SMEs' usage of different financing sources (Chittenden et al. 1996; Ferrando and Griesshaber 2011; Hall et al. 2000; Mac an Bhaird and Lucey 2010). However, many previous studies focused on a single financing instrument and did not investigate the complementary and substitutive use of different debt and equity instruments (exceptions are, e.g. Beck et al. 2008; Casey and O'Toole 2014; Lawless et al. 2015; Moritz et al. 2016).[2]

Furthermore, several previous studies have analysed the effect of country-specific and macroeconomic variables on SME financing. For instance, the gross domestic product (GDP) is an indicator for a country's economic development, and its influence on the capital structure of firms has been widely investigated (e.g. Bopkin 2009; Mokhova and Zinecker 2014). Prior research found that there is a negative relation between both GDP and GDP growth and the firm's capital structure choices (Bopkin 2009; Gajurel 2006). Also, the unemployment rate is used as an indicator of economic development. However, prior findings on the influence of a country's unemployment rate on the capital structure of firms have been mixed (Camara 2012; Mokhova and Zinecker 2014). Moreover, empirical studies investigated the effect of the inflation rate on the financing of firms but also with mixed findings. Camara (2012), Hanousek and Shamshur (2011) Sett and Sarkhel (2010) identified a positive effect on the firm's leverage, but Gajurel (2006) reported a negative influence of the inflation rate on total leverage. Beside these factors, prior research investigated the effect of macroeconomic indices, such as the legal system index or the property rights index (e.g. Duan et al. 2012). It has been found that companies in countries with better protection of property rights use to a larger extent

[2]Refer to Moritz (2015) who provides a comprehensive and detailed literature review on SME financing and its influencing factors.

external financing, especially bank and equity finance, as better protection of property rights increases the security for capital providers (Beck et al. 2008; Psillaki and Daskalakis 2009).

However, most prior studies are either focused on larger firms or did not investigate the complementary and substitutive use of different financing instruments (e.g. Beck and Demirgüç-Kunt 2006; Bopkin 2009; Chavis et al. 2011). We tap into this research gap by developing an empirical taxonomy of SME financing patterns and characterise the patterns according to the macroeconomic variables.

3 Data, Method and Variables

3.1 The SAFE Survey

The main dataset used for our analysis is obtained from the "Survey on the access to finance of enterprises (SAFE survey)", which is conducted on behalf of the European Central Bank (ECB) and the European Commission (EC). The SAFE survey is run on a biannual basis by the ECB, while it is carried out once a year (since 2013) through cooperation between EC and ECB (European Central Bank 2016; European Commission 2015). The difference between the biannual and annual questionnaire is the number of questions asked and the participating countries. The firms in the sample are selected randomly from the Dun & Bradstreet database by a specialist research institute, to underline the fact that it is anonymous and professional.

The SAFE survey contains various firm-specific information, such as firm size (turnover, number of employees), firm age, ownership structure, main activity (industry, trade, construction, service), growth, innovation activity and financing information (e.g. current financing sources, evaluation of the access to finance). According to the size categories, the SAFE differentiates between micro (1–9 employees), small (10–49 employees), medium-sized (50–249 employees) and large firms (>250 employees). The sample of the SAFE survey is artificially distorted due to the sampling process. Therefore, we used post-stratification weights (calculated on the basis of Eurostat data) in order to restore the non-distorted proportions based on the approach applied by Moritz et al. (2016). For our analysis, we used the joint EC/ECB wave number 13 that was conducted between April and September 2015. In total, the sample includes 17,950 firms in 39 European countries.

3.2 Method

In order to identify an empirical taxonomy of SME financing patterns, we conduct a hierarchical cluster analysis. Cluster analysis is an appropriate method to identify

groups of firms that use similar financing instruments. The goal is to identify clusters which are relatively homogeneous within the clusters but are distinctively different from each other (e.g. Hair et al. 2010; Özari et al. 2013).

Different hierarchical cluster analysis algorithms were tested (single linkage, average linkage, complete linkage and Ward's method) in order to identify an empirical taxonomy of SMEs in Europe. We decided to use Ward's method because this algorithm generated relatively homogeneous clusters with balanced cluster sizes, whereas the other methods provided unbalanced cluster sizes or clusters with high intra-cluster heterogeneity (Backhaus et al. 2013). Furthermore, this approach allows us to directly compare our results with the analysis by Moritz et al. (2016), without causing differences due to the application of a variety of methods. Consistent with Ward's algorithm, we used the squared Euclidean distance as a measure of proximity. Based on the validation tests (test of Mojena and elbow criterion), as well as face validity and theoretical foundation (Backhaus et al. 2013; Mojena 1977), we identified seven distinct SME financing clusters.

3.3 Variables

3.3.1 Active Cluster Variables

In the SAFE survey, the participating SMEs are asked about the financing of their company and, in particular, the financing instruments used. The question consists of two parts: First, the enterprise was asked whether it had used the specific financing instrument in the past or would consider using it in the future (i.e. whether the financing instrument was relevant to the firm). Second, the company was asked whether it had used the financing instrument during the past 6 months. The following financing instruments were queried: (a) retained earnings or sale of assets; (b) grants or subsidised bank loans; (c) credit line, bank overdraft or credit card overdrafts; (d) bank loans (both short and long term); (e) trade credit; (f) other loans (e.g. from family and friends, a related enterprise or shareholders); (g) leasing or hire purchase; (h) factoring; (i) debt securities issued; (j) equity (quoted shares, unquoted shares or other forms of equity provided by the owners or external investors, such as venture capital companies or business angels); and (k) other sources of financing (subordinated debt instruments, participating loans, peer-to-peer lending, crowdfunding).

3.3.2 Passive Cluster Variables

To characterise the different financing patterns, several firm-, product-, industry- and country-specific determinants are included as passive cluster variables based on prior research (e.g. Ferrando and Griesshaber 2011; Mac an Bhaird and Lucey 2010). The majority of the variables is retrieved from the SAFE survey (see Table 1). To analyse

Table 1 Passive cluster variables

Passive cluster variables	Coding	Comments
Firm size (1): number of employees How many people does your company currently employ either full- or part-time in [country] at all its locations?	1 = from 1 employee to 9 employees 2 = 10–49 employees 3 = 50–249 employees 4 = 250 employees or more	Category 4 was excluded from the analysis
Firm size (2): turnover What was the annual turnover of your enterprise in 2014?	5 = up to EUR 500,000 6 = more than EUR 500,000 and up to EUR 1m 7 = more than EUR 1m and up to EUR 2m 2 = more than EUR 2m and up to EUR 10m 3 = more than EUR 10m and up to EUR 50m 4 = more than EUR 50m	Category 5, 6 and 7 are recoded to "up to EUR 2m"
Firm age In which year was your enterprise first registered?	1 = 10 years or more 2 = 5 years or more but less than 10 years 3 = 2 years or more but less than 5 years 4 = less than 2 years	Recoded in the dataset
Ownership Who owns the largest stake in your enterprise?	1 = public shareholders 2 = family or entrepreneurs 3 = other enterprises or business associates 4 = venture capital enterprises or business angels 5 = one owner only 7 = other	
Growth in the past (1): employee growth Over the last 3 years (2012–2014), how much did your firm grow on average per year in terms of employment regarding the number of full-time or full-time equivalent employees?	1 = over 20% per year 2 = less than 20% per year 3 = no growth 4 = got smaller	
Growth in the past (2): turnover growth Over the last 3 years (2012–2014), how much did your firm grow on average per year in terms of turnover?	1 = over 20% per year 2 = less than 20% per year 3 = no growth 4 = got smaller	

(continued)

Table 1 (continued)

Passive cluster variables	Coding	Comments
Growth expectation Considering the turnover over the next 2–3 years (2015–2017), how much does your company expect to grow per year?	1 = grow substantially—over 20% per year 2 = grow moderately—below 20% per year 3 = stay the same size 4 = become smaller	
Profit Has profit decreased, remained unchanged or increased over the past 6 months?	1 = increased 2 = remained unchanged 3 = decreased	
Access to finance problems How important have the following problems been for your enterprise in the past 6 months? (scale 1–10)	1 = it is not at all important 10 = extremely important	Recoded in the dataset: 1 = low (1–3) 2 = medium (4–6) 3 = high (7–10)

the country-specific differences, we add macroeconomic variables provided by the OECD, the European Commission, the Heritage Foundation and the World Bank.[3]

3.4 Descriptive Statistics

For our research goal to identify financing patterns of SMEs in Europe, we include all firms from the SAFE survey with less than 250 employees according to the definition of the European Commission (European Commission 2005). Hence, our study includes 13,098 firms (see Tables 2 and 5). We reweighted the sample using data on firm size, economic activities and countries by Eurostat in order to make valid statements for the overall population of SMEs in Europe. The final reweighted sample mainly consists of micro firms with less than ten employees (93%). Moreover, 6% of the firms employ 10–49 people, whereas only 1% of the firms have 50–249 employees. Furthermore, approximately 90% of the companies have an annual turnover of less than EUR 2m. Regarding to firm age, most of the firms (71.8%) are mature companies ($\geq$10 years old). The majority of SMEs is from Italy (16.8%), France (13.3%), Spain (10.4%), Germany (9.7%) and the United Kingdom (7.9%). With regard to the active cluster variables, credit lines, bank overdrafts or credit card overdrafts were the external financing source that the largest share (33.9%) of firms in the sample used over the past 6 months. Many firms (40.6%)

[3]Please refer to the EIF Working Paper for a detailed explanation of the variables included: Masiak, C., Block, J., Moritz, A., Lang, F., und Kraemer-Eis, H. (2017): Financing Micro Firms in Europe: An Empirical Analysis, EIF Working Paper 2017/44, available at: http://www.eif.org/news_centre/publications/eif_wp_44.pdf.

Table 2 Sample description (active cluster variables)

Source of financing	Used in the past 6 months
Retained earnings or sale of assets	10.7%
Grants or subsidised bank loans	5.3%
Bank overdraft, credit card overdrafts, credit lines	33.9%
Bank loans	14.3%
Trade credit	15.7%
Other loans	9.6%
Debt securities issued	1.2%
Leasing, hire purchase or factoring	12.5%
Equity	1.2%
Other sources of financing	1.0%
Factoring	2.9%
No external financing used	40.6%

in the sample, however, did not use any external financing in the last 6 months. Table 3 provides a detailed overview of the utilisation of the different sources of financing.

4 Empirical Analysis

4.1 Identifying an Empirical Taxonomy of SMEs in 2015

To identify an empirical taxonomy of SMEs based on different financing instruments, we perform a cluster analysis. In total, 13,098 SMEs are included in the analysis, providing a 7-cluster solution ($p < 0.01$). The results of the cluster analysis are shown in Table 3.

Cluster 1 (mixed-financed SMEs with focus on other loans) This cluster is characterised by the utilisation of a large number of different financing instruments. However, the main focus is on "other loans", such as loans from family and friends or related companies, which were used by 93.9% of SMEs in the cluster. 1129 SMEs (8.6% of the number of firms in the whole sample) belong to this cluster.

Cluster 2 (mixed-financed SMEs with focus on retained earnings or sale of assets) Firms in this group also use a great variety of financing instruments. However, the most important financing sources are retained earnings or sale of assets (92.8%). 1324 SMEs (10.1%) belong to this cluster.

Cluster 3 (state-subsidised SMEs) The state-subsidised SME cluster contains the smallest number of firms (602 SMEs, 4.6%). All firms in this cluster use government grants or subsidised bank loans over the previous 6 months. In addition, short-term debt in terms of credit lines, bank overdrafts or credit card overdrafts (56.5%) and bank loans (49.7%) are important financing sources.

Table 3 Cluster results

Financing instruments	Mixed-financed (other loans)	Mixed-financed (retained earnings or sale of assets)	State-subsidised SMEs	Debt-financed SMEs	Trade-financed SMEs	Asset-based financed SMEs	Internally financed SMEs	Pearson Chi^2
Retained earnings or sale of assets	7.5%	**92.8%**	12.7%	0.0%	1.0%	0.0%	0.0%	10,511.2***
Grants or subsidised bank loans	6.2%	1.1%	**100%**	0.0%	0.3%	0.0%	0.0%	11,406.4***
Credit line, bank overdraft or credit card overdrafts	48.5%	35.5%	56.5%	**85.7%**	45.8%	37.2%	0.0%	6038.7***
Bank loans	21.8%	14.6%	49.7%	35.6%	18.4%	0.0%	0.0%	2632.5***
Trade credit	23.7%	22.1%	29.2%	0.0%	**95.6%**	0.0%	0.0%	8453.6***
Other loans	**93.9%**	14.2%	0.0%	0.0%	0.5%	0.0%	0.0%	10,405.3***
Debt securities issued	0.5%	0.4%	1.0%	0.0%	9.8%	0.0%	0.0%	1021.7***
Equity	0.9%	10.4%	0.0%	0.0%	0.5%	0.0%	0.0%	1074.9***
Leasing, hire purchase or factoring	16.8%	20.3%	23.0%	6.9%	23.6%	**100%**	0.0%	6106.6***
Other[a]	11.7%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	1413.5***

(continued)

Table 3 (continued)

Financing instruments	Mixed-financed (other loans)	Mixed-financed (retained earnings or sale of assets)	State-subsidised SMEs	Debt-financed SMEs	Trade-financed SMEs	Asset-based financed SMEs	Internally financed SMEs	Pearson Chi^2
No external finance	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**100%**	13,098.0***
N	1129	1324	602	2481	1382	859	5321	
Percentage of firms	8.6%	10.1%	4.6%	18.9%	10.6%	6.6%	40.6%	
Description	Firms that use a large variety of financing instruments with focus on other loans	Firms that use a large variety of financing instruments with focus on retained earnings or sale of assets and equity	Firms that use grants/ subsidised bank loans but also other types of debt	Firms that use different types of debt, in particular short-term debt	Firms that use mainly trade-related types of financing	Firms that mainly use asset-based related types of financing (leasing, hire purchase or factoring)	Firms without external financing	

Notes: N = 13,098

Pearson's chi-square test: ***p < 0.01, **p < 0.05, *p < 0.1

[a]Other financing instruments = subordinated debt instruments, participating loans, crowdfunding

Cluster 4 (debt-financed SMEs) The debt-financed SME cluster is the second largest group in the sample with 2481 SMEs (18.9%). This cluster focuses on short-term debt (85.7%) and long-term debt (35.6%). Firms included in this group use leasing, hire purchase or factoring to a lesser extent (6.9%).

Cluster 5 (trade-financed SMEs) SMEs in this cluster (1382 firms, 10.6%) focus on trade credit. 95.6% of the SMEs in this cluster use this source of financing. In addition, short-term debt is used by 45.8% of SMEs in this cluster. The trade-financed SME cluster is the only group where the issuance of debt securities plays a considerable role (9.8%).

Cluster 6 (asset-based-financed SMEs) The asset-based financed SME cluster is the second smallest group with 859 firms (6.6%). All SMEs in this group use leasing, hire purchase or factoring as an external source of financing.

Cluster 7 (internally financed SMEs) The majority of firms belong to the internally financed SME cluster (5321 firms, 40.6%). All firms rely on internal financing and do not use any external financing instruments over the past 6 months.

4.2 Profiling and Describing the Taxonomy

Since we focus in this article on macroeconomic and country-specific differences, we briefly summarise the main results of the remaining passive cluster variables in Table 4.[4]

According to our cluster analysis, country-specific characteristics are the most important variables ($p < 0.01$) that affect the distribution of SMEs across clusters. We highlight and discuss the main results of the cluster characteristics regarding macroeconomic variables and country differences in the following.

4.2.1 Macroeconomic Variables

The cluster analysis reveals that a country's inflation rate (Cramer's $V = 0.085$) and inflation volatility (Cramer's $V = 0.107$) appear to be important factors, in determining the financing patterns of SMEs (see Table 5). SMEs in countries with a higher inflation rate tend to use less trade financing and state subsidies, but are comparatively more often in the debt-financed cluster. Previous research found that higher inflation is negatively associated with the utilisation of external financing

[4]For a detailed analysis of the taxonomy concerning firm-, product- and industry-specific variables, please refer to EIF Working Paper: Masiak, C., Moritz, A., and Lang, F. (2017): Financing Patterns of European SMEs Revisited: An Updated Empirical Taxonomy and Determinants of SME Financing Clusters, EIF Working Paper. Available at: http://www.eif.org/news_centre/publications/EIF_Working_Paper_2017_40.htm. Accessed 01 October 2018.

Table 4 Cluster summary concerning firm-, product- and industry-specific variables

Cluster	Financing in cluster	Firm-specific	Product-specific	Industry-specific
Mixed-financed SMEs (with focus on other loans)	SMEs that used a large variety of instruments with a focus on other loans (94%)	More often younger micro- and medium-sized firms with larger turnover; esp. single-owner firms, public shareholder, VC-financed firms or other firms/business associate as owner; more often negative past growth but high growth expectations	More innovation	More likely for service and trade sector
Mixed-financed SMEs (focus on retained earnings or sale of assets)	SMEs that used a large variety of instruments with a focus on retained earnings or sale of assets (93%); only cluster with a noteworthy amount of equity financing (10%)	More often older, small- and medium-sized firms with ownership by VCs and BAs relatively high represented; moderate to high past growth and high future growth expectations	More innovation	Most likely for industry sector
State-subsidised SMEs	100% of SMEs used grants or subsidised bank loans; large use of other bank loans	More often very young and small- or medium-sized firms; esp. family firms/entrepreneurial teams and public shareholders; with moderate and high employee growth in the past; high growth expectations	More innovation	Most likely for industry sector
Debt-financed SMEs	86% of SMEs used credit line/bank overdraft/credit card overdrafts and 36% bank loans; some used leasing/factoring	More mature micro and small firms; esp. family firms/entrepreneurial teams or single-owner firms; no growth in the past and relatively low growth expectations	Average innovation	More likely for construction and trade sector
Trade-financed SMEs	96% of group used trade credit and 46% credit line/bank overdraft/credit card; some used leasing/factoring, bank loans; only cluster with	More often younger (2–5 years) and small-/medium-sized firms; esp. family firms/entrepreneurial teams or other firms/business associates;	Average innovation	Most likely for trade sector

(continued)

Table 4 (continued)

Cluster	Financing in cluster	Firm-specific	Product-specific	Industry-specific
	considerable use of debt securities	high employment and turnover growth in the past; no high growth expectations		
Asset-based financed SMEs	100% of group used leasing/factoring and 37% credit line/bank overdraft/credit card overdrafts	Low innovation	Most likely for service sector	Esp. in Western European, non-distressed countries
Internally financed SMEs	100% of group did not use any external debt	Low innovation	Most likely for service sector	Esp. in Eastern European, former socialist countries

(Beck et al. 2008), but, at the same time, higher inflation rates and higher expected inflation rates seem to increase the leverage ratio of SMEs (Frank and Goyal 2009; Öztekin 2015). However, we find a contrary result: firms in countries with low inflation volatility more often tend to be in the debt-financed SME cluster. Regarding inflation volatility, we find that SMEs in countries with very high inflation volatility tend to be comparatively more often in the internally financed or mixed-financed cluster (with a focus on other loans). This can be explained by the fact that high inflation volatility decreases the predictability of a country's future development, which in turn increases the business risk of firms. As a consequence, firms are more likely to avoid long-term debt in this uncertain environment (Ball 1992; Fan et al. 2012; Frank and Goyal 2009).

Furthermore, we find that GDP per capita (Cramer's $V = 0.100$) and GDP growth rates (Cramer's $V = 0.125$) are related to the financing of firms. Both variables provide information about the economic condition of a country (Bas et al. 2009; De Jong et al. 2008). Our cluster analysis reveals that SMEs in countries with high GDP per capita are comparatively more often in the mixed-financed (with a focus on retained earnings or sale of assets), asset-based and debt-financed clusters. Hence, SMEs in more developed and economically sound countries seem to be able to obtain financing from a larger variety of financing sources (Bas et al. 2009). In line with this finding, firms in countries with relatively high GDP growth rates appear to use a broader range of financing instruments (18.0% of SMEs in countries with an average GDP growth rate of $\geq$3% from 2011 to 2015 belong to the mixed-financed SME cluster with a focus on retained earnings or sale of assets), whereas SMEs in countries with lower GDP growth rates are more likely to use state subsidies. This result implies that SMEs in less well developing countries obtain more government support than SMEs in countries with high GDP growth rates.

SMEs in countries with higher tax rates are more likely to be in the debt-financed cluster (22.1% of SMEs in countries with a total tax rate of >50% belong to the debt-financed cluster) and in the state-subsidised cluster, in which the use of bank loans is

Table 5 Cluster comparison: country-specific characteristics

Variable	Categories	Total sample	N	Mixed-financed SMEs (with focus on other loans)	Mixed-financed SMEs (with focus on retained earnings/ sale of assets)	State-subsidised SMEs	Debt-financed SMEs	Trade-financed SMEs	Asset-based-financed SMEs	Internally financed SMEs	Test statistic	
											Pearson Chi^2	Cramer's V
	SMEs per cluster			8.6%	10.1%	4.6%	18.9%	10.6%	6.6%	40.6%		
Country level												
Inflation rate	Deflation (<0%)	28.3%		9.8%	9.1%	4.3%	14.4%	14.9%	6.8%	40.6%		
	0 to <0.5%	61.4%		8.2%	11.0%	4.8%	20.7%	9.0%	6.3%	39.9%		
	≥0.5%	10.3%	13,098	7.8%	7.4%	3.8%	20.8%	8.1%	7.2%	44.8%	190.0^{***}	0.085
Inflation volatility (standard deviation over the preceding 4 years)												
	0 to <0.5	2.9%		4.7%	13.7%	3.1%	16.6%	8.5%	13.5%	39.9%		
	0.5 to <1	30.6%		7.5%	11.9%	2.7%	22.4%	5.3%	9.1%	41.1%		
	1 to <1.5	50.7%		9.1%	9.0%	6.3%	18.6%	13.4%	4.2%	39.3%		
	1.5 to <2	11.3%		7.9%	8.4%	3.7%	13.7%	15.7%	9.0%	41.6%		
	≥2	4.4%	13,098	14.7%	12.1%	1.4%	13.8%	2.9%	4.9%	50.2%	597.6^{***}	0.107

Tax payments (number per year)												
	Low (0–10)	63.8%		9.0%	10.6%	3.4%	17.9%	10.3%	7.4%	41.4%		
	Medium (11–20)	34.2%		8.1%	9.5%	7.1%	20.7%	11.1%	4.9%	38.7%		
	High (>20)	2.1%	13,098	5.8%	6.6%	0.7%	21.9%	9.5%	7.7%	47.8%	158.0***	0.078
Time for paying taxes (hours per year)												
	Very fast (0–100)	2.1%		10.8%	17.9%	2.9%	15.4%	15.0%	6.5%	31.5%		
	Fast (101–200)	50.4%		9.0%	10.9%	3.3%	18.2%	11.5%	6.4%	40.8%		
	Slow (201–300	41.7%		7.5%	9.1%	6.8%	20.3%	10.0%	7.1%	39.2%		
	Very slow (>300)	5.8%	13,098	12.4%	7.9%	1.3%	16.8%	4.6%	4.5%	52.5%	245.6***	0.079
Total tax rate												
	Low (0–25%)	1.7%		8.3%	15.7%	2.3%	17.0%	14.7%	5.5%	36.4%		
	Medium (26–50%)	44.7%		10.3%	9.8%	3.1%	15.2%	11.0%	8.7%	41.9%		
	High (>50%)	53.7%	13,098	7.2%	10.2%	5.9%	22.1%	10.1%	4.8%	39.7%	268.1***	0.101

(continued)

Table 5 (continued)

Variable	Categories	Total sample	N	Mixed-financed SMEs (with focus on other loans)	Mixed-financed SMEs (with focus on retained earnings/ sale of assets)	State-subsidised SMEs	Debt-financed SMEs	Trade-financed SMEs	Asset-based-financed SMEs	Internally financed SMEs	Test statistic	
											Pearson Chi^2	Cramer's V
GDP per capita (in US Dollar)												
	Very low (0–20,000)	20.0%		10.7%	9.2%	2.7%	14.5%	10.1%	7.2%	45.5%		
	Low (20,001–40,000)	34.8%		7.7%	8.7%	7.9%	20.2%	13.0%	4.0%	38.5%		
	High (40,001–60,000)	44.1%		8.5%	11.5%	2.8%	19.9%	9.0%	8.1%	40.1%		
	Very high (>60,000)	1.1%	13,098	5.0%	14.2%	3.5%	21.3%	3.5%	12.8%	39.7%	391.1***	0.100
Average of annual GDP growth rate (averaged through 2011–2015)												
	<0%	34.6%		7.7%	8.6%	8.0%	20.2%	13.0%	4.0%	38.4%		
	0 to <1%	22.9%		6.6%	11.2%	2.4%	23.6%	5.8%	6.9%	43.5%		
	1 to <2%	22.1%		10.0%	10.2%	2.9%	17.8%	4.6%	9.8%	44.6%		
	2 to <3%	18.3%		10.4%	10.5%	3.3%	13.0%	18.6%	7.2%	36.9%		
	≥3%	2.0%	13,098	16.1%	18.0%	1.1%	10.5%	12.7%	6.4%	35.2%	823.5***	0.125

Unemployment rate												
	Low (0–6%)	15.9%		10.3%	9.7%	2.7%	19.3%	4.5%	10.9%	42.6%		
	Medium (7–13%)	62.5%		7.9%	11.1%	5.1%	20.0%	10.9%	5.9%	39.2%		
	High (>13%)	21.6%	13,098	9.5%	7.6%	4.6%	15.7%	13.9%	5.3%	43.4%	269.5***	0.101
Property rights												
	Very low (30–50)	9.2%		11.6%	8.4%	1.4%	14.1%	15.5%	5.4%	43.6%		
	Low (51–70)	40.9%		7.8%	8.9%	7.6%	19.2%	12.0%	5.2%	39.4%		
	High (71–90)	48.9%		8.8%	11.4%	2.7%	19.6%	8.6%	7.8%	41.1%		
	Very high (>90)	0.9%	13,098	5.7%	12.2%	3.3%	21.1%	4.1%	14.6%	39.0%	355.9***	0.095
Economic freedom index												
	Low (50–60)	3.7%		7.9%	5.0%	2.5%	7.7%	30.5%	4.6%	41.8%		
	Medium (61–70)	61.6%		7.5%	10.0%	5.8%	21.1%	9.8%	5.5%	40.3%		
	High (>70)	34.7%	13,098	10.7%	10.8%	2.6%	16.3%	9.8%	8.7%	41.1%	424.0***	0.127

Notes: Pearson's chi-square test and Cramer's V for categorical variables

The table should be read by comparing the share of SMEs per cluster and the share of SMEs in each category of passive cluster variables

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

also relatively high. In contrast, SMEs in countries with lower tax rates tend to use a larger variety of financing instruments as well as trade financing. This result is in line with trade-off theory, which is based on the idea that firms have to make a trade-off decision between a positive tax effect of debt and bankruptcy risk (Miller 1977; Myers 1977). Therefore, firms in countries with higher tax rates are able to generate a higher positive tax effect and are therefore more likely to use more debt than firms in low tax rate countries (Graham 2003; Jensen and Meckling 1976; Myers 1977; Psillaki and Daskalakis 2009).

A number of European countries suffered from economic instability and high unemployment rates due to the financial and economic crisis, which started in 2007. The banking system was strongly affected by these developments, and firms still suffer from bank lending constraints (Casey and O'Toole 2014; Ferrando and Griesshaber 2011; O'Higgins 2012; Tanveer et al. 2012). It has been found that firms with bank lending constraints are more likely to use internal financing and alternative financing instruments, for instance, trade credit (Casey and O'Toole 2014; Ferrando and Mulier 2015; Love et al. 2007). These findings are reflected in our cluster analysis, which shows that SMEs in countries with high unemployment rates (>13%) are more likely to be in the internally financed and trade-financed cluster.

In addition, we find that SMEs in countries with low property rights protection tend to rely strongly on internal rather than external financing. Nevertheless, trade finance and other loans (e.g. from family and friends, a related enterprise or shareholders) also appear to be important financing instruments in these countries. Property rights protection is closely related to financial development and the effectiveness of financial contracting (Beck et al. 2003; La Porta et al. 1997). Therefore, better protection of property rights is associated with better access to external financing for SMEs (Beck et al. 2008; Psillaki and Daskalakis 2009). This finding is further supported by looking at the economic freedom index. We find that SMEs in countries with higher economic freedom use a broader range of financing instruments and are consequently more likely to be in the mixed-financed clusters. In addition, our cluster analysis reveals that SMEs in countries with a very low level of economic freedom seem to be more often in the trade-financed cluster (30.5% of SMEs in countries with an economic freedom index between 50 and 60 belong to this cluster). This finding might also be due to the financial crisis and the difficulties faced by various European countries, especially Greece (Drakos 2012; Gibson et al. 2012).

4.2.2 Country-Level Characteristics of the Clusters

Country-specific characteristics To analyse the effect of country-specific variables on SME financing, we follow the approach of Moritz et al. (2016) and categorise the various countries according to their geographic location in Europe, their financial market system and the effect of the financial market crisis (distressed vs. non-distressed countries) (see Table 6). To be able to analyse country-specific

Table 6 Cluster comparison: country-specific characteristics

	Mixed-financed SMEs (with focus on other loans)	Mixed-financed SMEs (with focus on retained earnings/ sale of assets)	State-subsidised SMEs	Debt-financed SMEs	Trade-financed SMEs	Asset-based financed SMEs	Internally financed SMEs	Test statistic	
								Pearson Chi^2	Cramer's V
Groups of countries by region (UNSD) (N = 13,098)									
Eastern Europe[a]	10.2%	8.8%	2.8%	15.0%	10.4%	7.1%	45.7%		
Northern Europe[b]	11.0%	12.8%	2.8%	12.6%	16.9%	7.7%	36.3%		
Southern Europe[c]	7.7%	8.6%	7.9%	20.2%	12.9%	4.1%	38.6%		
Western Europe[d]	7.6%	11.3%	2.8%	22.8%	5.1%	8.5%	42.0%		
Total sample	8.6%	10.1%	4.6%	18.9%	10.6%	6.6%	40.6%	651.7***	0.129
Groups of bank-based, market-based and former socialist countries (N = 13,068)									
Bank-based countries[e]	7.4%	10.3%	5.9%	21.9%	9.5%	6.1%	38.9%		
Market-based countries[f]	10.8%	10.2%	2.2%	13.6%	15.0%	7.3%	41.0%		
Former socialist countries[g]	10.7%	9.5%	2.7%	14.4%	9.9%	7.5%	45.5%		
Total sample	8.6%	10.1%	4.6%	18.9%	10.5%	6.6%	40.6%	295.2***	0.150

(continued)

Table 6 (continued)

	Mixed-financed SMEs (with focus on other loans)	Mixed-financed SMEs (with focus on retained earnings/ sale of assets)	State-subsidised SMEs	Debt-financed SMEs	Trade-financed SMEs	Asset-based financed SMEs	Internally financed SMEs	Test statistic	
								Pearson Chi^2	Cramer's V
Groups of non-distressed vs. distressed countries (N = 13,098)									
Non-distressed countries	9.1%	10.8%	2.8%	18.2%	9.1%	8.0%	42.0%		
Distressed countries[h]	7.8%	8.7%	7.9%	20.3%	13.2%	3.9%	38.2%		
Total sample	8.6%	10.1%	4.6%	18.9%	10.6%	6.6%	40.6%	325.5***	0.158

Notes: Pearson's chi-square test and Cramer's V for categorical variables

***p < 0.01, **p < 0.05, *p < 0.1

[a]BG, CZ, HU, PL, RO, SK

[b]DK, EE, FI, IE, LT, LV, SE, UK

[c]CY, ES, GR, HR, IT, PT, SI

[d]AT, BE, DE, FR, LU, NL

[e]AT, BE, CY, DE, ES, FI, FR, GR, IE, IT, LU, PT

[f]NL, SE, UK, FI

[g]BG, CZ, EE, HR, HU, LT, LV, PL, RO, SI, SK

[h]CY, ES, GR, IE, IT, PT, SI

effects in more detail, we included a number of macroeconomic variables in our analysis. Using Cramer's V as an indicator of the ability to explain the cluster affiliation, we find that country-specific and macroeconomic differences are more pronounced than the differences by product-, firm- and industry-specific characteristics.

Drawing on the classification by the United Nations Statistics Division (UNSD), we divided Europe into Northern Europe, Southern Europe, Eastern Europe and Western Europe. Our cluster analysis reveals that, although internally financed SMEs have the highest percentage within each European region, SMEs in Eastern European countries seem to rely particularly on internal financing (45.7%). This result is in line with prior research (Moritz et al. 2016) and might be explained by the historically underdeveloped financial markets in Eastern European countries (Črnigoj and Mramor 2009; Klapper et al. 2002). Northern European SMEs are comparatively more often mixed-financed or trade-financed SMEs. Prior studies have found that Northern European countries have well-organised financial market systems and consequently have access to a large number of financing instruments (Demirgüç-Kunt and Maksimovic 1999; Guiso et al. 2004). Furthermore, firms in countries with well-developed financial markets have been found to use trade credit more often as it is an attractive alternative to other, mainly bank-related, short-term debt (Demirgüç-Kunt and Maksimovic 1999; Guiso et al. 2004; Marotta 2005). Southern European SMEs, however, tend to be more likely to be in the state-subsidised cluster. This result might be explained by the aftermath of the financial market crisis, as access to finance for SMEs in countries such as Spain, Greece or Portugal was especially difficult (Ferrando and Mulier 2015) and government support programmes were issued to support the economy in these countries (Casey and O'Toole 2014; Ferrando and Griesshaber 2011). Western European firms are comparatively more often in the debt-financed cluster (22.8%), which is likely to be explained by the relatively strong banking sector in these countries (Allard and Blavy 2011; Demirgüç-Kunt and Maksimovic 1999).

To delve deeper into the differences due to the prevailing financial market system, we distinguished the European countries included in our study into bank-based, market-based and former socialist countries. Bank-based financial systems are characterised by the dominant role of banks (Demirgüç-Kunt and Levine 1999; Levine 2002). The results of our cluster analysis are in line with previous research and show that SMEs in bank-based countries tend to be more often in the debt-financed cluster relying mainly on bank financing (Moritz et al. 2016; Nyasha and Odhiambo 2014). In addition, SMEs in bank-based countries tend to be more often in the state-subsidised cluster which is characterised by a high degree of financing with government grants and subsidised loans. During and in the aftermath of the recent financial crisis, banks reduced the availability of bank loans especially for risky and small firms (Ferrando and Griesshaber 2011). Bank-based financial market systems were particularly affected by this change in lending policies and required government actions to secure financing alternatives for firms in these countries. Interestingly, this cluster is also characterised by a high degree of bank loans

which cannot easily be explained by the firm characteristics of SMEs in the state-subsidised cluster. Hence, it seems that government subsidies might provide a positive signal for other capital providers, in particular financial institutions (Beck et al. 2008; Freel 2006; Mina et al. 2013). Previous research revealed that SMEs in particular faced financing constraints during the recent economic and financial crisis (Ferrando and Griesshaber 2011). To understand how the financial market crisis affected the financing patterns of SMEs, we divided the countries into distressed and non-distressed countries (Moritz et al. 2016). We find that SMEs in distressed countries seem to be more likely to fall into the trade-financed or state-subsidised cluster. This result is in line with previous studies that indicated an increasing utilisation of alternative financing instruments in deteriorating financial markets (Casey and O'Toole 2014; Moritz et al. 2016). Furthermore, SMEs in distressed countries appear to rely more on grants or subsidised bank loans, which can be explained by financial constraints and the higher availability of subsidies (Casey and O'Toole 2014).

5 Discussion

5.1 Summary of Main Findings and Contributions

We developed an empirical taxonomy of European SME financing patterns using the SAFE survey 2015H1 and identified seven financing types: mixed-financed SMEs with a focus on other loans, mixed-financed SMEs with a focus on retained earnings or sale of assets, state-subsidised SMEs, debt-financed SMEs, trade-financed SMEs, asset-based financed SMEs and internally financed SMEs. The seven clusters differ according to firm-, product-, industry- and country-specific characteristics (including macroeconomic variables). Table 7 summarises the main results of the cluster analysis.

Our study has several implications for both theory and practice. According to the theoretical contribution, our research extends the SME finance literature in particular in three ways. First, we contribute to the literature with regard to substitutive and complementary use of different financing instruments for SMEs. While previous research focused mainly on a single financing source or a small number of financing instruments (few exceptions are Beck et al. 2008; Berger and Udell 1998; Casey and O'Toole 2014; Lawless et al. 2015; Moritz et al. 2016; Robb 2002), for instance, bank loans, trade credit or venture capital, we considered a large variety of different financing instruments (Andrieu et al. 2018; Cosh et al. 2009; Hutchinson 1995) by creating an empirical taxonomy of SME financing patterns. Second, we examine whether the empirical taxonomy of SME financing patterns found by Moritz et al. (2016) remains stable over time. The authors identified six distinct SME financing types, namely, mixed-financed SMEs, state-subsidised SMEs, debt-financed SMEs, flexible-debt-financed SMEs, trade-financed SMEs and internally financed SMEs. Our study shows similar financing patterns which strongly indicates that specific financing instruments are often used as complements or substitutes. Third, we extend

Table 7 Cluster summary

Cluster	Financing in cluster	Country-specific	Macroeconomic variables
Mixed-financed SMEs (with focus on other loans)	SMEs that used a large variety of instruments with a focus on other loans (94%)	Esp. in Northern and Eastern European countries; more often in market-based or former socialist countries	More often low inflation rate but high volatility and high annual GDP growth rate in the past 5 years; more likely high tax rate and high economic freedom score
Mixed-financed SMEs (focus on retained earnings or sale of assets)	SMEs that used a large variety of instruments with a focus on retained earnings or sale of assets (93%); only cluster with a noteworthy amount of equity financing (10%)	Esp. in Northern European/Western and bank-/market-based countries; non-distressed countries	More often very high GDP per capita and annual GDP growth rate in the past 5 years; more likely medium unemployment rate, low tax rates and very high protection of property rights and high economic freedom score
State-subsidised SMEs	100% of SMEs used grants or subsidised bank loans; large use of other bank loans	Esp. in Southern, bank-based and distressed countries	More often low annual GDP growth rate in the past 5 years; more likely medium to high unemployment rate, medium economic freedom and low property rights index
Debt-financed SMEs	86% of SMEs used credit line/bank overdraft/credit card overdrafts and 36% bank loans; some used leasing/factoring	Esp. in Western European, bank-based and distressed EU countries	More often low inflation volatility and annual GDP growth rate in the past 5 years; more likely high tax rate and high protection of property rights
Trade-financed SMEs	96% of group used trade credit and 46% credit line/bank overdraft/ credit card; some used leasing/factoring, bank loans; only cluster with considerable use of debt securities	Esp. in Northern and Southern European countries; more often in market-based and distressed EU countries	More often deflation, but relatively high inflation volatility and high unemployment rate; more likely low tax rate, low protection of property rights and very low economic freedom index
Asset-based financed SMEs	100% of group used leasing/factoring and 37% credit line/bank overdraft/credit card overdrafts	Esp. in Western European, non-distressed countries	More often low inflation volatility and moderate annual GDP growth rate in the past 5 years; more likely

(continued)

Table 7 (continued)

Cluster	Financing in cluster	Country-specific	Macroeconomic variables
			high unemployment rate and very high protection of property rights
Internally financed SMEs	100% of group did not use any external debt	Esp. in Eastern European, former socialist countries	More often high inflation rate and volatility: low annual GDP growth rate in the past 5 years and very low GDP per capita; more likely high unemployment rate and very low protection of property rights

the study of Moritz et al. (2016) by adding macroeconomic variables to the dataset. Not only firm-, product- and industry-specific variables affect the financing patterns of SMEs (e.g. Beck et al. 2008; Cosh et al. 2009; Michaelas et al. 1999) but also country-specific characteristics, which we analysed in greater depth by investigating their macroeconomic differences (e.g. Beck and Demirgüç-Kunt 2006; Chavis et al. 2011; Hernández-Cánovas and Koëter-Kant 2011).

The results of our research can help policy makers to develop and adapt government support programmes. Our results reveal that several homogeneous SME financing patterns exist in Europe. They can be characterised by different firm-, product-, industry- and country-specific characteristics and use financing instruments in different combinations as substitutes or complements. Furthermore, the cluster analysis identifies the impact of macroeconomic variables on the financing patterns of European SMEs. By comparing Cramer's V, we find that macroeconomic differences are more pronounced than firm level characteristics with regard to European financing patterns. Therefore, policy makers should consider macroeconomic factors, such as the country's inflation volatility, the property rights or the unemployment rate and their impact on the firms' financing. As the financing mix of the enterprises in a country depends on this country's macroeconomic, legal and regulatory framework conditions, there is no "one fits all" solution for policy measures to improve companies' access to finance. Rather, policy makers should base decisions on a careful analysis of the situation in the respective country.[5]

[5] An example of such an approach are the ex-ante assessments that have been performed on behalf of countries and regions in Europe as a prerequisite to implement financial instruments under the European Structural and Investment Funds. See for an overview of such assessments with respect to SME financing Kraemer-Eis, H., and Lang, F. (2014): A Practical Approach to the Market Analysis Part of SME-Related *Ex-Ante* Assessments. In: "European Structural and Investment Funds Journal (EStIF)" 2014/3, Lexxion, November 2014, pp. 200–211. Available at: http://www.eif.org/news_centre/research/index.htm (accessed 11 October 2018).

5.2 *Avenues for Future Research*

To obtain a full picture of the stability of financing patterns over time, a panel dataset of SMEs is required. Even though the ECB has introduced a (small) panel component to the survey, a complete panel dataset for all waves is not available (European Central Bank 2016). However, future research could include the different waves of the SAFE survey in the cluster analysis and use the wave number as a passive cluster variable to examine the stability of the clusters over time. Furthermore, the relationship between financially constrained SMEs and the use of alternative financing instruments, including switching between instruments over time, would be an interesting research area. Hence, including separate categories in the research for new financing instruments, such as crowdfunding, could shed more light on the trends in SME financing. Also, future research could investigate the differences in financing of micro-, small- and medium-sized companies. In particular, research into the financing of micro firms and how this differs to that of larger SMEs is still scarce.[6]

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[6] A notable exception is Masiak et al. (in press).

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The European Capital Markets Union and its Impact on Future SME Financing

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Abstract Small- and medium-sized enterprises (SMEs) are facing enormous changes in the European financial sector. A growing number of international businesses are being confronted with a shift in financing towards international sourcing opportunities. Thus, to make international capital markets more attractive to European SMEs, the European Commission is currently implementing 33 new measures (the European Capital Markets Union). The goal of these measures is to incentivise more capital market-based forms of financing. However, the question of whether these new measures will also lead to an effective improvement in new venture and growth financing has not been answered. Our article intends to fill this gap in the research literature by applying a mixed-method approach focussing on experts (interviews) and SME firms (survey). We find that the Capital Markets Union will by no means make regional banking systems superfluous with regard to future SME financing. We conclude that banks and capital markets can only contribute significantly to stabilising the European financial system by complementing each other.

Keywords European Capital Markets Union · Entrepreneurial finance · Crowdfunding · SME bonds · German banking sector · Brexit

1 Introduction

More than 10 years after the beginning of the financial crisis, large parts of Europe have still not been able to recover economically. Moreover, an increasing social and economic disparity between the north and the south of Europe is observable (European Commission 2017c, pp. 3–17). Thus, even economically stable countries

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are increasingly questioning the economic advantages of the European Union (European Commission 2017b). The preliminary climax of these developments was the exit referendum (Brexit) endorsed by the British population in 2016.

Consequently, since the appointment of Jean-Claude Juncker as the President of the European Commission in 2014, the main focus of the European Commission has been on promoting employment and growth to return a consolidated Europe to its growth track. According to the European Commission, an inadequate supply of real economy credit financing by banks is seen as one of the factors that are responsible for the continuing weak growth (McGuinness and Hogan 2016). In general, the freedom of capital movement represents one of the four basic market principles. However, even 60 years after the Treaty of Rome was signed, it still has not been fully implemented. In fact, the fragmentation of the European capital market has increased on the national level since the last financial and sovereign debt crisis (European Commission 2015b, pp. 12–17; Véron and Wolff 2016, pp. 130–133). Against this background, the European Commission emphasises that a strengthened single internal financial market is necessary to exploit its full potential:

> Over time, I believe we should complement the new European rules for banks with a Capital Markets Union. To improve the financing of our economy, we should further develop and integrate capital markets. This would cut the cost of raising capital, notably for SMEs, and help reduce our very high dependence on bank funding. This would also increase the attractiveness of Europe as a place to invest. (Juncker 2014, p. 7)
>
> (Jean-Claude Juncker, 15. July 2014, Straßbourg)

In 2015, the green paper and the action plan were published to implement the European Capital Markets Union. In these documents, the European Commission outlined concrete milestones for setting up the fully functional and integrated supranational EU Capital Markets Union by 2019 (Deipenbrock 2017, pp. 61–63).

Based on more Anglo-Saxon-style capital market-based corporate financing, the European Commission is striving to complement the financing spectrum for SMEs by promoting a European capital market. The Commission is underpinning this initiative with scientific findings suggesting that national economies with a capital market-oriented financial system tend to recover faster from exogenous shocks and crises than bank-based economies (Schumacher and Paul 2017, pp. 289–297). Those findings, however, do not necessarily hold for SME and start-up financing, as such firms often view capital market financing rather sceptically. In large parts of the continental European financial system, a (regional) banking system has evolved over time, which is highly rated by SMEs with respect to business financing (Gischer and Ilchmann 2017; Hernández-Cánovas and Martínez-Solano 2010).

A good example of this is the German system, with its characteristic three-column banking market.[1] In times of crisis and turbulence on the international capital markets, the German system has proven to be particularly resistant. Essentially, the reason behind this stability is an anti-cyclic bank lending code of practice of

[1]The German banking sector is organised into commercial banks, public-sector banks and cooperative banks.

small, regionally oriented principal banks, which secure the credit supply for SMEs (Hofmann 2013). Moreover, the fundament of this particular business policy has been characterised by a decade-long business relationship between the SMEs and their principal banks (Lee et al. 2015). In fact, studies have revealed the economic advantages of this model for all parties (Berger and Udell 1995; Elsas and Krahnen 1998; Petersen and Rajan 1994). Thus, in this context, the European Commission's justification of the need for the European Capital Markets Union has been subjected to some criticism (Kraemer-Eis and Lang 2017, pp. 107–108).

Even more than 3 years after the publication of the green paper and action plan, the chances and risks of the Capital Markets Union have mostly been neglected by the literature; that is, it is still regarded as a largely "white spot" on the politico-economic and microeconomic research map (Gabrisch 2016, pp. 891–893). Without a doubt, the success of the European Capital Markets Union is contingent on the applicability of capital market-based financial instruments to small- and medium-sized businesses. The present article intends to fill a gap in the research literature first by focussing critically on the question of whether and how SMEs might still accept or turn their back on the bank that they trust in favour of a European capital market. Secondly, this paper addresses the question of which elements of the Capital Markets Union are complementary, substitutional or conflicting to the European bank-based financial system. Overall, we reach the conclusion that a more intensive debate in the research literature has to be initiated regarding the future responsibility of banks in a more capital market-oriented European financial system.

The rest of the paper is structured as follows. Based on the outline of the politico-economic European guidelines as well as intentional individual measures to create the Capital Markets Union, we first classify and review the EU plans in detail. Based on the results, we then study the suitability of specific capital market instruments for start-up and SME financing. To achieve this, our analysis adopts a quantitative and qualitative research approach. Finally, we conclude with a discussion of our main results, some limitations of our analysis and questions for future research. We find that growth-promoting interplay between the banking system and the capital market system is an important issue that should not be neglected. Whilst the European Capital Markets Union certainly offers great potential in the area of SME and start-up financing, the established European financing structures should not deliberately be pushed back. Following such reasoning, the focus of the Commission regarding further measures should improve the effective and efficient interaction between banking and capital markets in Europe.

2 European Capital Markets Union

2.1 Green Paper

Weak economic growth in Europe is regarded as the main reason for the attempt to implement a supranational European capital market. According to the European

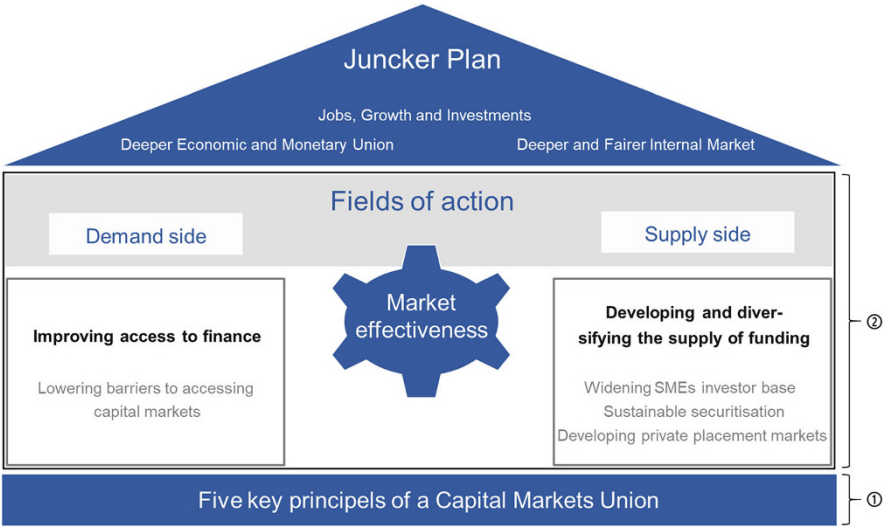

Fig. 1 Objectives of the European Capital Markets Union (own representation)

Commission, the cause of such weak growth tendencies in Europe can be traced back to an overly strong and—at least in part—reputedly negative dependency of the real economy on banks in financing matters (European Commission 2015a, pp. 2–3). Moreover, there is some evidence in the research literature that capital market-oriented financial systems seem to recover from crises faster than their bank-based counterparts (Allard and Blavy 2011). Consequently, with the publication of the green paper "Building a Capital Markets Union" in February 2015, the European Commission started the preparations for creating a European Capital Markets Union by 2019 (see Fig. 1) (European Commission 2015a, c). Based on this idea, a fully integrated, supranational European single market should contribute significantly to stronger diversification of the real economic financing spectrum (Elsinger et al. 2016, pp. 447–449). It should not only reduce the traditional bank dependency but also contribute to increasing the resilience of the financial system. Besides the enhanced financing situation for companies, international investors will be mobilised and attracted to make more investments in Europe. Consequently, more capital will be invested in the European Union, making a significant contribution to an increasing level of investments sustainably (Kaserer 2015, pp. 50–53).

Essentially, the European Capital Markets Union is based on five key principles (see ① in Fig. 1) (European Commission 2015a, p. 5):

- Maximum benefit for the economy, growth and employment
- Cross-border movement of capital
- Holistically implemented rules and regulations
- Ensuring consumer and investor protection
- Improvement of European competitiveness

For the realisation of cross-border movement of capital, the three following superordinate fields of action are relevant (see ② in Fig. 1) (Ossig 2015, pp. 14–16):

1. *Improving access to finance (demand side)*

   Capital market-based financing via the placement of shares or bonds is a possibility that is frequently used by large companies. The due diligence and reporting requirements, however, cause high fixed costs so that the economic feasibility is no longer given for most (smaller) SMEs. Nevertheless, creating special growth markets for SMEs based on simple and standardised regulations could result in more affordable market access for those SMEs. Investors gain increased market depth and liquidity as a result of such actions.

   Furthermore, the needs of young businesses with significant growth opportunities are reflected in deeper venture capital markets (Berger and Udell 1998). Integrated markets for collateralised notes are great opportunities for banks and investors. Bearing the sustainable safeguarding of European competitiveness in mind, initiatives for promoting the emergence of investments in long-term projects, such as infrastructure, are being pursued (European Commission 2015a, pp. 13–16).
2. *Market effectiveness*

   The key idea underlying the European Capital Markets Union is market effectiveness. That is, the main goal of effective and efficient capital markets is the allocation of capital to the most productive application (Schumacher and Paul 2017, pp. 294–297). Prevailing national legal provisions, however, prohibit the cross-border movement of capital. National co-determination rights of EU legal acts lead to a distortion of competition in the field of capital market law. Therefore, a harmonised legal framework is the basis for a European level playing field (i.e. uniform competitive conditions) and essential for attractive capital markets. Consequently, European convergence is the explicit objective—especially in the fields of competition law, investor protection and investor and company law as well as insolvency and tax law (European Commission 2015a, pp. 21–26).
3. *Developing and diversifying the supply of funding*

   The main focus of this field of action is on the diversification of the supply side of funding, which could be considered as a mirror image of the described demand side of funding. With regard to the outstanding position of institutional investors on capital markets in general, a reduction in the existing regulatory and legal barriers is assumed to have a stimulating impact on the international activities of investors. The different legal provisions, for example, in the fields of asset management, retirement benefits and the insurance sector, are responsible for the high costs to date. In addition, when setting up funds as well as the approval of the investment company, these barriers cause a growth-inhibiting character and inhibit the release of large financial resources, especially in the institutional sector (European Commission 2015a, pp. 16–17). Moreover, private equity and venture capital offer a lucrative alternative to traditional bank loans (Berger and Schaeck 2011, pp. 461–464; de Bettignies and Brander 2007). The affected regulatory

policy for European venture capital funds and, respectively, the European funds for social entrepreneurship has had a positive impact. Further extensive measures are necessary and contemplated for the next level of development. Public institutions should increasingly act as investors. At present, the lack of exit routes represents a substantial barrier for investors. In this context, the central position of banks is noticeable. That is, even in a more capital market-oriented European financial system, banks act on the one hand as loan creditors and on the other as issuers, investors and intermediaries on capital markets. The point is to complement these important capital supply chains with innovative and bank-independent forms of financing, such as peer-to-peer loans or crowdfunding, which are more focussed on the requirements of start-up and SME financing (Block et al. 2017a, pp. 239–250; European Commission 2015a, pp. 17–20).

In the context of the fundamental significance of the establishment of the European Capital Markets Union by 2019 and as an integral part of the subordinated fields of action, the Commission strongly insists on the implementation of the following five measures (European Commission 2015a, pp. 10–12; Ossig 2015, pp. 19–34; Schumacher and Paul 2017, pp. 297–302):

- *Lowering barriers to accessing capital markets*
  Firstly, a review of the prospectus requirements is close to the top of the agenda (Bendel et al. 2016, pp. 38–40). Here, it is imperative to reduce disproportionate bureaucratic barriers successively. In addition, selective alleviations, like the "Refit Programme", for a more efficient and effective framework with regard to the promotion of entrepreneurship and SMEs, are targeted.
- *Widening SMEs' investor base*
  Secondly, the limited availability of SME creditworthiness information can lead to an increased probability of default and unfavourable credit terms. Due to this lack of information, the spectrum of alternative financial facilities is also limited. Therefore, a database of standardised creditworthiness information to minimise this informational problem is being considered.
- *Sustainable securitisation*
  Thirdly, the revitalisation of securitisation markets is planned to support the capacity of banks to grant loans. A securitisation is commonly regarded as an effective instrument to convert a non-tradeable loan into a tradeable security paper and can serve as an instrument for risk sharing (Hartmann-Wendels et al. 2015, p. 188).
- *Boosting long-term investment*
  Fourthly, the European investment offensive—which started in 2014—fosters the sustainable and long-term increase of the overall investment level. Elementary instruments here are the European funds for strategic investments (EFSIs) and the European long-term investment funds (ELTIFs).
- *Developing private placement markets*
  Finally, it can be observed that larger SMEs, with capital requirements usually of more than 20 million euros, increasingly use American private placement markets. The advantage of such placement markets is that they can target

potential investors outside the public marketplace. Thus, there is a strong need for action with regard to creating a standardised legal framework for such private placement that is valid across Europe.

2.2 Action Plan

On the basis of more than 700 received statements in the period of a 3-month consultation, the European Commission published a concrete action plan for setting up the European Capital Markets Union on 30 September 2015 (European Commission 2015c, pp. 3–6). The main focus of these statements also rests on the noticeable easement of the financing conditions of SMEs. Of the 33 individual measures described in the action plan, more than 20 had already been implemented at the time of the midterm review in June 2017 (see Figs. 2 and 3) (European Commission 2017d, p. 4).

With the EU exit of Great Britain intended to take place in March 2019 and the exit from the single market at the end of 2020, Europe will lose its most significant financial market, which is a complicating factor (Ständer 2016, pp. 6–8).[2] In the latest published announcement, the Commission confirmed that it will finalise the outstanding measures by the end of the 2019 term of office. Thus, all the building blocks for a European Capital Markets Union should be finished and available by this date (European Commission 2018a, pp. 1–3).

The 33 individual measures listed in the action plan can be categorised into six superordinate subject areas. This paper will only deal with the three issues relevant to SME financing, specifically "financing for innovation and start-ups", "easier access to public markets" and "leveraging banking capacity".[3]

1. *Financing for innovation and start-ups*

   Young and innovative businesses are driving forces for growth and catalysers of dynamic national economies (Block et al. 2017b; Pott and Pott 2015, pp. 1–8) (see Fig. 4). Consequently, possible financial funding gaps can result in severe adverse effects on growth. The Capital Markets Union is meant to offer especially young companies additional financing alternatives as a supplement to traditional bank-based credit financing (European Commission 2015c, pp. 7–8; Jõeveer 2013).

   Innovative technology-based financing forms, such as peer-to-peer loans or crowdfunding, are an attractive source of financing for start-ups because the

[2] At present, the UK is regarded as the most important place in Europe for many capital market segments. According to estimates, the depth of the EU capital market will be reduced by approximately 16% due to the exit. Noticeable cuts are expected for venture capital markets.

[3] The main focus of the subject areas not presented here is firstly on the promotion of long-term infrastructure and sustainable investments, secondly on fostering retail investments and finally on the alleviation of cross-border investments.

Superordinate subject areas	Completed actions (8 June 2017)
Financing for innovation and start-ups	**1.** European venture capital funds and multi-country funds **2.** EuVECA and EuSEF review **3.** Study on tax incentives for VC and BA **4.** Principles for banks' feedback on declined SME credit applications **5.** Map out existing local or national capacities across the EU **6.** Crowdfunding report
Easier access to capital on public markets	**7.** Modernise the Prospectus Directive **8.** Consolidated corporate tax base and debt–equity tax bias
Long-term, infrastructure and sustainable investments	**9.** Review of infrastructure calibrations for banks (CRR) **10.** Review of Solvency II (insurance companies) **11.** Impact analysis of the financial reforms
Fostering retail investment	**12.** Green paper on retail financial services and insurance **13.** Consultation on the main barriers to the cross-border distribution of investment funds **14.** Policy framework for a European personal pension product
Leveraging banking capacity	**15.** Credit unions' authorisation outside the EU capital requirements **16.** Regulatory STS framework **17.** EU-wide framework for covered bonds
Cross-border investments	**18.** Report on national barriers to free capital movement **19.** Business restructuring and second-chance framework **20.** Strategy on fostering supervisory convergence

Fig. 2 Overview of the 20 completed actions. Own representation based on European Commission (2017e, pp. 16–17)

supply and demand of capital come together worldwide in an affordable way (see Fig. 5) (Kraemer-Eis and Lang 2017, pp. 100–103).

In the light of the concentration of approximately 500 European crowdfunding platforms on a few financial centres, the EU market is regarded as being very heterogeneous and fragmented (Ziegler et al. 2018, pp. 23–35). The reasons for this, among others, are conflicts between the protection of investors on the one side and the further development of the market on the other, as each national jurisdiction lays down its own regulations. To promote cross-border business activities and release further capacities, the EU legal framework proposed in March 2018 is planning supranational valid EU approval for crowdfunding platforms. Such approval is obligatory for investment and credit-based crowdfunding methods, whilst the donation and trade-off model is to be excluded from the regulation for purposes of maintaining the principle of proportionality (European Commission 2018b, pp. 1–3).

Superordinate subject areas	Outstanding actions (8 June 2017)
Financing for innovation and start-ups	**1.** Pan-European information system **2.** Approach to loan origination by funds and assessing the case for an EU framework
Easier access to capital on public markets	**3.** Review regulatory barriers to SME admission on public markets and growth markets **4.** Review EU corporate bond markets (focussing on improving liquidity)
Fostering retail investment	**5.** EU retail investment product markets' assessment **6.** Assessment of the prudential treatment of private equity and privately placed debt in Solvency II
Cross-border investments	**7.** Targeted actions on securities ownership rules and third-party effects of the assignment of claims **8.** Review progress in removing Giovannini barriers **9.** Best practice and code of conduct for relief-at-source from withholding tax procedures **10.** Study on discriminatory tax obstacles to cross-border investment by pension funds and life insurers **11.** ESA's funding and governance **12.** Technical assistance to support capital markets' capacity **13.** Review of the EU macroprudential framework

Fig. 3 Overview of the 13 outstanding actions. Own representation based on European Commission (2015c, pp. 29–30)

Moreover, business angels support the growth of start-ups through both financial means and their personal know-how (Croce et al. 2018). Here, it seems sensible to promote the consolidation of business angels and innovative businesses via a European platform (European Commission 2017e, pp. 26–29). Likewise, tax relief could represent an effective instrument to stimulate the Europe-wide business activity of business angels.

In addition, the Commission considers the performance of the current financial system for financing the expansion phase of young businesses to be inadequate. Based on the legislation review of the European Venture Capital Funds (EuVECA Regulation) adopted in July 2016 and, respectively, the European social entrepreneurship funds (EuSEF regulation), the activity of the venture capital sector is additionally increasing. The subject matter of the amendment was, on the one hand, the inclusion of large-scale fund managers and, on the other hand, the reduction of participation hurdles, to increase the investor radius (European Commission 2017d, pp. 4–5).

In the field of non-bank financing, the existing information asymmetries between (innovative) SMEs and investors are regarded as a significant barrier (Backes-Gellner and Werner 2007). By decreasing the information gap, the costs for investors to locate and identify economically attractive businesses are

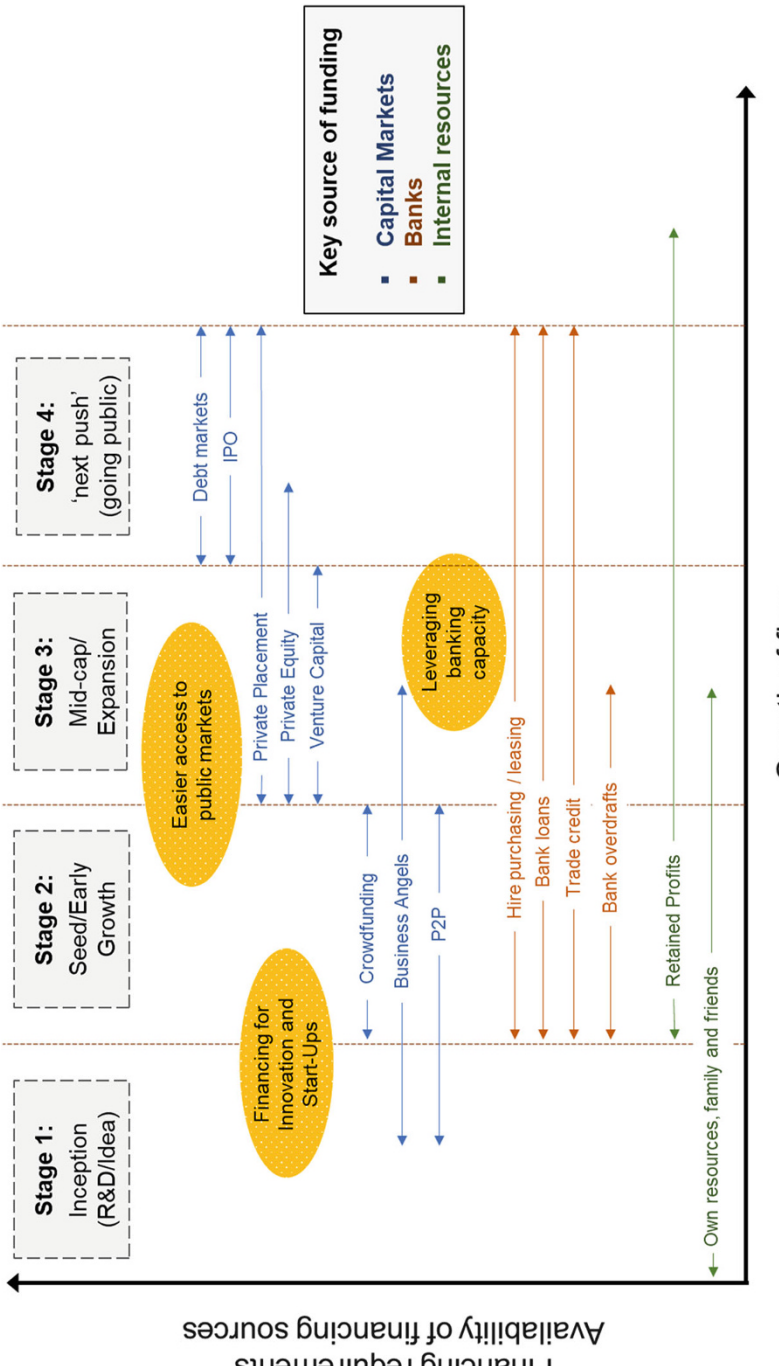

Fig. 4 SME finance subject areas applied to the funding escalator. Own representation based on European Commission (2015d, p. 33)

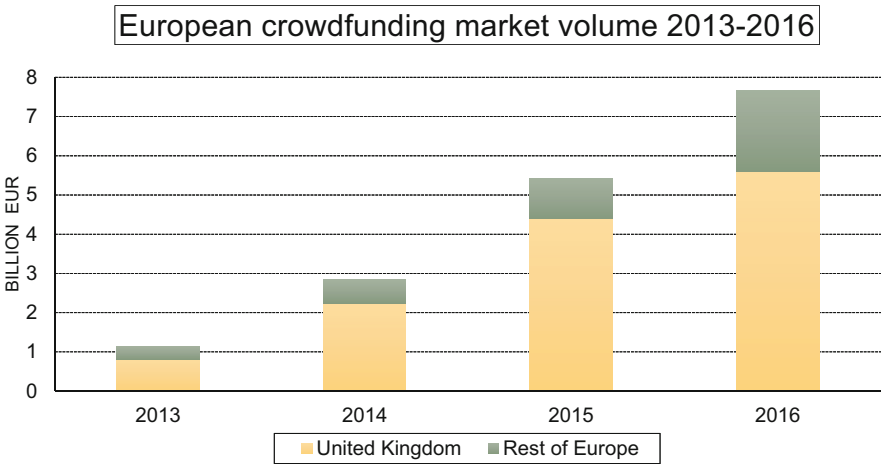

Fig. 5 Development of European crowdfunding markets. Own representation based on Ziegler et al. (2018, p. 21)

reduced. A Europe-wide information system is currently being discussed as an approach to solve this information asymmetry problem (European Commission 2015c, pp. 9–10). In this respect, profound knowledge of the SME in search of capital via suitable capital market-based financing instruments is essential.

Due to comparatively low regulatory requirements as well as a nonbureaucratic credit-awarding process combined with the high flexibility of this instrument, credit funds have been enjoying increasing popularity for years. They are regarded as the jigsaw piece to complete a diversified real economic financing spectrum (European Commission 2015c, p. 10).

Private placements are an interesting instrument of medium- to long-term financing primarily for upmarket small- and medium-sized companies. Private placements commonly take place outside the public marketplace, where the regulatory requirements are less restrictive. The German best-practice model "Schuldscheindarlehen" and the French Euro PP market are pioneers in Europe (European Commission 2017e, pp. 32–33). By using holistic processes and documentation, additional potentials are being made accessible. However, crucial for the future practice is that, despite the aspired-to Europeanisation, the actual advantages are not at risk of standardisation.

2. *Easier access to capital on public markets*

To make access to public capital markets noticeably easier for SMEs, it is mandatory to reduce the disproportionate regulatory requirements (Deipenbrock 2017, pp. 65–68). In particular, the compilation of a security prospectus, usually covering more than 100 pages, is something that companies of a small and medium size can hardly accomplish. The revised prospectus guideline provides for prospectus-free security emission to a total redemption amount of 8 million within 12 months (Wegerich and Recklin 2018). A further instrument is the so-called EU growth prospectus for the promotion of a special SME growth

segment. In addition, companies of which the securities have already been traded or are to be traded in the future and that had an average market capitalisation of less than 500 million euros in the past 3 calendar years can use these measures. This also includes companies with a public nominal value of less than 20 million euros within 12 months and an average number of employees of up to 499 in the past business year (Wegerich and Krümpelmann 2017).

3. *Leveraging banking capacity*

   Due to the sale or securitisation of receivables, additional scope can be created in the bank balance sheets (leveraging banking capacity). This enables further credit expenditures and promotes the wider economy. Actually, with respect to the financing of start-ups and small companies, decentralised and regionally broadly positioned banks are the main contact (Hasan et al. 2017). Regarding medium-sized and large companies, bank-based credit financing contributes to diversifying their liabilities. To prevent growth-inhibiting regulations and to grant proportionality, it is initially intended to review the regulatory framework of the banking sector (Bank for International Settlements 2017; Europäische Kommission 2016). Additional incentives are also being considered for non-profit-oriented banks, like credit cooperatives or savings banks. In regard to the low-risk business model and the nonsystemic significance, no negative feedback effects on the stability of the European financial system are to be expected from specific regulatory simplifications (Hackethal and Inderst 2015).

   Securitisations still have a crisis-inducing stigma. Despite this, the revitalisation of the securitisation market using high-quality securitisations is highly important. In 2016, the structural quality criteria for STS securitisations were defined. These were supplemented in 2017 by features for classification as STC.[4] Consultation on the regulatory treatment of such securitisations started in July 2017.

2.3 Reactions and Critical Reflection

2.3.1 Role of the Financial System

As mentioned above, only a very limited number of studies have focussed on the above-described measures to create and implement a European Capital Markets Union (Bendel et al. 2016; Demary et al. 2015; Franke and Krahnen 2017; Gabrisch 2016). However, as described earlier, there is an agreement that the European Capital Markets Union's main objective is to improve the resilience of the European financial system to new financial crises. In addition, it is often stated

[4]STC means "simple", "transparent" and "comparable"; STS means "standardised", "transparent" and "simple".

that the main cause of the weak growth that has continued since the financial crisis is the lack of performance of the current European financial system.

In general, the elementary purpose of any financial system is to bring providers and seekers of capital together in the most efficient and effective way possible (Gabrisch 2016, pp. 892–894). In the case of the European Capital Markets Union, the theoretical relationship of the green paper and the action plan for the Anglo-Saxon capital market-oriented financial system suggests the superiority of this system to the European system.

The following comparison illustrates the key advantages and disadvantages of these two systems:

- In bank-based financial systems, banks generate creditworthiness-relevant credit information via screening or monitoring activities. This is what mainly influences the decision to grant credit. Based on information usually collected over many years (i.e. relationship banking), banks behave counter-cyclically in times of crisis and provide the real economy with tailor-made financing solutions. In contrast, due to standardised products, capital markets are more pro-cyclic (Song and Thakor 2013).
- There are also differences with respect to corporate governance issues. Whilst the price mechanism develops a disciplinary effect on capital markets, banks, besides deciding to grant credit as such, can determine the terms of the loan as a form of pressure instrument at their disposal (Beck et al. 2015, pp. 25–26).
- The diversified and customisable range of banks' products has encouraged intertemporal distribution of risk. Standardised capital market products, in contrast, induce cross-sectional risk diversification (King and Levine 1993). Furthermore, bank-based financial systems are judged to be less innovation friendly than capital market-based systems. The main reason for this certainly lies in the conservative mode of the functionality of bank loans (Morck and Nakamura 1999; Rajan 1992). Despite securities being provided, when a company becomes bankrupt, banks usually do not regain large parts of the loan granted. If the firm displays high growth tendencies, the bank is only rewarded with the previously agreed interest rate. Banks thus tend to finance less risky undertakings rather than more innovative, high-risk ones. Supporters of the bank-based financing solutions contest the financial planning reliability for companies at this point. From this point of view, banks appear to support innovations. Via the multitude of market participants, capital markets, in contrast, enable the prompt provision of capital. Furthermore, profit sharing gives proprietary capital investors additional incentives for their commitment.

Hence, the relevant empirical literature shows that a certain orientation of a financial system cannot be made categorically responsible for the differences in growth (Beck and Levine 2002; Demirgüç-Kunt and Maksimovic 2002; Levine 2002).

2.3.2 Relevance of Bank-Based SME Financing

However, the focus solely on improved SME financing methods via capital markets has been exposed to extensive criticism. Important in this context is the pecking order theory, according to which the source of financing chosen by a company is significantly influenced by the degree of information asymmetry. According to an entrepreneur, from this arises a conflict of objectives between reducing capital costs and securing autonomy. As a result, internal financing takes precedence over external financing. In the latter case, debt capital instruments, especially bank loans, are preferred to equity capital instruments (Börner et al. 2010; Myers and Majluf 1984).

In line with the theory, there are two possible reasons for SMEs not being financed by capital markets:

- The information asymmetries between capital market investors and SMEs are considered to be pronounced, not least due to relatively low disclosure requirements. The reduction of these asymmetries is also often associated with high costs. Aside from the immense burden of fixed costs caused by documentation and prospectus obligations, the loss of decision-making authority associated with the capital market fortifies the capital market aversion of many SMEs (Deipenbrock 2017, pp. 65–67). In the case of firms with a comparatively small size, only a small proportion are in fact public limited companies (AG). Consequently, a large number of all potential target companies do not fulfil the necessary basic requirement for direct capital market financing due to their legal form. The sceptical tenor of many SMEs with regard to capital market financing is not discussed in detail in the green paper or in the action plan.
- Bank-based financing solutions still play an elementary role for SMEs. According to the survey conducted by the ECB, 19% of European SMEs applied for a bank loan in 2011 (see Fig. 6).[5] An average of 63% were granted the full loan and 18% part of the loan; 4% of the companies turned down the opportunity to take out a loan due to disadvantageous conditions. The refusal rate on the part of the bank was on average 11% across Europe (Ipsos Mori 2011, p. 30).

Moreover, in comparison with 2011, the terms of bank financing for SMEs have actually improved. During the period under consideration, between April and September 2017, 26% of SMEs applied for a loan; 73% of them were granted the total loan requested. Merely 5% of the applications were refused (European Commission 2017a, pp. 41–43; Ipsos Mori 2011, p. 30).

The special position of banks in Europe can be illustrated using the German financial system. Of the current number of European credit institutions, somewhat more than 3100, around 1700 are domiciled in Germany. The three-column model characterising the German banking market differentiates between private

[5]Only bank loans themselves are considered here—credit lines, bank overdrafts and credit card overdrafts are explicitly not included in the statistics quoted.

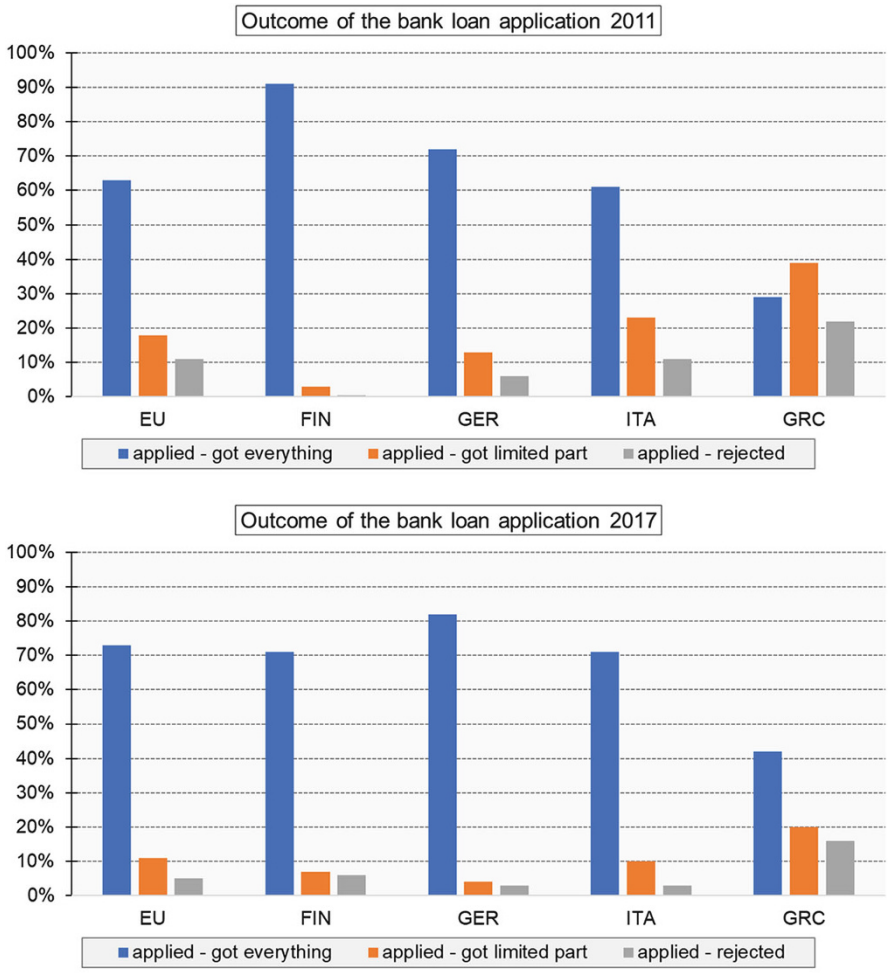

Fig. 6 Outcome of bank loan applications in 2011 vs. 2017. Own representation based on European Commission (2017a, pp. 41–43), Ipsos Mori (2011, p. 30)

commercial banks, public institutions and cooperative banks (Gärtner and Flögel 2017). Characteristically, there is a high regional presence of both public-sector savings banks and cooperative banks focussed on their members. Empirical studies have provided sound evidence that a trusting business relationship lasting for many years is beneficial financially for both sides (Boot 2000; Elsas and Krahnen 1998; Petersen and Rajan 1994). Even in the past financial crisis, German regional banks managed to secure the financing of SMEs through anti-cyclic loan provision (Hofmann 2013; Mitter 2012). Indeed, even the estimated capital requirements for the realisation of expansion efforts in a time frame of 2–3 years can easily be met by bank loans (see Fig. 7) (European Commission 2017a, p. 111).

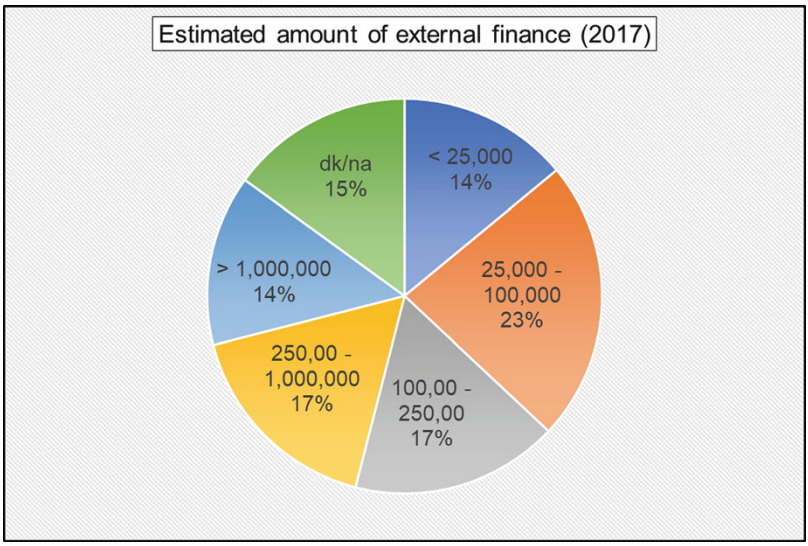

Fig. 7 Capital requirements to realise expansion. Own representation based on European Commission (2017a, p. 111)

Moreover, the latest developments arising from the finalisation of the banking supervisory framework (Basel III) appear to be controversial. Should the transfer to European or national law remain unchanged, negative consequences for the financing situation in the real economy can be expected. For example, the planned definition of a rigid granularity criterion leads to a systematic disadvantage for small institutions compared with large banks in the retail business. Furthermore, the recalibration of risk weights combined with the abolition of the SME support factor (Art. 501 CRR) will lead to a noticeable shortage and price increase of SME loans (Bank for International Settlements 2017; Ben Naceur et al. 2018).

2.3.3 Critical Reflection

Essentially, the overall underdevelopment of the EU financial system, as suggested by the EU Commission, and the financing bottlenecks supposedly resulting from this for SMEs cannot really be observed (Aghion et al. 2005). Moreover, the assumption of underdevelopment neglects important historical circumstances that make a considerable contribution to the development of the financial system. Examples are the respective legal system and real economic structures (Carlin and Mayer 2003; La Porta et al. 1997, 1998; Tadesse 2002). In line with that are even the national culture influences and individual risk attitude (Kwok and Tadesse 2006). Thus, the assumed state of underdevelopment of the European capital markets has to be assessed against the background of the (historically) well-developed EU banking sector. For example, only 7% of European SMEs actually rate the access to credit instruments as their

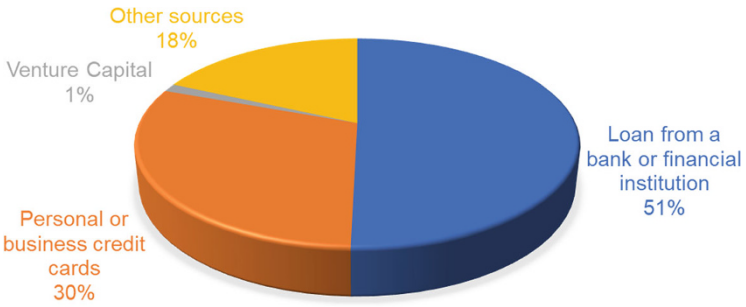

Fig. 8 Financing sources of US SMEs. Own representation based on European Savings and Retail Banking Group (2016, p. 7)

greatest challenge. Relatively more important are the search for customers (24%), the availability of specialists or qualified managers (23%) and the pressure of competition (13%) (European Commission 2017a, p. 136). In a related vein, more than 60% of European SMEs stated in 2017 that they have resorted to bank loans to finance growth.

Retrospectively, the principal bank concept can be considered as the foundation for today's economic strength of Germany. Scepticism regarding the one-sided state of dependence of SMEs on the principal bank, also due to market power, can therefore be disregarded. Moreover, it must be emphasised that, even in capital market-based financial systems, bank-based financial solutions are an important source of financing for SMEs (in the following illustrated by the financing sources of US SMEs; see Fig. 8) (Mills and McCarthy 2016, p. 25).

In addition, the use of the term SME by the Commission must be noted critically. Studies have shown distinctive heterogeneity among EU SMEs. These differences are inevitably also reflected in their financing requirements and preferences (Kraemer-Eis and Lang 2017, p. 96; Moritz et al. 2016).

To sum up, the research literature has provided evidence that, especially in developed national economies, the capital and banking markets complement each other. With a balanced coexistence, positive growth effects can be obtained. In addition, this hybrid model offers the advantage that, in the event of shocks or crises, the eligibility for financing of the real economy is temporarily secured by a complementary sector. This "buffer function" can reduce the extent of the crisis (Kaserer 2015, p. 65).

3 Study

3.1 Research Design, Database and Method

As mentioned above, research on the possible effects of the Capital Markets Union on SME financing is still in its infancy. Thus, we applied an explorative research design to understand the future role of the Capital Markets Union in SME financing.

To gain as much information as possible, a "mixed-method research design" was chosen (Molina-Azorín et al. 2012). In the quantitative analysis, a total of 23,363 firms from the regions of South Westphalia and East Westphalia Lippe (North Rhine-Westphalia, Germany) were invited to take part in the survey in spring 2018. The addresses and further company information were obtained from the pan-European financial database AMADEUS. The focus of the survey was on small- and medium-sized companies. A total of 342 companies filled in the questionnaire—this equates to a response rate of 1.46%. Moreover, 19% of them belong to commerce, 16% to the construction trade and 23% to industry.

The objective of the quantitative analysis was to obtain the expertise of the SMEs on the creation of the European Capital Markets Union and to acquire key information with respect to local bank relationships. Moreover, the intention was to gain further knowledge about the suitability of selected capital market-based financial instruments for financing start-ups and SMEs. The qualitative research design took the form of three expert interviews. The basis for the interviews was a semi-structured interview guideline (Döring and Bortz 2016, pp. 63–72). This guideline covered a total of nine both fundamental and subject-specific questions. These experts have extensive practical experience as well as written scientific publications in the field of interest. The expert interviews were held on 26 June 2018, 3 July 2018 and 5 July 2018. The interviews lasted between 15 and 20 min.

3.2 Analysis

3.2.1 Initial Knowledge

The analysis of the quantitative data shows that almost 26% of the companies stated that they know that the European Commission is currently implementing a European Capital Markets Union. Most of these companies are small firms (71%), followed by medium-sized companies (27%) and large firms (2%).[6] However, the share of companies within these firm size categories with knowledge about the European Capital Markets Union is 25% for small firms, 28% for medium-sized companies and 33% for large firms. Therefore, it can be concluded that the Capital Markets Union is less known to smaller companies than their larger counterparts. Viewed negatively, we believe that the reason for this is that, to date, the majority of the capital market-based financing instruments are unattractive to smaller firms.

In the following analysis, we focus firstly on a fundamental study of the suitability of selected financing instruments for start-up financing. Secondly, we investigate the opportunities offered by new technology-based financing forms. Based on that, we then study the suitability of direct capital market financing, for example, SME

[6]Company specification in line with the definition of the IfM Bonn.

bonds, for upmarket SMEs. Finally, the implications for the future role of principal banks and the three-column model in Germany are outlined.

3.2.2 Implications for Start-up and Growth Financing in Europe

As is commonly known, 93% of European companies can be characterised as micro SMEs. Enhanced funding opportunities in this area are considered to be particularly attractive (European Commission 2017f). In the field of growth financing, in particular, noticeable deficits in the performance of the European financial system have been highlighted by experts.

> Start-up financing is quite alright and bank financing of ongoing business also works well. What does not work well is the provision of growth financing for young companies. The USA has a huge advantage over Europe here. On-market financing for SMEs is also working rather badly. The cause of this is that the entire capital cycle is not closed. Young companies have to be able to go public. Mature companies are provided with all possibilities of growth on the stock exchange or from principal banks. If the younger companies cannot go public, the growth phase prior to going public will not work well. Then the investors will worry about losing their money because the subsequent financing is not secured.

Independent from capital market-based financing, a consistent and proportionate regulation across Europe is regarded as necessary to tap the potential.

> We need a simple arrangement. In a single European market, we need simplified access for small and medium-sized companies to the capital markets. It does not matter in what way that happens, not that the entrepreneur also has to decide what is easier in regulatory terms. For this reason, the arrangement has to be simple, holistic and transparent.

This requirement also applies to innovative forms of financing, such as crowdfunding. At the same time, EU approval for platform operators is welcomed by the experts.

> There are such cross-border platforms on a small scale. Of course, when these become larger and arouse more public attention, they will become more positive. That will mainly be due to the large area of fundraising.

Most importantly, a justifiable effort in the course of the approval procedure is seen to be of significance for platform operators. In the context of a targeted standardised regulation frame across Europe, the intended option for platforms in the core areas between national and EU supervision is questioned critically. On the one hand, the regulation forfeits transparency for users; on the other, the degree of regulatory fragmentation increases. This offers additional incentives for deregulatory competition between Community legislation and national legislation.

Especially with regard to the practical application to German start-ups and SMEs, sovereign-specific regulations do not seem to be perfect. In Germany, for example, the law covering fixed assets is decisive. It concedes prospectus-free brokerage of fixed assets, such as profit-participating loans and subordinated loans, up to total procurement of 2.5 million euros. Instead of the prospectus, however, a three-page maximum investment information sheet [Vermögensanlage-Informationsblatt

(VIB)] is to be deposited with the Federal Institute for Financial Service Supervision (BaFin). A prospectus-free issue of proprietary capital instruments, such as shares of up to 8 million euros, is planned. Concerning the predominant legal form of SMEs, limited liability companies (Ltd.), this approach is not sufficient. It results in a regulation-related disadvantage of limited liability company shares in relation to shares in a public limited company. In this case, the prospectus-free selling of limited liability company shares would only be permitted up to 100,000 euros. The inclusion of limited liability companies in the already-recognised privileged swarm financing under the Wealth Investment Act would remedy this situation. With that, the disadvantage would decrease significantly, by more than 90%. The German investor protection for so-called nonqualified investors limits the participation of 1000 euros and, respectively, 10,000 euros in such prospectus-free issuances. According to associations and practitioners, this leads to initial undercapitalisation. Instead of a fixed threshold, a "suitability test" is under discussion. The investor would have to conduct this test every 2 years (Bundesverband Crowdfunding 2018).

> There already are such platforms that try to bring people together. The difficulty is, however, that none of the platforms advertise properly or really have awareness. If so, then there would have to be a platform, maybe run by the state, which is fed money properly and which can generate real "awareness".

According to our experts, an elementary issue for prosperous cross-border investment dynamics of SMEs is a specific SME credit information database. Currently emerging database variations are not seen to have any potential for a Europe-wide application. Because of their focus on the private sector, these platforms do not act supranationally. The necessary financial resources are lacking expansion. A model launched by the European Community thus appears to be necessary. The public character would not only secure Europe-wide standardisation of the information but also increase the plausibility of the information. However, to date, corresponding concrete measures by the EU Commission are still undergoing preparation (European Commission 2017d).

Furthermore, tax incentives or improved exit routes should increase the attractiveness of business angel engagements in Europe; they are not, however, the immanent driving forces.

> Tax must not be the reason why someone makes an investment. However, it is incomprehensible why bonded capital is given tax privileges over proprietary capital. One has to be very careful. In the new market, for example, this in particular has led to overheating.

Primarily personal conviction is cited as an important motivational factor for business angels. The decisive factors for commitment are their personal interests and their profession or professional expertise.

> Business angels predominantly act out of personal conviction. The difficulty thus lies in them not finding anything in line with their interests. A former engineer will not look for a tech start-up. Nor do we have such personalities as Elon Musk in Germany and Europe.

There is scepticism with regard to the extensive engagement of institutions as investors for European venture capital funds. Funds such as the EuSEF, the

EuVECA and even the German high-tech start-up funds have been designed to cover costs and tend to work by providing subventions. Institutional investors, in contrast, primarily have the intention to gain profits. It is thus to be expected that such investors will invest directly in the market.

3.2.3 Direct Capital Market Financing for SMEs

When it comes to direct capital market financing, the fundamental sceptical tenor of many SMEs does not appear to change much. The reduction in bureaucracy achieved is commonly recognised from the revised prospectus regulation; however, the capital market-oriented financing approach for SMEs is still deemed to be (too) cost-intensive:

> Capital market financing can also be interesting for small enterprises. For example, a 25 million EUR bond was issued for the construction of a hotel and restaurant. The project was very successful and the bond was repaid early. For example, a company with 8 or 10 employees cannot compile a prospectus of several hundred pages in the scope of project financing. The reliefs introduced are not of a fundamental nature. If a 200-page prospectus is now to be compiled and, in the future, a 150-page one, it is questionable whether that will attract middle-class persons to the capital markets in great numbers. A fundamental change, for example, in the shape of an information sheet with a "question and answer format" on 20–30 pages would be necessary instead.

> Capital market financing works more or less efficiently with transaction volumes of 20 million EUR. In the bonded capital sector, it lies at around 50 million EUR per issuance.

Presumably, the mainly owner-operated SMEs in Germany are not willing to disclose detailed company information, such as patents. In addition, there is a lack of sound expertise in capital market financing. In short, the interest of German and European SMEs in capital market financing is low, reflecting the companies' satisfaction with the existing financing spectrum from banks:

> Once a company is listed, there is much less effort. Taking up capital of 8 million then is absolutely efficient. The huge problem at present is that these alleviations depend on whether a company is listed in a growth sector. It should actually depend on the company. The conditions of how an SME can be financed should be the same in every marketplace. At present, there is only one SME growth market—namely "Scale" on the Frankfurt Stock Exchange.

Even if attractive alternative financing possibilities are in reach, it cannot be expected that economically stable SMEs will engage in growth markets in the near future. Moreover, the experts recognise the generally known high loss rate of loans to SMEs in recent times. However, at this point, the positive effects must also be highlighted:

> At the moment, we are recording 25% defaults due to insolvencies, but these are normal starting difficulties of every new segment. In contrast, one considers the companies that did not fail. Many exited the loan, yet the loan made the companies more attractive to banks, for example. This way, subsequent financing is easier to obtain and would possibly not have been obtainable in this way without the loan. More recent studies also show that many SMEs

> want to increase their reputation and degree of awareness by going public. With smaller businesses, this degree of awareness can also be seen firstly in the closer proximity. Consequently, the companies were usually able to increase their turnover noticeably by 50% and more.

In contrast, especially economically troubled SMEs could attempt to obtain capital on such markets. Against the background of the history of the German market for SME loans, it must be ensured that these markets do not turn into "lender of the last resort" markets. Consequently, "bonded loans" offer enormous potential. Firstly, they are not subject to any extensive disclosure requirements:

> Private placements are always an effective means. Fundamentally, the private shareholder should, however, also be considered. Private placements only are not productive. Risk and rate of return belong in the private sector.

This instrument also offers possibilities to recruit family members or employees as investors. Furthermore, diversified designs, such as cancellation rights or coupon amounts, lead to greater flexibility. Last but not least, companies can use this form of finance as an instrument for employee retention.

3.2.4 The Future Role of Banks

The survey also confirmed the preference of SMEs for primarily regionally oriented principal banks (see Fig. 9).

The average business relationship between SMEs and their principal bank lies between 24 and 30 years in all three categories. Keeping both the previously described predominant satisfaction of the German SMEs with their principal bank and the opinion of the experts in mind, a European capital single market has to be of a complementary (and not a substitutional) character:

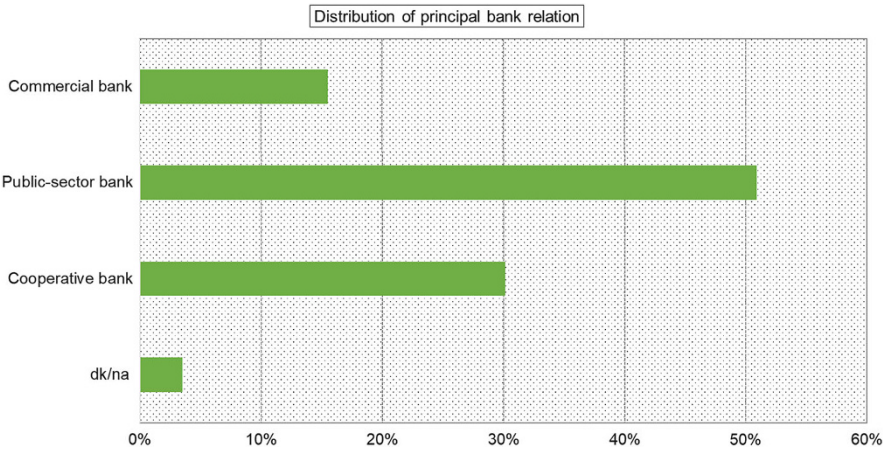

Fig. 9 Distribution of the banking relationship of German SMEs (own representation)

> The more holistic the capital market becomes, the fewer companies will depend on the local structures that can then also be sensitive to crises. If California has a budget problem, the financing of growth companies does not suffer a whit from that. If we have a crisis in Italy, then we have a huge problem in the Italian companies.

Banks are showing increased interest in financing in the start-up and seed phase. Through collaboration and takeovers of FinTech (e.g. Lendico by ING-Diba), banks try to keep in touch with the entrepreneurs of the twenty-first century. With the establishment of the fact that many SMEs are lacking the necessary capital market know-how, principal banks can increasingly act as adviser and broker for capital market-oriented financing solutions and thus directly contribute to the stabilisation of the European financial system:

> SMEs need supporting structures. A DAX company can set up its own special department. SMEs, in contrast, can afford an all-rounder with fundamental understanding, but SMEs can get themselves specialists at very efficient costs, who support them from case to case.

Without a doubt, capital market-oriented major banks have both the know-how for advising and the necessary infrastructure for such a service. However, it is questionable whether regionally oriented institutes have an appropriate infrastructure and the necessary expertise. In the future, banks could increasingly act as intermediaries for capital market-based financing solutions in relation to medium-sized companies instead of their current primary role as lenders.

Securitisation markets have a key function in the interlocking of the bank and capital markets. Securitisations are still commonly given a crisis-intensifying image in the public eye.

> Securitisations help bring risks into portfolios where they can be managed efficiently if the securitisation is used to hide risks that are not ideal.

Without question, especially the US American securitisation markets registered high loss rates in the financial crisis (Meister 2015). In contrast to that, the loss rates on the European markets were at an acceptable level. To prevent their reputation for being damaged from recurring, most financial service providers are still reserved in using securitisations. Presumably, securitisations are in any case inadequate means for regional small banks. This group of institutes lacks direct access to the capital market due to their size.

4 Conclusion

In sum, the European Capital Markets Union is fundamentally to be welcomed. There are many favourable arguments that the diversification of the economic financing spectrum in Europe will contribute to an improvement in the resilience of our financial system.

Firstly, the support of both innovative forms of start-up and growth financing and the setting up of an SME credit information database will noticeably improve the

financing possibilities of start-ups and young businesses. A major factor for long-term efficiency is a holistic regulatory framework. In the cases concerning direct SME financing on capital markets, the results of our analysis coincide to a great extent with those mentioned in other papers. Even with simplified disclosure obligations, direct capital market financing is still not feasible for the majority of SMEs. Extensive use of capital markets by SMEs in the near future thus seems improbable. Rather, the significance of banks in the continental European financial system is to be recognised and accommodated. Accordingly, effective interlocking of the banking and capital markets can be achieved, which will then play a key role in the European financing system. This approach can promote the efficiency and advantages of the existing structures and offer selective complementary financing alternatives.

Bearing the upcoming Brexit in mind, the need for a European Capital Markets Union is gaining importance. However, despite all the efforts for fast compensation, the intended completion of the Capital Markets Union by 2019 appears to be ambitious and hard to manage. The European Commission should thus act with a greater sense of proportion. The conscious disconnection of the real economy from banks in favour of capital markets could trigger a seismic effect. With respect to a future crisis, the weakening of tried and tested financing structures will involve the latent risk of negative feedback effects. Consequently, the implementation of one-sided individual measures and regulations should be regarded rather critically in this respect as well. With insufficient consideration of the heterogeneity of the European financial systems, the Community runs the risk of giving some individual national economies an advantage and others, in contrast, a disadvantage. Without farsighted action, Europe will not find its way back onto the path of growth and, in the worst case, risks collapsing from the economic divergence.

Some other limitations should be kept in mind when considering our results. The first limitation results from the qualitative research design chosen. The interviews are based on past experience and thus limit the validity of the information. Moreover, only three interviews were conducted, which means that the results may not cover all aspects of our research questions. Additionally, we cannot presently test directly whether and how SMEs will really react to the European Capital Markets Union because many measures have not been implemented to date. Nevertheless, even with these limitations, we strongly believe that our findings provide a best-practice approach and the basis for a future discussion in academic research with respect to the great changes in the European financial sector that small- and medium-sized enterprises will be facing in the near future.

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Innovation and Investment Finance in Comparison

Volker Zimmermann

Abstract This article compares the financing of innovation and investment in small- and medium-sized enterprises (SME). The central finding of the study is that the financing of these two types of projects differs substantially. Innovations are for the most part covered by internal funds. Other sources of funding play a subordinate role. For investments, on the other hand, both internal funds and bank loans play an important role. The study provides evidence that points to the existence of special restrictions for the external financing of innovations. For example, the share of bank loans only increases comparatively little as innovation expenditure goes up. In addition, the share of bank loans decreases as the share of R&D expenditure on innovation spending increases. This is in line with the consideration that special features of innovation projects, such as uncertainty about the success and asymmetric information between the firm and the potential outside investor combined with a lack of new assets to collateralise bank loans, counteract external financing. Financing restrictions are likely to lead to the innovation potential lying idle due to market imperfections. Working against it thus represents a permanent task of economic policy.

Keywords Financing of innovation · Financing constraints · Debt and internal financing · Small- and medium-sized enterprises

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1 Introduction

Innovation and the resulting technological progress are considered to be the key determinants of economic growth (Ulku 2004; OECD 2007). Innovations improve the use of resources, open up new sales potential and accelerate structural change (Dachs et al. 2017). Numerous studies have also shown the positive effects of innovations on performance indicators at company level (Lachenmaier and Rottmann 2007; Coad and Rao 2008; Zimmermann 2009, 2014; Falk 2015; Coad et al. 2016b; D'Attoma and Pacei 2018). However, the economic success of innovations is uncertain. As a result, high costs, high risks and financing difficulties are, unsurprisingly, the most important obstacles to innovation from a company's point of view (Arend and Zimmermann 2009; Rammer and Peters 2010; Thomä and Zimmermann 2016; Rammer et al. 2016). Theoretical considerations suggest that the financing difficulties mentioned may be an expression of a market failure in the external financing of innovations. They arise because of the particular characteristics of innovation projects—characteristics which do not mark investments projects, for example, in a comparable manner (Czarnitzki and Hottenrott 2010; Kerr and Nanda 2015). In particular, widespread financing via bank loans (Zimmermann 2013a; Schwartz 2017) in Germany is counteracted by these characteristics.

Harhoff (1998) is the first to study the financing of innovation activities of companies in Germany. A lot of studies followed. In most cases, the level of research and development (R&D) expenditure (Czarnitzki 2006; Müller and Zimmermann 2009; Schäfer et al. 2017; Peters et al. 2017) or the innovation expenditure was analysed (Hottenrott and Peters 2012; Schäfer and Stephan 2017). In addition, there are studies on the sources used for financing innovation (Spielkamp and Rammer 2009; Zimmermann 2013b, 2015; Rammer and Peters 2015). This paper revisits the latter approaches. In contrast to existing research, I compare the use of financial sources for innovation expenditure with those for investment in fixed assets, e.g. machinery, equipment or real estate. Innovation expenditure consists only to a small part of fixed assets. Innovation expenditure includes all costs incurred in the development and introduction of new or improved products and processes. In addition, the focus is on small- and medium-sized enterprises (SME), including companies with less than five employees. Thanks to a cooperation with Vereine Creditreform e.V., Neuss, it is possible to include the credit ratings of companies in the analysis. In particular, a distinction can be made between financing via internal funds, bank loans, subsidies and a residual category. The aim of the study is to draw conclusions on the existence of restrictions on the external financing of innovations. Financing restrictions may exist depending on the characteristics of the companies and their innovation activities.

Of course, the results for Germany cannot be generalised for the whole of Europe. Nevertheless, the German example in particular can give a good insight into the problems of external financing of innovations. This applies because Germany traditionally has a bank-oriented financing system—which means that bank financing is widespread—and innovation activities are very common in German SMEs.

The main result of the study is that the financing of these two types of projects differs substantially. While innovation is largely funded from internal sources, internal sources and bank loans play a serious role in investment. In fact, there are indications that, due to market imperfections, the external financing of innovation is more difficult than that for investment. This may be due to the particular characteristics of innovation projects, such as high uncertainty about success, difficulties in assessing innovation projects by external financiers or that innovation projects generate only a few assets that can be used to collateralise loans.

The article is structured as follows: After the conceptual background is presented in Sect. 2, the empirical approach and the database are explained in Sect. 3. Section 4 is devoted to the results of the empirical analysis. Finally, Sect. 5 concludes.

2 Conceptual Background

Innovation projects—compared to investment projects—exhibit special characteristics that make external funding difficult. In this regard, it is stated that innovation projects involve a particularly high uncertainty of success. Uncertainty means that not only the probabilities for the achievement of the project goals are unknown but also the possible outcomes of the project themselves (Knight 1921). Apart from technological uncertainty, innovation projects are characterised by strategic and market uncertainty (Encaoua et al. 2000). In addition, results of innovation projects follow an extremely skewed distribution. High potential gains often contrast with high uncertainty about the project's success (Scherer and Harhoff 2000; Carpenter and Petersen 2002). This makes the evaluation of innovation projects difficult. Due to the uniqueness, the technology-based nature and the often high degree of complexity of the projects, an evaluation is more feasible for the innovating company than for a potential external financier (Holmstrom 1989; Guiso 1998; Magri 2009). This leads to an asymmetric distribution of information on the project quality. These characteristics are likely to be most pronounced in R&D projects (Arrow 1962). R&D is a subset of possible innovation activities and is defined as "creative and systematic work undertaken in order to increase the stock of knowledge [. . .] and to devise new applications of available knowledge" (OECD 2015).

In addition, the dissolution of the information asymmetry between the innovating company and an outside investor is made difficult because innovators refrain from disclosing the details of their projects to avoid an unwanted outflow of knowledge (Bhattacharya and Ritter 1983). Consequences of information asymmetry can be problems of adverse selection and of moral hazard, so that external financiers are less willing to finance such projects (Czarnitzki and Hottenrott 2010; Hall and Lerner 2010; Kerr and Nanda 2015). Imperfect capital markets can, therefore, lead to underinvestment in innovation.

In the model of Myers and Majluf (1984), external investors claim an additional premium for the provision of funds in the presence of asymmetric information. This leads to a financial preference of the companies, according to which internal funds

are used first. If these are insufficient, loans and finally external equity are used for financing (Myers 1984). Such a financing hierarchy can be deduced not only from the argument of adverse selection as in Myers and Majluf (1984) but also from moral hazard problems between the company and the external financier (Jensen and Meckling 1976) or from taxation (Frank and Goyal 2008).

In the credit rationing model of Stiglitz and Weiss (1981), asymmetric information leads to banks not granting loans rather than demanding higher, market-clearing interest rates. The reason for this is that companies with high-risk projects are more willing to accept high financing costs, while companies with relatively secure projects with increasing interest rates are leaving as credit users. This gives the lender an optimal, profit-maximising interest rate that will not be exceeded, even if companies are willing to accept a higher interest rate.

In both explanatory approaches, information asymmetries lead to restrictions on external financing. Companies either face excessive return expectations (including an uncertainty premium) or do not receive an offer for external financing at all. The more pronounced the information asymmetry between the potential outside financier and the company, the lower the willingness to invest in the corresponding project (Calomiris and Hubbard 1990).

Financing via bank loans is especially difficult, as a lender is impacted by the uncertainty of the project's success (which is often tied to the success of the enterprise itself). But he cannot participate in any high profits in the event of success due to the fact that the interest rate is not performance-based. This makes it more difficult to offset losses in the portfolio through successful exposures and reduces the average risk that can be taken in the portfolio (Stiglitz 1985; Himmelberg and Petersen 1994).

An obstacle to loan financing is also that only 30% of innovation expenditure goes towards typical tangible investments, such as the purchase of buildings, machinery, etc. (Rammer et al. 2017). For R&D expenditures this share is as little as 8% (Stifterverband 2017). As a result, innovation projects hardly generate any assets that can be used as collateral for lending (Berger and Udell 1990, 1998; Himmelberg and Petersen 1994; Almeida and Campello 2007).

As a further characteristic, innovation projects are often not arbitrarily divisible: A given innovation project often has a minimum size, independent of the characteristics of the innovating enterprise, so that its execution has the character of fixed costs (Galbraith 1952; Cohen and Klepper 1996). As a result, small companies in particular are disproportionately burdened by the implementation of innovation projects, even if they focus on projects that require a comparatively low use of funds (Zimmermann 2017). This restricts the possibilities of risk diversification by pursuing several innovation projects (Behrens et al. 2017) and means that the failure of one project often jeopardises the existence of the entire enterprise.

In addition, the volumes requested by SMEs are often relatively low from the perspective of an external financier. As a result, the expected returns are more likely to be unfavourable for the transaction costs (such as project evaluation, credit assessment, monitoring), which means that it is often not worthwhile for potential financiers to overcome the information asymmetry—or only in the case of

correspondingly increased return requirements. This problem is compounded by the fact that small businesses are often considered to be particularly opaque. Less extensive publication rules mean that fewer and only coarser company key figures are available for an assessment (Hao and Jaffe 1993; Cosh and Hughes 1994; Berger and Udell 1998; Levenson and Willard 2000; Czarnitzki and Hottenrott 2011). Eliminating the lack of transparency should be particularly difficult in young or newly founded companies. For these companies no or only a short track record exists, which can be used (Petersen and Rajan 1994; Berger and Udell 1995; Coad et al. 2016a).

These factors are particularly important in the financing of small businesses, as these companies have fewer opportunities for risk diversification (Winker 1996), less credit collateral (Harhoff and Körting 1998; Berger and Udell 1998) and generally a higher risk of failure (Fritsch et al. 2006; Müller and Stegmaier 2014). In principle, these factors should affect the financing of both investments in tangible assets and innovation projects of SMEs. Because of the greater uncertainty, lesser collateral and lower requested funding levels (Zimmermann 2018; Schwartz 2017), it can be expected that they are more serious in innovation financing.

These arguments make it clear that the financing of bank loans, which is otherwise widespread in Germany, is particularly difficult for innovation projects. Therefore, Hall (1992) and Himmelberg and Petersen (1994) emphasise that the availability of internal funding is more important for innovation funding than for other types of investment.

This applies in particular to Germany, since equity capital is rarely used for financing purposes. Especially venture capital (VC) should, as smart capital, be better able to overcome the existing information asymmetries and to actively support their investments in the management. This should increase the likelihood of success and thus the willingness to invest in such a company (Ueda 2004). Last but not least, participation in the profits of a successful exposure enables VC companies to take on a higher average risk in the portfolio (Himmelberg and Petersen 1994). However, the equity capital market in Germany is poorly developed in international comparison. Also, the use of VC requires a high growth potential of the target companies and the willingness of the owners to hand over control and ownership rights.

3 Method

3.1 Database

The analysis is based on the KfW SME Panel. This is a representative longitudinal dataset, in which companies in Germany with an annual turnover of up to EUR 500 million are recorded. A special feature of the KfW SME Panel is that it also covers companies with less than five employees. They account for around 82% of all companies with an annual turnover of up to EUR 500 million but are often not included in other data sets. The public sector, banks and non-profit organisations are

excluded from the KfW SME Panel. The survey is carried out as a stratified random sample, using as stratification characteristics the aggregated economic sector (six classes), the number of employees (six classes), the region where the company is located (Eastern vs. Western Germany) and the subsidy status (funded or not funded by KfW) (Schwartz 2017). As part of a broad-based cooperation with Vereine Creditreform e.V., Neuss, the credit ratings of the companies surveyed in the KfW SME Panel were merged. For almost 95% of the companies from the 15th wave of the KfW SME panel, information about their creditworthiness could be obtained in this way. The data used for the analysis were collected in 2017. A total of 11,043 companies participated in the survey, of which—after exclusion of outliers—almost 2250 innovative and 4150 investing companies were included in the analysis. Due to the overlap between innovation and investment expenditures, the investment expenditures take only those companies into account that did not also spend on innovation. The information on financing behaviour relates to the year 2016. The survey results are extrapolated to the totality of small- and medium-sized enterprises as defined in the KfW SME Panel. The crucial descriptive results are tested for their statistical significance using hypothesis tests.[1]

3.2 Variables

In the study, I examine the share of each source of funding in innovation and investment finance. In terms of sources of funding, I differentiate between internal resources (e.g. current cash flow, provisions, cash reserves), debt financing (bank loans) and promotional funds (e.g. promotional loans, supported equity, allowances/grants). Third-party participations, mezzanine capital and a (no further specified) category "Other" were combined into "Other sources of funding" due to the small number of cases. According to the common definition (OECD 2005), innovation expenditures include all expenses, including personnel costs and related investments, which are related to the development and introduction of product and process innovations.[2] Investment expenditures include all expenses for fixed assets such as machinery, equipment, vehicles or real estate.

The proportions of sources of funding are evaluated according to the following dimensions: The size of the enterprise is measured as the number of employees in full-time equivalents. It is calculated including the active owners but excluding trainees and apprentices. Two part-time employees are counted as one full-time

[1] Since the Stata programme package used for the analysis has not implemented t-tests for weighted values, Wald tests are used for this purpose.

[2] These include expenditures for internal and external R&D, innovation-related expenses for machinery, equipment, software and external knowledge (e.g. patents, licences). In addition, this includes expenses for product design, engineering, conceptualisation of services and preparation for the production and sale of innovations, as well as training in connection with innovations and their market introduction.

employee. The age of the company is calculated from the founding date—regardless of subsequent acquisitions or changes in legal form. The intensity of the type of expenditure means the amount of innovation (respective investment) in relation to the annual turnover. The Creditreform credit rating, which is used in this study, is based on a total of 15 criteria. They include information on the financial status and liquidity (data on the annual statements), structural risks (branch of industry, company size and age, productivity) and soft factors (payment history, order book and orders received, management quality). The credit rating is indicated on a scale of 100–600, with 100 being the highest achievable credit rating.[3] The return on sales is measured as profits related to the annual turnover. The financing of innovation expenditure will also be examined in terms of the share of R&D in innovation expenditure. See Table 1 for the exact question and further explanation of the definitions. The continuous variables are each subdivided into four groups, where possible, the group boundaries are drawn so that approximately equal groups arise.

4 Empirical Results

4.1 Overall Sample

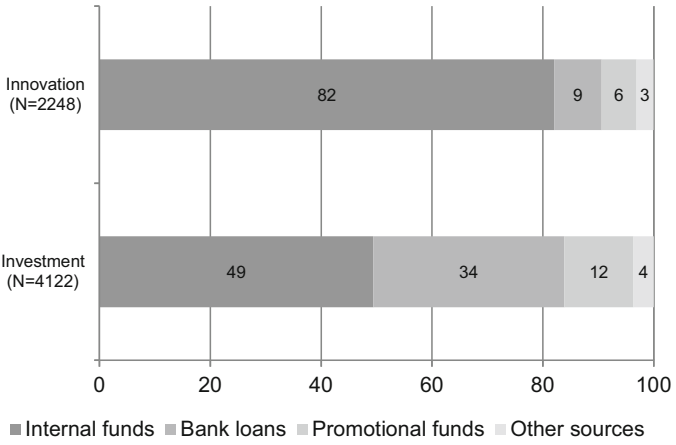
Figure 1 compares the share of funding sources in innovation spending with those of investment. As was to be expected from what was stated in Sect. 2, the financing of innovation projects differs strongly from investment: With 82% of innovation expenditure, internal funds dominate innovation financing. Internal funds also account for the largest share of investments. However, at 49%, internal resources are much less used for investments than for innovations. Considerable differences are also evident in the use of bank loans. Only 9% of innovation expenditures are financed through bank loans. The corresponding share in the investments amounts to 34%.

Promotional funds make up 6% of innovation expenditures and 12% of investments. Public funds are also a cost-effective source of financing and can substantially increase the financial leeway of a company. However, companies also incur transaction costs when using promotional funds. For example, information on the funding opportunities must be obtained, applications submitted and, if necessary, reporting requirements fulfilled. The amount of the transaction costs depends essentially on the design of the respective funding measure. They are typically related to funding intensity. At first glance, it is surprising that promotional funds present a higher proportion in investment funding than in innovation. However, the fact that investment promotion often takes place with the help of subsidised promotional

[3] Values of 500 indicate a massive default in payment and 600 the suspension of payments. In order to exclude enterprises that were already experiencing massive payment difficulties, the analysis only includes enterprises with a credit rating of no worse than 400.

Table 1 Overview over the variables used

Variable	Question	Explanations
Innovation expenditure	What was your company's total spending on innovation activities (including spending on research and development) in 2016?	The query takes place within a block of questions on innovation behaviour in which the definitions are explained in advance
Investment expenditure	What was the sum of all investments in 2016?	The query takes place within a block of question on investment behaviour. It follows directly on the question of whether the company in question carried out investments in 2016
Share of each source of funding	How did you or your company finance the total investment in 2016? How did you or your company finance innovation spending in 2016?	The query is made in the respective block for investment or innovation behaviour Regarding the answers, the following categories can be distinguished: public funding (referred to as promotional fund), own funds (referred to as internal fund), bank loans (referred to as bank loans), participations of third parties, mezzanine capital, and others (referred to as other sources)
Number of employees	How many employees of the following groups did your company have approximately on the specified reporting dates?	The following groups of employees are included: full-time employees, part-time employees, and active and responsible owners/managing directors/shareholders. The information used is based on the reporting date 31.12.2015
Company age	When was your company originally founded (i.e. the first start of operations, regardless of any later merger/change of legal form)?	
Intensity of the type of expenditure compared to the annual turnover	What was the turnover of your company in 2015 and 2016?	The amount of the respective expenditure related to the annual turnover in 2016
Intensity of R&D in innovation expenditure	What was the expenditure on research and development in 2016?	The amount of R&D expenditure related to total innovation expenditure in 2016
Credit rating		Credit rating by Vereine Creditreform e.V. at the beginning of 2016
Return on sales	What was the profit/loss before tax in 2015 and 2016?	Profit related to annual turnover in 2015



Extrapolated with the number of employees, investment: only companies with no innovation expenditure

Fig. 1 Innovation and investment finance in comparison—share of funding sources in the respective expenditure category in %

loans must be taken into account. These are of low aid intensity. Support for innovation, on the other hand, usually means grants for R&D activity with a comparatively high aid intensity. The remaining 3% and 4%, respectively, are spread over the other sources of funding. The factors influencing the use of the financing sources are examined in more detail below.[4]

4.2 Company Size

Small and large SMEs, in particular, finance both their innovations and their investments heavily via internal funds (Fig. 2). The fact that companies with fewer than five employees finance their expenditure internally, despite their comparatively low internal financing capacity, is likely to be due to their poorer access to external financing (Zimmermann 2016). The reasons for this are—as already explained—diverse. They range from relatively small financing volumes (from the point of view of the lender), through the lack of diversification possibilities in connection with greater difficulties to provide sufficient collateral, to higher risks and lower transparency.

[4]Due to a small number of missing observations on some characteristics, the results may differ slightly from those for the whole dataset.

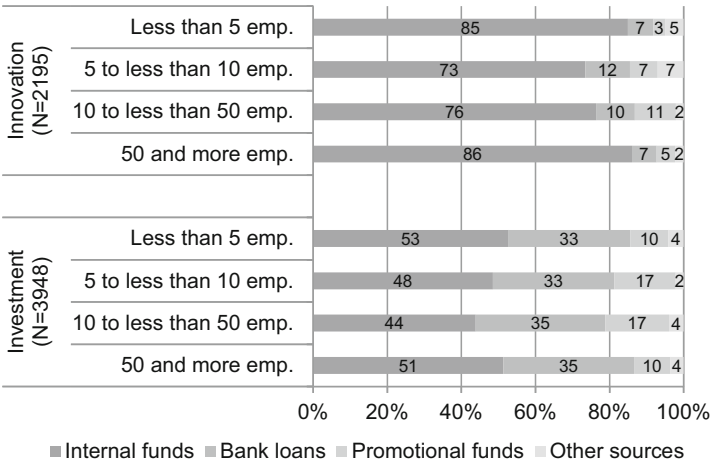
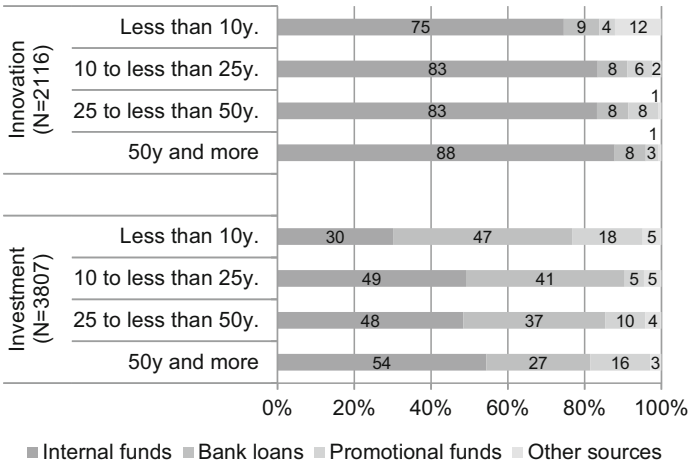


Fig. 2 Innovation and investment finance by company size—share of funding sources in the respective expenditure category in %

As the size of the company increases, access to credit improves, which is reflected in an initially increasing proportion of bank loans. At the same time, however, the internal financing power is also increasing. From a certain company size, companies succeed better in incurring their expenses internally. This is especially true because the relative financial burden caused by innovation eases with increasing company size (Zimmermann 2017). According to the pecking order hypothesis, the companies make use of that. As a result, the share of internal funds in innovation expenditure is rising again, while the share of bank loans is falling. Accordingly, a Wald test rejects the null hypothesis that the shares of internal financing in the categories "5 to less than 10 employees" and "50 and more employees" are the same, with test statistics of $F = 5.19$ (P-value $= 0.0228$). The identical Wald test with regard to the development of the proportion of bank loans, on the other hand, does not meet the usual criteria for rejecting the null hypothesis [$F = 2.00$ (P-value $=0.1572$)]. The growing share of internal funding with a simultaneously, at least in the tendency, decreasing share of bank loans, especially in innovation financing, is due to the greater uncertainty of the success of innovation projects which makes it more expensive, if there are financing offers at all. In contrast, bank loans are available at a lower cost for financing investments, so that the share of bank loans—as well as that of internal funding—even increases somewhat. However, with P-values of 0.6249 ($F = 0.24$) and 0.5839 ($F = 0.30$), these changes remain within the statistical imprecision of the analysis.

The use of public funding also increases to companies with 10 to less than 50 employees. This may be due to the fact that larger companies are more familiar with public support measures and the application for public funding than smaller ones. The lower proportion of public funds among companies with more than



Extrapolated with the number of employees, investment: only companies with no innovation expenditure

Fig. 3 Innovation and investment finance by company age—share of funding sources in the respective expenditure category in %

50 employees may result from the fact that promotional measures are limited in part to companies with fewer than 249 employees.

4.3 Company Age

With regard to the age of the company, both in terms of innovation and investment, there is a higher proportion of internal financing as the company ages (Fig. 3). This is likely to be due to a higher internal financing power with age and is consistent with the expectation that internal finance will be the first choice of companies. In terms of investment, even the share of bank loans is declining sharply. In contrast, the share of bank loans does not change considerably in the case of innovations.

It is also noticeable that promotional funds make up a particularly high proportion in the investments of young companies. This is likely to reflect the special focus of funding policies on start-ups. This is not the case with innovations. Instead, the "other sources" make up a large proportion of these innovations. Behind this lies a share of 4 percentage points of equity capital.[5] In this regard, it can be assumed that there is also a high proportion of promotional funds in the case of equity capital.

[5]The innovation financing of young enterprises is the only category examined here, in which equity financing could be determined to an evaluable extent.

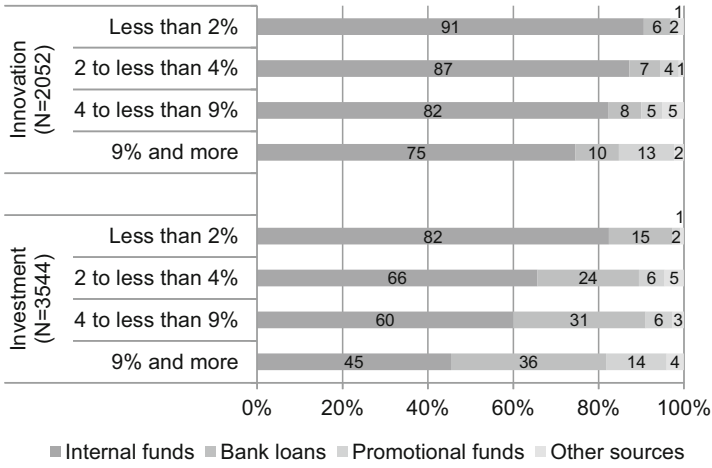
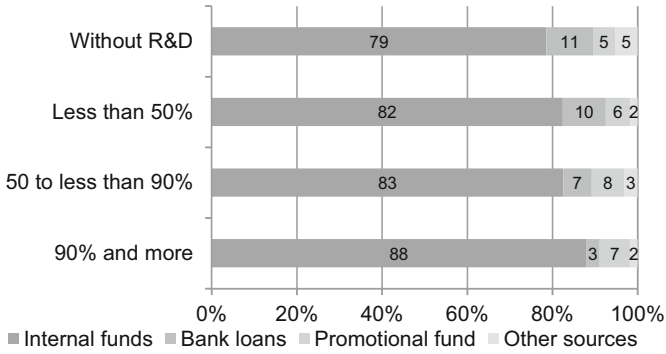


Fig. 4 Innovation and investment finance by intensity of expenditure—share of funding sources in the respective expenditure category in %

However, the companies may not report this because they are less aware of the public funding.

4.4 Amount of Expenditure Related to Annual Turnover

The argument of the pecking order hypothesis, according to which external funds are used only when internal resources are insufficient, is also supported by the following finding. From the smallest to the highest category of expenditure intensity, the share of internal funds falls by −18% for innovation and even by −45% for investments. The corresponding null hypotheses, according to which the respective proportions are equal, are rejected with P-value = 0.0001 (F = 16.38) and P-value = 0.0000 (F = 113.68). Both, innovation and investment, are financed to a higher extent by external means, the greater the expenditure compared to the company turnover (Fig. 4). This holds especially for investments. The share of bank lending in investment expenditure increases from the smallest to the largest category by 2.4 times. The corresponding null hypotheses (equality of shares) is rejected [P-value = 0.0000 (F = 42.28)]. With regard to innovations, the share of bank loans only increases by two thirds. Testing this increase using a hypothesis test shows that this change is within the statistical inaccuracy of the analysis [P-value = 0.1719 (F = 1.87)]. The lower—and in the statistical sense insignificant—increase in the share in innovation financing indicates that specific features, as mentioned above, are opposed to bank financing.



Extrapolated with the number of employees, N=2143

Fig. 5 Innovation finance by intensity of R&D in innovation expenditure—share of funding sources in %

4.5 Share of R&D Expenditure in Innovation Expenditure

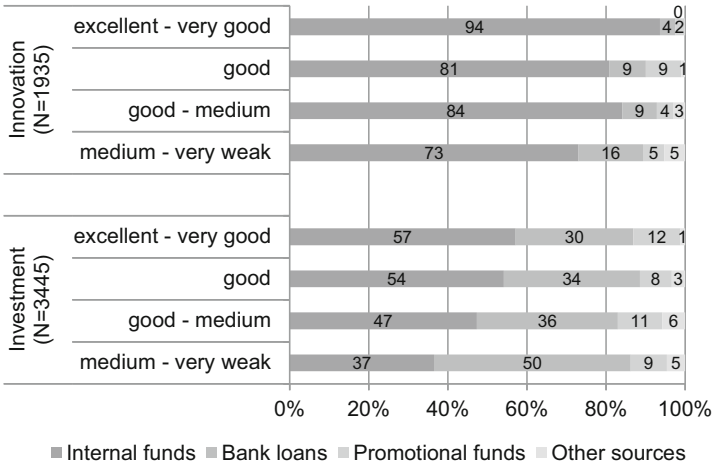
The analysis of innovation financing according to the share of R&D expenditures in innovation expenditure confirms the assumptions stated in Sect. 2. As Fig. 5 shows, the proportion of internal financing increases by more than one tenth as the share of R&D in innovation expenditure increases from the smallest to the highest category. Simultaneously, the share of bank loans falls to just over a quarter to that in the smallest category. Both changes prove to be statistically significant. The corresponding hypothesis tests clearly reject the null hypothesis (equality of the respective proportions) with a P-value = 0.0120 (F = 6.31) and a P-value = 0.0004 (F = 12.43). This finding is in line with the consideration that R&D projects in particular are characterised by high uncertainty, valuation problems and low collateral. It underlines the lower risk-bearing capacity of bank loans.

In addition, innovation projects with a R&D share of more than 50% are slightly more funded by means of subsidies. The share of funding here is between 7 and 8%, against 5 and 6% in companies with less R&D.

4.6 Credit Rating

The possibilities of a company to finance innovations and investments depend not at least on its financial situation. Positive financial indicators speak for a high internal financing power. At the same time, the financial situation also determines whether and on what terms bank loans can be taken. Which aspect prevails in the financing decision is thus unclear from a theoretic point of view.

For both innovation and investment, the proportion of expenditure that comes from internal resources decreases as credit ratings get worse. Simultaneously, the



Extrapolated with the number of employees, investment: only companies with no innovation expenditure

Fig. 6 Innovation and investment finance by creditworthiness—share of funding sources in the respective expenditure category in %

share of bank loans increases (Fig. 6).[6] In terms of innovation, the share of bank loans even quadruples from the group of companies with the best compared to the weakest credit rating.[7] The unambiguousness of the correlation surprises at first glance. As creditworthiness can be regarded as an indicator of access to credit, the opposite trend could have also been assumed. However, the finding that the proportion of bank loans deepens with increasingly lower creditworthiness does not mean that the volume of loan financing is increasing. On the contrary, it can be determined that the volume of innovation and investment spending is declining with increasingly weaker credit ratings. The average innovation spending drops from EUR 150,000 in the best-rated category to EUR 28,000 in the lowest rating category. In this respect, the findings of Gerstenberger et al. (2016) were confirmed, according to which companies with weak credit ratings can only implement innovation and investment projects to a smaller extent or with more frequent delays.

The declining share of internal financing and the increasing share of bank loans are therefore likely to conceal the fact that the credit rating, at least to some extent, also reflects the internal financing power. For example, against the background of the fixed cost nature of innovation projects, a lower internal financing power means for

[6]In order to rule out any influence of the current financing on the credit rating, the credit ratings used, refer to the beginning of the period under consideration.

[7]The category "excellent–very good" includes the companies with an index value of maximum 199, the categories "good" and "good–medium" the index values from 200 to 249 and 250 to 299 and the category "medium–weak" companies from an index value of 300.

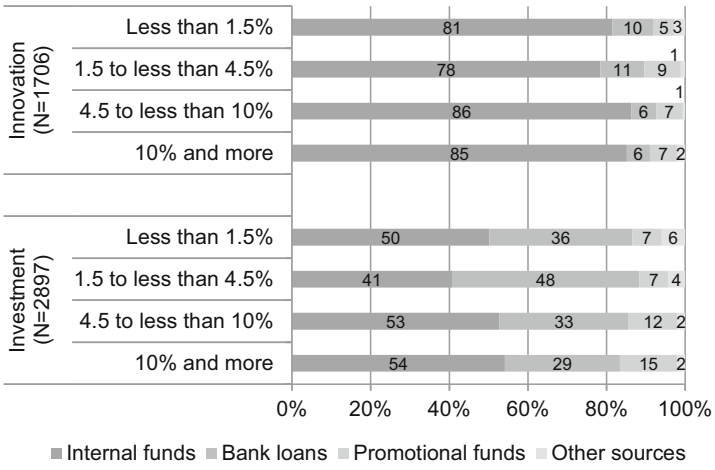


Fig. 7 Innovation and investment finance by return on sales—share of funding sources in the respective expenditure category in %

the company that decreasing internal resources must be supplemented by external ones. Especially for innovation projects, this is unlikely to be achieved by all companies (Stiglitz and Weiss 1981) and—as the pecking order hypothesis states—only by increased financing costs. As a result, the volume of innovation spending decreases. By comparison, it should be easier for companies with investment projects to supplement their internal funds with bank loans than for innovators.

4.7 Return on Sales

This consideration is confirmed by the results for the relationship between the use of funding sources and the return on sales (Fig. 7).[8] As the return on sales increases, the proportion of internal financing initially decreases and then increases in both innovation and investment. At the same time, the share of bank loans is initially increasing and then decreasing to its lowest value. This can be attributed to the fact that with increasing return, access to credit is easier and more cost-effective. However, from the category of companies with a yield of 1.5 to less than 4.5%, the increasing internal financing power in the financing mix predominates. Financing through internal funds is becoming increasingly possible, and correspondingly bank loans are used less as a source of financing, as stated in the pecking order hypothesis.

[8] Also for classifying the return on sales, the value refers to the previous period.

5 Conclusion

The present article examines the financing of innovations and investments in small- and medium-sized companies. In contrast to similar studies, the focus is on the shares of the corresponding sources of funding in the volume of the respective expenditure category. Internal resources, bank loans, promotional funds and a residual category can be considered. The aim of the study is to draw conclusions on the existence of restrictions on the external financing of innovations, which are due to the special characteristics of innovations and therefore do not exist in a comparable form for investments.

The main finding of the study is that the financing of innovations and investments differ substantially. Innovations are for the most part covered by internal funds. Other sources of funding play a subordinate role. As far as investments are concerned, both internal funds and bank loans play an important role. It is true that innovations and investments also show similar financing patterns for some of the features studied. There is evidence that in both investment and innovation financing, companies resort to internal financing—instead of bank loans—whenever possible. This finding is in line with the pecking order hypothesis.

Nonetheless, the study also provides evidence that points to the existence of special restrictions for the external financing of innovations. Apart from the generally lower use of bank loans in innovation financing, there is only a comparatively small increase in the share of bank loans with increasing expenditure intensity. For example, the share of bank lending in investment from the lowest to the highest expenditure category increases 2.4-fold, while this increase in innovation is much smaller and turns out to be statistically insignificant. The finding that from a business size of five to less than ten employees, the share of bank lending in innovation finance diminishes (albeit not to a statistically significant extent), while this share of investment spending increases, points to higher costs in financing innovation via bank loans than in financing investments. In addition, the share of bank loans decreases as the share of R&D expenditure on innovation spending goes up.

These findings are therefore in line with the considerations outlined above, according to which financing restrictions may occur as a result of various characteristics of innovation projects. Funding restrictions may occur because innovation projects are affected by asymmetric information between the innovative company and a potential external financier and because they create less collateral. This applies in particular to R&D projects in which the characteristics of innovation projects are in a pointed form. With regard to financing via bank loans, it can be argued that they only have a comparatively low risk-bearing capacity.

As a result of the lack of external funding opportunities, SMEs' innovation activities strongly depend on the availability of internal sources. This implies several disadvantages: As internal resources are limited, companies invest less in innovation than the socially desirable level (Martin and Scott 2000). Due to financial restrictions, innovation projects are not tackled, scaled down, time-delayed or cancelled (Mohnen et al. 2008; Gerstenberger et al. 2016; Garcia-Quevedo et al. 2018).

Another consequence of this may be that long-term innovation projects are threatened but projects that can be realised at shorter notice are more likely to be tackled. Studies confirm that companies in Germany forego the entry into new market segments and the realisation of technologically demanding projects due to financial difficulties (Rammer and Peters 2015; Behrens et al. 2017). In addition, if innovation activity has to be reduced in economically difficult phases (Giebel and Kraft 2018), companies threaten to lose important company-specific know-how as a result of staff turnover. A restart or the expansion of the innovation activity then becomes more difficult. Due to the demographic development, the external staffing will be even more challenging in the coming years.

The problems in financing innovation are likely to lead to the innovation potential lying idle due to market imperfections and even dwindling in the longer term (Rammer and Schubert 2018). Working against it thus represents a permanent task of economic policy. An important task thereby is to support those companies that play a pioneering role in the innovation process. These are particularly affected by the financing difficulties.

However, large numbers of SMEs pursue innovation strategies that target incremental improvements and customer-specific solutions. The innovation efforts of these companies cause the diffusion of innovations in the economy. They help the SME sector to fulfil its role in the value chain and ensure the competitiveness of the German economy as a whole. They too are hindered by financing obstacles in their innovation activities. In addition to the promotion of excellence, therefore, the support of innovation efforts in the middle of the SME sector is also necessary (Thomä and Zimmermann 2016).

It would also be desirable to include in the analysis the emerging financing instruments for innovations such as crowd financing or initial coin offerings (ICO), which are not included in the underlying database, or equity financing (such as venture capital or business angel financing). However, the remaining category "Other sources" in this analysis is very small at 3% and 4%, respectively. Therefore it is reasonable to suppose that these new financing instruments—similar to equity financing—do not yet account for a large proportion of the financing volume in the SME sector in Germany. In order to analyse these comparatively rarely used financial instruments, it would be necessary to either considerably increase the sample size or to focus on specific market segments during the survey in order to collect enough observations for an analysis. However, since this requirement is not given in the present database, this is reserved for future research. Other interesting insights could also be the distinction of bank financing in short-term (e.g. bank overdrafts, credit lines) and longer-term financing. But this is also not possible with the underlying database.

Last but not least, the present study offers only a descriptive analysis. A multivariate regression analysis could provide more in-depth results in terms of relationships and directions of impact than the cross-sectional analysis performed here. The data structure and the regression method would have to take account of the existing interactions between the company characteristics, the financing structure and the volume of expenditure.

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Trends in Financing Programmes for the Development of Micro, Small and Medium Enterprises (MSMEs) in Nigeria: A Qualitative Meta-synthesis

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Abstract Financing programmes for micro, small and medium enterprises (MSMEs) in Nigeria assume different forms with different conditions tied to disbursement. The purpose of this research is to discuss the trends in financing programmes for the development of MSMEs in Nigeria using qualitative meta-synthesis. This method provides a rich analytical tool for understanding any subject of inquiry without in-depth evidence-based findings. This analytical technique integrates findings from previous studies on trends in financing programmes for MSMEs in Nigeria. To forestall biases in the selection of articles, the authors conducted a search on Google Scholar and similar databases for academic publications on the financing programmes in Nigeria. From over 100 publications generated by the databases, a sample of 38 relevant publications was selected. Other publications that did not specifically focus on Nigeria were used in the literature review to gain more insights into the discourse. The sampled publications with heterogeneous findings were systematically reviewed and synthesised as integrated findings explaining the trends in financing programmes for MSMEs in Nigeria. The findings reveal that the financing instruments available for MSMEs in Nigeria with different degrees of challenges include personal savings, loans from commercial and microfinance banks, co-operatives and other development financial institutions, business angel financing, intervention funding of venture capitalists, several government-led micro-enterprise funds, pension fund assets, sovereign fund wealth and Islamic financing. While crowdfunding or crowd equity funding is popular in developed economies, it is an emerging financing option in Nigeria. The chapter concludes with research implications, empirical limitations and suggestion for further research.

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1 Introduction

Micro, small and medium enterprises (hereafter MSMEs) have been identified as an engine of economic growth in developing countries (Gbandi and Amissah 2014). A widely reported survey of the National Bureau of Statistics (NBS) in collaboration with the Small and Medium Enterprises Development Agency (SMEDAN) indicated that there are 17 million small- and medium-sized enterprises in the country, playing a significant role in the economy of Nigeria (Raimi 2015; Eniola and Entebang 2015). Additionally, MSMEs generate massive employment opportunities, develop local technologies, enhance output diversification and accelerate forward integration with large-scale industries through their inputs (Ogujiuba et al. 2004; Akingunola 2011; Gbandi and Amissah 2014; Raimi 2015). At present, MSMEs in Nigeria make up 90% of the businesses, yet the sector's contributions to the nation's GDP is below 10% because of poor financing programmes. The clarion call on businesses to boost Nigeria's GDP contribution depends a great deal on access by MSMEs to stable sources of financing to scale up and develop business technologies and scope of operations (Taiwo et al. 2016; Gbandi and Amissah 2014; Uremadu et al. 2016). For MSMEs to be able to sustain economic growth and development as explained above, there is a need for an injection of massive funds into their operations across the country because of the intensity of macroeconomic problems slowing down their growth potentials in Nigeria (Ikpor et al. 2017). Dependence on commercial banks makes MSMEs more vulnerable as they are exposed to shocks in the banking system in Nigeria during periods of financial instability (Ogujiuba et al. 2004).

Unfortunately, the main goal of commercial banks in Nigeria's entrepreneurial financing is fundamentally profit-seeking (Oluitan 2015), whereas commercial banks and other financial institutions in a developing context should be concerned with financial deepening, that is, providing the required financial resources and financial services to MSMEs on demand to stimulate economic growth (Ovat 2013). Historically, MSMEs in Nigeria have been largely excluded from the financing activities of the commercial banks (especially at the start-up and early growth stages) for reasons that range from lack of collateral, a higher rate of interest, poor financial records, relatively small scale of operations and geographical disadvantage as most MSMEs operate in remote areas (Oluitan 2015). The exclusion of MSMEs from commercial banks' interventions was further compounded by the recapitalisation exercise of 2004 and 2008, although recapitalisation policy aimed at fortifying and strengthening the banking system in order to become competitive in the African regional and global financial system (Achua 2008; Sanusi 2010). Apart from increasing the capital base of commercial banks to 25 billion naira minimum, another major goal of the recapitalisation exercise was to increase financial deepening, by way of forcing commercial banks to reach the unreached members of the

society (Olawumi et al. 2017). Unfortunately, the recapitalisation exercise was counter-productive, as several MSMEs remained unable to access formal loans and business financing from the well-capitalised commercial banks in Nigeria.

Similarly, the development finance institutions (DFIs) especially the Bank of Industry (BOI) and Bank of Agriculture (BOA) were set up to provide financing opportunities to MSMEs, because MSME activities fall within their interventions support services (Central Bank of Nigeria 2018). Besides, the microfinance institutions (MFIs) provide formal financing assistance to MSMEs that have been eclipsed from financing arrangements of commercial banks (Ogujiuba et al. 2013). Although informal microfinancing had been in existence before the formal microfinancing, the former was largely targeted at building social impact and driven by non-profit structures (Siwale and Okoye 2017; Babajide 2011). In 2005, CBN launched a Microfinance Policy, Regulatory and Supervisory Framework (MPRSF) to primarily boost monetary stability by bringing informal financing institutions under the scope of CBN's supervision (Babajide 2011). The MPRSF was later revised in 2011 to incorporate international best practices in microfinancing. At present, there are 1024 licenced microfinance institutions in the country (Central Bank of Nigeria 2018). The formal microfinance model in Nigeria is more broad-based and targeted many beneficiaries in rural and urban areas of the country. Over 200 microfinance banks have been liquidated, an ugly incident that resulted in depositors losing billions of Naira (Babajide et al. 2017). Other development agencies of the government that had provided support for entrepreneurial initiatives at different periods in Nigeria included the Agricultural Credit Guarantee Scheme Fund (ACGSF), National Economic Reconstruction Fund (NERFUND) and the Small and Medium Enterprise Equity Investment Scheme (SMEEIS) (Mordi et al. 2010; Ogujiuba et al. 2013).

In view of the foregoing, the objective of this chapter is to discuss the trends in entrepreneurial financing programmes for the development of MSMEs in Nigeria. The supply-leading hypothesis (SLH) and demand-following hypothesis (DFH) are the two financing theories that justify the need for financial deepening for MSMEs in the developing context such as Nigeria. Financial deepening as mentioned above is the deliberate attempt to increase the supply of financial resources in the economy. The two main research questions that this chapter intends to answer are as follows: (1) What are the trends in entrepreneurial financing programmes for the development of MSMEs in Nigeria? (2) What are the key challenges facing entrepreneurial financing programmes for the development of MSMEs in Nigeria? Overall, there are five sections in this chapter. Section 1 provides a concise introduction to the paper including the methodology. Section 2 discusses the conceptual framing of entrepreneurial financing in its broader perspective and the challenges of entrepreneurial financing in Nigeria. Section 3 looks at the theories of entrepreneurial financing—supply-leading hypothesis (SLH) and demand-following hypothesis (DFH). Section 4 presents the key entrepreneurial challenges. Section 5 gives an overview of the findings, conclusions and research implications.

1.1 Methodology and Approach

A qualitative meta-synthesis is used because it provides a rich analytical tool for international readers to understand the current trends in entrepreneurial financing from the emerging economy of Nigeria, where MSMEs are needed to grow the economy. The qualitative meta-synthesis integrates findings from previous studies on trends in financing programmes for MSMEs in Nigeria. In line with the qualitative research tradition, the extracted pieces of information are analysed using qualitative meta-synthesis, a method which integrates findings from previous studies on entrepreneurial financing for MSMEs in Nigeria. To forestall bias in the selection of articles, the authors conducted a search on Google Scholar and similar databases for academic publications on the financing programmes in Nigeria. From over 100 publications generated by the databases, a sample of 38 relevant publications that focus on financing in Nigeria was selected from the period 2004 to 2018 leveraging a purposive sampling technique. Other publications that did not specifically focus on Nigeria were used in the literature review to gain more insights into the discourse. The sampled publications with heterogeneous findings were systematically reviewed and synthesised as integrated findings, which provide rich information on the trends in financing programmes for MSMEs and associated challenges in Nigeria.

2 Conceptual Issues

2.1 Entrepreneurial Financing and Financing Programmes in Nigeria

The literature on entrepreneurial financing in Nigeria is vast, but the majority of the scholarly articles discussed the macroeconomic environment and challenges in facing new ventures. Broadly, entrepreneurial financing is defined as the process of raising the required capital for running commercial enterprises and/or social enterprises (Leach and Melicher 2012). There are different entrepreneurial sources of financing, which are influenced by the predilections of different entrepreneurs as well as the alternatives that are available to MSMEs (Eniola and Entebang 2015). The various financing options for new ventures could be summarised into two broad categories, namely, formal entrepreneurial financing and informal entrepreneurial financing (Gbandi and Amissah 2014). Each categorisation has a number of financing programmes under them. This section provides in-depth explanations of entrepreneurial financing options in Nigeria.

From the formal and the informal categorisations, the sources of financing can be further sub-grouped into debt financing and equity financing. Nigeria's formal financing landscape comprises licenced financing organisations like development finance institutions, microfinance institutions, commercial banks and international development agencies (Gbandi and Amissah 2014; Central Bank of Nigeria 2018).

The formal funding organisations (commercial banks and thrift and credit societies) have well-organised structures with highly regulated financial activities (Olawumi et al. 2017). Nigeria's informal financial sector, on the other hand, comprises savings and loans associations, credit unions, family members and friends, informal money lenders and co-operative societies (Gbandi and Amissah 2014). Broadly, there are equity and debt sources of financing. It is important to mention that the formal financing sources are regulated by the government and other agencies, while the informal financing sources are not well regulated by the government (Terungwa 2012).

Equity financing is essentially the primary source of financing for most entrepreneurs in Nigeria. The most common equity financing source is personal savings because the reasonable portion of the fund needed to start a small business often comes from the owner—called owner's equity. Other primary sources of equity financing are financial support from family members, friends, venture capitalists, community assistances, village unions, the existing business (ploughing back profits), selling personal household items and selling part of the business to willing partners. With partners putting in money, it is operationally easier to raise the needed start-up funding internally with less risk and operational hassle (Higgins 2012; Eniola and Entebang 2015).

Debt financing is a financing option that comes in handy when equity financing is unavailable or grossly inadequate. When equity sources are not enough, the entrepreneur has the option of borrowing from other secondary sources. Debt financing can be obtained from two sources, formal and informal sources. Formal sources are borrowing from institutional sources, whereas informal sources refer to family, friends, directors, suppliers (trade credit) and so on. Debt financing occurs when investors provide capital in the form of mutually agreed loans to business owners for running their businesses (Eniola and Entebang 2015). The informal debt is a loan raised from informal groups such as money lenders, landlords, personal friends, close relatives and traditional co-operatives. It is a financing programme that is appropriate for new start-ups or early growth businesses in Nigeria because of ease of access and lack of stringent terms associated with formal debt financing. Informal debt financing is called different names by different ethnic nationalities in Nigeria such as Esusu, Ayo, Isusu, Osusu, Adashi, Dashi and Etibe (Gbandi and Amissah 2014).

The next subsection discusses the trends of entrepreneurial financing in Nigeria with a specific focus on ten (10) major *sources of financing*.

1. *Personal savings*: In practice, personal savings, that is, funds kept with the building society or savings accumulated as bank balances, are common sources of financing in Nigeria. Most MSMEs started their businesses with personal savings in view of the fact that this financing option is highly liquid and does not require the fulfilment of a loan obligation often imposed by the commercial banks (Gbandi and Amissah 2014). Personal savings have consistently been described as the most realistic financing option for start-ups for procurement of capital equipment and preoperational expenses. According to Akingunola

(2011), personal savings are appropriate for start-ups, as they functionally protect start-ups from high financial risk associated with high interest payments. An old, but important study by the Nigerian Institute for Social and Economic Research (NISER) indicated that about 73% of businesses in Nigeria noted that they raised their start-up funds through personal savings, while about 2% of the businesses surveyed obtained their finances from formal outlets (Terungwa 2012).

2. *Commercial bank loans*: This is a debt financing arrangement that is negotiated between the bank (as a creditor) and the business owner (as a debtor). All the commercial banks in Nigeria provide loans and advances to peasants, farmers and other businesses on request at a specified interest rate and terminal duration. Usually, the maturity of commercial loans ranges from a year to more than 10 years (Ojeaga et al. 2013; Padilla-Pérez and Ontañon 2014).
3. *Small and Medium Enterprises Equity Investment Scheme* (*SMEEIS*): This is a credit-guaranteed scheme introduced by the Bankers' Committee as a risk-sharing arrangement to support SMEs in Nigeria. Functionally, it is designed to encourage the banks to channel funds to the SMEs subsector for accelerating business growth, which would later translate into sustainable economic development. Unfortunately, the SMEEIS fund was not accessed by the target beneficiaries, because the eligibility terms and conditions for accessing the funds are very stringent; hence a large number of SMEs could not access the fund for business development in Nigeria (Terungwa 2011).
4. *Micro, Small and Medium Enterprises Development Fund* (*MSMEDF*): MSMED Fund was launched officially by the Central Bank of Nigeria on August 15, 2013, with a take-off seed capital of N220 billion to accelerate the growth of the MSME subsector in the Nigerian economy (MSMEDF 2014). The MSMED fund is a unique financing programme purposely launched to empower women MSMEs and economically active entrepreneurs with physical disabilities (Sanusi 2010).
5. *Business angel* (*BA*): This is a contemporary financing model in the urban centres in Nigeria. Business angels are defined as wealthy and entrepreneurially driven investors who invest in new start-ups or early growth businesses in return for a certain proportion of equity ownership. It is often believed that business angels take on very high financial risk by agreeing to be part of start-ups and early growing businesses with a high possibility of failure (Hüsler and Platzer 2014). The $400 million World Bank's Youth Employment and Social Support Operations (YESSO) programme and the $100 million Tony Elumelu Entrepreneurship Programme (TEEP) launched in Nigeria are examples of financing interventions from the business angels (The World Bank Group 2018; MSMEDF 2014). For TEEP, the beneficiaries receive up to $10,000, and the risks of collaterals are practically avoided. Business angels are unique investors looking out for specifics—they focus on entrepreneur's personality and 'investor fit' when making considerations on financing support to start-ups (Mason and Stark 2004).

6. *Venture capital* (*VC*): VC is another financing option that provides investible funds to MSMEs as equity or quasi-equity capital. However, the seed or start-up capital provided by the venture capitalists are not traded in the capital market; hence financial analysts and academics describe VC as risky capital. The venture capitalists in Nigeria invest in operationally promising businesses in early stages of business development, but may occasionally extend financing support for business expansion and buyout, when such an opportunities arise (Abereijo and Fayomi 2005; Gbandi and Amissah 2014).
7. *Pension fund assets* (*PFAs*): Financing MSMEs through PFAs is another source of financing in Nigeria sequel to the adoption of a contributory pension scheme in 2004. Operationally, the Pension Act of 2004 allows the pension companies to invest 5% of the accumulated PFAs into private equities, venture capital investments, money market and equities of listed companies in the Nigerian Stock Exchange (Gbandi and Amissah 2014). Official statistics indicated that PFAs have been well accessed and harnessed by MSMEs operating in different sectors of the economy. Nigeria Bureau of Statistics (NBS) reported that the accumulated PFAs increased by N351 billion to N7.5 trillion in 2017. With regard to funds utilisation for investment, it was reported that N4.04 trillion (53.81%) of the funds were invested in the Federal Government of Nigeria (FGN) Bonds, while N1.18 trillion (15.38%) was invested into Treasury Bills (TBs). Another N672.23 billion (8.94%) was invested into public companies as domestic ordinary shares, N626.3 billion (8.33%) was invested in banks, and N262.49 billion (3.48%) was invested into corporate bonds (Vanguard 2018).
8. *Sovereign wealth fund* (*SWF*): This is another recent financing alternative in Nigeria. Retrospectively, it was established over three decades ago as stabilisation funds with a view on helping to neutralise disturbances arising from volatile oil prices and other export commodities on the budget, monetary policy and economy of oil-exporting countries (Jen 2007). Conceptually, SWF is a government-owned fund invested in foreign currency-denominated assets managed differently from a country's official reserves (Jen 2007; Nnamocha and Okonkwo 2015). It has also been defined as pools of assets owned managed directly or indirectly by governments to achieve national objectives. SWF has been economically beneficial, as it helps keep real interest rates lower than they should have been, had the fund been moved into the local economy (Blundell-Wignall et al. 2008). The United States' JP Morgan was appointed as the custodian of Nigeria's SWF, while the Nigeria Sovereign Investment Authority (NSIA) is the agency of government empowered to manage Nigeria's initial $1 billion SWF. NSIA invested the nation's SWFs into three diversified portfolios of medium- and long-term assets, namely, stabilisation fund, future generation fund and Nigerian infrastructure fund (Nnamocha and Okonkwo 2015).
9. *Islamic financing* (*IF*): Islamic financing is another emerging financing option provided by few banks and nonbank financial institutions in Nigeria. The World Bank (2015) posits that Islamic financing is underpinned on risk-sharing and profit- and loss-sharing arrangement while prohibiting interest and speculative practices in commercial dealings. Put differently, Islamic financing alternative is

asset-backed, equity-based, ethical, environmentally friendly and socially responsible while at the same time connecting with the global financial industry. Modes of financing for asset acquisition and business development under Islamic financing are categorised into three, namely, investment, trade and lending (Bazza et al. 2014). Asset acquisition for businesses are financed by Islamic banks based on specification of customers and marking-up of the cost of assets, while full payment (cost of assets plus mark-up) is allowed to be spread over a period of time agreed upon by the banks and the business owners (Clifford-Obiyo 2008; Sapovadia 2015). In Nigeria at present, Jaiz Bank, Sterling Bank Islamic Window and Stanbic IBTC Bank Plc provide an array of Islamic financing options (Raimi et al. 2013). With regard to patronage and profitability, Jaiz Bank 2014 financial report indicated that the bank had a remarkable growth with total assets rising by 24% from N33.9 billion in 2013 to N42 billion, while total income increased by 220% (Sapovadia 2015). Similarly, Sterling Bank Plc (non-interest banking window) secured a $15 million facility from the Islamic Corporation for the Development of the Private Sector (ICD) to deepen Islamic finance in Nigeria (Nelson 2017).

10. *Crowdfunding*: This is a novel source of financing made popular in Nigeria by the advent of social media platforms and growing Internet usage. Crowdfunding is an Internet-driven and digital-based tool for fundraising for different social projects contributing to urban development (Abdullahi 2018). Kuti and Madarász (2014) explained that globally the sum of US$2.7 billion was raised through the crowdfunding platforms in 2012. Another study on crowdfunding in Europe's alternative finance market indicated that this financing option increased 101% from 1019m euros to 2063m euros in 2016. The study further states that there has been an average annual growth of 85% in crowdfunding between 2013 and 2016 (Ziegler et al. 2018). The crowdfunding option does not have continent-wide acceptability in developing countries because there are no far-famed laws that guide crowdfunding in contrast to well-developed climes such as the United States, Canada, Turkey, the United Kingdom and Europe where crowdfunding is properly guided by enabling legislation (Eniola and Entebang 2015). Crowdfunding has been described as an effective entrepreneurial financing programme for businesses and social entrepreneurs with creative ideas and innovative projects for sourcing investible funds from a large number of people that believe in their ideas (Eniola and Entebang 2015; Belleflamme et al. 2014; Nehme 2018).

Flowing from the discussions above, different sources of financing fit specific business growth stages as depicted in Fig. 1. For start-ups and early growth businesses, the four (4) relevant financing programmes are personal savings, financing support of business angels, equity funding of venture capitalists and well-designed Internet-driven crowdfunding campaigns. The above-mentioned sources of financing are common and preferred by MSMEs because commercial banks and other financial institutions do not provide financing to new businesses. For most start-ups and early growth businesses in Nigeria, it has been noted that access to the capital

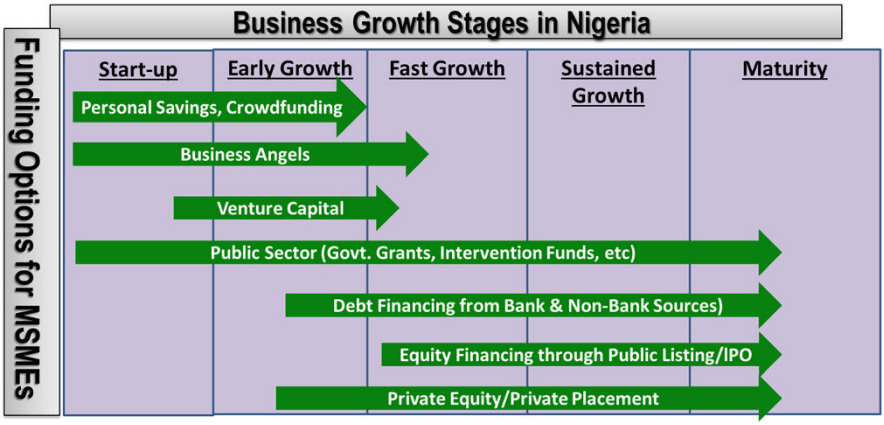

Fig. 1 Authors' contextualisation of funding options—business growth stages

market for the sale of shares is institutionally restricted. Access to equity capital for start-ups is further restricted because bankers and business angels may not be willing to take on new businesses. Even venture capitalists that may be interested would do so after carrying out thorough due diligence on the business plan and supporting documents (Yung 2009). For the businesses within the fast growth, sustained growth and matured stages, there is unhindered access to commercial loans, public sector funding, equity financing in the capital market and other stringent financing sources because at such growth stages, businesses have profile of success stories, assets/collateral securities and presentable financial records and corporate goodwill.

Table 1 shows a systematic review of scholarly works on the trends in financing programmes for MSMEs in Nigeria vis-à-vis their degrees of constraints.

The next section discusses the entrepreneurial financing theories and key entrepreneurial financing challenges in Nigeria.

3 Theories of Entrepreneurial Financing

In every economy, MSMEs require financial deepening to actualise the anticipated socio-economic impacts such as job creation, wealth creation, capital formation and sustainable development in the economy. Financial deepening (deliberate attempt to increase the supply of financial resources in the economy) should be the primary concern of the banks and other financial institutions. Financial deepening is important to create enabling conditions for economic growth and development leveraging two contrasting channels (Isu and Okpara 2013). The two contrasting, but mutually reinforcing, theories that explain financing deepening for MSMEs in a developing context are supply-leading hypothesis (SLH) and demand-following hypothesis (DFH).

Table 1 Trends in entrepreneurial financing in Nigeria

SN	Author and date	Findings on financing options
1	Aruwa (2004)	Small and Medium Industries Equity Investment Scheme (SMIEIS), microfinance institutions, savings, commercial bank loans, merchant bank loans, loan from the Bank of Industry (BOI), capital market, venture capital financing, leasing and CBN intervention funds are financing options
2	Onugu (2005)	Banking and personal financing are key financing options
3	Abereijo and Fayomi (2005)	Debt and equity financing are the prevalent financing options
4	Olaitan (2006)	Agricultural Credit Guarantee Scheme Fund (ACGSF) is an alternative financing option for SMEs in the agricultural sector
5	Oyefuga et al. (2008)	Alternative funding strategy is the Small Enterprises Equity Investment Scheme (SMEEIS)
6	Adekunle and Tella (2008)	Commercial banks and merchant banks
7	Peter and Inegbenebor (2009)	Alternative financing option is the Small and Medium Enterprises Equity Investment Scheme
8	Olu (2009)	Microfinance institutions (MFIs)
9	Obamuyi (2009)	Microcredit institutions and public credit schemes were identified as common funding options
10	Central Bank of Nigeria (2018)	N500 billion Small and Medium Enterprises Credit Guarantee Scheme. N300 billion for power projects and the remaining N200 billion is for restructuring SMEs in the manufacturing sector
11	Babagana (2010)	In Bauchi Nigeria, microfinance banks (MFBs) have been largely successful as financing option for SMEs
12	Sanusi (2011)	Commercial Agricultural Credit Scheme (CACS), Small and Medium Enterprises Credit Guarantee Scheme (SMECGS), microfinance institutions (MFIs), microfinance banks (MFBs) and Nigerian Incentive-Based Risk Sharing System for Agricultural Lending (NIRSAL)
13	Terungwa (2011)	Small Enterprises Equity Investment Scheme (SMEEIS) was a financing option created to bridge poor access to bank loans
14	Nkamnebe and Idemobi (2011)	Microfinance institutions (MFIs) and intervention fund of the United Nations Development Programme
15	Akingunola (2011)	The major sources of SME financing are debt funds from banks and equity funds from owner's fund, SMEs Equity Investment Scheme (SMEEIS), bootstrapping, profit retention, preference share and equity shares
16	Babajide (2012)	Strong preference for microfinance banks by SMEs in the Southwest
17	Gulani and Usman (2012)	Financing options are loans/grants from family and friends, personal savings, commercial banks, microfinance institutions and money lenders
18	Kadiri (2012)	The financing options are commercial loans, loans from money lenders, traders, families and friends
19	Sanusi (2012)	Micro, Small and Medium Enterprises Development Fund or MSMEDF was designed by the government to increase women's and disabled access to business finance in Nigeria

(continued)

Table 1 (continued)

SN	Author and date	Findings on financing options
20	Ovat (2013)	Owner's equity, loans and grants are entrepreneurial financing
21	Onakoya et al. (2013)	Commercial bank loans and SMEs Equity Investment Scheme (SMEEIS)
22	Onakoya et al. (2013)	Commercial loans from banks
23	Alese and Alimi (2014)	Commercial bank loans
24	Gbandi and Amissah (2014)	Loans from commercial, microfinance banks, co-operatives, other finance institutions, pension fund assets, venture capitalists and business angel financing
25	Bazza et al. (2014)	Islamic financing is emerging in non-interest banks
26	Okeke (2014)	Microcredits alternatives are provided to MSMEs on reasonable terms
27	Imoughele (2014)	Commercial bank credits to SMEs
28	Agwu and Emeti (2014)	Financing options are soft loans, government-guaranteed long-term loans, government-owned SMEs funding agency and public-private partnership (PPP) funding option
29	Eniola (2014)	Bank of Industry (BOI), Bank for Commerce and Industry (NBCI) and National Economic Reconstruction Fund (NERFUND)
30	Bazza et al. (2014)	Islamic financing (IF) is an emerging financing option provided by a number of banks in Nigeria. Islamic financing focused on investment, trade and lending
31	Nnamocha and Okonkwo (2015)	Sovereign wealth fund (SWF) under Nigeria Sovereign Investment Authority (NSIA) is invested into three medium- and long-term assets, namely, stabilisation fund, future generation fund and Nigerian infrastructure fund
32	Eniola and Entebang (2015)	Crowdfunding and crowdsourcing of fund
33	Alimi and Yinusa (2016)	Commercial credit financing from the commercial banks
34	Taiwo et al. (2016)	Formal sources include owner's savings, loans from banks, venture capital financing, financing from government institutions, local authorities, co-operative societies, relatives and friends and moneylenders
35	The World Bank Group (2018)	The $400 million World Bank's Youth Employment and Social Support Operations (YESSO) programme and the $100 million Tony Elumelu Entrepreneurship Programme (TEEP)
36	Ikpor et al. (2017)	Bank loans have been reported as major financing options
37	Abdullahi (2018)	Crowdfunding and online fundraising
38	Nehme (2018)	Crowd equity funding

Source: Extractions by the scholarly articles

According to Ovat (2013), the SLH is a finance-led growth theory, which presupposes that financial institutions are relevant in the economy because they supply financial resources and vital financial services to economic agents on demand. SLH supports a unidirectional causality from financial market activities to economic growth. Moreover, SLH financial institutions are critical in the growth and

development process for two reasons: (a) they aid transfers of resources from non-growth traditional sectors to growth-oriented modern sectors and (b) they stimulate entrepreneurial response in the modern sectors among entrepreneurs as well as open new horizons of investment alternatives where surplus resources are channelled. The second strand of theory called demand-following hypothesis (DFH) contends that impactful growth in the economy over a period of time deepens the financial system. In other words, economic growth inherently stimulates the demand for financial resources, which consequently prompts the financial system to provide financial resources to enterprises for further expansion. The DFH theoretically supports a unidirectional causality from economic growth to the financial system (Isu and Okpara 2013). The direction of causality of both SLH and DFH is as depicted in Fig. 2.

Figure 2 explains that when creating enabling conditions for growth in the economy through financial deepening, two channels could be explored—the supply-leading hypothesis (SLH) which contends that financial development functionally provides stimulation for economic growth. This is shown by the movement of an arrow from financial resources (left side) to economic growth (right side) in the figure. Conversely, the demand-following hypothesis (DFH) explains that financial deepening takes place when economic growth stimulates and triggers the demand for financial resources for more inclusive economic growth. This process is explained by the movement of an arrow from economic growth (right side) to financial resources (left side) in the figure.

With specific reference to the trends of entrepreneurial financing in Nigeria, it is apt to state that the supply-leading hypothesis (SLH) and the demand-following hypothesis (DFH) are both appropriate for explaining financial deepening in the economy at different stages of venture growth. For entrepreneurs that financed their businesses through personal savings, crowdfunding, business angels and venture capitalists, the DFH applies because financial deepening for these businesses is

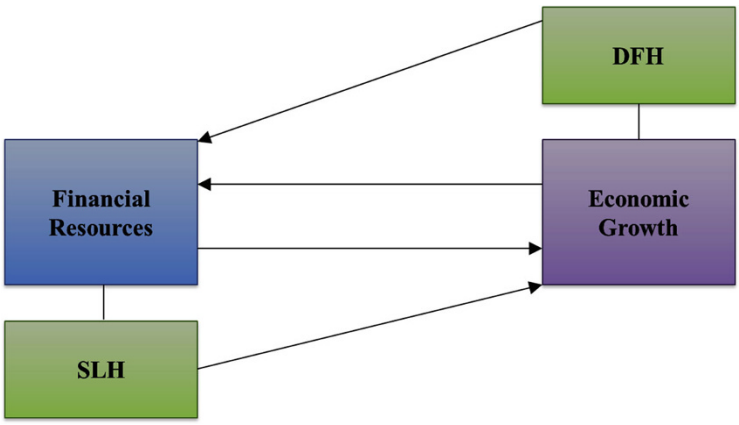

Fig. 2 Direction of causality between financial resources and economic growth (Authors' configuration)

expedient when their potentials and possibilities for accelerating economic growth have been discovered, whereas loans of commercial banks, Islamic banks, microfinance banks, co-operatives, MSME intervention fund, SMEEIS, pension fund assets and sovereign fund wealth are theoretically supported by SLH. These financial intermediaries aid the transfer of financial resources from non-growth traditional sectors to growth-oriented modern sectors as well stimulate entrepreneurial culture among MSMEs. Out of the ten entrepreneurial financing programmes discussed in Table 2, a total of four sources of financing are driven by DFH, while the remaining six financing sources are driven by SLH.

Table 2 Summary of the entrepreneurial financing challenges facing MSMEs

SN	Entrepreneurial financing programmes	Summary of associated challenges
1	Personal savings	Personal savings are often grossly inadequate to grow businesses beyond start-up and early growth stage
2.	Commercial Loans	Elaborate business information and financial records are required by bankers before granting commercial loans. Other challenges are high interest rates, need for collateral securities and short-term tenor of repayments
3	SMEEIS fund	Poor access to SMEEIS funds is inhibited by limited awareness of MSMEs. Other problems are rigid eligibility criteria and extensive paper documentations
4	MSMED fund	The eligibility conditions are too stringent. MSMEs cannot access the fund except through participating financial institutions (PFIs) that have signed a Memorandum of Understanding (MoU) with the Central Bank of Nigeria
5	Business angels	There are few business angels with interest in start-ups in Nigeria
6	Venture capitalists	Venture capitalists practically look for enterprises on the stability and rapid growth stages, not start-up businesses with high-risk profile
7	Pension fund assets	The funds are not fully available to MSMEs. The provisions guiding the pension scheme allows 5% of the fund to be used for private equity. The majority of the funds are invested into federal government bonds, Treasury Bills and shares of public companies
8	Sovereign wealth fund	Based on policy requirements, the funds are not available for financing MSME. The funds are fully invested abroad into foreign securities under the management of JP Morgan
9	Islamic financing	This is an emerging financing programme with low patronage. There are few Islamic banks with a poor branch network. Misconception abound that it is for Muslims. Requirements before benefitting from Islamic financing are not being met by MSMEs
10	Crowdfunding	These Internet-driven financing programmes lack wider acceptability in Nigeria because there are no far-famed laws guiding its operation. Many MSMEs in Nigeria lack the skills and capacities for leveraging crowdfunding

Source: Authors' qualitative meta-synthesis

4 Key Entrepreneurial Financing Challenges in Nigeria

In spite of the role of financing for the growth of MSMEs and economic development, there are a number of challenges inhibiting entrepreneurial financing in Nigeria. These have been systematically discussed. Personal savings as financing options are often grossly inadequate to grow businesses beyond start-up and early growth stage. Many owners of MSMEs operating in the informal sectors with low educational attainment do not have personal savings accounts with banks. For formal loans from commercial banks, microfinance banks and other financial institutions, Bazza et al. (2014) noted that banks provide short-term loans at higher interest rates as well as imposed very stringent conditions on MSMEs that are fortunate to be supported by these banks. Apart from very high interest rates, there are other associated transaction costs—a situation that makes commercial loans unfriendly to MSMEs (Onakoya et al. 2013). Unfriendly interest rates charged by commercial banks discourage start-ups and early growth businesses from patronising these banks for loans. Loans from commercial banks are also inhibited by the inability of most MSMEs to provide the needed collateral securities when requested to do so by financial institutions (Okpara 2011; Ehimagunmwende 2016). Provision of collateral securities is a precondition required by the commercial banks and development banks before granting loans to MSMEs (Abereijo and Fayomi 2005; Onugu 2005). The challenge of collateral securities is a major lending issue in Nigeria (Hinson 2011; Acha Ikechukwu 2012). In fact, for microfinancing in Nigeria, Olowe et al. (2013) noted that most MSMEs could not access funds because of an inability to provide collateral. Without collateral securities, banks do not provide financial support regardless of the viability of the business models. This negative attitude of banks is born out of operational experiences with MSMEs. Many MSMEs borrowed for investment, but abandon repayment with impunity.

Besides, Mason and Stark (2004) identified an inability of prospective borrowers to provide the required information and documents as another challenge in entrepreneurial financing. They explained that most banks are confronted with a problem of information asymmetry when assessing and scrutinising the viability of loan applications submitted by prospective borrowers. They further reported that new businesses are the most informationally opaque because of lack of track on business records. Inability to access the needed information from MSMEs by the banks functionally creates two types of risks for the banks—risk of adverse selection and risk of moral hazard. Risk of adverse selection is a judgmental risk that leads banks' credit committees into lending to the wrong businesses that eventually failed (type 1 error) or not lending to good businesses with inherent tendencies to become successful (type 2 error). The risk of moral hazard, on the other hand, is a procedural risk that arises because of the inability of banks' credit committees to monitor funds loaned out to businesses, thereby preventing diversion of approved funds to unapproved risky projects (Theilen 2003; Jiménez and Saurina 2004).

In a bid to strengthen SMEs in Nigeria, the Small and Medium Enterprises Equity Investment Scheme (SMEEIS) was introduced by the Bankers' Committee in 1999 to augment access to business financing. Unfortunately, the MSMEs could not access the fund because of other challenges linked to uncoordinated business plans, poorly packaged projects, lack of awareness about SMEEIS potentials and

its stringent fund disbursement terms (Oyefuga et al. 2008; Terungwa 2011). Poor access to SMEEIS funds is inhibited operationally by limited awareness by MSMEs and associated rigid eligibility criteria (Peter and Inegbenebor 2009).

With regard to SWFs, it is important to note that in spite of its laudable goal of wealth creation for long-term national development, utilisation of the fund by MSMEs is restricted. At present, MSMEs have no access to the SWF because it is invested abroad into Investment Grade Corporate Bonds, US Treasury Bills and US Treasury Bonds and other long-term investments and assets for future generations of Nigerians under the management of JP Morgan.

For the Islamic financing programme, a number of structural and operational challenges made it unattractive to MSMEs as a financing option. An exploratory study of Clifford-Obiyo (2008) explained that the regulatory regime for Islamic financing is still undeveloped and that there is need to reframe the financial regulations and enable banking laws to accommodate the principles of Islamic financing. Related to this is the acceptability of Islamic financial products in a multi-religious society. Also, the Islamic financing principle of profit-loss-sharing requires free access to records and financial transactions of borrowers to know the actual profit/loss, but small businesses in Nigeria do not keep accounts, and those with records do not keep proper accounts. For the larger businesses, the issue of financial disclosure of real accounting records to banks is resisted and unattractive for confidentiality and cover-up for tax authority. Apart from the challenges above, Bello and Abubakar (2014) identified low awareness about Islamic financing, few outlets for Islamic financing, religious and cultural differences of the prospected borrowers and Shari'ah-related issues as key hurdles that made Islamic financing options unattractive to most MSMEs. There is a misconception that Islamic financing is restricted to Muslims—a dangerous opinion that affected patronage by non-Muslims (Fada and Wabekwa 2012).

From the foregoing, the key challenges affecting entrepreneurial financing programmes in Nigeria are summarised in Table 2. It is obvious that all the financing options/sources in Nigeria suffer from negative perception of MSMEs as high-risk borrowers by banks, high interest rates relative to low return on investment, other high transaction costs, stringent eligibility criteria for loans, weak governance structures of MSMEs, poor information asymmetry and a weak regulatory environment for Islamic financing and crowdfunding. For MSMEs in Nigeria to stimulate technological progress, wealth creation and employment generation, there is a need for improved financial deepening leveraging formal and informal financing programmes with stronger government oversight.

5 Overview of Findings on Entrepreneurial Financing in Nigeria

From the qualitative meta-synthesis [leveraging both supply-leading hypothesis (SLH) and demand-following hypothesis (DFH)], this study found that the trends of entrepreneurial financing programmes in Nigeria oscillate around personal

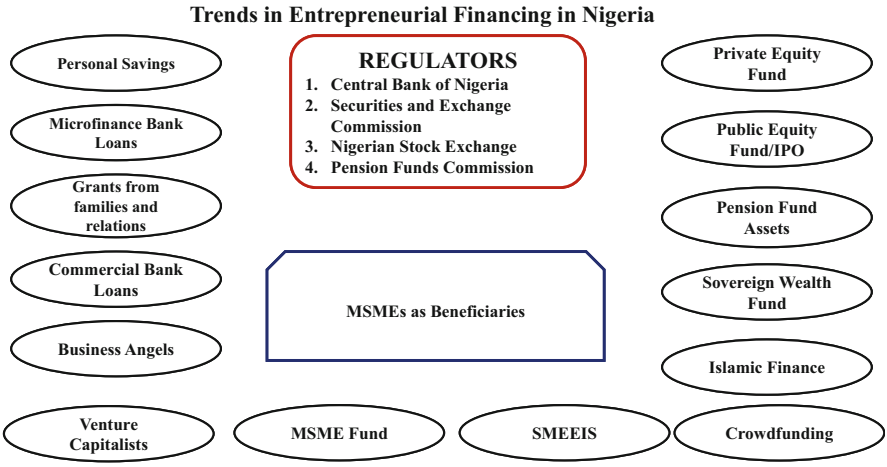

Fig. 3 Trends in entrepreneurial financing and options (Authors' configuration)

savings, loans of commercial and microfinance banks, co-operatives and other development financial institutions (DFIs), business angel financing, intervention funding of venture capitalists, MSMED fund, SMEEIS, other intervention grants from government agencies, pension fund assets, sovereign wealth fund and Islamic financing. While crowdfunding or crowd equity funding is popular in developed economies, it is an emerging financing option in Nigeria. The trend of entrepreneurial financing programmes in Nigeria is depicted in Fig. 3.

6 Conclusion, Implications and Recommendations

This paper sets out to discuss the trends in financing programmes for the development of MSMEs in Nigeria. It was observed that, for start-ups and early growth businesses, the relevant financing programmes are personal savings, financing support of business angels, equity funding of venture capitalists and well-designed internet-driven crowdfunding campaigns. For most start-ups and early growth businesses in Nigeria, it has been noted that access to the capital markets for sales of shares is institutionally restricted. The access to equity capital for start-ups is further compounded because bankers and business angels may not be willing to take on new businesses. Even venture capitalists that may be interested would do so only after carrying out thorough due diligence on the business plan and supporting documents. For the businesses within the fast growth, sustained growth and matured stages, there is unhindered access to commercial loans, public sector funding, equity financing in the capital market and other stringent financing sources because, at such growth stages, businesses have a profile of success stories, assets/collateral securities and presentable financial records and corporate goodwill. However, the key challenges

standing as obstacles to entrepreneurial financing programmes in Nigeria include perception of MSMEs by banks as high-risk borrowers, high interest rates relative to low return on investment, other high transaction costs, stringent eligibility criteria for loans, weak governance structures of MSMEs, information asymmetries (i.e. information failure when the borrower in loan transaction has greater material knowledge than the lenders/banks) and weak regulatory environment for Islamic financing and crowdfunding. For MSMEs in Nigeria to stimulate technological progress, wealth creation and employment generation, there is a need for improved financial deepening leveraging formal and informal financing programmes with stronger government oversight.

A number of research and policy implications have emerged from this chapter. Firstly, the chapter has enhanced the understanding of local and international readers about entrepreneurial financing in Nigeria with 38 integrated scholarly findings. By extension, entrepreneurship literature financing programmes in Nigeria has been enriched. Secondly, the chapter has established that MSMEs in Nigeria are challenged from making a positive impact on enterprise growth and economic development because of key entrepreneurial challenges, namely, negative perception of MSMEs as high-risk borrowers by banks, high interest rates relative to low return on investment and weak governance structures of MSMEs. For MSMEs to grow steadily, there is a need for stable financing programmes with effective governance relations. Thirdly, the chapter supports and validates both supply-leading hypothesis (SLH) and demand-following hypothesis (DFH) as two channels of financial deepening for MSMEs. The chapter's rich integrated findings suffer empirical limitation as this qualitative meta-synthesis is not based on empirical investigation within a given time and space. For further study, an empirical study is suggested to strengthen and fortify this study.

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Part II
Entrepreneurial Finance from Established Risk Capital Providers

Research on Venture Capitalists' and Business Angels' Investment Criteria: A Systematic Literature Review

Christian Granz, Marisa Henn, and Eva Lutz

Abstract This systematic literature review of 54 articles investigates quantitative and qualitative studies published between 1974 and 2017 in terms of differences in investment criteria between venture capitalists (VCs) and business angels (BAs). Research has shown a persistent interest in examining VCs' and BAs' investment criteria; however, inconsistent findings demonstrate the need for a review of the aggregate extant knowledge. We clarify what is known about the controversial debate on VCs' and BAs' investment criteria and shed light on key issues that can lead to a better understanding of why VCs and BAs focus on certain investment criteria. To achieve these objectives, we develop a conceptual framework grounded on agency theory for investment criteria that VCs and BAs use for funding decisions. Our review reveals that VCs in the first instance focus on the business and financial traction, whereas BAs initially employ investment criteria related to the management team. These differences between VCs' and BAs' investment decision policies support the agency view. In addition, we propose a detailed path for future research and provide entrepreneurs with practical implications.

Keywords Venture capitalists · Business angels · Investment criteria · Decision policies

1 Introduction and Motivation

Venture capitalists (VCs) and business angels (BAs) operate in a hazardous environment characterized by substantial asymmetric information and agency issues (Fiet 1995; Van Osnabrugge 2000). Examining how VCs and BAs carefully screen and select their investment targets to reduce information asymmetries, previous research has found conflicting results. For instance, research indicates that both

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VCs and BAs place a major emphasis on the entrepreneurial team and their experiences (e.g., Franke et al. 2006; Haines et al. 2003; Mason and Harrison 1996). In contrast, the literature is contradictory as to whether both investor types focus even more heavily on the attractiveness of the business opportunity rather than the quality of the management team (e.g., Hall and Hofer 1993; Kaplan et al. 2009; Mitteness et al. 2012).

Overall, the literature body in this research field is unstructured and heterogeneous because of the large number of publications and inconsistent results. This strand of literature lacks a conceptual framework that systematizes and categorizes the empirical quantitative and empirical qualitative findings of VCs' and BAs' investment criteria research. Therefore, the current paper addresses the debate on VCs' and BAs' investment criteria by investigating how VCs and BAs evaluate new ventures and determining which characteristics of the entrepreneurs and the new ventures result in a positive funding decision for both VCs and BAs.

Against this backdrop, we adopted a systematic literature review. We identified and reviewed 54 articles on VCs' and BAs' investment criteria from the early 1970s to 2017.[1] Our review enabled us to categorize the literature on VCs' and BAs' investment criteria into three main investment criteria groups: (1) *the management team*, (2) *the business*, and (3) *financial traction*. Our research supports the findings of previous studies that VCs prioritize business and financial traction because of their limited partners' return expectations (e.g., Baum and Silverman 2004; Kaplan et al. 2009; Mason and Stark 2004). Nonetheless, the relevance of the management team in VCs' funding decisions is not to be underestimated. On the other hand, the angel industry primarily focuses on the entrepreneurial management team, whose relevance as an investment criterion is explained by BAs' motivation to build personal relationships with the entrepreneurs and to share personal experiences that help reduce information asymmetry. Overall, these findings were in line with the agency view (Fiet 1995; Hsu et al. 2014; Van Osnabrugge 2000). These differences in investment decision policies can be determined by investigating information asymmetries and agency risks structured into VC and BA deals. Beyond that, based on the prevailing literature, we identified shortcomings and new research streams to be investigated in the future.

We offer two contributions to the extant research. First, we lay out our review to provide an overview of the ongoing research debate on VCs' and BAs' investment criteria (e.g., Bernstein et al. 2017; Hsu et al. 2014; Mason and Stark 2004). Previous literature has primarily focused on the decision criteria of single investor types [e.g., VCs (Franke et al. 2006; Macmillan et al. 1985) and BAs (Carpentier and Suret 2015; Sudek 2006)]. We detected academic gaps in this debate by systematizing and categorizing the pertinent literature strands on both VCs' and BAs' decision criteria into a framework. In this regard, we identified and reviewed both quantitative and qualitative literature and attempted to correct the lack of conceptual clarity between

[1]We did not address bank-affiliated (De Bettignies and Brander 2007; Hellmann et al. 2008; Ueda 2004), corporate (Souitaris and Zerbinati 2014) or philanthropic VCs (Scarlata et al. 2016).

the research strands on VCs' and BAs' investment criteria. To the best of our knowledge, this article is the first systematic literature review to holistically consider investment criteria within the VC and BA industries. Second, our review proposes certain opportunities for future research by capitalizing on the inconsistencies and deficiencies within our literature body; in doing so, we are able to provide detailed research avenues. We present these directions for future research by proposing research gaps, possible research questions, and suggestions for suitable methodological approaches.

Our paper proceeds as follows. In Sect. 2.1, we offer an overview of our review approach. We use an agency lens to construct our conceptual framework in Sect. 2.2. Section 2.3 presents a descriptive analysis of the literature body, and Sect. 2.4 systematizes and categorizes pertinent academic publications. Section 3 addresses the paper's limitations, and Sect. 4 provides grounds for future research. Finally, Sect. 5 lays out our study's conclusions.

2 Review of Literature on VCs' and BAs' Investment Criteria

2.1 Review Approach

We conducted the literature search between October and December 2017. For our systematic review, we adopted the following approach to ensure completeness, consistency, and transparency (Tranfield et al. 2003; Webster and Watson 2002):

We defined several keywords before starting our Internet search for publications. We included the words "venture capital," "venture capitalists," "formal investors," "business angels," "informal investors," "angel investors," and "early-stage investors" and combined them with the terms "investment decision criteria," "investment criteria," "investment decision-making," and "investment decision policies" when searching for titles, abstracts, keywords, and introductions of articles. We used several literature sources to ensure a comprehensive selection of academic articles: first, we started our search using EBSCOhost via the Business Source Premier and ScienceDirect databases. Second, we employed issue-by-issue searches when examining relevant academic journals.[2] Third, we manually searched for relevant literature via references from previous publications. Finally, we screened Google Scholar and SSRN to find further publications. Because of the high number of empirical-quantitative and empirical-qualitative publications from top-ranked academic journals identified during the first three steps of our literature identification process,

[2]We looked for field-relevant journals only as Moritz and Block (2016) did in their literature review on crowdfunding. Among others, the most frequently cited journals in our review included the *Journal of Business Venturing*, *Entrepreneurship Theory and Practice*, the *Journal of Venture Capital*, *the Journal of Finance*, the *Academy of Management Journal*, and *Management Science*.

we decided to exclude working papers and nonacademic articles (Köhn 2017). Furthermore, we excluded other literature reviews and conceptual-theoretical articles to form a rigorous, evidence-focused literature body.

We focused on the early 1970s–2017 to define the widest possible time boundary for our research topic. A publication by Wells (1974) was the first one on VCs' investment criteria that differentiates between successful and unsuccessful new ventures, thus marking the beginning of our time span. Finally, our review approach is biased toward English language literature only to maintain a standard of high quality (e.g., Podsakoff et al. 2005).

In sum, the initial application of our literature identification process yielded 197 potentially relevant publications. To narrow them down, we defined inclusion criteria to determine the final studies for our review. We included (1) publications focusing on early-stage investors, (2) publications that analyze the investment criteria of VCs and/or BAs, and (3) publications focusing on investment decision-making, behaviors, and policies in both the VC and the BA industries. Using EBSCOhost and ScienceDirect, we identified 143 potentially relevant publications. Applying our inclusion criteria, we retained 40 articles for the literature review. The issue-by-issue search, as well as the search via references from previous articles, enabled us to find 14 additional articles. Ultimately, we ended up with 54 publications published between 1974 and 2017 being relevant for our analysis, which is a comparable size to other literature reviews in entrepreneurial finance (e.g., Klotz et al. 2014; Politis 2008).

Finally, we used a twofold approach for our analysis of the literature: In the first step, we read and classified all 54 articles. We started by sorting the literature into VC-based studies, BA-based studies, or studies focusing on both. In the second step, we reexamined all the articles to extract various kinds of investment criteria. We compared and contrasted different investment criteria and then critically reflected upon their similarities and differences (Wood and McKelvie 2015).

2.2 A Comprehensive Framework Based on Agency Theory

After identifying the relevant publications that address VCs' and BAs' investment criteria, we first developed a theoretical framework by adopting agency theory (Eisenhardt 1989; Jensen and Meckling 1976).[3] Agency problems and associated costs are attributed to the following three cases: (1) the delegation of work from principal to agent (Jensen and Meckling 1976), (2) the goal conflict between principal and agent (Eisenhardt 1989), and (3) the information asymmetries between principal and agent, resulting in limited opportunities for the former to monitor the latter (Eisenhardt 1989; Shapiro 2005). Agency theory has been a frequently used

[3]We followed the approach by Hsu et al. (2014), who theoretically derived VCs' and BAs' focus on investment criteria by relying on agency theory to find attributes for their conjoint analysis.

instrument in venture capital literature (Arthurs and Busenitz 2003; Van Osnabrugge 2000), as earlier studies confirmed goal conflicts between VCs (principal) and entrepreneurs (agent) (Amit et al. 1998; Fiet 1995). This goal conflict exists because VCs aim to maximize their overall portfolio return, whereas entrepreneurs seek to maximize the return of their own venture (Van Osnabrugge 2000). When VCs invest in new ventures, they face high market risk and opportunistic behavior by the entrepreneur (Fiet 1995). VCs use portfolio investments and syndication as tools to lower their market risk exposure (Fiet 1995; Zacharakis and Meyer 2000) while reducing the entrepreneur's opportunistic behavior through stage compensation and funding arrangements (Ibrahim 2008). For example, this is implemented by screening and monitoring VCs' portfolio firms based on sophisticated contracts to control decision-making in portfolio firms (Gompers 1995).

BAs primarily aim to use their knowledge and skills to help the entrepreneur become successful, whereas VCs invest money for their limited partners and seek to maximize portfolio returns (Arthurs and Busenitz 2003; Mason and Harrison 2002b). Agency problems in the angel-entrepreneur dyad partly exist because of the low level of sophistication of angel contracts, which makes it difficult to verify information (Fiet 1995; Van Osnabrugge 2000). Fiet (1995) argued that information asymmetries in the angel-entrepreneur dyad increase BAs' exposure to human risk compared to market risk. Thus, angels faced relatively high information asymmetries related to the management team rather than market-related factors. Therefore, it is particularly important for BAs to monitor the entrepreneur on a personal level (Van Osnabrugge 2000).

Agency theory assumes that the principal tries either to lower the goal conflict with the agent or to use control mechanisms to verify information provided by the agent so that the agent acts in accordance to their interest (Eisenhardt 1989). Consequently, VCs and BAs may use either behavior-oriented control mechanisms to observe and monitor the agent's behavior or outcome-oriented mechanisms to provide the agent with incentives for certain behavioral outcomes (Eisenhardt 1989).

VCs invest on a portfolio basis (Gompers and Lerner 2001), and they are not deeply engaged in the daily operations of their portfolio firms (Wright Robbie 1998). Against this backdrop, VCs implement contractual milestones for their portfolio firms that entrepreneurs need to successfully meet (Gompers 1995); otherwise (staged), capital injections are declined (Hellmann 1998). Therefore, it is argued that VCs' control mechanisms are primarily outcome-oriented (focusing on the business and its financials) than behavior-oriented (focusing on the entrepreneurial team), especially when the goal conflict is large, as this enables VCs to efficiently align goal interests between the VC and the entrepreneur (Eisenhardt 1989).

Unlike VCs, angels encounter problems verifying information provided by the entrepreneur (Van Osnabrugge 2000). Although some angel investors conduct due diligence, the average information content is to be less extensive as that of VCs, who have much more opportunities to extract information from the broad operational and financial network of their portfolio firms (Brander et al. 2002; Prowse 1998). This shows the difference in VCs that information asymmetries in the angel-entrepreneur dyad cannot usually be reduced through due diligence. Prowse (1998) argues that angel investors prefer entrepreneurs they know well, trust, and work with when screening

investment targets. Therefore, BAs rely on behavior-oriented tools to reduce information asymmetries, confirming that they are more concerned about human factors compared to VCs, who focus more on the economic outcome of an investment to meet their limited partners' return expectations (Hsu et al. 2014). Based on behavior-oriented and outcome-oriented control mechanisms used for early-stage investments, we formulated these three main investment criteria groups that VCs and BAs focus on to systematize and categorize the literature on early-stage investors' investment criteria: (1) *the management team*, (2) *the business*, and (3) *financial traction*.

2.3 Descriptive Literature Analysis

The 54 articles relevant to our systematic review were published between 1974 and 2017. More than half of our literature body (N = 26) was published in the *Journal of Business Venturing* (N = 17) and in the *Journal of Venture Capital* (N = 9).

Table 1 and Fig. 1 present descriptive statistics for our body of research articles.

Panel A describes the distribution of articles on VCs' and BAs' investment criteria over time. The first wave of literature (between 1980 and 1995) mainly focused on VCs and was primarily empirical-qualitatively driven. At that time, equity financing industry had become more important, as new rules for institutional investors were introduced in the USA and the UK (Gompers and Lerner 2004). However, articles that built upon post-interviews have often been criticized for problems arising from retrospective and self-reporting biases (Shepherd and Zacharakis 1999). Since the mid-1990s, empirical-quantitative research has evolved, especially for articles that focused solely on VCs' investment criteria. This progress reflects the growing role of VCs in financial intermediation and is thus indicative of the increasing access to data that enables sophisticated data analyses in this field (Bottazzi and Da Rin 2002; Gompers and Lerner 2004).

Overall, the literature body on VCs' and BAs' investment criteria features a transition in methodologies. Panel B and Fig. 1 present evidence suggesting a trend from descriptive studies (market-based and practice-oriented studies, descriptive, profile-focused) to more analytical studies (quantifiable, theory-oriented, behavior-driven, post-investment relationship-focused). The first publications in our research field merely investigated investment criteria via questionnaires with a descriptive appraisal. Later publications (from the early 1990s) used more experimental methodologies for data analysis (e.g., conjoint analysis) to overcome problems of post hoc biases.[4] Researchers have applied a balanced range of quantitative and qualitative methodologies to investigate the phenomenon of VCs' and BAs'

[4]These kinds of biases may arise from respondents' stimulus to bias results (Feldman and March 1981), perceptual and cognitive restrictions (Nisbett and Ross 1980), and variability, depending on the data collection method (Muzyka et al. 1996; Riquelme and Rickards 1992; Shepherd et al. 2000).

Table 1 Descriptive statistics of the literature body

	VCs		BAs		VCs and BAs		Total	
Number of publications	Absolute	in %	Absolute	in %	Absolute	in %	Absolute	in %
Panel A: Period								
1974–1980	3	9.09	–	–	–	–	3	5.56
1981–1990	8	24.24	1	5.55	–	–	9	16.67
1991–2000	13	39.39	5	27.78	1	33.33	19	35.19
2001–2010	8	24.24	7	38.89	1	33.33	16	29.62
2011–2017	1	3.03	5	27.78	1	33.33	7	12.96
∑	33	100	18	100	3	100	54	100
Panel B: Methodology								
Quantitative	17	51.52	6	33.33	2	66.67	25	46.30
Qualitative	16	48.48	12	66.67	1	33.33	29	53.70
∑	33	100	18	100	3	100	54	100
Panel C: Countries								
U.S.	15	45.45	5	27.78	1	33.33	21	38.89
U.K.	2	6.06	4	22.22	2	66.67	8	14.81
Canada	2	6.06	5	27.78	–	–	7	12.96
Australia	2	6.06	1	5.55	–	–	3	5.56
Europe	3	9.09	–	–	–	–	3	5.56
Asia	2	6.06	–	–	–	–	2	3.70
Spain	1	3.03	–	–	–	–	1	1.85
Germany	–	–	1	5.55	–	–	1	1.85
Portugal	1	3.03	–	–	–	–	1	1.85
Sweden	–	–	1	5.55			1	1.85
Multiple	3	9.09	1	5.55	–	–	4	7.41

(continued)

Table 1 (continued)

	VCs		BAs		VCs and BAs		Total	
Number of publications	Absolute	in %	Absolute	in %	Absolute	in %	Absolute	in %
N/A[a]	2	6.06	–	–	–	–	2	3.70
∑	33	100	18	100	3	100	54	100

This table presents the descriptive statistics of the literature body, sorted by VC-focused studies, BA-focused studies, and studies on both VCs and BAs. Panel A presents the number of articles over time by investor type. Panel B provides the number of studies by research methodology and investor type. Panel C shows the number of publications clustered by focus country in the respective dataset and investor type. Minor differences from rounding may occur in the disclosure of relative weights. N = 54

[a]Not applicable due to missing specifications

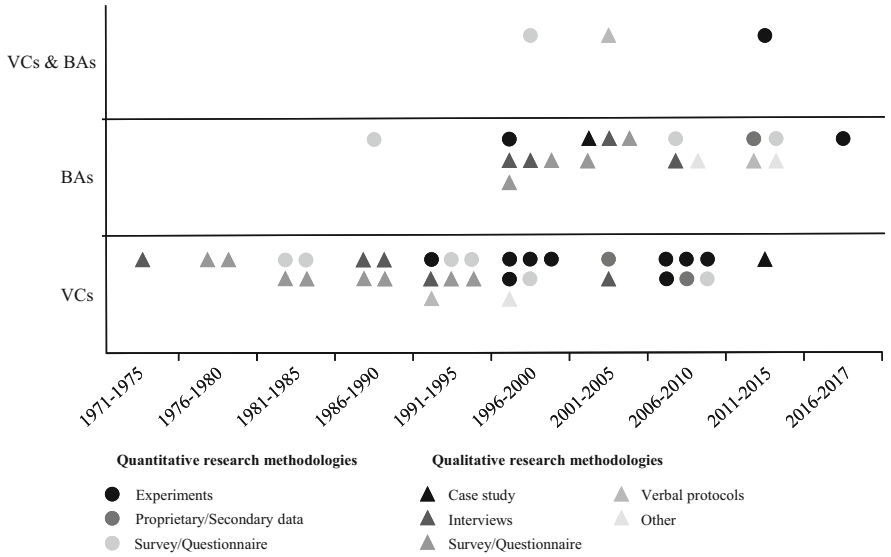

Fig. 1 Research methodologies. This figure provides an overview of the type of research methodologies used over time, clustered by investor type. N = 54

investment criteria. Regarding trends over the investigation period, we found that more than half (~52%) of all publications exclusively focused on VCs utilized quantitative research methods. Meanwhile, 66.67% of articles addressing BAs utilized qualitative approaches.

Finally, Panel C presents the literature body's distribution across countries. Most datasets focus on the USA (~39%) (e.g., Chen et al. 2009), the UK (~15%) (e.g., Mason and Stark 2004), and Canada (~13%) (e.g., Knight 1994a), and numerous studies analyzing investment behavior in these three regions used qualitative research methods (~61%). The small number of publications using continental European (e.g., Knockaert et al. 2010) or Asia Pacific (e.g., Rah et al. 1994) datasets may indicate an inferior database on VCs' and BAs' investment criteria in these regions.

2.4 Literature Systematization and Categorization

The following thematic analysis of our literature body on VCs' and BAs' investment criteria refines the dispersed opinions of the previous entrepreneurial finance studies on this topic. A considerable number of articles have been published on VCs' investment criteria, but no apparent consensus has been found regarding which criteria dominate their investment policies. BAs' investment criteria differ from those of their opposing institutional investment community (Hsu et al. 2014; Mason and Harrison 1996; Van Osnabrugge 2000). The BAs' decision model is

rather narrow and parsimonious, resembling decision heuristics compared to the VC approach, wherein funding decisions are based on a more holistic decision model (Maxwell et al. 2011).

We analyzed research material on VCs' and BAs' investment criteria on the following three main investment criteria groups: (1) *the management team*, (2) *the business*, and (3) *financial traction*. Tables 2, 3, and 4 provide an overview of the main studies on VCs' and BAs' investment criteria discussed in this paper.

2.4.1 Investment Criteria Regarding the "Management Team"

Venture Capitalists With regard to the funding of new ventures, the literature reveals that the management team, or rather the entrepreneur, are salient factors for VCs' investment decisions (Franke et al. 2008; Fried and Hisrich 1994; Johnson 1979; Knockaert et al. 2010; Macmillan et al. 1985; Pintado et al. 2007; Shepherd et al. 2000; Shepherd 1999a; Tyebjee and Bruno 1984; Wells 1974; Zutshi et al. 1999). Drawing on cognitive theory, an experienced management team is a crucial decision criterion that VCs employ when assessing new venture proposals (Shepherd et al. 2003). The evaluation of human capital involves predictions regarding the management team's performance (Smart 1999). Hence, VCs appreciate an experienced management team because experience can moderate the future failure risk of an investment and, in turn, increases the future returns VCs might earn through exits (Dixon 1991). Furthermore, to investigate and pass investment proposals through the due diligence process, VCs expect entrepreneurs to use their management experience for specific sectors. VCs do not classify managerial experience into a subset of criteria of the compensatory process (Riquelme and Rickards 1992). Thus, the experience of the management team cannot be compensated by the high value of another criterion.

Moreover, industry-related experience (Muzyka et al. 1996) outweighs other investment criteria, such as the field and level of education, relationships among team members, experience in leading teams, prior job experience, and age of team members (Franke et al. 2008). Both industry-specific experience and domain-specific expertise (e.g., in high-technology sectors such as biotechnology or financial technology) allow VCs to assess the viability of the new venture's product range and business model (Chemmanur et al. 2016). VCs prioritize the connections among entrepreneurs within the same industry (Muzyka et al. 1996) to ensure that VCs know when to bail out, if necessary, and how to do so (Macmillan et al. 1985). These findings are also in line with those by Franke et al. (2008), who conducted a conjoint experiment with 51 German and Austrian professionals in VC firms. They reported that both novice and experienced VCs consider industry experience as their central investment criterion. Although no differences were found in the top three investment criteria between novice and experienced VCs, their ratings differed for lower-ranked criteria. For instance, mutual acquaintance within the entrepreneurial team (professional or private relationships within the team prior to the new venture foundation) is ranked highly by experienced VCs, while novice VCs rank it one of the lowest

Table 2 Selected studies on investment criteria research (VCs)

Study (year)	Geographic focus	Methodology	Sample size	Key criteria		
				Management team	Business	Financial traction
Baum and Silverman (2004)	Canada	Quantitative (Secondary data)	675 investment decisions		X	
Boocock and Woods (1997)	UK	Qualitative (archival records)	1 VC		X	
Chen et al. (2009)	USA	Quantitative (field/laboratory experiment)	55 VCs	X		
Dixon (1991)	UK	Qualitative (survey)	30 VCs	X		
Franke et al. (2006)	Germany, Austria	Quantitative (conjoint analysis)	51 VCs	X		
Franke et al. (2008)	Germany, Austria	Quantitative (conjoint analysis)	51 VCs	X		
Fried and Hisrich (1994)	USA	Qualitative (interviews; questionnaire)	18 VCs	X	X	X
Hall and Hofer (1993)	USA	Qualitative (verbal protocols)	4 VCs, 16 protocols		X	X
Hisrich and Jankowicz (1990)	N/A[a]	Qualitative (interviews)	5 VCs	X		
Johnson (1979)	USA	Qualitative (survey)	49 VCs	X		
Kaplan et al. (2009)	USA	Quantitative (secondary data)	50 VCs		X	
Knight (1994a)	Canada, Asia Pacific, Europe	Quantitative (survey)	134 VCs	X		
Knight (1994b)	Canada	Quantitative (survey)	128 VCs	X		
Knockaert et al. (2010)	Europe	Quantitative (conjoint analysis)	68 VCs	X	X	X
Macmillan et al. (1985)	USA	Quantitative (questionnaire)	100 VCs	X		
Macmillan et al. (1987)	USA	Quantitative (questionnaire)	67 VCs, 150 investment decisions		X	
Muzyka et al. (1996)	Europe	Quantitative (conjoint analysis)	73 VCs	X		
Petty and Gruber (2011)	Europe	Qualitative (exploratory case study)	1 VC		X	

(continued)

Table 2 (continued)

Study (year)	Geographic focus	Methodology	Sample size	Key criteria		
				Management team	Business	Financial traction
Pintado et al. (2007)	Spain	Quantitative (questionnaire)	51 VCs	X		
Poindexter (1976)	USA	Qualitative (questionnaire)	97 VCs			X
Rah et al. (1994)	Korea	Qualitative (survey)	74 VCs	X		X
Rea (1989)	USA	Qualitative (questionnaire)	18 VCs		X	
Riquelme and Rickards (1992)	N/A[a]	Quantitative (conjoint analysis)	13 VCs	X	X	
Robinson (1987)	USA	Qualitative (questionnaire)	53 VCs			X
Shepherd (1999a)	Australia	Quantitative (conjoint analysis)	66 VCs	X		
Shepherd et al. (2000)	Australia	Quantitative (conjoint analysis)	64 VCs	X		
Silva (2004)	Portugal	Qualitative (interviews)	1 VC, 16 proposals	X	X	
Timmons et al. (1987)	USA	Qualitative (interviews)	47 VCs	X	X	X
Tyebjee and Bruno (1981)	USA	Qualitative (questionnaire)	46 VCs	X		
Tyebjee and Bruno (1984)	USA	Qualitative (questionnaire)	41 VCs	X	X	
Wells (1974)	USA	Qualitative (interviews)	8 VCs	X		
Zacharakis and Meyer (1998)	USA	Quantitative (decision experiment)	51 VCs		X	
Zutshi et al. (1999)	Asia	Quantitative (questionnaire)	31 VCs	X		

This table presents all studies solely focusing on VCs' investment criteria. It lists relevant descriptive parameters and shows which key criteria the respective study places the greatest emphasis on. N = 33. Eight studies include evidence on more than one key criterion

[a]Not applicable due to missing specifications

Table 3 Selected studies on investment criteria research (BAs)

Study (year)	Geographic focus	Methodology	Sample size	Key criteria		
				Management team	Business	Financial traction
Bachher and Guild (1996)	Canada	Qualitative (questionnaire)	20 BAs	X		
Bernstein et al. (2017)	USA, UK, Canada, Australia	Quantitative (experiment)	2295 BA investment decisions	X		
Brush et al. (2012)	USA	Quantitative (proprietary dataset)	332 BA proposals	X	X	
Cardon et al. (2009)	USA	Quantitative (survey; video analysis)	150 BAs, 60 video presentations by BAs	X		
Carpentier and Suret (2015)	Canada	Qualitative (longitudinal analysis)	85 BAs, 636 proposals	X	X	
Feeney et al. (1999)	Canada	Qualitative (interviews)	153 investment decisions	X	X	
Haar et al. (1988)	USA	Quantitative (survey)	130 BAs	X		
Haines et al. (2003)	Canada	Qualitative (interviews)	51 BAs	X	X	
Hindle and Wenban (1999)	Australia	Qualitative (questionnaire)	36 BAs	X		X
Landström (1998)	Sweden	Quantitative (conjoint analysis; questionnaire)	44 BAs	X	X	
Mason and Harrison (1996)	UK	Qualitative (interviews)	31 BAs	X		
Mason and Harrison (2002a)	UK	Qualitative (questionnaire)	74 BAs		X	
Mason and Harrison (2003)	UK	Qualitative (real-time case study)	30 BAs	X		
Maxwell et al. (2011)	Canada	Qualitative (verbal protocols)	150 BAs	X	X	X
Mitteness et al. (2012)	USA	Quantitative (questionnaire)	57 BAs, 159 proposals	X	X	

(continued)

Table 3 (continued)

Study (year)	Geographic focus	Methodology	Sample size	Key criteria		
				Management team	Business	Financial traction
Paul et al. (2007)	UK	Qualitative (interviews)	30 BAs	X		
Stedler and Peters (2003)	Germany	Qualitative (questionnaire)	232 BAs	X	X	
Sudek (2006)	USA	Qualitative (participant observation)	72 BAs	X		

This table presents all studies solely focusing on BAs' investment criteria. It lists relevant descriptive parameters and shows which key criteria the respective paper places the greatest emphasis on. N = 18. Nine studies include evidence on more than one key criterion

Table 4 Selected studies on investment criteria research (VCs and BAs)

Study (year)	Geographic focus	Methodology	Sample size	Key criteria		
				Management team	Business	Financial traction
Hsu et al. (2014)	USA	Quantitative (conjoint analysis)	50VCs 31 BAs			X
Mason and Stark (2004)	UK	Qualitative (verbal protocols)	3 VCs 4 BAs		X	X
van Osnabrugge (2000)	UK	Quantitative (questionnaire)	119 VCs 143 BAs		X	X

This table presents all studies focusing on both VCs' and BAs' investment criteria. It lists relevant descriptive parameters and shows which key criteria the respective paper places the greatest emphasis on. N = 3. Two studies include evidence on more than one key criterion for the respective investor type

criteria. Novice VCs tend to focus more on the qualifications of the team, whereas experienced ones focus more on team cohesion. This variation in different criteria weights shows that a consensus on investment criteria—what constitutes a well-functioning team—does not exist.

Furthermore, there is an effect of complementary capabilities within the management team (Franke et al. 2008). VCs focus on dispersed competencies within the team, whereas the distribution is irrelevant. If a certain competence is not represented by any team member, a knockout effect will emerge, meaning the VC investor would directly disregard this entrepreneurial team. However, the effect of complementary capabilities within the management team challenges Byrne's (1971) similarity hypothesis, which states that the more similar a person is to another, the more positively that individual assesses that person. Considering the interaction between VCs and entrepreneurs, a similarity bias reveals that VCs systematically deviate from their ratings when screening proposals (Franke et al. 2006). For example, VCs who have worked for start-ups or large firms tend to select management team members with professional experience similar to their own. This hypothesis also holds true for educational background. Even though a similarity bias among VCs may exist, VCs aim to diversify the management teams of portfolio companies in terms of educational backgrounds, thus generating some team heterogeneity. Expanding on this, VCs trade off certain team characteristics for a lack of another characteristic, which can take the effect of a penalty, resulting in the failure of the investment proposal in the screening process (Franke et al. 2008).

The evidence available so far indicates why VCs value the experience criterion of a management team: research shows that an experienced management team contributes to the expansion of a new venture, especially in later stages, when tasks and responsibilities become more complex and heterogeneous (Robinson 1987). However, there is contradicting evidence on later-stage firms, that is, if the new venture's critical resources are its human assets, the management team is important in differentiating one venture from another (Rajan 2012; Wernerfelt 1984), particularly if the new venture is in its early stages and needs to justify its existence to investors (Kerr et al. 2014).

Moreover, VCs' funding decisions also depend on soft criteria, especially when assessing the management team. They expect ventures' management teams to demonstrate cognitive characteristics (e.g., realism, problem-solving abilities), have certain personality traits (e.g., interpersonal skills, integrity), and fulfil motivational variables (e.g., personal drive, power) (Schefczyk and Gerpott 2001). Additionally, using verbal protocol analysis, Hall and Hofer (1993) investigated subjective investment criteria that are crucial for funding decisions and which particularly affect the VC-entrepreneur relationship. For example, the ability to cooperate, as well as the relationship between VCs and entrepreneurs, influences VCs' decision-making process. In accordance with this, the entrepreneur's ability to recognize risks (Macmillan et al. 1985) and tenacity and ability to communicate (Knight 1994a) are further significant criteria in VCs' assessment of management teams. For example, the ability to recognize and manage risk is essential for new ventures to counteract turbulent market environments (Dubini 1989). Consequently,

a multidisciplinary team—characterized by the entrepreneur's staying power, ability to handle risk, familiarity with the business, and leadership ability—is what VCs postulate from investment proposals (Knight 1994a, b). Furthermore, VCs also try to evaluate the degree of the entrepreneur's commitment and thorough understanding of the business idea (Silva 2004). Criteria such as entrepreneurial passion, which the VCs might sense during business plan presentations, influence their funding decisions. During business plan presentations, VCs distinguish between entrepreneurial passion and preparedness. The former is conveyed through facial expressions and body language, whereas the latter is demonstrated through the verbal content and substance of the presentation. Ultimately, preparedness has a more significant influence than passion on VCs' funding decisions (Chen et al. 2009). Additionally, personal construct psychology confirms the dependency of VCs' investment decisions on soft facts such as interpersonal chemistry or the pragmatism of the entrepreneurs rather than their creativity (Hisrich and Jankowicz 1990). Hence, these fine-grained investment criteria affirm the challenge VCs face when evaluating managerial capability as part of the venture selection process (Rah et al. 1994).

Business Angels A large number of scholars have investigated the impact of the management team on BAs' investment decisions. Among those, Bernstein et al. (2017) conducted a randomized field experiment among US, UK, Canadian, and Australian angel investment decisions to illustrate how the average angel focuses on the founding team and disregards other information such as financial traction. Investigating 44 Swedish BAs in a conjoint experiment, the work of Landström (1998) confirmed the importance of the compatibility between the entrepreneur and the investor as a decision-making criterion.

Alongside the different stages in the decision heuristics angels go through prior to an investment, a large angel financing group provides evidence that during the desk rejection stage, BAs frequently rely on quantifiable and tangible investment criteria (Brush et al. 2012; Maxwell et al. 2011). For instance, BAs evaluate the entrepreneur's organizational readiness, that is, whether key management roles are filled. However, as it has a significant positive effect on the desk rejection stage, the size of top management negatively influences BAs' investment decisions in the later investment stages, such as in later negotiations. Moreover, during the final stage of the funding process, BAs employ further subjective and intangible decision criteria. When they start investigating less quantifiable intangible decision criteria, such as the entrepreneur's trustworthiness (Sudek 2006), personal commitment to the new venture (Cardon et al. 2009; Erikson 2002), passion (Cardon et al. 2009; Chen et al. 2009), and persuasiveness (Mason and Harrison 2003), BAs increase their standard of scrutiny and analysis (Brush et al. 2012).

Finally, when BAs face an investment decision, they are likely to invest their private funds into early-stage firms based on soft decision heuristics, meaning they primarily focus their investment decisions on the entrepreneur or rather, the investor fit (Landström 1998; Mason and Stark 2004). Investigating management team characteristics enables the investor to draw conclusions about the new venture's quality information, which can influence the investment decision (Bachher and Guild 1996;

Hindle and Wenban 1999). Because of their investment objectives and decision policies, BAs place greater emphasis on agency risk compared to VCs (Fiet 1995). Agency risk affects BAs more than VCs because a missing institutional setting prevents the smooth exchange of information between the angel and the entrepreneur, thus rendering the angel more sensitive to agency risk than to market risk (Fiet 1995; Van Osnabrugge 2000). In turn, this finding confirms the classification of BAs as hands-on investors because they focus on personal relationships with the entrepreneur, therefore placing greater weight on the management team (Fiet 1995; Van Osnabrugge 2000). Hence, it is the "chemistry" (Mason and Stark 2004) between entrepreneurs and the BAs themselves that BAs place particular focus on during the investment process.

Recently, scholars have acknowledged the importance of entrepreneur trustworthiness, management team quality (e.g., passion, commitment), enthusiasm (Cardon et al. 2009; Sudek 2006), and affective passion (Hsu et al. 2014) in BAs' investment decisions. This phenomenon can be explained by BAs' perception of the influence of entrepreneurs' commitment and enthusiasm on new ventures' success. Not only does the entrepreneur's trustworthiness matter, but angels are also more likely to invest if they receive referrals for new ventures from trusted sources (Harrison et al. 1997). Additionally, Haines et al. (2003) examined expert interviews of 51 BAs and showed that BAs look for honest, ethically conscious entrepreneurs with a clear and rational understanding of how a new business might succeed. These kinds of soft decision factors play a more important role in the BA investment process than that of the VC because of the hands-on role BAs take in the investee venture (Mason and Stark 2004; Paul et al. 2007). For instance, impression management is another key criterion for BAs to consider a new venture ready for funding (Mason and Harrison 2003; Stedler and Peters 2003). To seek funding, during their final presentations, entrepreneurs need to not only convince angels of their management competencies and their business idea but also impress the angel committee with the style, content, and structure of the presentation. However, these findings stand in contrast to those of Haar et al. (1988), who found that angels should not focus too much on sales pitches when presentations primarily focus on the product or on the protection of intellectual property.

In sum, the "management team" investment criterion may be less important to VCs compared to the BA industry. BAs prefer to focus their investment decisions on the entrepreneurial management team, as this careful selection allows them to mitigate their behavior-oriented agency problems (Ibrahim 2008). Because of the lack of an institutional setting in the angel industry, this behavior-oriented approach is much more important than for VCs, who primarily focus on outcome-driven mechanisms (Eisenhardt 1989). Furthermore, BAs' hands-on investing style makes them more engaged emotionally compared to VCs, which results in a broader and deeper emphasis on their personal affiliation with the entrepreneur.

2.4.2 Investment Criteria Regarding the "Business"

Venture Capitalists When selecting investment targets, VCs also place significant weight on the business along with the management team (Baum and Silverman 2004; Kaplan et al. 2009; Petty and Gruber 2011; Rea 1989; Zacharakis and Meyer 1998). The "business" criterion entails both physical and nonphysical assets, such as patent and intellectual property assets.

The business idea and sustainable advantage—the new venture's ability to secure its value adds by protecting innovation—as well as growth potential are factors VCs extract from a business plan and evaluate (Silva 2004). Likewise, the market that new ventures aim to gain a foothold in must offer unconstrained (Rea 1989) and long-term profitable (Boocock and Woods 1997; Hall and Hofer 1993) growth opportunities.

Furthermore, VCs also consider the competitive surroundings of the new venture and the demonstrated market acceptance of the product as the two decisive criteria for determining a new venture's success (Macmillan et al. 1987). Hence, the quality of the business concept may be indicative of whether the new venture can achieve substantial competitive advantage (Fried and Hisrich 1994; Hisrich and Jankowicz 1990). Tyebjee and Bruno (1984) summarize this criterion as resistance against general environmental threats. Because of the high competitiveness among early-stage ventures, numerous VCs focus on high-technology investments and in turn include technological progress as a criterion in their investment policies focusing on the business (Hsu et al. 2014). Finally, using secondary data, Baum and Silverman (2004) find that for a sample of 675 investment decisions in Canada, VCs are attracted by both start-ups with strong alliances to other ventures and those holding patents on their technological innovations. VCs act as "scouts" because they focus their investment screening on promising technology rather than on the right management team. Subsequently, VCs assume the role of a "coach" by applying appropriate management skills when they find the right venture to invest in.

Business Angels BAs may also place emphasis on the market potential of the business and the overall business opportunity (Feeney et al. 1999; Haines et al. 2003; Landström 1998). Based on verbal protocols with 150 Canadian BAs, findings by Maxwell et al. (2011) indicated critical business factors—summarizing a larger list of investment decision criteria—used as heuristics by angels to reduce the number of investment opportunities (elimination-by-aspects model): adoption, status, protectability, customer engagement, route-to-market, and market potential. The first three factors relate to the product. Adoption is important for BAs to assess how attractive the product is to potential customers (Feeney et al. 1999). Product status and protectability ensure an evaluation of a product's market readiness (Mason and Harrison 2002a) as well as its competitive positioning (Sudek 2006). Additionally, angels look for competitive insulation during the early stages of a new venture, as competition has a negative effect on profits (Haar et al. 1988). The latter factors refer to the market. The critical factor of customer engagement enables BAs to evaluate

whether the new venture's customers are actively engaged in product development, which will ensure the business meets its value proposition (Mason and Stark 2004). Finally, BAs appreciate large markets that allow the business to grow rapidly (Bachher and Guild 1996).

Furthermore, angel investors place emphasis on the industry as well as the technological surroundings of the product or service. BAs prefer to invest in industries they feel familiar with and in which they have previously gathered experience so that they can get involved in the business rather than simply gloss it over (Haar et al. 1988; Kelly and Hay 1996). Industry knowledge therefore enables angel investors to realize the uniqueness of a new venture's product or service (Bachher and Guild 1996; Hindle and Wenban 1999). Hence, entrepreneurs' ventures should possess organizational, strategic, and especially technological readiness when seeking funding through angel investors. Beyond that, using a proprietary US dataset on 332 angel proposals, Brush et al. (2012) found that intellectual property and protectability help new ventures proceed in the funding process. Finally, the location of the new venture is critical to angels' investment decision-making (Brush et al. 2012; Paul et al. 2007). Given that BAs like to get involved in new ventures' business by contributing their experience to the firm, angels prefer that new ventures be accessible (Mason and Rogers 1997).

In sum, institutional investors may place more weight on the investment criterion "business"—compared to those in the angel industry—which may find support from the outcome-oriented control mechanisms to minimize their goal conflicts (Fiet 1995). VCs see this criterion as the key to a new venture's success. The institutional setting where VCs operate in allows them to conduct a more profound due diligence than BAs. In doing so, VCs intensively focus on criteria such as growth potential, competitive surroundings, and market acceptance, as well as the technological progress of the product. In contrast, angels usually lack these detailed comparative data to assess market risk. Therefore, BAs merely evaluate the business in addition to its fit to their personal investment criteria regarding the management team (Mason and Stark 2004).

2.4.3 Investment Criteria Regarding "Financial Traction"

Venture Capitalists The third group of criteria deals with the financial characteristics of new ventures, which influence VCs' investment decisions (Timmons et al. 1987). In their conjoint analysis, Knockaert et al. (2010) identified three clusters VC investors focus on. One of these targets VCs that primarily focus their investments on financial conditions. Financial investors are keen on return on investment as well as on the growth and profitability forecasts the new venture might achieve, as one of VCs' objectives is to deliver high returns to their investors (Mason and Stark 2004). Next to the high rate of return, the time-to-exit opportunity plays an important role (Fried and Hisrich 1994). VCs consider the latter criterion because the duration of the time-to-exit influences their returns (Armstrong et al. 2006). In conjunction with

VCs' expectations for the new venture's positive earnings performance, the cash-out factor (Tyebjee and Bruno 1981; Tyebjee and Bruno 1984) is an important criterion that VCs employ during their due diligence. VCs do not focus on new ventures where investments are locked up and cannot be cashed out for long periods. For instance, such a setup is relevant for products or services that have not yet fulfilled the proof of concept and entail an illiquid investment, thus not offering an easy cash-out opportunity (Macmillan et al. 1987). Because of the high risk that VCs take on, a certain liquidity of their investment is postulated (Poindexter 1976; Robinson 1987). Finally, research shows evidence that VCs set financially driven milestones for entrepreneurs and their ventures (Gompers and Lerner 2001). Hsu et al. (2014) conducted a conjoint analysis with 50 US VCs and showed that they place greater emphasis on the economic potential of a new venture because of their outcome-driven ex post control mechanisms, which are, in turn, based on the new venture's performance.

Business Angels In addition to nonfinancial investment criteria, BAs to some extent assess financial information that new ventures provide within their business plans, especially when the investment process proceeds from the initial screening to the next investment stage (Hindle and Wenban 1999; Paul et al. 2007).

Even though BAs are also motivated by the capital gains from their investments, the satisfaction and pleasure derived from being involved in the entrepreneurial process prevail over both market and finance issues (Mason and Stark 2004; Mason and Harrison 2002a). Moreover, there is evidence by Dixon (1991) that VCs greatly employ financial investment criteria and frequently conduct return calculations. In turn, BAs are rather cynical about the explanatory power of such financial predictions (Mason and Rogers 1997). Beyond that, poor pricing strategy and deal structuring (Mason and Harrison 1996), as well as the undercapitalization of the new venture (Feeney et al. 1999), are criteria for why entrepreneurs do not receive funding from angels.

Finally, although angels usually invest more in the early stages of business development compared to VC investors, they do not require greater financial compensation for this additional risk (Feeney et al. 1999). This follows from the fact that BAs are more likely to invest in businesses they are familiar with, thus, leading to BAs' awareness of an adequate risk level to bear (Freear et al. 1997). Yet, angels still face the uncertainty of agency risk because of the lack of an institutional setting compared to VCs (Fiet 1995; Van Osnabrugge 2000).

Regarding the investment criterion of "financial traction," institutional investors particularly focus on economic-driven outcomes (Hsu et al. 2014). They set these milestones for their investee ventures to apply outcome-oriented tracking instruments. In contrast, angels place less focus on economic potential, as this criterion cannot help decrease their information asymmetry and address the agency problem (Van Osnabrugge 2000).

Finally, the large number of publications in which VCs' and BAs' investment criteria have been quantitatively and qualitatively investigated constitutes the importance of this unstructured and heterogeneous research field. Figure 2 summarizes the

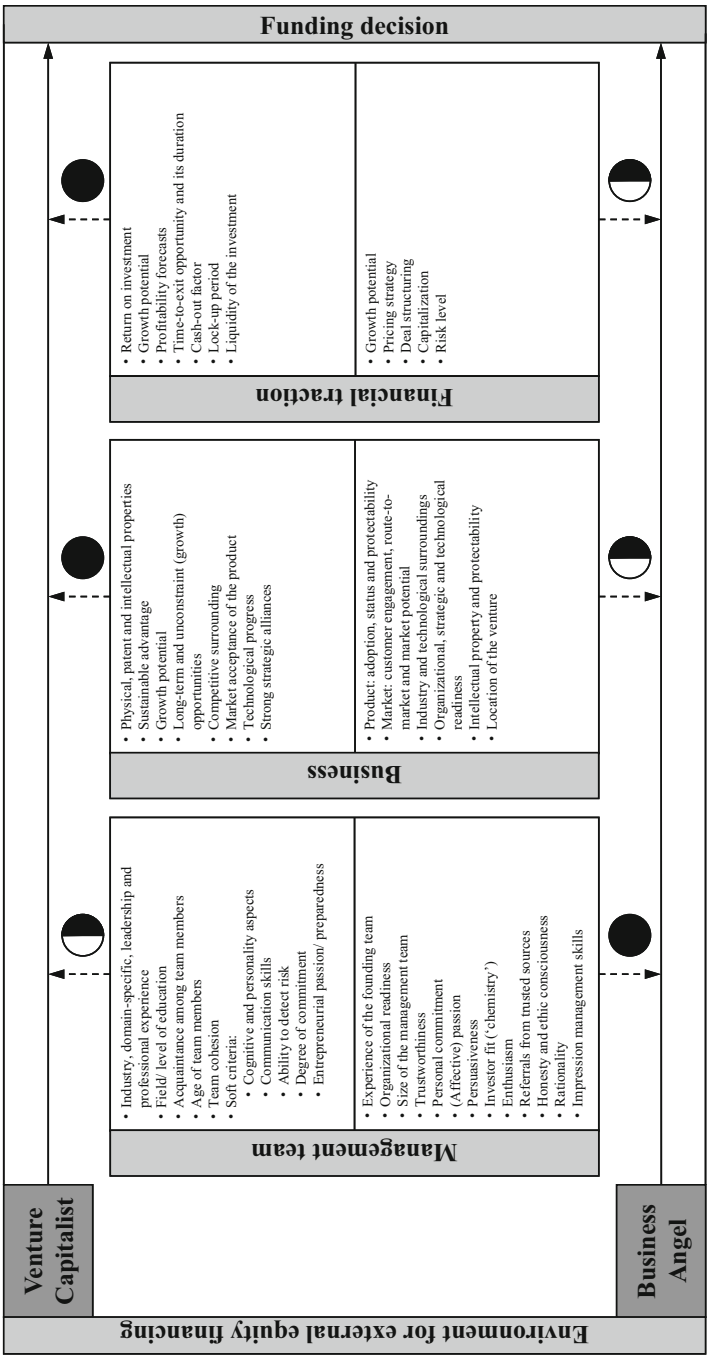

Fig. 2 Conceptual framework. This figure provides a conceptual framework based on the VC and BA investment criteria literature. It presents the three major investment criteria groups that VCs and BAs focus on during their investment decision: (1) the management team, (2) the business, and (3) the financial traction

main investment criteria VCs and BAs employ for their decision policies that have been discussed in this literature review.

3 Limitations

This paper has revealed VCs' and BAs' investment criteria across the entrepreneurial finance literature body; however, it has some limitations that should be acknowledged. First, we only included published academic studies in our literature body to guarantee a high-quality review. However, other significant findings from working papers or nonacademic publications may have been neglected. Second, we did not adopt any specific cut-off criteria, such as an impact factor such as the Thomson Reuters "Journal Citation Reports (JCR) Impact factor" (e.g., Bouncken et al. 2015). We did not include such a cut-off requirement to account for the particularly practice-oriented research field and to avoid a possible publication bias (Dickersin and Min 1993). Third, we did not rule out that there may be seminal academic and nonacademic publications in other languages, but we believe that the pertinent literature in the entrepreneurial finance context is primarily published in English. Fourth, the inclusion criteria employed during our literature search may have been too stringently defined.

4 Avenues for Future Research

First, further research on early-stage investors' decision policies is needed. It is not yet understood how VCs or BAs rate entrepreneurs' (business) failure experience (Cope et al. 2004). If they value this experience as a (positive) decision criterion, why and how does this influence VCs' decision-making? Similarly, it may be fruitful to investigate whether the relative weight of entrepreneurial failure experience is a decisive criterion for BAs and why it might be more important for BAs than for VCs. Additionally, it would be useful to examine differences in the perception of failure between these two investor types, which also raises the question of whether a relationship exists between an early-stage investor's failure and an entrepreneur's failure. Finally, future research should consider the results of the current study investigating possible similarity biases that might arise during the investment decision process. Accordingly, we suggest more intensive research activities in the entrepreneurial finance cosmos relying on conjoint analyses. As a theoretical starting point for methods best suited to answer the proposed research questions, we refer to the work by Hsu et al. (2017).

Second, even though a wide range of literature on VCs' and BAs' investment criteria exists, findings on corporate VCs (Siegel et al. 1988), bank-affiliated[5] VCs, and philanthropic VCs (Scarlata and Alemany 2009) are scarce. Accordingly, future research might aim to investigate the heterogeneity of different investor types and compare investment criteria among independent VCs, corporate VCs, bank-affiliated VCs, philanthropic VCs, and BAs, for example, by capitalizing on the publication of Mason and Stark (2004), to gain a better understanding of the investment criteria different funders focus on when screening a business plan. Additionally, an experimental analysis such as in Hsu et al. (2014) might help identify the different weighting of criteria between these investor types. Hence, an empirical investigation of these five types of external equity providers may supply entrepreneurs with further insights into external equity providers' expectations on new venture financing and ultimately provide insights into how early-stage investors interrogate business plans.

Third, our literature body shows that researchers prefer the well-developed US, UK, and Canadian contexts to investigate early-stage investors' investment criteria. Therefore, researchers may expand the geographical scope of their analyses to investigate the variability of results on the debate on VCs' and BAs' investment criteria across further countries that can be influenced by endogenous factors such as different legal, regulatory, industrial, and cultural settings. For instance, the currently increasing number of VC deals, as well as the amount of money raised by venture-backed firms in Germany, France, and Israel, may be a good starting point to expand investment criteria research based on European samples (KPMG 2018). Finally, 79.6% (n = 43) of studies in our literature body focus their work on single countries. To investigate the influence of these endogenous factors on certain investment criteria, future studies should investigate cross-country datasets.

Fourth, researchers prefer to use post hoc methodologies to investigate VCs' and BAs' investment criteria (Shepherd and Zacharakis 1999). However, these retrospective methodologies are hazardous because of the recall and post hoc rationalization biases and the lack of introspection among informants (Golden 1992; Zacharakis and Meyer 1998). For instance, people do not have a full understanding of their decision-making processes and cannot precisely recount their cognitive processes in retrospect (Nisbett and Wilson 1977). Thus, their self-reported data as gathered by post hoc methodologies are deemed invalid (Zacharakis and Meyer 2000) and do not reflect the actual decision-making process (Mason and Stark 2004). Furthermore, post hoc studies do not offer the possibility to investigate contingencies in VCs' and BAs' relationships. Therefore, these types of studies cannot provide a comprehensive understanding of their decision policies, as only what Argyris and Schon (1974) refer to "espoused" decision policies are evaluated, and "in-use"

[5]To the best of our knowledge, no appropriate publications exist on bank-affiliated VCs' investment criteria. For instance, previous research on bank-affiliated VCs investigated bank behavior in terms of VC investing and lending activities (Hellmann et al. 2008) and the effects of bank-affiliated VC activities on portfolio companies (Cumming and Murtinu 2016).

decision policies are not considered (Shepherd 1999b). However, these post hoc limitations can be overcome by focusing on real-time research methodologies. On the one hand, verbal protocols aim to gather self-reported data through "think-aloud protocols". This kind of experiment enables data gathering of early-stage investors' thought processes, thus eliminating any recall and post hoc rationalization bias (Sandberg 1988). In general, verbal protocols provide detailed information of (1) how early-stage investors analyze business plans, (2) which factors they focus on to make a decision, and (3) how information in the business plan is processed. This information helps scholars absorb investors' actual and stated decision policies (Zacharakis and Meyer 1998). On the other hand, the entrepreneurial finance literature has rarely borrowed conjoint analysis from the marketing research field, in which this real-time methodology is rooted (Green and Srinivasan 1990). Conjoint analysis enables the entrepreneurial research field to disaggregate the decision process into its core structure based on various profiles, which are investigated in real time. This type of analysis also helps uncover early-stage investors' decision theories "in-use" (Shepherd and Zacharakis 1999).

Fifth, we want to direct future research to carry out an investigation of the importance of VCs' and BAs' investment criteria across the literature through a systematic aggregation and evaluation of existing empirical evidence. Hence, a meta-analysis can shed additional light on the overall direction of early-stage investors' investment criteria as well as on effect sizes in-between certain criteria groups (Glass 1976; Rauch and Frese 2006). We suggest using our literature body as a basis for a possible meta-analysis. In the next step, scholars need to define inclusion criteria specific to a meta-analysis to narrow down the number of publications. These may include the characteristics of the variables, the availability of report sample sizes, and the outcome statistics. As outlined by our literature body, studies use different research methodologies, definitions of investment criteria, as well as samples from different populations. Thus, a main challenge in such a meta-analysis will be to deal with equal measures for differently labelled constructs and vice versa across publications (Lipsey and Wilson 2001).

Finally, a comparatively young research field places emphasis on the opposite side of the research efforts on early-stage investors' investment criteria, namely, by investigating how early-stage entrepreneurs evaluate and select their venture capital providers (e.g., Drover et al. 2014; Hsu 2004; Valliere and Peterson 2007). One reason for the academic restraint in this research field is the limited number of public data regarding past financing rounds of new ventures. Additionally, entrepreneurs are rather reluctant to communicate financial and strategic information (Cassar 2004). At this point, the increasing acceptance of experimental designs in entrepreneurial finance research (Kraus et al. 2016) opens a possibility to enlarge the proposed research strand by investigating how entrepreneurs select external equity providers. This possibility may help both future research and practitioners in the entrepreneurial finance world better meet the requirements of the other.

5 Conclusion

In this paper, we systematically reviewed the literature on VCs' and BAs' investment criteria, thereby identifying and organizing the extant knowledge in this research field. We selected 54 articles focusing on VCs' and BAs' investment criteria and showed how this research field has developed over the last four decades. This paper helps to enlarge the current research field dealing with VCs' and BAs' investment criteria, as it recomposes the unstructured and heterogeneous literature field on such criteria. We reviewed pertinent literature to create a cogent understanding of where the current debate on VCs' and BAs' investment criteria stands. In doing so, we derived a framework based on agency theory that helps distinguish between the different types of investment criteria VCs and BAs employ. We illustrated how VCs' investment decisions are in the first instance motivated by criteria related to the business and financial traction. VCs especially focus on financially driven criteria to satisfy the return expectations of their fund providers. In contrast, the BA industry prioritizes the management team before looking at other investment criteria, which can be explained by the missing institutional setting in the angel-entrepreneur dyad. Beyond that, we revealed avenues for future research, which would further disentangle the debate on VCs' and BAs' investment criteria.

Furthermore, our review has practical implications. For entrepreneurs seeking venture funding, our results show that VCs and BAs have different preferences in terms of their investment policies. Entrepreneurs have only one opportunity to present their business idea to a VC or BA investor. Even though VCs and BAs place different weights on investment criteria, our review shows that they all holistically examine the management team, the business, and the financial traction. However, entrepreneurs face the problem of not knowing exactly, which criteria VCs and BAs primarily place emphasis on. Our structured overview of investment criteria provides entrepreneurs with a better and more profound understanding of which criteria VCs and BAs focus on enabling entrepreneurs to better tailor their pitches when seeking external equity financing. In this kind of self-presentation, entrepreneurs seeking funds from VCs should emphasize their business and financials. Conversely, entrepreneurs seeking funds from BAs should prioritize the management team.

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Measuring Venture Capital Sentiment in Europe

Walter Diegel, Alexandra Moritz, Joern H. Block, Antonia Botsari, Frank Lang, and Helmut Krämer-Eis

Abstract Sentiment indices are widely used tools that are often used to predict market developments. However, only a few indices exist for venture capital (VC) markets, mostly specializing in certain regions or types of investors. This paper introduces a VC market sentiment index that is based on a survey of 379 European VC investors who are almost all decision-makers within their firms, such as partners or CEOs. Hence, it is possible to compare the expected VC market development across different European regions, as well as across industry focuses and investment stage focuses. Additionally, the introduced index allows for a separation between the perception of the market and the perception of the participants' own funds and portfolios. This study aims to set the starting point for a sentiment index of the European VC market that will be repeated on a regular basis. The results of this index, or a modified version of it, will be published by the European Investment Fund's Research & Market Analysis.

While overall European VC market sentiment is found to be very positive, investors consistently perceive their own businesses as more positive than the market. Later-stage investors perceive the market slightly more positively than seed/startup investors. Investors that focus on cleantech investments regard the market as worse than investors focusing on information and communications technology and Life Science but still relatively positive. VC investors that are located in the UK and Ireland show only a slightly positive sentiment. Their assessment of the

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market, especially compared to that of other European regions, is barely positive. On the other hand, they assess their own funds and portfolios comparatively positively.

Keywords Venture capital · Sentiment index · Europe · Business environment

1 Introduction

Entrepreneurial activities can have strong implications for the economic growth of a country or a certain region. Especially in highly developed countries, total entrepreneurial activity has a significant positive effect on GDP growth (Acs and Armington 2006; Audretsch et al. 2006; Van Steel et al. 2005). However, the ability to start a company is limited by the founder's access to financial resources. While many entrepreneurs in the seed stage use capital from informal sources, e.g., from their family or friends, in the later stages, more financing is required, which typically cannot be provided by these informal sources (Bruno and Tyebjee 1985). In this case, one solution can be equity capital provided, for example, by venture capital (VC) firms. Investments of VC firms can have strong impacts on the startup company, for example, regarding the startups' signaling of credibility toward potential employees or other investors (e.g., Davila et al. 2003). VC firms tend to invest higher amounts, particularly after the seed and startup stage, highlighting that VC financing is an important part of the European financing landscape (Freear and Wetzel 1990; KPMG 2018).

Taking a closer look at the European VC market, the total value of VC investments in European companies increased from 3.2 billion euros in 2012 to 6.4 billion euros in 2017 (Invest Europe 2018). This increase of 100% within 5 years shows the rising importance of VCs for European enterprises. From a governmental perspective, improving market conditions in favor of entrepreneurs and VCs could improve economic welfare. Keuschnigg and Nielsen (2001) show that cost-effective productive contributions by the government, such as offering entrepreneurial training or technological services, do increase welfare gains. Hence, not surprisingly, a number of governmental institutions are active in the VC market, providing monetary and nonmonetary support mechanisms. One of these institutions is the European Investment Fund (EIF), with whom this study was conducted. The EIF is a specialist provider of risk finance to benefit small and medium-sized enterprises (SMEs) across Europe. By developing and offering targeted financial products to its intermediaries, the EIF enhances SMEs' access to finance. The EIF is a leading institution in the European VC market, focusing on the establishment of a sustainable VC ecosystem in Europe to support innovation and entrepreneurship. The EIF concentrates on building the necessary private sector VC infrastructure to address market gaps and opportunities with the aim of further enhancing the attractiveness of European VC financing as an alternative asset class. The EIF works with VC funds, which act as

intermediaries and invest in innovative high-tech SMEs in their early and growth phases.[1]

To provide adequate market support, the EIF and other governmental institutions require information about the current state and future development of the VC market. Furthermore, practitioners that directly participate in the VC market, i.e., VC investors as well as entrepreneurs, can benefit from information regarding the VC market's development. For example, VC investors receive an opportunity to benchmark their own perception of the market and its development against the general sentiment. This additional information can enrich the foundation of their strategic decisions. In addition, entrepreneurs can make use of this information when seeking funding. Depending on the expected market trend, an entrepreneur could delay or accelerate his/her application to receive VC financing. Another benefit drawn from this information could be the opportunity to learn something about how well innovative startups are doing and to predict upcoming initial public offerings (IPO), as VC investors enhance a venture's probability for a successful IPO as well as the amount of money raised in such a case (e.g., Barry et al. 1990; Chang 2004). One of the tools typically used to predict market trends is confidence indices. The predictive power of confidence indices, such as the Index of Consumer Sentiment by the Survey Research Center of the University of Michigan, is broadly accepted and confirmed empirically (e.g., Howrey 2001).

This paper's goal is to introduce a new VC market sentiment index for the European market. This "European VC market sentiment index" is meant to support practitioners and governmental institutions by providing insights into the current state and future development of the European VC market. The European VC market sentiment index is based on the results of the EIF VC Survey, which was conducted in the fourth quarter of 2017 and will be repeated regularly among VC fund managers that are active in Europe.[2] This paper describes the methodology used to calculate the VC market sentiment index. The results of this index, or a modified version of it, will be regularly published by the EIF's Research & Market Analysis.[3]

The paper is structured in five sections. Following the introductory Sect. 1, Sect. 2 describes in greater detail the EIF VC Survey and discusses issues relating to data collection and sample composition. Section 3 discusses sentiment measurement in general and the development of the proposed European VC market sentiment index. Section 4 presents the results of several statistical tests as well as the results of the European VC market sentiment index for the overall sample, followed by more detailed analyses of the differences in index values across different investment stages, industry focuses, and European regions. Finally, Sect. 5 addresses the limitations of the study and provides an outlook on the upcoming EIF VC Survey waves.

[1]More information about the EIF can be found on the EIF website www.eif.org

[2]See Kraemer-Eis et al. (2018a, b) for more information about the EIF VC Survey. The second wave of the EIF VC Survey was launched in February 2019.

[3]More information about EIF's Research & Market Analysis (RMA) can be found here: http://www.eif.org/news_centre/research/index.htm

2 Survey, Sample, and Data

2.1 Description of the Survey

One of the EIF VC Survey's aims was to obtain deeper insights into the European VC firms' market sentiment. Therefore, fund managers were asked about their current business situation and their expectations for the future. The sentiment questionnaire was separated into two parts. First, the respondents had to answer questions related to the VC firm they were working for, such as questions about the firm's headquarters, its country of focus, its industry of focus, its assets under management, its most important investment stage, and its ownership type, as well as a question asking for the respondent's position within the firm. These questions enabled us to make group splits to gain deeper insights into the sentiment of, for example, a certain region. The second part contained questions related to market sentiment and were typically split into two subquestions: first, respondents were asked about their current or past situation, and second, respondents were asked about future expectations. This enabled us to analyze the VC fund managers' current situation and to also appraise their expectations about the market. Some further questions were not directly related to market sentiment but offered insights into the challenges in the European VC market, investment behavior, and exit activities of portfolio companies.

2.2 Sample and Collection of Data

The EIF VC Survey comprises VC firms that are headquartered in a country of the European Union (EU28) as well as those that are headquartered in Switzerland, Norway, and Turkey. To qualify as a participant, fund managers had to meet several criteria. First, their firm had to be headquartered in one of the countries mentioned above; second, the company needed to be classified as a "Venture Capital" firm; and third, the potential participant had to be in a leading position within the firm, such as partner, CEO, director, or similar. This approach provided a unique sample of decision-makers in 1453 European VC firms.

The survey was created using SurveyMonkey, an industry-standard online tool used for the professional creation of online surveys. The survey was conducted between the 7th of November and the 18th of December, 2017.

In total, 2032 VC investors, representing 1453 different companies, received links to the online questionnaire. The questionnaire was completed by 379 VC fund managers from 316 different VC firms, leading to a response rate of 18.7% at the individual level and 21.7% at the company level. VCs from 26 different countries participated in the survey, giving a very broad sample distribution across most European countries. Most respondents are from VC firms headquartered in the UK

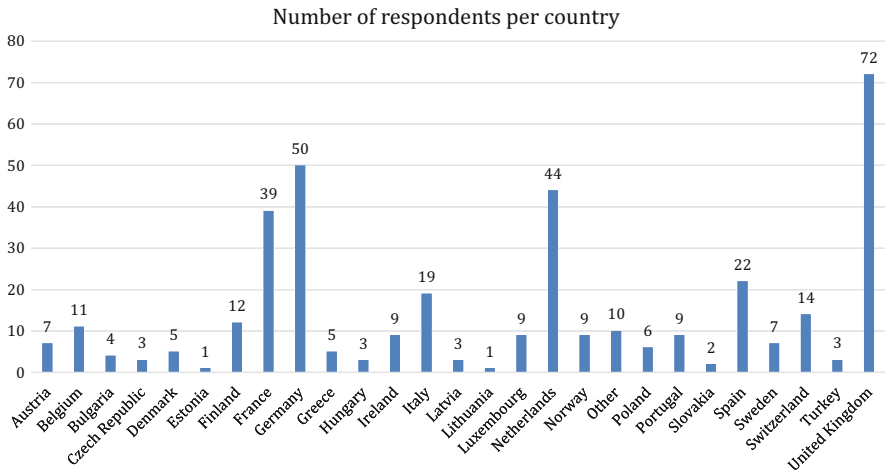

Fig. 1 Geographical distribution of respondents (by VC firm headquarters)

(72), Germany (50), the Netherlands (44), and France (39). These countries account for 54.1% of all answers (Fig. 1).

It is also interesting to know in which countries these firms focus their investment activities. To acknowledge that the VC firms probably also invest in other countries besides their domicile, respondents were asked to name up to three of the most important countries in which they invest. Figure 2 provides an overview of the respective answers.

In line with the geographical distribution of respondents by VC firm headquarters, Fig. 2 also shows that the most important investment target country is the UK (71 respondents), followed by Germany (65), France (41), and the Netherlands (32). Interestingly, there is also a considerable share of respondents (89) that indicated some "Other" option, suggesting that important investments can also be found outside the EU28, Norway, Switzerland, and Turkey.

2.3 Descriptive Statistics

This study aimed at receiving data from the individuals that can be considered to be decision-makers in their respective VC firms. Indeed, most of the actual respondents are partners (67.3%) or CEOs (16.9%). Thirty respondents (7.9%) were stated to be directors or principals/vice presidents of the companies they work for. The remaining 30 respondents indicated holding an "Other" position (13 of them were stated to be CFOs, 2 to be chairmen, 2 to be directors/heads of finance, and the remaining 13 to be managers or analysts). This means that only 3.4% of the surveyed fund managers are not in a leading position within a VC firm (Fig. 3).

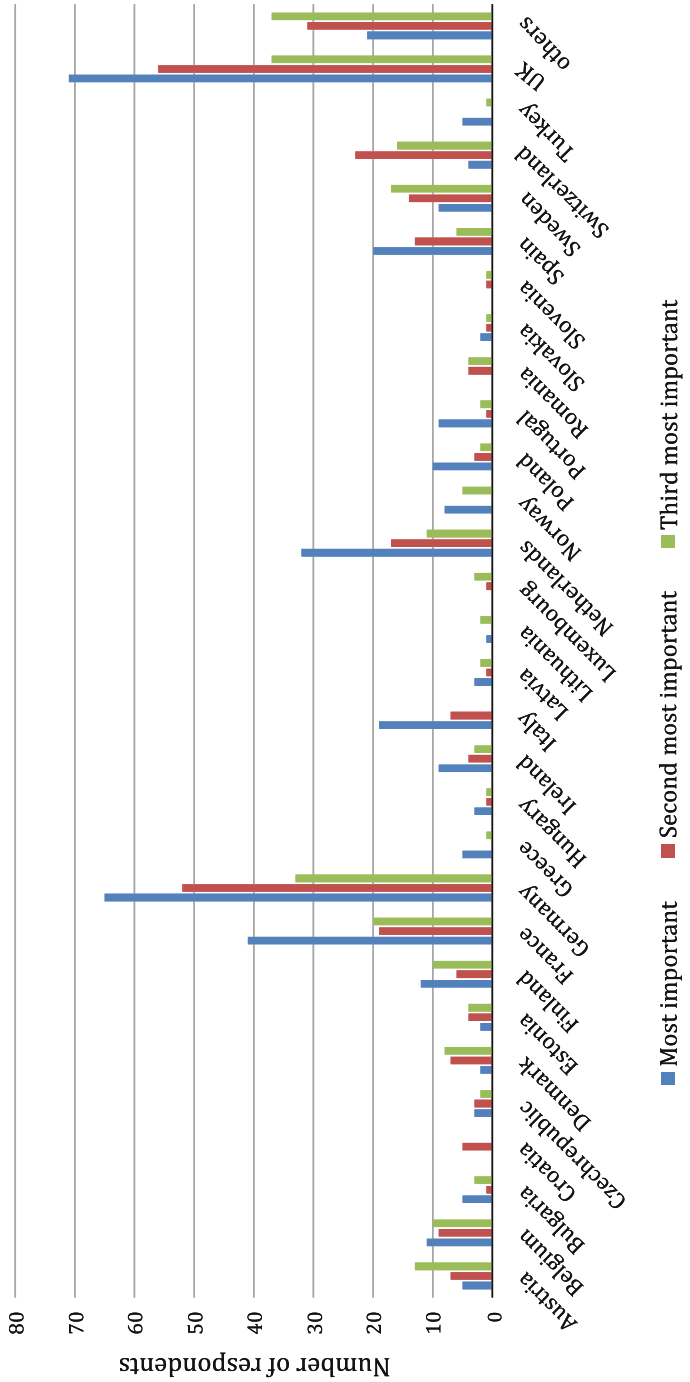

Fig. 2 Most important countries of investment

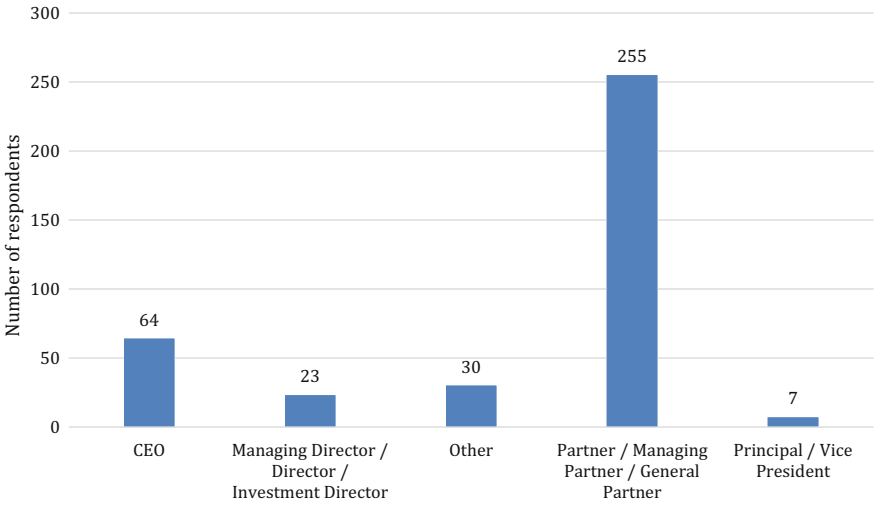

Fig. 3 Position of respondents within the VC firm

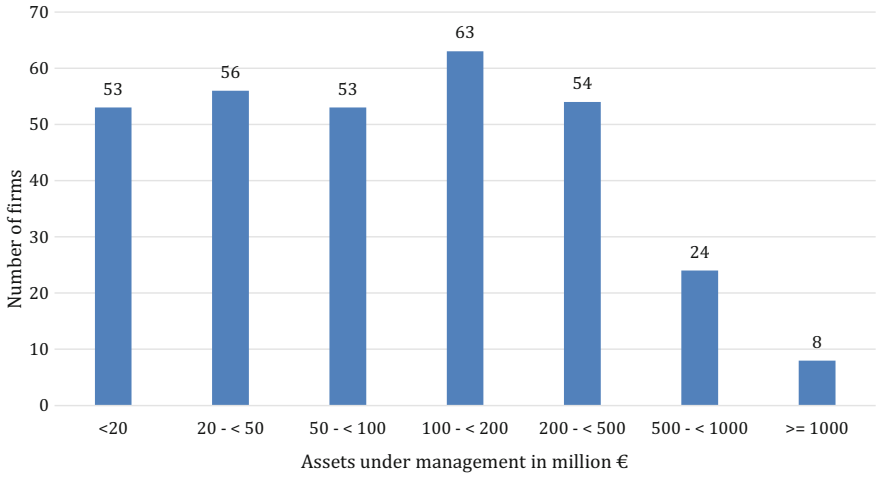

Fig. 4 Assets under management (in million euros per company)

The VC firms' values for total approximate assets under management range from 0.5 million euros to 2.3 billion euros. The companies' mean value of approximate assets under management is 178 million euros (Fig. 4).

As Fig. 5 shows, 252 respondents stated that information and communications technology (ICT) is the most important industry in which their VC firm invests. Additionally, 37 respondents stated ICT to be their second most important industry, while 21 respondents marked it as the third most important. This means that 81.8%

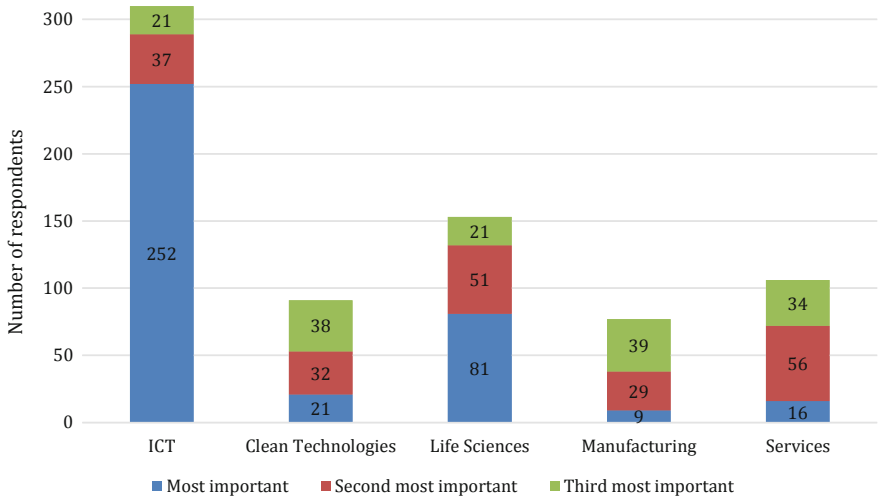

Fig. 5 Most important industries

of the survey participants consider the ICT industry to be important for their investment activities. ICT is followed by Life Science, with 81 respondents identifying it as their most important industry.

2.4 Representativity of the Data

One of the main goals of the European VC market sentiment index is to provide representative information on the sentiment of European VC investors. Considering a sample to be representative in the field of VC can be quite challenging due to the lack of information on the VC market population. Certain databases, such as PitchBook, try to overcome this shortcoming by providing data that were self-reported by VC investors. While it can be argued that self-reported data tend to be biased, research has shown that this type of database provides unbiased information that can be utilized for research purposes (e.g., Kaplan et al. 2002). To achieve a sample that is able to encompass the majority of European VC investors, we decided to use, inter alia, PitchBook. Research has shown that PitchBook offers one of the most comprehensive databases of VC investors and investments (Bowden et al. 2016).

After obtaining the addresses of European VC investors (constituting our initial sample), we calculated, for each country, the share of investors in this particular country relative to the overall sample. Due to the comprehensiveness of the PitchBook database, these relative country shares are assumed to represent the regional distribution of European VC investors quite well. The regional distribution

of the initial sample was then compared with the regional distribution of the received answers. Figure 6 illustrates that a country's share of investors relative to the initial sample is generally comparable to the country's share of respondents relative to the total answers received.

3 Theory on Sentiment Measurement

3.1 General Information on Sentiment Measurement

The first attempts at measuring the sentiment or confidence of a specific group through qualitative questionnaires and predicting future developments with the collected data originated at the University of Michigan Survey Research Center in the 1940s. It was proposed that by letting consumers answer a number of questions, their future spending and economic development in general could be predicted (Dominitz and Manski 2004). In the 1950s, researchers were able to confirm that these qualitative measurements have the ability to predict future spending (e.g., Mueller 1957; Tobin 1959). The predictive power of these studies varies according to certain conditions. For example, the predictive power seems to be stronger in times when there is more divergence between changes in income and changes in attitude (Mueller 1957). This finding can be explained by the theory of psychological economics, where it is expected that changes in attitudes in a group of consumers occur prior to their changes in deferrable spending. The keyword *changes* also highlights that this sort of study needs to be conducted in a longitudinal way to detect these changes in attitudes (Katona 1957). Hence, applied to the European VC market sentiment index, the first survey should be understood as a starting point that measures the current sentiment of VC investors. However, the survey should be repeated on a regular basis to allow us to detect the changes in attitudes with the intention, inter alia, to predict upcoming changes in the European VC market.

Researchers broadly accept the connection between attitudes, behavior, and finally market development in general and were also able to confirm it empirically (e.g., Dreger and Schumacher 2005; Jansen and Nahuis 2003; Ludvigson 2004). Hence, a broad variety of consumer confidence indices are established, such as the US Consumer Confidence Index (CCI), the German ifo Business Climate Index or the European Commission's Economic Sentiment Indicator (ESI), and Business Climate Indicator (BCI).

In addition to the named indices, which mainly focus on consumer confidence, there are also some indices that are more specialized, such as indices surveying the sentiment of VC or private equity investors. These include, for example, the German CVC Sentiment Index, the US Silicon Valley Venture Capitalist Confidence Index, or the KfW German Private Equity Barometer. While the mentioned indices are restricted to certain countries or even only certain regions, this paper introduces an index representing the sentiment of European VC firms.

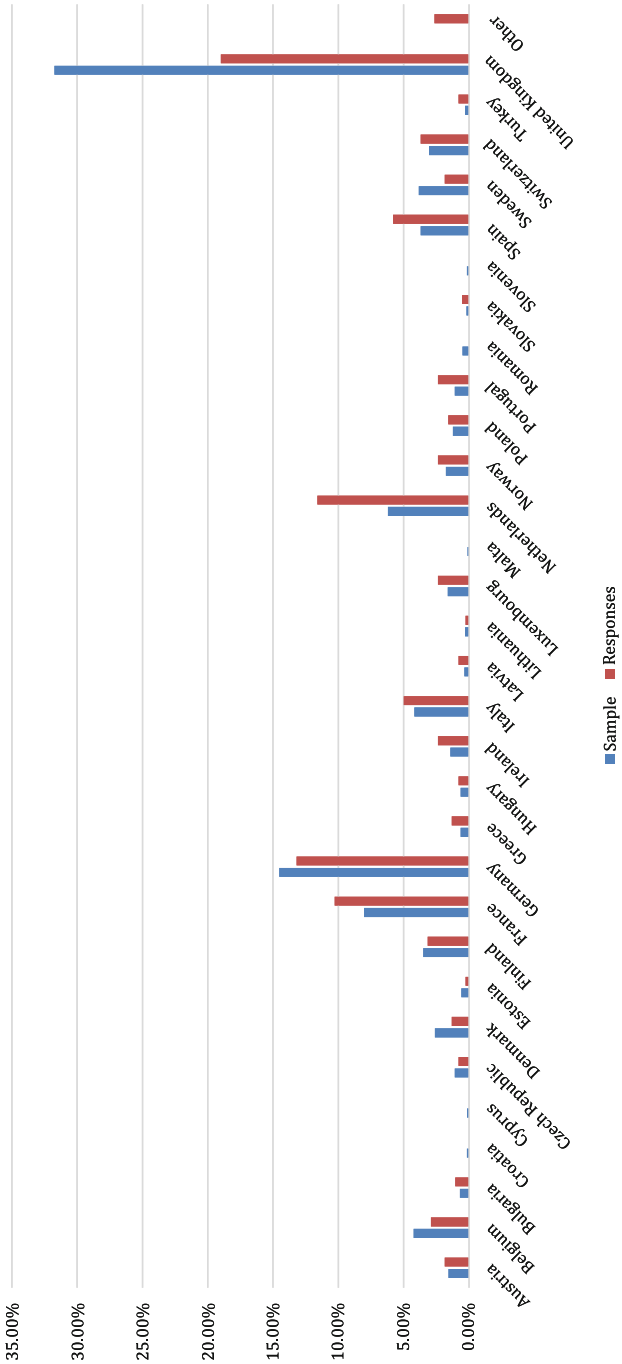

Fig. 6 Comparison between countries' share in sample and share in responses

3.2 Examples of Sentiment Index Calculation

A sentiment or confidence index is supposed to measure whether the individuals of a certain group show a more positive or a more negative attitude toward a certain topic. In this case, contrasting the number of positive answers with the number of negative answers serves as the indicator for the sentiment. The calculation of such an index is primarily conducted using the net balances of these answers. Questions that are answered neither in a negative nor in a positive way are regarded as neutral answers and are typically not considered for the calculation due to their lack of predictive power (ifo Institute 2018). Regarding, for example, the Conference Board US CCI, the participants are required to answer only five questions in total. These questions are separated into two categories, with two questions asking for the respondents' evaluation of the current situation (present situation index) and three questions asking about their expectations for the next 6 months (expectations index). The responses can be either positive, neutral, or negative (The Conference Board 2011). This approach, using only a few questions that are separated into current situation and expectations and offering only three distinct response options, is widely used among other confidence indices (e.g., ifo Institute 2018; Metzger 2018).

Assuming, as a simple example, that a sentiment is calculated with only one question, where 20 people answered in a positive way, 5 people answered in a negative way, and 3 people answered in a neutral way, the net balance of positive answers would be 20 minus 5, and therefore the sentiment would be considered to be positive. It needs to be taken into account that this example is highly simplified to understand the basic idea of sentiment calculation. In practice, multiple questions are typically used instead of a single question. The advantage of this approach is that certain measurement errors, such as participants' different understanding of the questions, can be reduced or eliminated (Mueller 1957).

To receive an index value that is easy to understand and reflects how strong the positive or the negative attitude toward the market is, the answers' net balances can be transformed with simple approaches. For example, The Conference Board CCI is calculated by using the relative values of the answers, i.e., by dividing the number of positive answers to a certain question by the sum of positive and negative answers to this particular question. This approach results in a figure between zero and one, where zero means that no participant answered in a positive way and one means that no participant answered in a negative way (The Conference Board 2011).[4]

The Conference Board CCI includes two subindices, each consisting of more than one question. One subindex investigates the participants' current situation and the other the participants' expectations. The "present situation index" is represented by the average of the values for the two questions concerning the present situation, while the "expectations index" is represented by the average of the values for the three questions concerning the future. The overall CCI value itself is the average of these five values. To make the historical index values easier to compare, the values

[4]If all participants answered in a neutral way, the sentiment index could not be measured.

of 1985 serve as a reference year, where the CCI is transformed to a value of 100. Based on the index of 1985, index values that are calculated for the following years always use the value of 1985 as a reference point, meaning that if the index for a year is above 100, the sentiment is more positive than in 1985 and if it is below 100, the sentiment is more negative than in 1985. This particular reference year was chosen because it was seen as an average year, meaning that it was neither overly positive nor overly negative (The Conference Board 2011). In the long term, a similar approach might be applied to the European VC market sentiment index. This grants a more straightforward understanding of the index. Furthermore, it offers the opportunity to avoid tendencies toward overoptimism or overpessimism.

3.3 Questions Used for the European VC Market Sentiment Index

The European VC market sentiment index introduced in this paper follows the basic principles of sentiment index measurement described in the previous subsection, containing questions about the VC fund managers' current situation as well as their expectations for the future. The index is separated into two subindices—one that is based on market-related questions and another that is based on questions about the VC firm itself and its portfolio companies (i.e., the VC firm's investments). The two subindices provide insights into the respondents' market sentiment and offer insights into the VC firms and their portfolio development. Finally, an overall index is calculated by using all questions of both subindices.

To construct the index, we designed a questionnaire tailored to the European VC market. The VC fund managers were asked about their current business situation but also about their expectations for the near future. Furthermore, more specific questions about the challenges of the VC managers but also of the overall VC market were included. The possible answers to these questions are expressed by using five-point Likert scales with two negative options (e.g., "slightly deteriorate," "strongly deteriorate"), one neutral option (e.g., "stay the same"), and two positive options (e.g., "slightly improve," "strongly improve"). Being able to categorize the given answers into "positive," "neutral," or "negative" is a compulsory condition for calculating the sentiment index proposed here (please compare Sect. 3.4).

The questions asked can be split into two subindices ("levels"), i.e., market-level questions and fund-/portfolio-level questions. The separation into these levels allows us to disaggregate the sentiment into a pure market view, where the respondents only assess the business environment in general, and into a pure self-view, where respondents only assess their own businesses. The answers from both levels are then combined, resulting in the overall VC sentiment index. In the following section, we describe the questions and their categorization into the subindices in more detail.

Market-Level Questions

1. *How would you rate the fundraising environment for venture capital funds over the past 12 months (good, average, bad)?*
2. *Over the next 12 months, how do you expect the fundraising to develop (improve, stay the same, deteriorate)?*

The fundraising environment is a critical aspect of VC firms because it determines whether they are able to receive enough funding to set up their funds. It is influenced by a broad variety of factors, such as changes in taxation and regulation, as well as economic development (e.g., Gompers 1994). These questions are intended to measure the sentiment toward the current fundraising environment and the expectations for its future development.

3. *Over the next 12 months: Do you expect that the overall venture capital market in Europe will (improve, stay the same, deteriorate)?*

This question directly asks for the attitude toward the expected development of the VC market and can therefore be seen as a more "classical" sentiment question.

4. *Over the next 12 months: What do you expect to happen to investment activities in the European venture capital market (improve, stay the same, deteriorate)?*

This question covers two different aspects: measuring the expected willingness of VC firms to invest within the next 12 months in general as well as the expectation toward the development of promising companies that are worth investing in. It can be assumed that if investors expect the number of promising target companies to rise over the next 12 months, they also expect that investment activities will improve.

Fund-/Portfolio-Level Questions

1. *How would you assess the current state of your business (good, average, bad)?*
2. *How do you expect the state of your business to change over the next 12 months (improve, stay the same, deteriorate)?*

These questions are comparable to the usual sentiment questions and ask directly for the VC fund managers' current and expected business situation.

3. *How did your portfolio companies develop over the last 12 months (above expectations, as expected, below expectations)?*
4. *Over the next 12 months, how do you expect that your overall portfolio will develop (improve, stay the same, deteriorate)?*

The ultimate goal of VC firms is to exit their portfolio companies to generate positive returns for their investors (e.g., Gompers and Lerner 2006). To achieve this, portfolio companies typically need to grow and/or become profitable. This development results in a higher company valuation making a profitable exit possible. By asking indirectly, the aforementioned questions three and four aim at understanding how the company portfolio has developed and will develop to comprehend the expected exit opportunities and hence the development of the VC firm altogether.

Table 1 Questions used in the European VC market sentiment index

	Current	Expectation
Market-level	1. How would you rate the fundraising environment for VC funds over the past 12 months?	2. Over the next 12 months, how do you expect the fundraising to develop?
		3. Over the next 12 months: Do you expect that the overall venture capital market in Europe will?
		4. Over the next 12 months: What do you expect to happen to investment activities in the European venture capital market?
Fund-/portfolio-level	1. How would you assess the current state of your business?	2. How do you expect the state of your business to change over the next 12 months?
	3. How did your portfolio companies develop over the last 12 months?	4. Over the next 12 months, how do you expect that your overall portfolio will develop?
		5. How do you expect the number of your new investments to develop over the next 12 months?

5. *How do you expect the number of your new investments to develop over the next 12 months (increase, stay the same, decrease)?*

This question is related to question four of the market-level questions. While the market-level question targets the VC fund managers' expectation about the development of the VC investment activities in Europe in general, this question asks explicitly how the VC firm will change its investment activities in the near future.

3.4 Calculation of the European VC Sentiment Index

As described in the previous subsection, the proposed sentiment index consists of two subindices: a *market-level index* and a *fund-/portfolio-level index* (Table 1). A value is calculated for each of the questions covered in each index using the following formula:

$$\frac{\text{Number of positive answers} - \text{Number of negative answers}}{\text{Number of positive answers} + \text{Number of negative answers}}$$

These values illustrate whether the sentiment is mainly positive or mainly negative, i.e., if there are more positive answers to a question, the value is above 0; if there are more negative answers to a question, the value is below 0. The index for each level is then calculated as the average of the respective values. With this approach, the sentiment can be divided into the VC fund managers' introspection

Table 2 Variables

Question	Variable name[a]	Index level
How would you rate the fundraising environment for VC funds over the past 12 months?	Current fundraising	Market-level
Over the next 12 months, how do you expect the fundraising to develop?	Expected fundraising	Market-level
Over the next 12 months: Do you expect that the overall venture capital market in Europe will?	Expectation overall	Market-level
Over the next 12 months: What do you expect to happen to investment activities in the European venture capital market?	Expected investment activity	Market-level
How would you assess the current state of your business?	Current state of business	Fund-/portfolio-level
How did your portfolio companies develop over the last 12 months?	Current portfolio development	Fund-/portfolio-level
How do you expect the state of your business to change over the next 12 months?	Expected state of business	Fund-/portfolio-level
How do you expect the number of your new investments to develop over the next 12 months?	Expected new investments	Fund-/portfolio-level
Over the next 12 months, how do you expect that your overall portfolio will develop?	Expected portfolio development	Fund-/portfolio-level

[a]Variables are coded as 5-point Likert scales, where "1" presents the most negative possible option, "3" represents a neutral option, and "5" represents the most positive option

regarding their own businesses and the VC fund managers' overall market perception. To calculate the overall VC sentiment index, the average value for all nine questions is derived.

The described approach results in 12 different values. One value for each of the nine questions, one average index value for the market-level questions (i.e., the market-level index), one average index value for the fund-/portfolio-level questions (i.e., the fund-/portfolio-level index), and finally the VC market sentiment index as the average of the nine single values (Table 2). Furthermore, we provide indices of the investors' current sentiment and their expectations for the overall sample (see Sect. 4.2), calculated as the average of the respective values for the current state and expectation questions.

4 Results

4.1 Correlations and t-Tests

First, this section shows statistics of the answers on the index questions. Table 3 shows the mean value and standard deviation of each question's answer, being coded from 1 (most negative option) to 5 (most positive option), including a neutral option coded 3.

Table 3 Standard deviation and mean values

Variable	Mean	Std. deviation	N
Current fundraising	3.44	0.905	379
Expected fundraising	3.21	0.802	379
Expectation overall	3.50	0.754	379
Expected investment activity	3.52	0.798	379
Current state of business	4.08	0.632	379
Current portfolio development	3.47	0.833	379
Expected state of business	3.88	0.851	379
Expected new investments	3.55	0.890	379
Expected portfolio development	4.11	0.646	379

The questions that achieve the most positive answers are "Over the next 12 months: How do you expect that your overall portfolio will develop?" with a mean of 4.11 and "How would you assess the current state of your business?" with a mean of 4.08. Additionally, both questions show the lowest variance, with standard deviations of 0.646 and 0.632. Regarding the expected fundraising over the next 12 months, it is relatively low, showing a mean of only 3.21.

The correlation matrix (Table 4) shows that each question used for the VC sentiment index correlates significantly with at least three other questions. However, the correlation is not very strong for most questions. Looking closer at the values, a few outstanding findings are shown. First, the *expectation overall* and *expected investment activity* correlate very strongly, with a value of 0.780, which is highly significant. Second, regarding the correlation between *expectation overall* and *expected fundraising*, a comparably strong and significant positive correlation with a coefficient of 0.419 can be found.

Furthermore, it is shown that some questions that are related to the same topic but different times (i.e., regarding current situation or expectation) are not significantly or are only weakly correlated. For example, *current fundraising* and *expected fundraising* do not correlate significantly, highlighting that the expected development of the fundraising environment is not necessarily connected to the current fundraising environment. Another finding shows that c*urrent state of business* and *expected state of business* are correlated with a relatively low effect of 0.150. This shows that these questions are not as strongly interconnected as one would assume. *Current fundraising* seems to be unconnected to fund-level expectations, i.e., *expected state of business*, *expected new investments*, and *expected portfolio development*. This also holds for the correlations between *expected fundraising* and fund-level expectations. Although the correlations with *expected state of business* and *expected new investment* become significantly positive, the correlation is still relatively weak. Overall, the correlation matrix shows that many questions are positively correlated with each other, although most effects are quite small. This indicates that the questions that were chosen to measure sentiment are, on the one hand, measuring the same aspects but, on the other hand, are diverse enough to grasp a broad feeling of the market, comprising different but relevant aspects of the VC market.

Table 4 Correlation matrix of all index questions

	Current fundraising	Expected fundraising	Expectation overall	Expected investment activity	Current state of business	Current portfolio development	Expected state of business	Expected new investments	Expected portfolio development
Current fundraising									
Expected fundraising	0.072								
Expectation overall	0.197***	0.419***							
Expected investment activity	0.179***	0.374***	0.780***						
Current state of business	0.325***	0.036	0.140**	0.130*					
Current portfolio development	0.042	0.009	0.091	0.112*	0.213***				
Expected state of business	−0.005	0.226***	0.205***	0.194***	0.150**	0.163**			
Expected new investments	−0.042	0.221***	0.173**	0.183***	0.025	0.070	0.260***		
Expected portfolio development	−0.015	0.071	0.217***	0.223***	0.115*	0.301***	0.299***	0.178**	

*Significant at 5%; **Significant at 1%; ***Significant at 0.01%

An additional robustness check was conducted with a linear regression analysis to test if the chosen questions are able to measure the participants' market sentiment and expectations. Answers to the question "On a scale of 1 to 10 how confident are you in the long-term growth prospects of the European venture capital industry?", where 1 is coded as *not confident at all* and 10 is coded as *very confident*, were used as a dependent variable. The mean value of the sentiment questions is used as an independent variable. The model also includes control variables such as industry, location of headquarters, investment stage focus, and assets under management. This regression shows that the *mean value of sentiment questions* is highly significant. Additionally, it has the highest standardized coefficient, showing on the one hand that the questions that were chosen for the sentiment have the power to predict the participants' C*onfidence in long-term growth of the European VC industry* and on the other hand that the participants are consistent in their answers (see Table 16).

In Sect. 3.3, it was proposed to consider the market-level as well as the fund-/portfolio-level for the calculation of the sentiment index. To test whether the market-level-related questions and fund-/portfolio-level-related questions are interchangeable measurements, a paired-sample t-test using the mean values of all market-level questions and mean values of all fund-/portfolio-level questions was conducted (Table 17).

The result shows that the mean values of the market-level questions and the mean values of the fund-/portfolio-level questions differ significantly, being higher for the fund-/portfolio-level questions. Hence, it can be precluded that both measurements are actually measuring exactly the same thing. Furthermore, the result shows that participants obviously differ in their perceptions of the market and of their own firm. A common explanation of this result could be the presence of an overoptimism bias, where fund managers are prone to overestimate possible outcomes and to underestimate the probability of negative upcoming effects (e.g., Eastwood and Nutt 1999; Heaton 2002; Ramnath et al. 2008).

4.2 Overall Sentiment Index Results

This subsection of the results shows the European VC market sentiment indices from all participants of the EIF VC Survey, divided into the two discussed levels. The following subsections go into more detail, illustrating sentiment differences in investment stage focus, industry focus, and regional differences across Europe.

As shown in Table 5, the market-level index has an average value of 0.59, signaling a positive sentiment regarding the market. While the current fundraising[5] environment is assessed similarly to the market-level average (0.59) with a question value of 0.57, expectations regarding the fundraising environment in the next 12 months are considerably lower (0.36). Nevertheless, the overall market-level

[5]Please note that "current" refers to the year in which the survey was conducted, i.e., 2017.

Table 5 European VC market sentiment index (overall sample)

	Market-level index				
	Current situation		Expectation		
	Fundraising over the past 12 months		Fundraising over the next 12 months	VC market development over the next 12 months	Investment activities over the next 12 months
Question value	0.57		0.36	0.73	0.69
Average market-level index	**0.59**				
	Fund-/portfolio-level index				
	Current situation		Expectation		
	Current state of business	Portfolio development over the last 12 months	Expected business state over the next 12 months	Number of new investments in the next 12 months	Overall portfolio development over the next 12 months
Question value	0.97	0.65	0.86	0.72	0.98
Average fund-level index	**0.84**				
Overall VC market sentiment index	**0.73**				
Current index/ expectation index	**0.73**		**0.72**		

N = 379. See Sect. 3.4 for further information on calculations

expectations are assessed very positively, with question values of 0.73 for the VC market development and 0.69 for the investment activities over the next 12 months.

Furthermore, the values that are directly related to the fund managers' VC firms and their respective portfolios are illustrated. First, the current business state value of 0.97 shows that fund managers are generally very positive regarding their own business situation. The current portfolio development is also assessed quite positively, with a value of 0.65. The question value for the expected business situation in the next 12 months (0.86) is found to be slightly below the question value for the current business situation but is still very high. The same applies to the expected number of new investments, with a question value of 0.72. Regarding the overall portfolio development over the next 12 months, the surveyed fund managers have a very optimistic outlook, with a question value of 0.98. Looking at the average index, i.e., the fund-/portfolio-level index, European VC fund managers show a very

Table 6 Overview of investment stage focus indices

	Average market-level index	Average fund-level index	Overall VC market sentiment index	N
Seed/startup stage	0.60 (0.59)	0.83 (0.84)	0.73 (0.73)	270
Later stage	0.60 (0.59)	0.91 (0.84)	0.78 (0.73)	46

Values of the overall sentiment in parentheses

positive sentiment, with an index value of 0.84. Comparing the average values between the two indices at market- and fund-level, it can be seen that while fund managers assess the market quite positively, they regard their own business situation and development to be even more positive.

The **overall VC market sentiment index**, calculated as the average of all nine questions, is very positive, with a value of **0.73**. The final row of Table 5 shows a comparison between the average value of all current state questions (at 0.73) and all questions regarding expectations (at 0.72). As this survey is planned to be repeated at regular intervals, it will be very interesting to track whether and how the perceptions of VC fund managers change over time. The results of the index, or a modified version of it, will be published by the EIF's Research & Market Analysis.

4.3 Investment Stage Focus Differences

This subsection illustrates sentiment differences according to different investment stage focuses.[6]

The comparison in Table 6 shows that the groups do not differ regarding their market-level index, which is 0.60 for both (being in line with the overall results for the market-level index of 0.59). Nevertheless, an obvious difference can be found in the fund-/portfolio-level index. While later-stage investors tend to answer fund-/portfolio-level-related questions very positively (0.91; overall sample = 0.84), seed/startup investors assess the fund-/portfolio-level sentiment comparably lower (0.83). The latter index value is still very high, but taking a look at the VC sentiment index shows that seed/startup investors achieve the same sentiment index as the overall sample (both at 0.73), while the later-stage investors assess the sentiment more positively (0.78).

[6]Since the participants had the possibility to select multiple investment stage focuses, Table 6 only includes those that focus on seed stage, startup stage, or both of these stages (seed/startup stage) or that focus on later-stage investments (later stage). Altogether, the group of later-stage investors consists of 46 participants, whereas the seed/startup investors comprise the answers of 270 investors.

Table 7 Overview of industry focus indices

	Average market-level index	Average fund-level index	Overall VC market sentiment index	N
ICT	0.61 (0.59)	0.86 (0.84)	0.75 (0.73)	250
Life Science	0.53 (0.59)	0.76 (0.84)	0.66 (0.73)	81
Cleantech	0.44 (0.59)	0.79 (0.84)	0.63 (0.73)	21

Values of the overall sentiment in parentheses

4.4 Industry Focus Differences

Since the survey also asked for the most important industry in which the participants invest, this subsection compares the sentiment indices for the three major industry focuses, i.e., ICT, Life Science, and Cleantech. The remaining industries (Services and Manufacturing) are not included due to small group sizes (Services had 16 participants and Manufacturing had 8 participants). Three investors did not state a major industry focus.

As Table 7 shows, comparing the sentiment indices of investors with different industry focuses, considerable differences can be found. First, regarding the market-level index, it is shown that investors with an ICT focus show the most positive sentiment with a value of 0.61, which is slightly higher compared to the overall sample. The market-level sentiment of investors focusing on Life Science is considerably less positive with a value of 0.53. This value is undercut by Cleantech investors, stating a particularly low market-level sentiment of 0.44.

The picture changes as soon as fund-/portfolio-level indices are taken into account, where Life Science investors mark the lowest index value at 0.76, which is below the overall sample's fund-level index of 0.84. Interestingly, investors focusing on Cleantech achieve a very positive fund-/portfolio-level index of 0.79, despite their low assessment of the market-level index. The best fund-/portfolio-level index is achieved by ICT investors, with a value of 0.86. Regarding the overall VC sentiment index, only the ICT investors show, with an index at 0.75, a value that is more positive than the overall sample's index at 0.73. Both Life Science investors (0.66) and Cleantech investors (0.63) show a lower VC sentiment index.[7]

4.5 Regional Differences

Due to the differences among the regional financial market systems in Europe (Moritz et al. 2016), we expect regional differences in the VC market environment.

[7]It must be noted that the latter two groups include, compared to the group of ICT investors, relatively few participants (Life Science with 81 participants and Cleantech with 21 participants).

Table 8 Overview of all regional indices

	Average market-level index	Average fund-level index	Overall VC market sentiment index
Benelux	0.73 (0.59)	0.80 (0.73)	0.77 (0.73)
CESEE[a]	0.73 (0.59)	0.85 (0.73)	0.80 (0.73)
DACH[b]	0.68 (0.59)	0.87 (0.73)	0.79 (0.73)
France	0.67 (0.59)	0.85 (0.73)	0.77 (0.73)
Southern Europe[c]	0.69 (0.59)	0.81 (0.73)	0.76 (0.73)
Nordic region[d]	0.59 (0.59)	0.83 (0.73)	0.72 (0.73)
UK and Ireland	0.23 (0.59)	0.83 (0.73)	0.56 (0.73)

Values of the overall sentiment in parentheses
[a]CESEE consists of Central-Eastern and Southeastern European countries, i.e., Bulgaria, Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Poland, Slovakia, and Turkey
[b]DACH consists of Germany, Austria, and Switzerland
[c]Southern Europe consists of Italy, Spain, and Portugal
[d]Nordic region consists of Denmark, Finland, Norway, and Sweden

Therefore, we illustrate in the following the VC market sentiment index for the different regions in Europe.

4.5.1 Overview

In this subsection, the regional differences of the indices will be illustrated and analyzed. Hence, the answers are split into several regions according to the reported VC firms' headquarters. The decision on which countries are grouped together was based on the homogeneity of the respective VC markets, following insights from the EIF.

Table 8 shows an overview comparing the market-level indices, fund-/portfolio-level indices, and the total sentiment indices of all identified regions. The regions and their respective individual indices are described in more detail later on.

4.5.2 Benelux

The Benelux region contains answers from 64 fund managers from Belgium, the Netherlands, and Luxembourg.[8] A closer look at the values of each single question offers interesting insights into the VC market sentiment in the Benelux region.

[8]There were 11 responses from Belgium, 9 responses from Luxembourg, and 44 responses from the Netherlands.

Table 9 VC market sentiment index

	Market-level index				
	Current situation		Expectation		
	Fundraising over the past 12 months		Fundraising over the next 12 months	VC market development over the next 12 months	Investment activities over the next 12 months
Question value	0.85 (0.57)		0.49 (0.36)	0.85 (0.73)	0.74 (0.69)
Average market-level index	0.73 (0.59)				
	Fund-/portfolio-level index				
	Current situation		Expectation		
	Current state of business	Portfolio development over the last 12 months	Expected business state over the next 12 months	Number of new investments in the next 12 months	Overall portfolio development over the next 12 months
Question value	1.00 (0.97)	0.44 (0.65)	0.84 (0.86)	0.70 (0.72)	1.00 (0.98)
Average fund-level index	0.80 (0.84)				
Overall VC market sentiment index	0.77 (0.73)				

Benelux; values of the overall sentiment in parentheses

Table 9 illustrates that fund managers from the Benelux region assess the current fundraising environment to be very positive, with a value of 0.85. However, the future outlook is more pessimistic, given that the question value regarding expectations toward fundraising in the next 12 months drops to 0.49. However, the expectations for the VC market development in the next 12 months (question value of 0.85) and the expectations toward investment activities in the next 12 months (question value of 0.74) are both very positive. Calculating the average index for the market-level sentiment, an index of 0.73 is achieved.

Looking at the fund-/portfolio-level, there are also some notable differences. While the current state of business is assessed to be very high, with the maximum question value of 1.00 (illustrating that there were no negative responses), the portfolio development over the last 12 months is assessed comparably more negative, with a value of 0.44. Regarding the expectations on the fund-/portfolio-level, the perception regarding the fund managers' state of business in the next 12 months appears to stay relatively stable, showing a value of 0.84. Additionally, the number of new investments in the next 12 months is expected to increase (question value of

0.70). The question value for the expected overall portfolio development in the next 12 months with a perfect value of 1.00 is noteworthy. This is quite a strong improvement compared to the current portfolio development (0.44). In total, the average value of the fund-/portfolio-level index is 0.80, slightly higher than the market-level index. Regarding the **overall VC market sentiment index** for the Benelux region, an index value of **0.77** is achieved, which is slightly higher than that for the overall sample (at 0.73).

4.5.3 Central-Eastern Europe, Greece, and Turkey

In addition to the Eastern European countries, Greece and Turkey are included in this region[9] (abbreviated as CESEE, i.e., Central-Eastern and Southeastern Europe).

As shown in Table 10, the current fundraising situation is assessed relatively positively by fund managers from the CESEE region with a value of 0.50. However, all market-level questions regarding expectations for the next 12 months exhibit higher values than those for the current situation. Looking at the expectations for the fundraising environment in the next 12 months, fund managers from the CESEE region are considerably more optimistic relative to their assessment of their current situation, reporting a value of 0.85. Expectations for the VC market development and for investment activities show slightly lower but still very positive values (0.79 and 0.80, respectively). The average market-level index is 0.73, indicating a very positive sentiment.

Looking at the fund-level questions, both the current state of business and the current portfolio development exhibit very positive values of 0.93 and 0.88, respectively. The questions regarding expectations show a little more variation. While the expected business state, with a value of 0.93, is considered to be positive, the number of new investments in the next 12 months is evaluated relatively less positive at 0.50. On the other hand, there are no negative expectations regarding portfolio development in the next 12 months, showing a value of 1.00. The average fund-/portfolio-level index for fund managers from the CESEE region is very positive, with a value of 0.85. The **overall VC market sentiment index** for CESEE fund managers is **0.80**, higher than that for the overall sample at 0.73.

[9]There were four responses from Bulgaria, three from Czech Republic, one from Estonia, five from Greece, three from Hungary, three from Latvia, one from Lithuania, six from Poland, two from Slovakia, and three from Turkey.

Table 10 VC market sentiment index

	Market-level index				
	Current situation		Expectation		
	Fundraising over the past 12 months		Fundraising over the next 12 months	VC market development over the next 12 months	Investment activities over the next 12 months
Question value	0.50 (0.57)		0.85 (0.36)	0.79 (0.73)	0.80 (0.69)
Average market-level index	0.73 (0.59)				
	Fund-/portfolio-level index				
	Current situation		Expectation		
	Current state of business	Portfolio development over the last 12 months	Expected business state over the next 12 months	Number of new investments in the next 12 months	Overall portfolio development over the next 12 months
Question value	0.93 (0.97)	0.88 (0.65)	0.93 (0.86)	0.50 (0.72)	1.00 (0.98)
Average fund-level index	0.85 (0.84)				
Overall VC market sentiment index	0.80 (0.73)				

CESEE; values of the overall sentiment in parentheses

4.5.4 DACH Region

The DACH region consists of fund managers from Germany, Austria, and Switzerland.[10] Using the two-level approach, the results presented in Table 11 reveal a disparity between how fund managers assess their own business and how they assess the market.

As Table 11 illustrates, fund managers from the DACH region valuate the current and future fundraising environment to be relatively the same: the question value for the current fundraising environment is equal to 0.54 and that for the expectations over the next 12 months is at 0.56. These values are still quite high but are the lowest of all the regions, indicating certain caveats related to the fundraising environment in the DACH region. Simultaneously, the expectation regarding the VC market development (question value of 0.80) and the expectation for future investment activities

[10]There were 7 respondents from Austria, 50 respondents from Germany, and 14 respondents from Switzerland.

Table 11 VC market sentiment index

	Market-level index				
	Current situation		Expectation		
	Fundraising over the past 12 months		Fundraising over the next 12 months	VC market development over the next 12 months	Investment activities over the next 12 months
Question value	0.54 (0.57)		0.56 (0.36)	0.80 (0.73)	0.83 (0.69)
Average market-level index	0.68 (0.59)				
	Fund-/portfolio-level index				
	Current situation		Expectation		
	Current state of business	Portfolio development over the last 12 months	Expected business state over the next 12 months	Number of new investments in the next 12 months	Overall portfolio development over the next 12 months
Question value	0.97 (0.97)	0.76 (0.65)	0.83 (0.86)	0.80 (0.72)	0.97 (0.98)
Average fund-level index	0.87 (0.84)				
Overall VC market sentiment index	0.79 (0.73)				

DACH; values of the overall sentiment in parentheses

(question value of 0.83) are both found to be very optimistic. In total, the average market-level index for the DACH region is at 0.68.

Fund managers from the DACH region have a very positive perception of their own VC business and portfolio. The current state of business and the current portfolio development are both assessed very positively, with question values of 0.97 and 0.76, respectively. Looking at the expectations over the next 12 months, fund managers from the DACH region also show a positive sentiment: the question value for the expected state of business is 0.83, that for the number of new investments is 0.80, and that for the expected portfolio development is 0.97.

As mentioned before, the sentiment between market-level and fund-/portfolio-level differs for fund managers from the DACH region. While the market-level index has an average value of 0.68, the fund managers' sentiment toward their own business and portfolio is comparably better, with an average index value of 0.87. The **overall VC market sentiment index** for the DACH region is **0.79**, slightly higher than that for the overall sample.

Table 12 VC market sentiment index

	Market-level index				
	Current situation		Expectation		
	Fundraising over the past 12 months		Fundraising over the next 12 months	VC market development over the next 12 months	Investment activities over the next 12 months
Question value	0.87 (0.57)		0.48 (0.36)	0.70 (0.73)	0.64 (0.69)
Average market-level index	0.67 (0.59)				
	Fund-/portfolio-level index				
	Current situation		Expectation		
	Current state of business	Portfolio development over the last 12 months	Expected business state over the next 12 months	Number of new investments in the next 12 months	Overall portfolio development over the next 12 months
Question value	1.00 (0.97)	0.55 (0.65)	0.79 (0.86)	0.90 (0.72)	1.00 (0.98)
Average fund-level index	0.85 (0.84)				
Overall VC market sentiment index	0.77 (0.73)				

France; values of the overall sentiment in parentheses

4.5.5 France

The calculation of the French indices comprises 39 responses of fund managers headquartered in France.

As Table 12 illustrates, fund managers located in France perceive the current fundraising environment as very positive, with a value of 0.87. This is different from the fundraising expectations over the next 12 months, which show only a value of 0.48. However, the expectation for the VC market development, with a value of 0.70, and the expectation for future investment activities, with a value of 0.64, are both perceived as quite positive. The average market-level index for fund managers from France is 0.67, slightly more positive compared to the market-level index for the overall sample, at 0.59.

Additionally, Table 12 shows that French fund managers perceive their current state of business as very positive, reaching a maximum value of 1.00, suggesting that there were no negative responses to this question. In contrast, the current portfolio development is assessed much lower with a value of only 0.55. Regarding the expectations for the fund-/portfolio-level questions, the question value for the

expected state of business drops from 1.00 to 0.79, which is still very high. Additionally, the number of new investments is expected to increase (question value of 0.90). Portfolio development is expected to improve strongly (question value of 1.00). The average fund-/portfolio-level index is 0.85, almost the same as that for the overall sample. Regarding the **overall VC market sentiment index** for fund managers from France, the total average value is **0.77**, which is slightly higher than the average index value for the overall sample.

4.5.6 Southern Europe

The aggregated region of Italy, Spain, and Portugal (i.e., Southern Europe) comprises answers from 50 respondents.[11]

Looking at the question that addresses the fundraising environment over the past 12 months, a relatively low value of 0.36 is reported. The questions regarding the future reflect a much more positive outlook. In particular, future fundraising, with a value of 0.60, is assessed more positively compared to the current situation. Additionally, the future VC market development is also assessed very high, with a value of 0.95. This is also true for the expected investment activities over the next 12 months, with a value of 0.85. The average market-level index for the Southern Europe region is 0.69, i.e., higher than the average market-level index for the overall sample.

As Table 13 illustrates, the current state of business for fund managers that are headquartered in the Southern Europe region is perceived very positively, with a value of 0.95. In contrast, the current development of the fund managers' portfolio is valuated more negatively at 0.43. It has to be noted, however, that significant improvements in the development of portfolio companies are expected in the near future (question value reaching the maximum 1.00). Taking expectations further into account, fund managers are very optimistic about their future state of business (question value of 0.95). New investments are also expected to increase (question value of 0.74). The average fund-/portfolio-level index is 0.81. In total, fund managers from the Southern Europe region are very optimistic, with an **overall VC market sentiment index** of **0.76**, being slightly above the sentiment index for the overall sample.

[11] In particular, 19 fund managers from Italy, 22 from Spain, and 9 from Portugal.

Table 13 VC market sentiment index

	Market-level index				
	Current situation		Expectation		
	Fundraising over the past 12 months		Fundraising over the next 12 months	VC market development over the next 12 months	Investment activities over the next 12 months
Question value	0.36 (0.57)		0.60 (0.36)	0.95 (0.73)	0.85 (0.69)
Average market-level index	0.69 (0.59)				
	Fund-/portfolio-level index				
	Current situation		Expectation		
	Current state of business	Portfolio development over the last 12 months	Expected business state over the next 12 months	Number of new investments in the next 12 months	Overall portfolio development over the next 12 months
Question value	0.95 (0.97)	0.43 (0.65)	0.95 (0.86)	0.74 (0.72)	1.00 (0.98)
Average fund-level index	0.81 (0.84)				
Overall VC market sentiment index	0.76 (0.73)				

Southern Europe; values of the overall sentiment in parentheses

4.5.7 Nordic Region

The Nordic region comprises answers from 33 respondents in total.[12]

As Table 14 illustrates for the market-level index, fund managers from the Nordic region seem to struggle with the fundraising environment compared to other regions—the question value for the current fundraising situation is positive but only at 0.40. This value is even lower (at 0.29) in the expected fundraising environment over the next 12 months. By contrast, expectations regarding the VC market development (with a value of 0.80) and future investment activities (with a value of 0.88) are both very optimistic. The average market-level index for fund managers from the Nordic region is 0.59.

Compared to the market-level questions, the values for the fund-/portfolio-level questions shown in Table 14 are more positive. First, the current business situation is

[12]Answers were provided by 5 investors from Denmark, 12 investors from Finland, 9 investors from Norway, and 7 investors from Sweden.

Table 14 VC market sentiment index

	Market-level index				
	Current situation		Expectation		
	Fundraising over the past 12 months		Fundraising over the next 12 months	VC market development over the next 12 months	Investment activities over the next 12 months
Question value	0.40 (0.57)		0.29 (0.36)	0.80 (0.73)	0.88 (0.69)
Average market-level index	0.59 (0.59)				
	Fund-/portfolio-level index				
	Current situation		Expectation		
	Current state of business	Portfolio development over the last 12 months	Expected business state over the next 12 months	Number of new investments in the next 12 months	Overall portfolio development over the next 12 months
Question value	1.00 (0.97)	0.57 (0.65)	0.92 (0.86)	0.65 (0.72)	1.00 (0.98)
Average fund-level index	0.83 (0.84)				
Overall VC market sentiment index	0.72 (0.73)				

Nordic region; values of the overall sentiment in parentheses

assessed very positively, taking the maximum question value of 1.00. The current development of the fund managers' portfolio is perceived less positively but still shows a relatively high value of 0.57. Regarding expectations at the fund-/portfolio-level, the fund managers' state of business (question value of 0.92) and new investments (question value of 0.65) are expected to improve and so is the development of portfolio companies (maximum question value of 1.00). The average fund-/portfolio-level index takes a considerably positive value of 0.83.

Due to the reasons outlined earlier, particularly when it comes to fundraising, the **overall VC market sentiment index** for fund managers from the Nordic region is **0.72**, slightly below the VC market sentiment index for the overall sample.

4.5.8 UK and Ireland

In 2016, the British people voted to leave the European Union. The implications of this Brexit vote are still unclear, resulting in increasing uncertainty regarding the future position of the UK in the European market. Uncertainty can have a negative

Table 15 VC market sentiment index

	Market-level index				
	Current situation		Expectation		
	Fundraising over the past 12 months		Fundraising over the next 12 months	VC market development over the next 12 months	Investment activities over the next 12 months
Question value	0.41 (0.57)		−0.14 (0.36)	0.35 (0.73)	0.30 (0.69)
Average market-level index	0.23 (0.59)				
	Fund-/portfolio-level index				
	Current situation		Expectation		
	Current state of business	Portfolio development over the last 12 months	Expected business state over the next 12 months	Number of new investments in the next 12 months	Overall portfolio development over the next 12 months
Question value	0.94 (0.97)	0.79 (0.65)	0.80 (0.86)	0.67 (0.72)	0.94 (0.98)
Average fund-level index	0.83 (0.84)				
Overall VC market sentiment index	0.56 (0.73)				

UK and Ireland; values of the overall sentiment in parentheses

impact on the VC market, the fundraising environment, and investment activities in general. These concerns are indeed reflected in the sentiment analysis concerning the region of the UK and Ireland. Table 15 shows the index values for respondents from these countries.[13] The benefits of a distinction between a market-level index and a fund-/portfolio-level index can be seen very clearly in this case.

Comparing the market-level average index of 0.23 to the fund-/portfolio-level average index of 0.83, an obvious disparity can be seen (Table 15). While VC fund managers headquartered in the UK and Ireland are very positive regarding their own business situation, they are only slightly optimistic regarding future market developments. These respondents valuated the current fundraising environment fairly positive with a value of 0.41. However, the expectation regarding fundraising in the future is pessimistic, with a negative value of −0.14. Furthermore, the expectations regarding the VC market development (with a value of 0.35) and the investment activities over the next 12 months (with a value of 0.30) are only slightly positive. These values are in striking contrast to the fund managers' perceptions of

[13]In total, 9 respondents are headquartered in Ireland, and 72 are headquartered in the UK.

their own businesses. Not only are the current states of their businesses and their current portfolio development assessed very positively (with values of 0.94 and 0.79, respectively) but also the same is true for their expectations regarding all fund-/portfolio-related aspects. More precisely, the expected state of business over the next 12 months is assessed very positively (question value of 0.80), the number of new investments is expected to rise (question value of 0.67), and the expectations regarding the overall portfolio development are also optimistic (question value of 0.94).

For the reasons discussed above, the **overall VC market sentiment index** for the UK and Ireland is **0.56**, considerably lower than that for the whole sample.

5 Summary, Limitations, and Further Outlooks

The aim of this paper was to set a starting point for the newly established European VC market sentiment index, based on a survey that will be conducted on a regular basis. A widely accepted approach, which is often used by other indices to measure the sentiment of certain groups, was applied and adjusted to the particularities of the VC market. Instead of asking only one or just a few very broad questions, we enriched the number of these more general questions with some further VC-specific questions, such as questions related to fundraising and portfolio development, to gain more comprehensive insights into the European VC market.

The overall results of the European VC market sentiment index show a quite positive picture of the European VC landscape. While the market-level index is slightly less positive, investors assess their funds and portfolios to be very positive. It is noteworthy that across all regions, market-level indices are consistently assessed less positively than fund- and portfolio-level indices. The Nordic region and the UK and Ireland account for the lowest market-level indices. Although both regions show comparably positive fund-level indices, their overall indices are the lowest in Europe (Nordic region = 0.72; UK and Ireland = 0.56). The most positive overall sentiment index can be found in the CESEE region (0.80), followed by the DACH region (0.79), Benelux and France (both 0.77), and the region of Southern Europe (0.76). Looking at the investment stage focus, we find that seed/startup investors and later-stage investors answered the market-level questions at an equally positive level (0.60) but differed according to the fund-/portfolio-level questions, where later-stage investors were more positive (later stage = 0.91; seed/startup = 0.83). Regarding different industry focuses, participants focusing on ICT investments show the highest market-level index (0.61), followed by Life Science investors (0.53) and Cleantech investors (0.44). The picture changes considering the fund-/portfolio-index. There, ICT investors still show the most positive assessment (0.86), while Cleantech ones assess their own fund and portfolio slightly higher (0.79) than Life Science investors (0.76).

The findings have considerable practical relevance for policy-makers and for investors but also for entrepreneurs seeking financing. Financing behavior and

financing needs of enterprises in general, and smaller enterprises in particular, are not homogenous but rather differ by different variables, such as firm-, product-, industry-, and country-specific characteristics (Masiak et al. 2017, 2019). More specifically, the European VC markets are fragmented by geographical boundaries (Kraemer-Eis et al. 2018). Policy measures at a European level, including financial instruments implemented by the EIF, aim at improving the market integration. There is evidence that these measures indeed have successfully contributed to increased cross-border investments (Kraemer-Eis et al. 2016). New policy instruments under the framework of the EU Capital Markets Union initiative aim at further deepening market integration and thereby improving the access to finance of enterprises (Kraemer-Eis and Lang 2017). In the EIF VC Survey, VC fund managers indeed called for more harmonization across the EU countries, as the currently still heterogeneous markets create challenges for VCs, but also from policy-makers when shaping policy measures for the VC market (Kraemer-Eis et al. 2018a). Hence, it is important to look at the differences by country or country groups.[14] For example, in our analysis, we find that the UK and Ireland show the lowest market-level sentiment in Europe, largely due to a pessimistic perception of future fundraising conditions. Policy-makers should be aware that uncertainties (such as those relating to Brexit) may indeed have a negative impact on the fundraising environment and consequently on investment capabilities.[15] Additionally, this study highlights that fund managers perceive the market conditions less positively compared to their own business. This could be due to a biased view: fund managers might overestimate their own business situation while being more negative about the general market environment.

By using the net balance of positive and negative responses and taking the mean values of these responses, subindices on two levels (market-level and fund-/portfolio-level) were calculated, in addition to an overall VC sentiment index. While this study is able to present a snapshot of the fund managers' sentiment, the more interesting part lies in the upcoming repetition of the survey, which is intended to produce a comparable index that will reveal whether and how the VCs' sentiment is changing over time.

In the long run, the index values of a year that will be considered normal (i.e., neither extremely positive nor extremely negative) might be used as a reference year and assigned a value of 100. The intention behind this approach is that it will be easier to track whether the fund managers' sentiment has become more positive, taking values in excess of 100, or more negative, taking values below 100. Another

[14] See Masiak et al. (2017) for an analysis of SME financing that provides, inter alia, an approach for categorizing European countries into country groups.

[15] Some insights into the reasons for the differences in the index values by region (as well as by other categories) can be derived from the EIF VC Survey question about the biggest challenges for the VC business. See Kraemer-Eis et al. (2018a) for details. The 2019 EIF VC Survey wave includes a question about the most important drivers of expected changes in a firm's state of business, investment activity, fundraising, and exits.

option might be to use an average value over a number of indices from more than one survey period as a reference.

The application of weightings could also be discussed for future index calculations. While it is difficult to achieve a sample of VC firms that is representative of the whole European market, weightings could be applied to alleviate possible biases. The problem in this case is to find appropriate and reliable statistics for the population that would enable us to derive the correct weights. Another approach could be to use the stated assets under the management of each VC firm as a weighting measure. Hence, answers from VCs with more assets under management would be valued more than those from VCs with fewer assets. The inherent problem with this approach would be that there is the possibility that respondents may be subject to self-reporting biases (e.g., stating wrong numbers). In this case, a weighting would do more harm than good.[16]

Furthermore, additional indices could be used or even established and compared to the development of the EIF VC market sentiment index. It could be shown that the sentiment of certain other (private equity) investors is correlated with the index that was established in this paper. An interesting topic of further research would be whether the VC investors' sentiment reacts differently to market developments compared to, for example, business angels. Hence, a sentiment index originating from the index presented in this paper but focusing on other types of investors, such as business angels, could be established. In this context, the results of a new survey on business angels launched by the EIF could indeed feed into the development of such an index.

One limitation of this study concerns the representativity of the sample. As the aim of the sentiment index is to unveil the fund managers' perception of the present and future VC landscape, it is imperative to use a sample that is as representative of the population as possible in a market that is still relatively opaque (see Sect. 2.4 for considerations regarding representativity). Using PitchBook, the regional distribution of the number of answers was compared to the regional distribution of contacts. With this approach, a representative sample could be approximated. Another limitation occurs in the case of certain subgroup analyses (i.e., regional groups): the number of respondents for some of the subgroups is rather small, which makes the analyses more vulnerable to biases in these cases. While this study deliberately only surveyed decision-makers, it could be meaningful to expand the sample by also asking employees that are not necessarily in decision-making positions in VC firms. This could enlarge the sample and lead to more responses, ensuring less biased results in those particular cases mentioned above and providing the possibility to compare all the different subgroups. To be more precise, this would allow for comparing not only regional differences but also, for example, different firm sizes

[16]If it is not clear which weighting approach to apply, it can be a more reasonable approach to refrain from weighting and to simply apply a group-based analysis and demonstrate the group-specific differences or commonalities in the results (Jacob et al. 2011). This is exactly the approach of our paper, as well as the related papers that present the EIF VC Survey results, i.e., Kraemer-Eis et al. (2018a, b).

of VC firms in Europe. However, asking staff members who are not in decision-making positions but rather focus on a particular subset of their VC firm's activities might lead to answers that are less representative of the overall activities of the respective VC firm. Moreover, it has to be acknowledged that the response rate to the EIF VC Survey and the total number of responses were very high compared to other VC market surveys and in particular when taking into consideration the specific target group of respondents.

Appendix

Table 16 Linear regression

Variable	Standardized coefficients	p-value
Most important investment stage(s)		
Seed stage	−0.063 (0.177)	0.241
Early stage	0.002 (0.207)	0.973
Later stage/growth stage	−0.091 (0.208)	0.110
Industry focus		
ICT	0.010 (0.856)	0.966
Cleantech	−0.033 (0.910)	0.791
Life Science	−0.111 (0.868)	0.607
Manufacturing	−0.061 (1.010)	0.486
Services	−0.111 (0.924)	0.324
Firm size		
Assets under management	0.131 (0.000)	0.012
Sentiment index		
Mean value of sentiment questions	0.344 (0.200)	0.000
R^2	0.304	
N	379	

Dependent variable = Confidence in long-term growth of the European VC industry (from 1 to 10). Model also includes companies headquarter as dummy variable, not shown for the sake of brevity. Standard deviation in parentheses

Table 17 Paired-sample t-test

Variable	Mean	Std. error	Std. deviation
Mean of market-level questions	3.416	0.030	0.583
Mean of fund-/portfolio-level questions	3.818	0.023	0.448
Difference	−0.402***	0.032	0.614

*Significant at 5%; **Significant at 1%; ***Significant at 0.01%

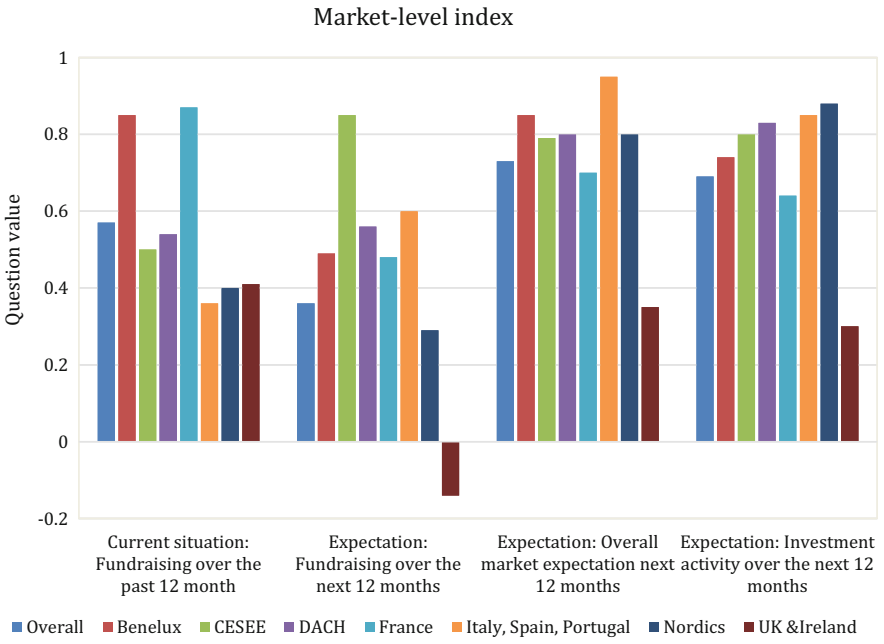

Fig. 7 Regional comparison of market-level questions

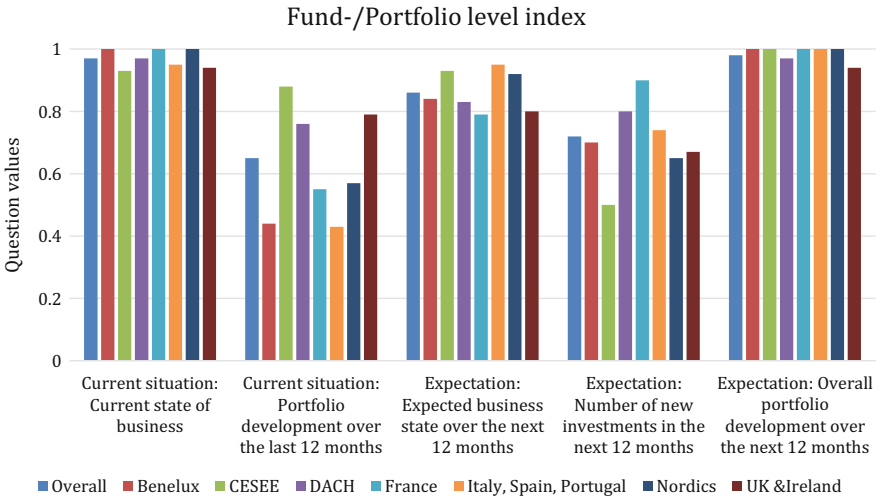

Fig. 8 Regional comparison of fund-/portfolio-level questions

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The Private Value of Patents for Government-supported Start-Ups: The Case of the European Investment Fund

Simone Signore

Abstract The creation of value through innovation is among the defining traits of new technology-driven ventures. In this context, patents are an important signalling device to attract external financing. In this paper we contribute to the literature by investigating the value of innovations for start-ups supported by the European Investment Fund (EIF), through its venture capital (VC) instruments, in the years 1996–2014. The value of innovations is measured through patent applications and renewals. We employ an established econometric model to estimate the euro value of innovations based on patent renewal decisions. We find that start-ups in the life sciences hold, on average, the most valuable innovations. At the same time, we find compelling evidence that selection bias, causing less promising inventions to be excluded a priori from patenting, is pervasive across industries and/or regions of Europe. Implications for policy and research are discussed.

Keywords Innovation · Venture capital · Patents · Renewal data · Start-ups · EIF

1 Introduction

The role of venture capital (VC) financing in spurring innovation has been extensively documented in the literature (Kortum and Lerner 2001, among others). This is because innovative small- and medium-sized enterprises (SMEs), risky by nature,

The views and opinions expressed in this paper are those of the author and can under no circumstances be attributed to the European Investment Fund. A prior version of this chapter has been part of the EIF Working Paper series with the number 2017/45 (Signore and Torfs 2017). This is an updated chapter based on the prior version.

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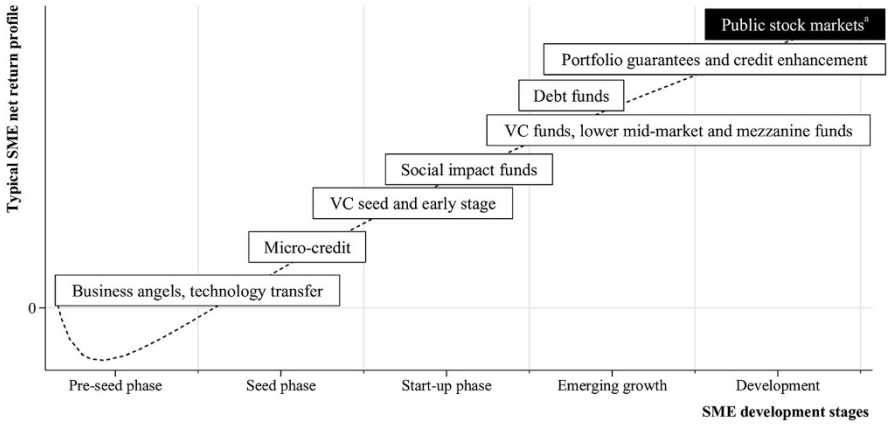

Fig. 1 EIF tool kit for SMEs. Source: Kraemer-Eis et al. (2018). [a]Not part of the EIF tool kit

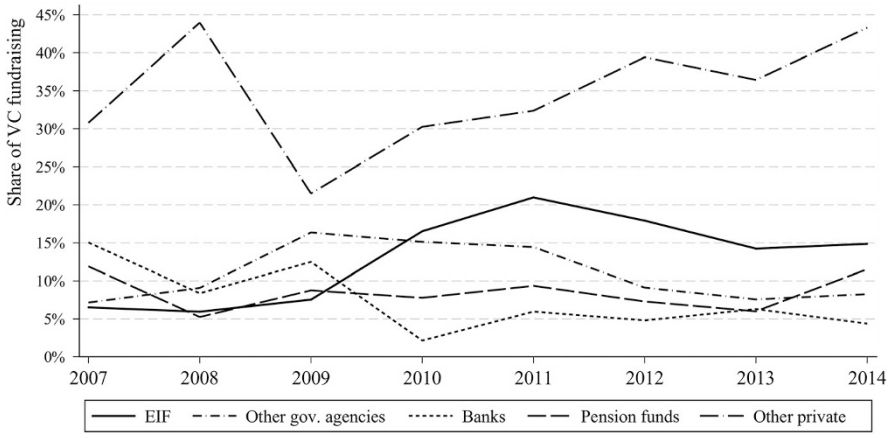

Fig. 2 VC fundraising in Europe, by investor type. Source: Kraemer-Eis et al. (2016, 2018), based on data from Invest Europe

are often unable to secure financing through traditional bank channels and therefore rely disproportionally on VC to meet their external financing needs.

Through its support for the VC ecosystem in Europe (Kraemer-Eis et al. 2016; Signore 2016), the European Investment Fund (EIF) has played a significant role in the development of an ecosystem that enables SMEs to reach their full innovative potential (see Fig. 1). In the aftermath of the global financial crisis, EIF's engagement in the European VC market has significantly risen, in response to a drop and a subsequent stagnation of European VC investments. Figure 2 shows the role of EIF in European venture fundraising.

EIF strives to address market gaps and to crowd-in private capital. In the VC space, this includes to act as counter-cyclical investor during downturns of the market, but as well to support first-time teams (where the uncertainty for other investors is the highest due to the shortage of track records). The aim of the EIF is to stimulate the market, not to make it become dependent on public financing.

Even though it manages resources on behalf of public institutions like the European Commission or the European Investment Bank, the EIF pursues public policy with a market-oriented strategy, investing pari passu with private investors (i.e. on the same terms and conditions) and seeking a positive return. In order to ensure sound investment decisions, based on market developments, the Fund has from inception and deliberately been a public-private partnership, teaming up with a broad range of equity market players across Europe. Over the last 20 years, EIF has built an extensive network, accumulating substantive market expertise, and established itself as the key public-private European VC investor in Europe. Several brand names of today's European VC community have been supported by the EIF in their earlier funds.

The rising significance of EIF's activity in the broader European venture capital landscape calls for a robust assessment of its activities, to measure whether the overarching economic goals set forth by the policymaker have been met. Against this background, this paper analyses the innovative capacity of EIF-backed venture capital (VC) start-ups by estimating the economic value of their patented innovations. This work complements a number of related studies that seek to measure the outcomes and the impact of the EIF on the European venture capital ecosystem.[1]

2 Related Literature

The need for robust estimates of the economic value of patents emerges in various contexts. At the microeconomic level, the knowledge of a company's own intellectual property (IP) portfolio is essential to undertake sound management decisions related to, e.g. IP protection and return strategy. In addition, an increasing number of firms reportedly use IP as a means to access external financing, such as venture capital and bank loans (Kamiyama et al. 2006). At the macroeconomic level, patent value estimates can prove useful for public policymakers to refine their understanding of the innovation process. This, in turn, stimulates the search for a better policy to support the innovative capacity of firms.

Pitkethly (1997) discusses several different methodologies to derive ex ante estimates of patent values. These approaches—leveraging on cost-, market-, discounted cash flow- and option pricing-based models—are considered appropriate to estimate the value of single patents, requiring in-depth information on the

[1] For more information, see Kraemer-Eis et al. (2016), Signore (2016), Prencipe (2017), Signore and Torfs (2017).

envisaged exploitation of the underlying IP.[2] Alternatively, Pitkethly mentions a class of valuation strategies—referred to as *econometric methods*—concerned with the ex post measurement of a patent's worth. This latter approach is often based on the stock market values of firms and/or patent renewal rates.

An attractive feature of econometric methods for patent valuation is that these allow to assess the value of numerous patents at once, e.g. patents pertaining to a specific industry, cohort and geographical region. However, Pitkethly notes that early implementations of this approach, based on the seminal work of Pakes and Schankerman (1984), lacked the ability to estimate the value of single patents and could only provide insights on the overall distribution of patent values. As a result, recent works in the field, most notably Bessen (2008) and Gupeng and Xiangdong (2012), extended Pakes and Schankerman's framework and enabled the estimation of the expected economic value for any single patent, conditional on its renewal pattern, patentor and patent attributes.

In this paper, we propose a simplified model of patent renewal and value based on Bessen (2008) and Gupeng and Xiangdong (2012). We employ this methodology to estimate the value of patent families linked to EIF-backed start-ups, a proxy for their innovative capacity. The estimates concern the *private* value of a patent, calculated as the (net present) value of all profits a start-up gains from exercising the patenting option. An implication of this approach is that the estimated value should, in theory, correspond to the minimum price the patentor would be willing to accept to sell the patent.

3 Data

3.1 Firm-Patent Matched Data

Patent data for this study mainly stems from Bureau Van Dijk's Orbis database and originates from the PATSTAT database, maintained by the European Patent Office (EPO). Our initial dataset contains both granted and non-granted patents for 2951 start-ups supported by EIF in the 1996–2014. The data relates to EIF-backed start-ups whose size, age and industry comply with the canons of conventional VC-targeted companies (Kraemer-Eis et al. 2016).

Patent data is matched with firms' identities following the matching strategy outlined in Thoma et al. (2010).[3] We discard patents whose initial date of application falls more than 15 years behind the firm's establishment date—on the assumption

[2]We considered implementing a full-fledged real option pricing model (e.g. Schwartz 2004). However, the data at our disposal could not satisfy the level of granularity and specificity required by such approach.

[3]For an elaboration on the matching methodology and a comprehensive collection of descriptive statistics, see Signore and Torfs (2017).

that start-ups have no incentive to protect and exploit innovations very close to fall in the public domain.

We select patent families as our main proxy for innovations. The EPO defines a patent family as "a collection of related patent applications that is covering the same or similar technical content", as well as "a collection of patent documents that are considered to be covering one single invention" (European Patent Office 2017). As such, patent families are regularly employed as a unit of analysis when the research focus is on firms' inventions (Hall 2014). For additional details on the notion of patent families, see Martinez (2010).

This work employs patent family *ownership*, as opposed to *registration*, as the main unit of analysis. The key difference is that the former can be transferred between entities following the acquisition of companies and/or their IP portfolios. Based on historical data on patent applicants, we can infer that about 86% of innovations owned by EIF-backed start-ups were also registered by them.[4] However, depending on the nature of the analysis, the distinction between *acquired* and *originated* IP may be irrelevant, as the two R&D strategies can be equally effective in the creation of new innovative capacity for the firm.

We find a total of 16,155 unique innovations associated with EIF-backed start-ups and initiated in the period 1997–2015.[5] Because of the time lag—up to 30 months for EPO data[6]—between the date of application and the time of publication in the PATSTAT database, we discard innovations initiated after 2012, which brings the total number of innovations to 14,292 (see Table 1 for an illustration of the sample breakdown). Figure 3 illustrates the evolution of EIF's innovation portfolio, while Fig. 4 maps the regional distribution of EIF-supported innovations.

Several features of EIF-supported innovations complement our firm-patent matched dataset. These are formed via aggregation of patent-specific characteristics at the level of the patent family, using the most appropriate technique. Notably, using the International Patent Classification (IPC) system, we grouped innovations into nine different sectors—following the 2007 sectoral classification of Invest Europe[7]—according to the most frequent sector observed in the underlying set of patents (for additional details on this approach, see Signore and Torfs 2017). Moreover, we used the location of patent offices receiving applications for a given innovation to derive a set of geographic indicators. These variables identify the geographic breadth (e.g. Europe, America, Asia) of patented innovations.

[4]For the remaining 1957 innovations, current ownership did not coincide with the original applicants. It ensures that these innovations were acquired by EIF-backed start-ups. Interestingly, the ownership of about 38% of acquired innovations further transitioned to other entities, following either the acquisition of the start-up or its bankruptcy.

[5]The figure does not account for utility models and designs, excluded from the analysis. In addition, note that the initial year of the innovation typically equates to the *priority year* of its underlying patents.

[6]Additional delay is most likely introduced by the subsequent matching with firms' identities.

[7]Available at http://www.investeurope.eu/media/12926/sectoral_classification.pdf [accessed: 11/2017].

Table 1 Patenting of EIF-backed start-ups: sample breakdown

	Innovations		Start-ups	
Sample description	Nr.	Time frame	Nr. (patentors)	Inv. time frame
Initial dataset	16,155	1977–2015	2951 (1080)	1996–2014
Of which				
Excluding patenting after 2012	14,292	1977–2012	2359 (984)	1996–2012
Of which				
Patenting while in EIF portfolio	11,571	1996–2012	2359 (875)	1996–2012
In-house patenting	12,335	1977–2012	2359 (942)	1996–2012
Of which				
While in EIF portfolio	10,098	1996–2012	2359 (840)	1996–2012
Patenting with renewal data info[a]	11,597	1987–2012	2359 (984)	1996–2012

Source: Signore and Torfs (2017)
[a]Only partial renewal data information could be retrieved for some innovations. See Sect. 3.2 for details

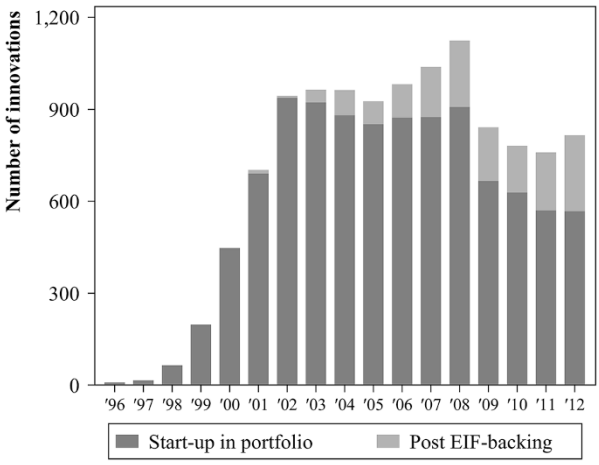

Fig. 3 The evolution of innovation creation by EIF-backed VC investees. Source: Signore and Torfs (2017)

Finally, motivated by the impracticality of identifying innovation fields via the IPC system, we devoted further effort to the detailed analysis of patent abstracts (for details see Signore and Torfs 2017). This exercise allowed the classification of innovations into 20 key technology fields, providing a granular yet intuitive classification of the key technology areas supported by EIF throughout the last 20 years, as illustrated in Fig. 5.

3.2 Patent Renewal Data

We sourced patent renewal data from databases of national and international patent offices, all accessible online. Since our original dataset contains more than

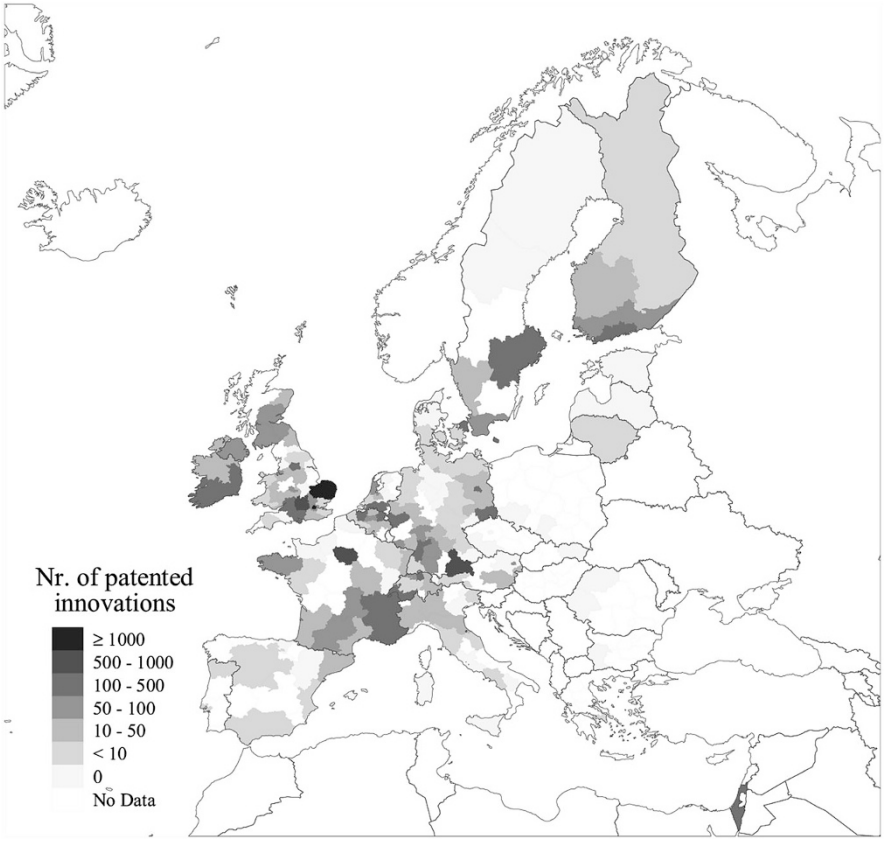

Fig. 4 Regional distribution of EIF-supported innovation at the NUTS2-level. Note: based on a sample of 11,030 innovation and 1966 start-ups supported by EIF with complete geographical data. Source: Signore and Torfs (2017)

80 different patent offices (POs), we restricted our analysis to European and US patent offices, selecting first the ten most frequent offices. To improve the geographical coverage, we included data from five additional European POs.[8] The inclusion of US renewal data follows the empirical finding that a sizeable share of EIF-backed start-ups favours the US Patent and Trademark Office (USPTO) over its European counterparts in the submission of their first IP protection claim, often abstaining from further pursuing IP protection in Europe.[9] This occurs with much lower frequency in the case of other international patent offices.

[8]The trade-off against full coverage was a need of PO-specific routines to scrape and/or bulk obtain data.

[9]We find over 7% of patenting ICT start-ups consistently following this route, while in other sectors, the incidence is lower than 1%. Nevertheless, 37% of patentors adopted such practice for at least one innovation.

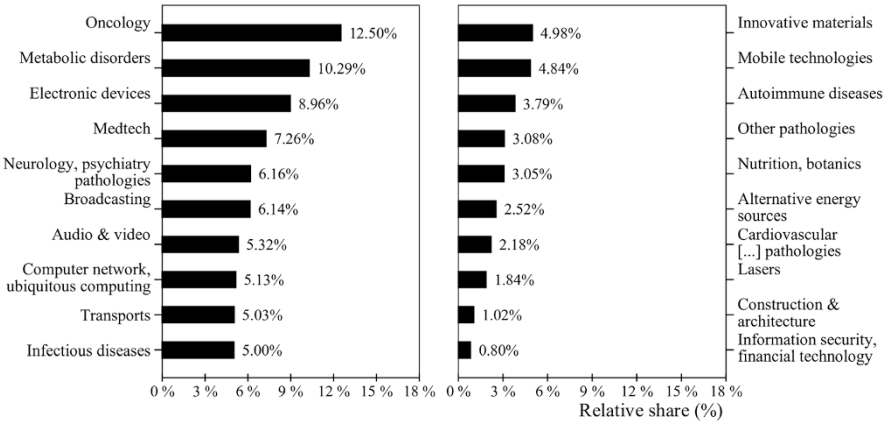

Fig. 5 EIF-supported innovations, by technology field. Source: Signore and Torfs (2017)

This geographic limitation implies that our analysis is restricted to the patent value generated in Europe and the USA, the two biggest patenting markets. The 15 POs covered make up for 93% of all patent applications submitted in these markets and amount to 55,961 application documents. In subsequent steps, we further limit our scope to applications submitted in the 1987–2012 period.[10] We obtain a final sample of 33,905 patent applications matched with renewal fee information. Table 2 lists the general features of the final dataset and compares renewal rates among different subgroups.

Based on the information contained in the final sample, we identify three key application groups:

1. EP/EP-PCT applications, which include European Patent Office (EPO) applications or Patent Cooperation Treaty (PCT) applications—submitted to the World Intellectual Property Organization, (WIPO)—further processed by the EPO. This group includes all applications related to the *national phase* of EP/EP-PCT applications. For an overview of the various patent application systems, see Chap. 3 of OECD (2009).
2. USPTO applications, which include only applications submitted to the US Patent and Trademark Office, either via PCT or directly to the USPTO.
3. (European) National applications, which include both PCT and non-PCT applications submitted directly to national European patent offices.

Patent applications to the EPO follow a more articulated path than national and USPTO patents. Yet, the EPO significantly reduces the burden (and cost) of multi-country patenting within member states of the European Patent Convention (EPC).

[10]The upper bound restriction is due to renewal data being collected up until 31 December 2016. As such, most applications submitted after 2012 will not have witnessed enough time for the accrual of renewal fees.

Table 2 Sample summary statistics and patent renewal rates

	Percent renewed until or expired during:					
	1st–4th year	5th–8th year	9th–12th year	13th–19th year	Full term	Observations
All patents	25.15	38.27	20.88	12.84	2.86	33,905
Application status						
Active	38.67	32.09	18.02	7.05	4.16	21,082
Lapsed	2.91	48.43	25.57	22.37	0.73	12,823
Application group						
EP/EP-PCT patents (incl. national phase)	18.46	37.03	24.78	18.42	1.31	21,303
USPTO patents	47.09	33.01	12.81	_[a]	7.10	9400
National patents	5.22	61.96	18.64	13.46	0.72	3202
Country of patent office						
EP	32.16	44.69	18.63	4.51	0.02	11,453
US	47.09	33.01	12.81	_[a]	7.10	9400
DE	6.05	25.59	27.80	37.39	3.17	4162
GB	_[a]	71.13	17.38	11.13	0.35	2255
AT	_[a]	54.48	27.05	16.28	2.19	1874
ES	0.68	18.81	39.83	37.85	2.83	1765
FR	22.83	43.15	22.20	11.02	0.79	635
Other POs[b]	0.34	19.44	35.62	41.89	2.71	2361
Start-up macro-region[c]						
BI	22.18	45.19	19.26	11.71	1.66	9834
DACH	25.03	36.97	21.10	14.21	2.68	8049
FR&BENELUX	25.17	35.90	22.07	14.32	2.53	7869
ROW	31.83	34.07	20.34	8.59	5.16	4822
NORDICS	24.60	31.53	23.85	15.71	4.30	2813
SOUTH/CESEE	23.83	38.48	18.75	14.84	4.10	512
Technology field						
Life sciences	25.70	35.76	21.38	14.42	2.73	16,528
ICT	24.82	40.83	20.29	11.25	2.81	8018
Electronics	24.41	41.69	19.05	11.60	3.24	5248
Other/missing	24.50	39.02	22.33	11.19	2.97	4111

[a]No renewal fees due in the period

[b]DK (obs: 894), PT (628), FI (56), SE (21), HR (11), PL (11), NL (7), BE (6)

[c]DACH: AT, CH, DE; NORDICS: DK, FI, NO, SE; FR&BENELUX: BE, FR, LU, NL; SOUTH: GR, ES, IT, MT, PT; BI (British Isles): IE, UK; CESEE: BG, CZ, EE, LT, LV, PL, RO, SK, TR, CY; N-AM: US, CA; ROW (Rest Of the World): AR, AU, CN, CR, HK, IL, IN, MX, PH, RU, SG, UY

For a complete overview of the EPO application process, see Harhoff and Wagner (2009). For the purpose of this analysis, it will suffice to mention that EP applications are first submitted to the EPO, where a first examination is carried. At the application stage, the patentor typically submits a list of member countries where s/he intends to later employ the patent. At this stage and until the patent is granted, the patentor must pay renewal fees to the EPO. If the EP patent is granted, it enters the so-called *national phase*. Here, in order to maintain the IP protection in the previously elicited countries, the patentor has to pay each national office separately.

Renewal fees are sourced from the websites of EPO, USPTO, WIPO and PatentVista. Historical data on renewal fee prices are available for EPO applications since 1978 and for USPTO since 1997. We convert all amounts EUR/ECU using end-year historical exchange rates published by the ECB.

With regard to fee prices for other national POs, we were not able to retrieve historical fee schedules. As a second-best solution, we retrieved the latest observable schedule (typically 2015/2016) from the above-mentioned sources and assumed historical prices to correspond to current fee prices in real terms. The assumption is based on the observation of Pakes et al. that "in most countries we have studied there has not been much intertemporal variation in these [fee] schedules in real terms" (Pakes et al. 1989, p. 369). It should be noted, however, that Pakes et al. (1989) refer in particular to short-term variation. Hence, we expect some bias with regard to older application vintages, due to our analysis' longer-run perspective.[11] All fee prices are further converted to EUR and deflated by the national GDP (base year 2005).

The analysis uses a number of relevant predictors to a patent's revenue stream, drawn from the existing literature. For instance, a higher *patent stock*, i.e. the size of the firm's patent portfolio when patent j was submitted, has shown an inverse relationship with patent value (Bessen 2008), confirming the findings in Lanjouw and Schankerman (2004) that patent productivity is inversely related to patent value and, to some extent, the "invention potential exhaustion" hypothesis in Evenson (1991). Similarly, a number of studies point to the positive relation between the inventor team size and the value of the innovation (e.g. Wuchty et al. 2007).

In addition, we account for citations and the number of claims in the patent. These quantities have been previously employed as proxies of patent value (Trajtenberg 1990). In the case of citations, we must differentiate between citations *made*, so-called reverse citations, and citations *received* (*forward citations*). Moreover, *reverse citations* directed at non-patent literature (e.g. scientific papers, reports) have been shown to affect the generality and *appropriability* of the underlying innovation (Trajtenberg et al. 1997).

In addition, we exploit data on claims to derive proxies of patent's technical content. In particular, we choose the *median claim length-to-words ratio*, which

[11]For instance, 19 March 2013 witnessed the largest price increase in USPTO renewal fees. Prices increased from a minimum of 24%, up to a 54% raise for the third and last renewal instalment.

Table 3 Summary statistics of explanatory variables

	Obs.	Mean	Std. error	Min	Max
Patent stock	33,905	21.94	33.165	0	256
Number of inventors	33,905	5.37	5.515	1	60
Reverse citations	33,905	14.41	30.921	0	999
Forward citations	33,905	4.79	20.588	0	1797
Non-patent citations made	33,905	7.63	20.773	0	579
Median claim length-to-words ratio	33,905	6.26	0.556	5.26	8.57
Patent received no citations[a]	33,905	0.28	0.449	0	1
Patent made no citations[a]	33,905	0.64	0.481	0	1
Patent made no non-patent citation[a]	33,905	0.42	0.494	0	1
Application period					
1987–2001[a]	33,905	0.24	0.425	0	1
2002–2007[a]	33,905	0.51	0.500	0	1
2008–2012[a]	33,905	0.25	0.436	0	1
Technology field					
ICT[a]	33,905	0.24	0.425	0	1
Electronics[a]	33,905	0.15	0.362	0	1
Life sciences[a]	33,905	0.49	0.500	0	1
Other[a]	33,905	0.12	0.326	0	1
Start-up macro-region					
DACH[a]	33,905	0.24	0.425	0	1
NORDICS[a]	33,905	0.08	0.276	0	1
FR&BENELUX[a]	33,905	0.23	0.422	0	1
SOUTH[a]	33,905	0.02	0.123	0	1
BI[a]	33,905	0.29	0.454	0	1
ROW[a]	33,905	0.14	0.349	0	1

[a]Dichotomic variable

computes the average length of words among claims of a specific patent, then draws its median value.[12] We hypothesise that a higher incidence of technical terms will produce a higher median claim length-to-words ratio, and we seek to measure how this feature relates to patent value. Table 3 lists descriptive statistics for the explanatory variables.

[12]To avoid the difference in average word length be driven by different patent languages, we only calculate this index for main/equivalent patents written in English.

4 The Economic Value of Start-Ups' Innovations

4.1 A Model of IP Protection Renewal and Value

This section tackles the general features of our theoretical framework. For a thorough discussion of the model, the reader is referred to Signore and Torfs (2017). Following Deng (2007), we postulate that IV_k—innovation k's private value—is equivalent to the cumulative value of all patents within the given patent family:

$$IV_k = \sum_{j=1}^{J} PV_j \tag{1}$$

where PV_j is the value of patent j. We define PV_j as the sum of all returns accruing to the patent holder, minus the patent enforcement costs, i.e. renewal costs. Renewal costs can be expressed as $c(t_i) = \{c_{t_i}\}$, a sequence of non-decreasing renewal fees payable at each period t_i, i=0,1,. . .,T, where T is the maximum renewal period and t_T is typically 20 years. For simplicity, we assume renewal fees to be due precisely at the start of each period, while late payments are not foreseen. Renewal fees and renewal periods can significantly differ across countries. Within each country, renewal fee prices are often indexed to, e.g. GDP prices and consumer prices. As such, they are updated periodically.

Following Pakes and Schankerman (1984), we impose a functional form for the return distribution. The patent revenue stream is defined by an *initial return* r_0, associated with the initial "quality" of the innovation. For instance, consider a major technological breakthrough that confers a high competitive edge to the innovator: *ceteris paribus*, s/he will be able to reap higher benefits from such innovation. In addition, we assume that revenues are subject to the exponential decay rate δ. This may be explained by technological obsolescence and/or increased pressure from competitors, who may catch up through similar innovations falling outside the remit of the original IP claim. Thus, the return function $r(t)$ can be expressed as follows:

$$r(t) = r_0 e^{-\delta t} \tag{2}$$

At first, the assumption of such a specific functional form for patent returns may seem unwarranted. Indeed, it is not rare that patentors apply for patent protection despite lacking a thorough strategy for the commercialisation of their IP. Nevertheless, this limitation does not appear to significantly affect estimation results: both Pakes (1986) and Lanjouw (1998) note that even when accounting for uncertainty and the discovery of new ways to commercially exploit patented IPs, no "learning" windfall can be observed by the 7th year after application.

Assuming that patentors are endowed with perfect rationality and information, the decision to renew at time t_i is only justified if the returns accruing in $[t_i, t_{i+1}]$ at least match the renewal costs c_{t_i}, i.e. if:

$$\int_{t_i}^{t_{i+1}} r(t)e^{-s\tau}\, d\tau \geq c_{t_i} \tag{3}$$

where s is the discount rate defining the time value of revenues.

Suppose there is no *right-censoring* of renewal rates, i.e. that the last observed payment can only indicate the patentor's unwillingness to withstand further renewal costs—as opposed to, e.g. not yet accrued renewal fees. Denote the last paid renewal period with $\lambda \in [0, \mathrm{T}]$. As per Eq. (3), patent revenues in $[t_\lambda, \mathrm{t}_{\lambda+1}]$ must be greater or equal to renewal costs c_{t_λ}, while returns in $[t_{\lambda+1}, \mathrm{t}_{\lambda+2}]$ must be lower than $c_{t_{\lambda+1}}$.

Similarly, the total (discounted) revenue stream PR, i.e. the value of all returns accruing in $[t_0, \mathrm{t}_{\lambda+1}]$, can be shown to lie between:

$$z_{t_\lambda} c_{t_\lambda} \leq PR < z_{t_{\lambda+1}} c_{t_{\lambda+1}} \tag{4}$$

where $z_{t_{\lambda+m}}$ is a function of δ, $t_{\lambda+m}$, $\mathrm{t}_{\lambda+(m+1)}$ and s. Discount rate s is assumed at 10% per annum as in Bessen (2008) and most similar works.[13]

To estimate the remaining quantities, we impose a parametric form to the distribution of PR. Ruling out the hypothesis that values are distributed *normally* (as per the existing literature and the claims made in the foreword of this chapter), we turn to the assumption that PR is *log normally* distributed,[14] i.e. that:

$$\ln\left(PR_j\right) \sim N\left(x_j\beta, \sigma_\epsilon\right) \tag{5}$$

where $\mathbf{x}_j$ is a vector of patent characteristics. As previously mentioned, ln (PR_j) is a *latent*, unobservable variable for patent j. However, we can exploit its *observable* last renewal period $\lambda_j \in [0, \mathrm{T}]$ to make an inference about ln (PR_j). The quantity λ_j is referred to as an *ordered response*, such that

$$\begin{aligned}
&\lambda_j = 0 \quad \text{if} \quad \ln\left(PR_j\right) < \ln\left(z_{t_1} c_{t_1}\right) \\
&\lambda_j = 1 \quad \text{if} \quad \ln\left(z_{t_1} c_{t_1}\right) \leq \ln\left(PR_j\right) < \ln\left(z_{t_2} c_{t_2}\right) \\
&\lambda_j = 2 \quad \text{if} \quad \ln\left(z_{t_2} c_{t_2}\right) \leq \ln\left(PR_j\right) < \ln\left(z_{t_3} c_{t_3}\right) \\
&\qquad\qquad \vdots \\
&\lambda_j = T \quad \text{if} \quad \ln\left(PR_j\right) \geq \ln\left(z_{t_T} c_{t_T}\right)
\end{aligned} \tag{6}$$

Given this formulation, it is now possible to estimate β, σ_ϵ and δ via maximum likelihood (ML) methods. However, we must first address the additional

[13]The model's sensitivity to this assumption is tested by varying s in the range of 5–15%. Because of the model's parametric form, all original MLE estimates are maintained, save for δ which shifts accordingly to counteract the increase or decrease in s. For additional robustness, we tested a firm-specific discount rate s, leveraging on firms' weighted average cost of capital (based on the methodology of Lünnemann and Mathä 2002). Results are very similar to the ones reported in the remainder of the paper.

[14]See Bessen (2008) for an overview of the literature on patent value distributions.

complication—stemming from the use of recent patent vintages—that generates *right-censoring* for patents whose renewal window has yet to conclude. To address this issue, we follow Gupeng and Xiangdong (2012) and introduce the *censoring variable* η_j, which has value 1 if the patent renewal window is right-censored and 0 otherwise. For instance, the response $\lambda_j = 2$ in Eq. (6) is updated as follows:

$$\begin{array}{c} \ln\left(z_{t_2} c_{t_2}\right) \leq \ln\ \left(PR_j\right) < \ln\ \left(z_{t_3} c_{t_3}\right) \text{ if } \eta_j = 0 \\ \ln\left(z_{t_2} c_{t_2}\right) \leq \ln\ \left(PR_j\right)\ \text{ if } \eta_j = 1 \end{array} \tag{7}$$

i.e. the revenue stream PR_j for the *active* patent j has a lower bound but no upper bound since we cannot observe future renewal decisions.

Concluding our analysis, we compute the expected values for ln (PR_j), conditional on the observed last renewal period λ_j, using ML estimates of β and δ. Finally, we use Eq. (1) to compute IV_k.

4.2 Estimation of Patent Values

Table 4 illustrates the estimation results. Due to significant differences in renewal fee schedules among various application groups, we were unable to fit the entire sample to the model at hand. As such, we carried out a separate analysis for each estimation group introduced in Sect. 3.

Column (1) of Table 4 contains the coefficients of the regression on the EP/PCT subsample of patent applications. We account for the EP *national phase* by assigning the *censored* status, i.e. $\eta_j = 1$, to granted EP applications entering this stage. We motivate this choice by observing that, after the grant date, the patentor is relieved from the duty to pay renewal fees to the EPO. At the same time, s/he can keep the patent enforcement through payments directed at each national office. Therefore, the *value* of an EP application leading to grant can be interpreted as right-censored.

The sample of EP/PCT applications yields a rate of technological decay $\delta = 0.25$, higher than in Bessen (2008) and in general lying in the upper range of decay rate values estimated in the literature. We believe this is due to the nature of our sample of patentors, composed exclusively of new ventures. Indeed, when estimating the model parameters on a subset of smaller firms, Bessen also encounters a higher value for the technology decay rate. Similarly, we note from Gupeng and Xiangdong (2012) that our correction to account for *censored* applications tends to further inflate the value of δ.

Column (2) shows the results of the regression on the national patents' subset. Compared to the former group, these patents present a much lower rate of technological decay ($\delta = 0.04$) as well as lower median (EUR 931, in 2005 prices) and average expected returns. With respect to the lower value of δ, we can observe a number of potential drivers of such significant difference, e.g. a higher proportion of innovations from information and communication technology (ICT) and a lower

Table 4 Maximum likelihood estimates of the patent renewal model

	EPO and national phase patents	National patents	USPTO patents	USPTO patents with $\delta = 0.25$
	(1)	(2)	(3)	(4)
	MLE	MLE	MLE	MLE
ln (patent stock)	-0.2963^{***}	-0.0657	-0.2756^{***}	-0.0850^{**}
	(0.030)	*(0.084)*	*(0.090)*	*(0.042)*
ln (number of inventors)	0.3966^{***}	0.0004	-0.2416^{*}	-0.1080^{*}
	(0.045)	*(0.140)*	*(0.136)*	*(0.065)*
ln (citations made)	1.5079^{***}	0.8295^{**}	0.8754^{***}	0.4504^{***}
	(0.108)	*(0.345)*	*(0.184)*	*(0.081)*
ln (citations received)	0.6141^{***}	0.4612^{***}	1.5594^{***}	0.7373^{***}
	(0.045)	*(0.136)*	*(0.186)*	*(0.052)*
ln (non-patent citations made)	-0.5637^{***}	-0.8838^{**}	-0.2007	-0.1004
	(0.107)	*(0.408)*	*(0.183)*	*(0.089)*
ln (number of claims)	-0.2228^{***}	-0.1609	-0.7772^{***}	-0.3718^{***}
	(0.051)	*(0.155)*	*(0.173)*	*(0.076)*
Median claim length-to-words ratio	-0.1349^{**}	0.6547^{**}	-0.8503^{***}	-0.4274^{***}
	(0.065)	*(0.254)*	*(0.209)*	*(0.094)*
Patent made no citation[a]	1.9742^{***}	-0.4231	-4.2608^{***}	-2.0226^{***}
	(0.199)	*(0.678)*	*(0.884)*	*(0.378)*
Patent received no citation[a]	0.9685^{***}	0.6404^{**}	0.0997	0.0501
	(0.113)	*(0.313)*	*(0.422)*	*(0.207)*
Patent made no non-patent citation[a]	0.9281^{***}	-2.1247^{***}	0.1874	0.1025
	(0.163)	*(0.645)*	*(0.502)*	*(0.244)*
Constant	8.6020^{***}	5.1791^{***}	16.2873^{***}	10.9265^{***}
	(0.520)	*(1.704)*	*(1.780)*	*(0.697)*

(continued)

Table 4 (continued)

	EPO and national phase patents	National patents	USPTO patents	USPTO patents with $\delta = 0.25$
	(1)	(2)	(3)	(4)
	MLE	MLE	MLE	MLE
Application period[b]	Yes	Yes	Yes	Yes
Technology field[c]	Yes	Yes	Yes	Yes
Start-up macro-region[d]	Yes	Yes	Yes	Yes
δ	0.251	0.041	0.849	0.251
σ_ε	3.07	4.02	7.59	3.72
Mean expected revenue (2005 EUR)	1,079,053	66,880	2,980,000,000	228,853
Log-likelihood	−35,402	−4391	−8605	−8640
N° of observations	21,303	3202	9400	9400

$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$

[a]Dichotomic variable

[b]Application periods: *1987–2001* (baseline), *2002–2007*, *2008–2012*. For columns (3) to (4), dummy "post-2008" used instead

[c]Technology fields: *ICT* (baseline), *electronics*, *life sciences*, *others*

[d]For the composition of regions refer to Footnote 9; family cluster-robust standard errors in brackets

proportion of seed stage, potentially more *disruptive* companies. However, the most plausible explanation would be twofold: first, innovators may have a better grasp of the appropriable returns from a patent when pursuing national IP protection, compared to the case of an international, European-wide patent; second, there could be a *selection effect*, justified by the lower rate of purely national applications,[15] due to firms pursuing national patents only in specific circumstances (e.g. moderate but predictable returns from innovation).

Finally, we note a potential limitation of our model, one that concerns the theorised constant nature of the decay rate δ. This point is also raised by Bessen in the context of USPTO patent applications submitted by foreign firms. Our regression on the USPTO subset of patents, shown in Column (3) of Table 4 reinforces this view. For this group, we estimate $\delta = 0.85$, more than three times the rate observed in the EP/PCT group of patent applications. Like in Bessen (2008), we note that such higher δ is accompanied by a significant increase in the standard deviation σ_ε. Bessen argues that the high δ evidences the failure of the constant depreciation assumption. Following his recommendation, in Column (4) we re-estimate the model by constraining the coefficient of δ to 0.25, i.e. the observed value for the EP/PCT sample.

5 Results

5.1 The Value of Innovations for EIF-Backed Start-Ups

We estimate the economic value for 11,597 unique patent families associated with start-ups supported by the EIF. Expressed in 2005 prices, values range from a few hundred EUR to more than EUR 402m, with a median and average price of EUR 138k and EUR 2.2m, respectively. The distribution of innovation values is heavily skewed. For instance, we find that only 96 innovations hold a value of EUR 50m or higher. These high-valued innovations are associated with 66 start-ups, out of a total 984 start-ups in our sample with at least one patented innovation. Figure 6 displays the overall distribution of innovation values.

5.2 Sectoral Differences

Figure 7 compares the distribution of innovation values among the two foremost industries, i.e. ICT and life sciences. It reveals fundamental differences not only in the innovative capacity of start-ups operating in these two sectors but also signals

[15] However, note that PCT applications never requiring the involvement of the EPO are also in this subset.

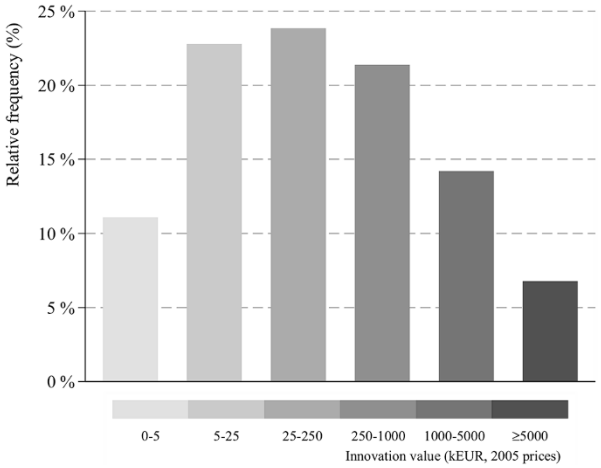

Fig. 6 Histogram of innovation values. Note: Based on a sample of 11,597 innovations from 984 EIF-backed start-ups with complete value data

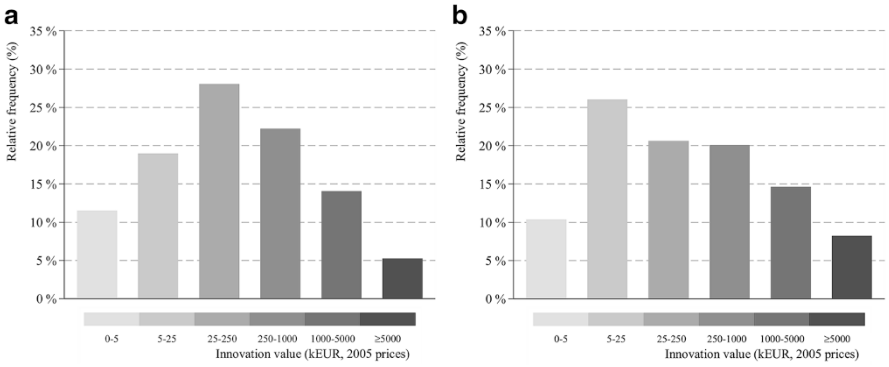

Fig. 7 Innovation values by start-up sector. (**a**) ICT and (**b**) life sciences

opposing IP protection strategies among the two groups. To support this claim, we note how the distribution of values for ICT start-ups peaks in the EUR 25–250k value range and is moderately less skewed than in the case of life sciences, which have their innovation distribution peak earlier in the EUR 5–25k bracket. A possible interpretation of this difference lies in the fact that innovations in life sciences may be subject to lower entry barriers for IP enforcement, e.g. due to a lower chance of imitation from competitors prior to the proven success in clinical trials. Against this background, the distribution of ICT innovations may suffer from *selection bias*,

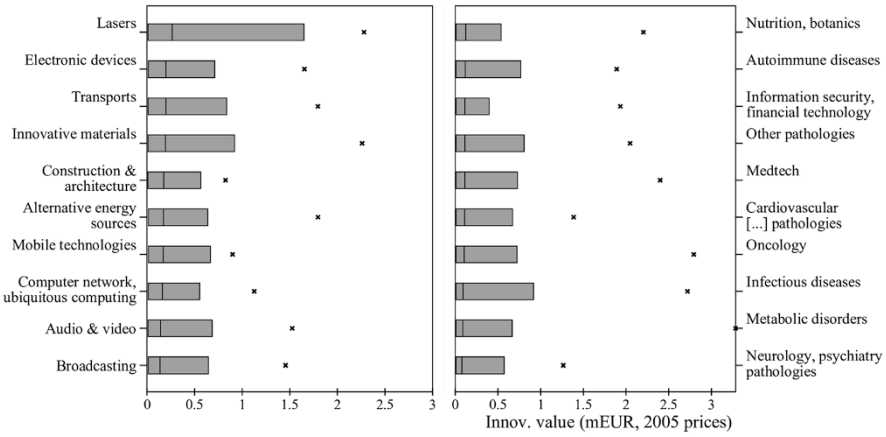

Fig. 8 Mean, median and interquartile range of patent families by innovation field. Note: Based on a sample of 8657 innovations associated with 894 EIF-backed start-ups. Boxes represent the interquartile range. The vertical line intersecting each box represents the median, while the cross represents the mean.

causing less promising inventions to be excluded a priori from patenting.[16] At the same time, the high incidence of outliers in life science innovations drives their higher overall worth.

Figure 8 displays the distribution of innovation values across the 20 most frequent technology fields. It ranks innovation fields from highest to lowest in terms of the median, providing evidence in support of our prior hypothesis: life sciences core fields such as oncology, metabolic disorders and infectious diseases treatments all show the highest average values, but occupy the lowest tier of the median ranking. Conversely, fields related to ICT and electronics typically hold the foremost positions and have less dispersed values. Interestingly—and perhaps fortuitous—the field of medtech lies almost precisely between its parent categories (i.e. life sciences and ICT/electronics).

5.3 Geographical Differences

Figure 9 hints that a similar phenomenon may be occurring at the geographical level. The left panel illustrates the distribution of innovation values for start-ups based in the British Isles, where the highest amount of innovations was produced over the observed period. However, the value of these innovations is lower compared to start-

[16]This phenomenon may not only be limited to innovations lacking the potential to produce outstanding economic returns but also covers IPs whose revenues may be harder to protect, easier to imitate, etc.

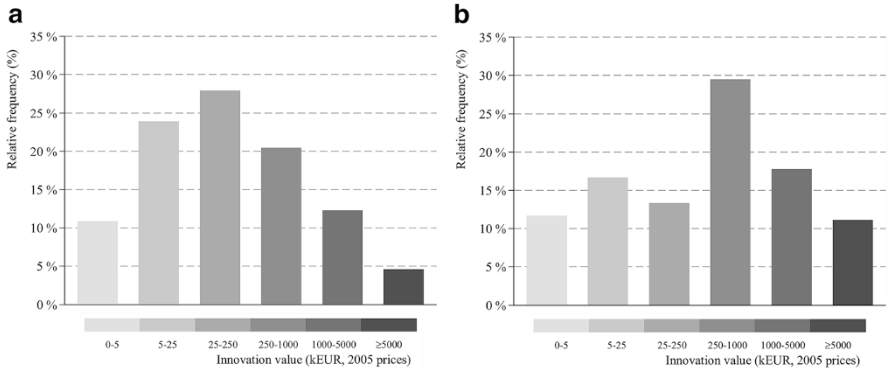

Fig. 9 Innovation values by start-up macro-region. (**a**) British Isles and (**b**) Southern Europe and CE-SEE

ups in other European regions, since highly valued innovations are observed less frequently.

At the other end of the spectrum, the right panel of Fig. 9 hints that, despite start-ups in the Southern European/CESEE regions being generally less productive in terms of patented innovations, their output has on average a higher value than in competing macro-regions.

5.4 Age and Timing of Innovations

We conclude this section by comparing innovation values and the age of start-ups at first EIF-backed investment. The seminal work of Macmillan et al. (1985) raised awareness on the role of patents in the decision-making process of venture capitalists. Since then, numerous empirical works have further discussed the importance of patents in the start-ups' pursuit of external financing (e.g. Hottenrott et al. 2016; Coad et al. 2016). In particular, Hoenen et al. (2014) analyse US-based biotechnology start-ups, financed in the 2001–2011 period, finding that patents were a significant predictor of first-round financing, but not second-round financing. Against this background, we would expect the pruning of low-valued IPs to be more prominent for younger start-ups.[17]

Figure 10 compares innovation values between the two groups. Figure 10a confirms that innovations for younger start-ups are slightly skewed towards higher values. However, it is for firms in the 5–10 age group that we find most evidence in

[17]Unfortunately, our dataset does not track financing rounds. Thus, in the remainder, we rely on the assumption that more mature start-ups face a higher likelihood of follow-on investment than younger ventures.

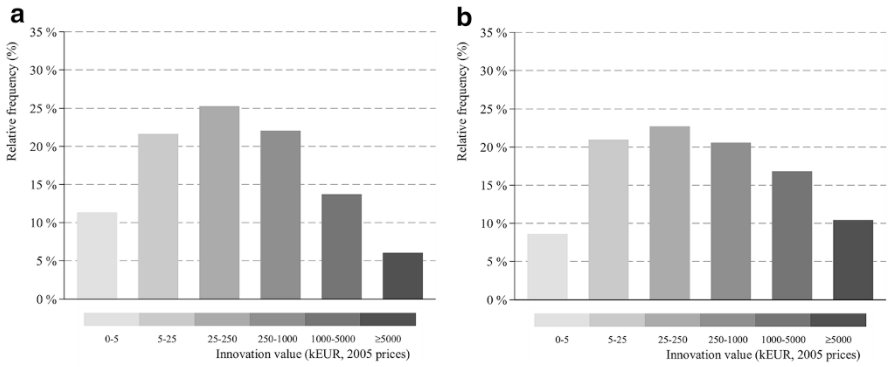

Fig. 10 Innovation values by start-up age. (**a**) 0–2, (**b**) 5–10

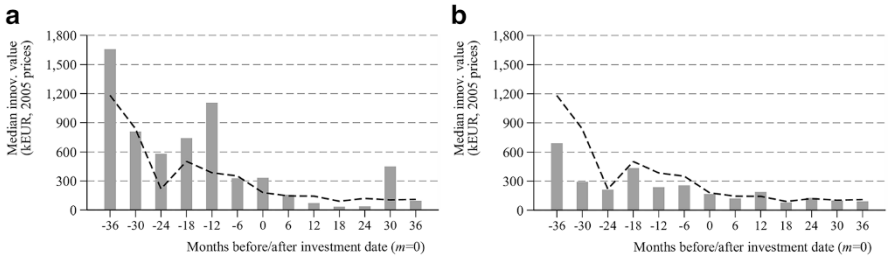

Fig. 11 Median innovation value prior/following first EIF-backed investment. (**a**) Initial innovation. (**b**) Follow-on innovation. Note: Only innovation 3 years before/after investment is shown. The grey line portrays the 6-month rolling median

support of selection bias. We test this hypothesis by regressing the logarithm of innovation values on age, observing a positive significant correlation. However, further controlling for the time lag between the innovation's first application date and the first VC investment date, the age effect becomes mostly non-significant (results shown in Signore and Torfs 2017). Although we could not find conclusive evidence on the relationship between age at first VC investment and innovation value, the correlation between innovation timing and value certainly calls for further investigation. To this end, Fig. 11 plots the median values of innovations for cohorts falling within 3 years of the first VC investment date.[18] For both initial (Fig. 11a) and follow-on innovations (Fig. 11b), values prior to investment date are unequivocally higher than in the post-investment period. Patent ownership prior to investment is widespread among EIF-backed start-ups, with 56% of patentors having initiated at least one patented innovation prior to investment date.

[18]While the skewed distribution imposes the use of medians, averages lead to qualitatively similar results.

To explain this result, we consider two different hypotheses. First, the finding could indicate the *selection effect* of investors, who prove effective in *sorting* start-ups by their innovative capacity—provided that patent applications are available. Start-ups lacking patent production prior to investment thus tend to be assessed on different grounds, not necessarily related to their propensity to patent. The *selection function* of VC firms is often highlighted in the venture capital literature: Peneder (2010) analyses VC- and non-VC-backed Austrian start-ups, observing a significant impact on start-up growth, but no tangible effect on innovation creation after investment. The author notes, however, that VC-backed start-ups tended to be patentors disproportionately more than their non-VC-backed counterparts, pointing out the significant role of investors to "pick", rather than "make", highly innovative start-ups. Similarly, Bronzini et al. (2017) analyse data on Italian start-ups to find that VC-backed companies face significant growth premia in all indicators but patent propensity.

Conversely, our second hypothesis confers a significant and positive impact of VC financing on the innovative capacity of start-ups. In this scenario, start-ups receiving financial backing obtain a twofold benefit: on the one hand, they are relieved from financing constraints and this, in turn, could lower their barriers to patenting (see Hall et al. (2016) and Coad et al. (2016) for a discussion), which may explain the lowering of median values for innovations submitted after the investment date. On the other hand, managerial support from VC firms may be crucial for start-ups to accelerate their path towards commercialisation and increase potential returns from pre-existing innovations. This view is consistent with Hellmann and Puri (2000), who find that venture capital financing led Silicon Valley-based start-ups to decrease their time to market. At the macro level, Samila and Sorenson (2010) also highlight the role of venture capital as a catalyst for commercialisation of existing innovations. It is not possible to identify the prevailing hypothesis with the data at our disposal. Nevertheless, we point out that the existing literature—mainly focusing on the post-investment phase—may have overlooked a potentially significant channel for VC financing to affect start-ups. It is also worth noting that despite their diverging implications, the two hypotheses may not necessarily be mutually exclusive. We leave the burden of proof to further research, based on, e.g. counterfactual assessment.

6 Conclusion

The paper employed a patent renewal model based on the seminal work of Pakes and Schankerman (1984) to estimate the private value of innovations owned by EIF-supported VC investees. The value of individual innovations is characterised by a large degree of heterogeneity, with values ranging from just a few hundred EUR to outliers exceeding EUR 400m. Importantly, these findings relate to the *private* value of patent protection, which is to be interpreted as the additional financial return resulting from the patent's protection of the underlying intellectual property. As

such, these estimates are likely to be the lower bound of the total social return, since the latter would include externalities such as non-appropriable knowledge-spillovers.

A comparison of innovations values over start-up industries and technology areas reveals that innovations stemming from the life sciences industry are, on average, more valuable than in other innovation areas. However, we also consistently observe a negative relationship between the *innovative propensity* of patentors in a given industry and the median value of patented innovations. Lower propensity to patent is correlated to a "shortage" of low-valued innovations that may be indicative of stronger barriers to patenting and can be observed in some sectors and geographies.

Finally, we compare the value of patented innovations to the date of the EIF-backed VC investment which, due to the nature of our sample, typically represents the date of the initial VC round for the start-up. Interestingly, we find that innovations initiated prior to the date of VC investment are significantly more valuable than post-investment innovations. This result is valid both for initial and follow-on innovations and is robust to a series of controlling factors. We discuss two potential explanations for this, concluding that future research on the effects of VC investments—mostly restricted to post-investment innovation—has typically neglected the potential effect of VC investors on pre-existing start-up innovation.

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In Which Regions Do Governmental, Independent, and Corporate Venture Capital Firms Invest? An Empirical Investigation across 402 German Regions

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Abstract We analyze the distribution of venture capital (VC) investments across German regions and explore the geographical determinants of these investments. So far, little is known about the regional determinants of governmental (GVC), independent (IVC), and corporate (CVC) VC firms and about whether these types of VC firms invest in different regions. Combining a dataset of 402 German districts, our regressions show that regions with a higher supply of human capital and knowledge creators attract a significantly higher number of GVC investments. Moreover, we find a significant difference in economically weaker regions but do not find a metropolitan bias. Hence, GVC firms do not invest more frequently in rural regions per se and do not prevent regional disparities more often than other types of VC firms. The implications of these findings for high-tech firms and regional policy are discussed.

Keywords Corporate venture capital · Governmental venture capital · Independent venture capital · Localization · Region · Venture capital

1 Introduction

Venture capital (VC) is an important source of funding for high-tech and entrepreneurial firms (e.g., Block et al. 2017, 2018a, b; Gompers and Lerner 2001). To foster the development of an active VC market, European policymakers have explicitly highlighted the provision of VC in the Europe 2020 political agenda (European

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Commission 2011). Hence, VC has become one of the key priorities in EU politics (Guerini and Quas 2016). From a government's point of view, VC firms are important for both realizing the objectives set by Europe 2020 and spurring innovational and economic growth in Europe (Bertoni and Tykvová 2015; Colombo et al. 2016; Guerini and Quas 2016). European and national policymakers, however, want to foster not only economic growth but also prevent regional disparities and inequalities (Bertoni and Tykvová 2015; Bottazzi et al. 2004). However, as prior research shows, VC is not equally distributed across countries, regions, and industries (e.g., Chen et al. 2010; Cumming and MacIntosh 2003; Fritsch and Schilder 2008; Sorenson and Stuart 2001).

The majority of prior studies look at the US market (e.g., Chen et al. 2010; Elango et al. 1995; Florida and Kenney 1988). Thus, little is known about a regional VC (equity) gap for young and innovative firms in Europe (exceptions are, for instance, Lutz et al. 2013; Martin et al. 2005; Streletzki and Schulte 2013). Furthermore, prior research has primarily focused on decision-making criteria of venture capitalists at the firm level (e.g., Block et al. 2019; Kirsch et al. 2009; MacMillan et al. 1985; Pierrakis and Saridakis 2017; Zhou et al. 2016), but has partially neglected both a potential regional dimension of VC firms and a differentiation between VC types. From a policy perspective, however, it is of utmost importance to develop regional clusters and to reveal regional characteristics to attract specific VC firms. Hence, our study focuses on the regional dimension of different VC firm types and examines which VC firm types provide financing for entrepreneurial opportunities. We aim to differentiate between different venture capital types and address the following research questions: which characteristics of German regions help to explain geographical patterns in VC investment, and how do particular types of VC investors, namely, governmental venture capital (GVC), independent venture capital (IVC), and corporate venture capital (CVC) firms, differ in their geographical investment patterns? Do local biases exist in that particular VC firms only invest in high-tech firms located relatively close to them geographically?

Combining a dataset of 402 German regional districts ("Kreise," NUTS 3-level) with a dataset of VC investments in Germany, we investigate the factors determining where VC investments occur in Germany. We distinguish between different types of VC investors: GVC, IVC, and CVC firms. Our findings show that regions with a higher technical university density and a higher student rate in the corresponding region have a significantly higher number of GVC investments. Furthermore, GVC firms appear to invest more frequently in rural areas than IVC firms. The GDP per employed person in the respective region, however, does not have a significant effect on GVC, IVC, or CVC investments.

Our study thus contributes to two particular streams of research in the innovation and VC literature. First, both trademarks and patents appear to be influenced by similar factors. Second, by comparing different types of VC investors and their investments, we contribute to the growing literature on differences among VC investors (e.g., Colombo and Murtinu 2017; Guerini and Quas 2016; Gupta and Sapienza 1992; Pierrakis and Saridakis 2017). In particular, GVC investments have a more regional component than other types of VC firms (IVC or CVC firms). Third,

by investigating regional characteristics of VC, we contribute to the literature about geographical determinants of VC investing (e.g., Chen et al. 2010; Gupta and Sapienza 1992; Mason and Pierrakis 2013) and regional biases that may exist (e.g., Chen et al. 2010; Fritsch and Schilder 2008; Mason and Harrison 2002). While prior research has shown that spatial proximity between VC investor and portfolio company is positively linked to the likelihood of a VC investment (e.g., Chen et al. 2010; Lutz et al. 2013; Martin et al. 2005), little is known about further regional characteristics that determine VC investments. Our study contributes to this discussion on regional determinants and reveals specific regional characteristics that influence the likelihood of VC investments of specific GVC, IVC, and CVC types in a region. Finally, from a policy perspective, our research sheds light on the competitiveness and innovation potential of specific regions and identifies important regional characteristics that attract VC investments.

2 Conceptual Framework and Hypotheses

2.1 Characteristics of GVC, IVC, and CVC Firms

Prior research shows that VC firms have a positive effect on portfolio firms' performance with regard to economic performance (e.g., Colombo and Murtinu 2017; Croce et al. 2013), innovation output (e.g., Bertoni and Tykvová 2015), and exit rates (e.g., Giot and Schwienbacher 2007). Furthermore, the different VC firms (GVC, IVC, and CVC firms) contribute and add value not only to the investee but also foster regional development. For instance, VC firms provide financial resources to the investee (Bertoni et al. 2013; Colombo and Murtinu 2017). In particular, young and innovative firms have a lack of financial resources due to market failures (Hall and Lerner 2010). Moreover, portfolio firms benefit from the certification effect of VC firms to external partners or financial providers (Colombo et al. 2016; Guerini and Quas 2016) and the network partners of the investor (Fried and Hisrich 1995). High-tech firms, for instance, increasingly innovate in networks instead of on their own. Also, VC firms monitor their portfolio firms in order to guarantee the success of entrepreneurial firms (Gompers 1995). Besides the contribution to the portfolio firms, VC firms in regions foster and support the economic development in those regions (e.g., Florida and Kenney 1988).

Due to the ownership and governance structures, however, the several types of VC firms differ significantly in terms of their primary objectives, the provision of added value to the portfolio company, and their regional focus (Bertoni and Tykvová 2015; Colombo and Murtinu 2017; Guerini and Quas 2016; Luukkonen et al. 2013). Hence, the investment patterns of the different VC firms may considerably differ from each other. We explicitly distinguish between independent venture capitalists, governmental venture capitalists, and corporate venture capitalists in our study and consider their expected geographical investment patterns. IVC firms are typically organized as limited partnerships, in which the investment process is run by an

independent management company that has no direct connection to the ultimate investor (Bertoni and Tykvová 2015; Colombo and Murtinu 2017). An independent venture capitalist's primary objective is to generate financial returns, part of which are received by the general partners of the VC firm (Bertoni and Tykvová 2015; Colombo and Murtinu 2017; Sahlman 1990). Beside the financial support, IVC firms provide value-adding services to the portfolio company. Since independent venture capitalists are especially interested in high financial returns, IVC firms have strong incentives to actively support the portfolio company. For instance, they provide the portfolio company with unique contacts to qualified workers and potential suppliers or customers (Bertoni and Tykvová 2015; Luukkonen et al. 2013).

GVC firms are usually not organized as limited partnerships, and the management company is not independent of the government (Bertoni and Tykvová 2015; Cumming and MacIntosh 2006). Prior research generally distinguishes between three different governmental funds: funds-of-funds, hybrid funds, and direct public funds (Colombo et al. 2016). A typical example of a VC funds-of-funds construct is the European Investment Fund (EIF), which invests in other investment funds instead of directly investing in a portfolio company (e.g., Pan-European Venture Capital Fund(s)-of-Funds program). Governmental venture capitalists may involve private investors in order to co-invest in funds (hybrid funds). The German High-Tech Gründerfonds fund includes, for instance, not only investors such as the German Federal Ministry of Economics and Technology but also industrial groups and is hence classified as a hybrid fund. Furthermore, direct public funds contain solely direct investments in portfolio companies by GVC firms (Colombo et al. 2016).

GVC firms have objectives and value-added services that differ from those of other types of VC firms. Whereas independent venture capitalists often focus on financial objectives, governmental venture capitalists' objectives are not limited to financial returns and are broader in nature (Bertoni and Tykvová 2015; Minola et al. 2017). First, governments regularly establish GVC funds to respond to equity gaps in the market, since private equity firms cannot meet all the demand of young and innovative firms (Luukkonen et al. 2013). GVC firms foster a crowding-in effect on the development of the entire VC market to correct market failures (Brander et al. 2015; Colombo et al., 2016). Second, the objectives of GVC firms are characterized by the entity that established them (Bertoni and Tykvová 2015; Colombo et al. 2016). In other words, positive externalities for the whole of society complement the financial objectives, namely, economical and regional development objectives (Colombo et al. 2016). In particular, peripheral regions that lack economic growth or are characterized by a high unemployment rate may benefit from governmental investments and are often explicitly mentioned in the agenda of GVC firms (Colombo et al. 2016).

Furthermore, the time horizon of GVC investments is oriented toward the long- rather than the short-term. Therefore, the period until the exit from a portfolio company is typically longer for GVC firms than it is for other types of VC firms (Sahlman 1990). Moreover, governmental venture capitalists are able to add value to the investee, in particular by providing unique relationships to universities or public

institutions (Pierrakis and Saridakis 2017). Nevertheless, prior research has indicated that GVC funds contribute to the portfolio company to a lesser extent than those of IVC funds, especially regarding the development of business ideas, professionalization, and exit orientation (Luukkonen et al. 2013). Reasons for the lower value-added activities of GVC firms might be the higher number of portfolio firms per manager and the minority stakes in the portfolio companies that lead to lower control and involvement by GVC firms (Cumming and MacIntosh 2007).

CVC firms are typically investment vehicles owned by an established, nonfinancial company (Colombo and Murtinu 2017). The parent company provides not only capital but also additional tangible or intangible resources to the portfolio company (Colombo and Murtinu 2017; Gompers and Lerner 2000; Rossi et al. 2017). In return, the corporate venture capitalist receives shares from the portfolio company. However, CVC firms differ, in several respects, from other VC types. First, CVC firms' objectives do not normally focus purely on financial returns, which is typically a minor motivator for a CVC investment. The majority of CVC programs seek a window on technology that is related to the core business of the parent company or complements the parent company's products (Dushnitsky and Lenox 2005). In other words, the CVC firms aim to source knowledge and learn about new technologies and consequently enhance the innovativeness of the parent company (Wadhwa et al. 2016; Yang et al. 2014). Second, the capabilities of corporate venture capitalists differ considerably from other types of venture capitalists. CVC firms are able to provide specialized knowledge from the parent company to the portfolio company, such as complementary competencies, distribution channels, or production capacity. Moreover, portfolio companies may benefit from the specialized and industry-specific network partners of the parent company (Colombo and Murtinu 2017). However, CVC firms represent an ancillary activity of a parent company. Hence, the capabilities and skills for supporting the portfolio company and the quality of value-enhancement activities of CVC firms are limited (Colombo and Murtinu 2017).

2.2 Regional Development Focus of GVC Firms

These findings from prior literature indicate that GVC firms in particular have varying objectives, ranging from the development of young industries, to supporting regional development and job creation by setting up regional funds (e.g., Luukkonen et al. 2013). Hence, the financial objectives are less pronounced in GVC than in IVC or CVC firms. Independent venture capitalists, for instance, often have specific incentive structures that focus on performance-linked bonuses (Leleux and Surlemont 2003). Governmental venture capitalists, however, consider investments that have a lower return but generate social payoffs and regional development and lead to job creation (Colombo and Murtinu 2017; Colombo et al. 2016). Furthermore, GVC firms aim to reduce VC investment disparities and foster the development of peripheral regions. Therefore, we expect that GVC firms invest more

frequently in economically weak and rural regions than other VC types and formulate the following hypotheses:

Hypothesis 1 GVC firms invest more often in regions with a low population density than (a) IVC and (b) CVC firms.

Hypothesis 2 GVC firms invest more often in regions with a low GDP per employed person rate than (a) IVC and (b) CVC firms.

2.3 Network Partners of GVC Firms

Knowledge spillovers, intense cooperation in R&D activities, and research efforts can lead to regional networks which favor the development of regional innovation systems (Block and Spiegel 2013; Cooke 2001). Universities are often considered as "knowledge suppliers," and various possibilities exist for firms to acquire knowledge from universities (Agrawal and Henderson 2002; Fisch et al. 2015). In particular, universities can be seen as regional suppliers of knowledge in two respects: first, universities include both explicit (codified) and implicit (tacit) knowledge. Whereas explicit knowledge is normally codified and can be transmitted verbally or in writing, implicit knowledge cannot be transmitted in a direct way, since it depends on experience, procedures, and learned behavior (Howells 2002). Universities produce and transfer this knowledge (knowledge spillovers) to a region that can be a source of entrepreneurial opportunities (Baptista and Swann 1998). Second, universities contribute to regional innovativeness and entrepreneurship by producing skilled employees. Highly educated workers have the ability to adapt and implement new technologies more easily (Vinding 2006).

Spatial proximity is an important factor that shapes the way in which firms and VCs profit from universities' knowledge. Previous research has indicated that knowledge spillovers are often limited to a certain geographic distance (Anselin et al. 1997). In particular, the tacit component of university knowledge spillovers requires face-to-face interaction and continuous personal contact (Audretsch and Lehmann 2005). Furthermore, prior research indicates that firms often recruit technical staff from local universities, and this source is more important than customers, suppliers, competitors, or other organizations (Dahlstrand 1999). Hence, spatial proximity favors both knowledge spillovers of universities and the recruitment of highly educated staff (e.g., Audretsch and Lehmann 2005).

We argue that knowledge spillovers of technical universities create entrepreneurial opportunities in a region and consequently attract VC firms to invest in these districts. A technical university plays a more important role in the context of high-tech firms and VC in particular, since the focus of a technical university is on engineering and science subjects. Therefore, both knowledge spillovers and (innovative) entrepreneurial opportunities may be spatially linked to the proximity of a technical university (Audretsch and Lehmann 2005). However, due to the different characteristics of GVC, IVC, and CVC firms, we expect that VC firms differ in the

usage of network partners such as technical universities. Whereas independent and corporate venture capitalists provide added value to the portfolio company by having contacts to qualified workforce, alliance partners, suppliers, or specialized knowledge, GVC firms especially have network partners in public institutions and interact more frequently with these public actors (Bertoni and Tykvová 2015; Colombo and Murtinu 2017; Pierrakis and Saridakis 2017).

Furthermore, the student rate in a region represents a potential source of highly qualified employees for the various firms and is used as a proxy for university knowledge spillovers (Block and Spiegel 2013; Dahlstrand 1999). In particular, GVC fund managers have a positive attitude toward academic entrepreneurship (Colombo et al. 2016). For instance, Knockaert et al. (2010) find that the availability of public funding in a VC firm's capital positively affects the investment manager's attitude toward an academic spin-off investment. Hence, we hypothesize:

Hypothesis 3 GVC firms invest more often in regions with a technical university than (a) IVC and (b) CVC firms.

Hypothesis 4 GVC firms invest more often in regions with a high student rate than (a) IVC and (b) CVC firms.

2.4 Local Bias of VC Investments

Prior research has shown that the geographical distance between the investor's location and the portfolio company has an influence on the VC investment patterns, also known as local bias (e.g., Cumming and Dai 2010). Two different explanations can account for a local bias of VC firms' investment patterns (Sorenson and Stuart 2001): first, VC firms identify and appraise investment targets in the pre-investment phase. As obtaining information regarding high-quality investment opportunities is time-consuming, VC firms typically rely on their own networks. Since networks tend to cluster in both geographic and social spaces, networks affect the location bias of investment activities. Beside the identification of investment opportunities, opportunity appraisal is essential for VC firms due to asymmetric information between investor and investee (Lutz et al. 2013). Using deep networks in an industry or a geographic area, VC firms are better able to evaluate the information regarding the quality of an investment opportunity (Sorenson and Stuart 2001). Furthermore, VC firms prefer investing in firms following recommendations from close contacts, such as from entrepreneurs that the VC previously financed (Fried and Hisrich 1995). The establishment of network contacts for both the identification and appraisal of investment opportunities is likely to decline considerably as the geographic distance increases.

Second, VC firms monitor and advise portfolio companies in the post-investment phase. Venture capitalists actively monitor their investee to mitigate asymmetric information (Gompers 1995; Trester 1998). Furthermore, venture capital represents smart capital. In other words, VC firms provide value-added services to the portfolio

company, such as financial expertise or advice on strategic and operational issues (Sapienza 1992). Both monitoring and value-added services include a geographical distance dimension (Sorenson and Stuart 2001). While monitoring requires regular visits to company operations, active assistance is easier by interacting frequently with the management at the portfolio company's location. Therefore, both monitoring and advising in the post-investment phase are more affordable as the geographical distance between investor and investee is shorter. Although all VC firms have to identify and appraise investment opportunities as well as monitor and advise their portfolio companies, we argue that the several VC types differ from each other. In particular, GVC firms are often tailored to a specific federal state, such as MBG Mittelständische Beteiligungsgesellschaft Baden-Württemberg GmbH or Bayern Kapital GmbH. These GVC firms, for instance, explicitly mention their sole concentration of investments in Baden-Wuerttemberg and Bavaria, respectively. Furthermore, GVC firms are shaped by economic and regional development objectives of the entity that established the GVC firm (Bertoni and Tykvová 2015; Colombo et al. 2016). Hence, the focus of investments in relation to the spatial proximity of regions and districts of the entity is obvious. On the contrary, IVC and CVC firms concentrate on high financial returns and complementary or new technologies (Wadhwa et al. 2016) and hence are more likely to have a broader investment pattern. Thus, we hypothesize:

Hypothesis 5 The local bias, the geographical distance between the investor's location and the portfolio company, of VC investments is more pronounced for GVC firms than for (a) IVC and (b) CVC firms.

3 Data and Variables

3.1 Data

For our empirical analysis, we used 402 regional German districts (NUTS 3-level) as our unit of observation. The NUTS classification is a hierarchical system designed to delineate the territory of the European Union, for example, for socioeconomic analyses (Eurostat 2015). The NUTS 3-level includes small regions and is equivalent to the German district level ("Kreisebene") including both districts ("Kreise") and autonomous cities ("kreisfreie Städte").

We collected data for these districts from various data sources. Data about the VC investments is obtained from Spotfolio, which is a German business matching platform that primarily focuses on innovative high-tech firms in Germany. According to Legler and Frietsch (2007), firms that exceed a 7% share of R&D expenditure in turnover belong to the high-tech sector, whereas a share of between 2.5% and 7% corresponds to medium-tech sectors. The remaining firms are classified as belonging to low-tech industries (Legler and Frietsch 2007). Beside this approach, Spotfolio uses the WZ Code to classify high-tech companies in Germany.

Therefore, specific firm data is available about German high-tech firms with regard to VC investments and different types of VC firms (government/corporate/independent VC firms). We aggregated the firm-level VC investments to a regional-level sample of 402 German districts ("Kreise") and autonomous cities ("kreisfreie Städte"). We assigned the VC investments to the districts by using the zip codes of the firm's headquarters.

Furthermore, we included regional data from four additional data sources: (1) Federal Office for Building and Regional Planning (BBSR), (2) Gründungsatlas, (3) Higher Education Compass, and (4) European Patent Office (EPO). The INKAR18F database of the Federal Office for Building and Regional Planning (BBSR) covers several regional characteristics regarding education, employment, and industry at the district level. Entrepreneurship data is obtained from the Gründungsatlas. The Higher Education Compass includes a list of all private and public German universities or universities of applied sciences. Moreover, we obtained information regarding regional patents from the European Patent Office by matching the regional code (NUTS 3-level) with the district code. As a result, our database covers a comprehensive list of VC-financed high-tech firms and regional data in Germany.

3.2 Variables

3.2.1 Dependent Variables

Since we investigate the geographical investment patterns of different VC investors (GVC, IVC, CVC), we calculate three dependent variables for each investor type, namely, number of GVC investments, number of IVC investments, and number of CVC investments, between 2011 and 2015 in the corresponding German district. For further robustness checks, we use the natural logarithm of the different dependent variables because the number of VC investments per district is highly skewed.

3.2.2 Independent and Control Variables

First, we measure the supply of entrepreneurs by using the start-up rate per district. The variable start-up rate measures the mean value of the number of start-ups between 2006 and 2010 divided by the number of inhabitants and is consequently a proxy for entrepreneurship (Block et al. 2013). Second, we include a dummy variable (technical university dummy), indicating whether a technical university or technical university of applied sciences exists in the respective district (coded as "1") or not (coded as "0"). This variable ascertains knowledge spillovers between technical universities and VC firms. We focus on technical universities because high-tech firms benefit more from technical universities focused on engineering or science subjects. In addition, technical universities receive higher funds than nontechnical

universities in order to compete for technology transfer (Audretsch and Lehmann 2005). Third, we include the population density to measure the degree of urbanization in a German district. The variable population density measures the mean value (2011–2015) of the number of inhabitants divided by km^2 in the respective district. VC firms might prefer a short distance to network partners and a better infrastructure for monitoring reasons. Fourth, we include the number of VC firms by calculating the natural logarithm of the number of VC investors' headquarters and branch offices per district. Prior research has shown that the spatial proximity between VC investor and portfolio company impacts the likelihood of a VC investment (Lutz et al. 2013).

As control variables, we include a variety of explanatory variables based on prior research on VC financing. We use the student rate as an indicator for human resources and firm-university knowledge spillover (Block and Spiegel 2013; Fritsch and Schwirten 1999). The variable student rate measures how many students are enrolled at a university or university of applied science divided by the number of inhabitants between 2011 and 2015 in that particular district. Furthermore, we measure the innovativeness of the regions by aggregating the mean value of number of patents granted (2011–2015) in the respective German district. Since the variable is highly skewed, we use the natural logarithm to reduce the skewness of that variable. Moreover, the variable GDP per employed person (in Euros) refers to the economic situation in the respective German district. In addition, industry variables are calculated as the number of firms in the particular industry divided by the total number of firms in the respective district (Block and Spiegel 2013). Table 1 provides detailed explanations of our variables.

3.3 Descriptive Statistics

The descriptive statistics apply to 402 regional districts in Germany. There are, on average, 2.05 VC investments per district in the years 2011–2015. The highest numbers can be found in Berlin (352 VC investments), Munich (123 VC investments), and Hamburg (47 VC investments). Furthermore, there are, on average, 1.07 IVC investments, 0.75 GVC investments, and 0.23 CVC investments per district between 2011 and 2015. The majority of governmental venture capitalists invest in Berlin (101 GVC investments), Munich (44 GVC investments), and Hamburg (24 GVC investments), whereas a large amount of IVC investments between 2011 and 2015 take place in Berlin (214 IVC investments), Munich (62 IVC investments), and Cologne (19 IVC investments). In addition, corporate venture capitalists invested in particular in Berlin (37 CVC investments), Munich (17 CVC investments), and Stuttgart (6 CVC investments). In addition, each district has on average 9.18 start-ups per 1000 inhabitants between 2006 and 2010, while there is less than one technical university or technical university of applied science per district. Furthermore, there are, on average, 0.54 VC firms per district (number of VC firms) and 518 people live per km^2 in each German district.

Table 1 Description of variables

Variable	Coding
Dependent variables	
Number of GVC investments	Number of GVC investments per German district (2011–2015)
Log (number of GVC investments)	Natural logarithm (number of GVC investments + 1)
Number of IVC investments	Number of IVC investments per German district (2011–2015)
Log (number of IVC investments)	Natural logarithm (number of IVC investments + 1)
Number of CVC investments	Number of CVC investments per German district (2011–2015)
Log (number of CVC investments)	Natural logarithm (number of CVC investments + 1)
Independent variables	
Population density	Number of inhabitants divided by km^2 (in 1000) per district
GDP/per employed person	Gross domestic product per employed people in 1000 €
Technical university (dummy)	Dichotomous variable (1 = at least one technical university/university of applied science exists in the corresponding German district; 0 = otherwise)
Students rate	Number of students enrolled at a university divided by inhabitants (in 1000)
Log (number of VC firms)	Natural logarithm (Number of venture capital firms + 1) in a district
Control variables	
Start-up rate	Mean value of number of start-ups divided by employed people (in 1000) per district from 2006 to 2010
Number of granted patents/log (number of granted patents)	Number of granted patents (EPO) from 2011 to 2015
Industry variables	Firms per industry divided by all firms (in a district)

Notes: N = 402 districts. If not other stated, the variables are mean values from 2011 to 2015.
Source: Authors

With regard to our control variables, the following results are noteworthy: the districts in our sample hold an average of 192.91 patents. However, the distribution is highly skewed: the kurtosis is 199.36 (skewness is 12.79). Concerning the student rate, we observe that on average the student rate (students enrolled at a university divided by inhabitants) is 32.6 per district between 2010 and 2014. Table 2 shows the corresponding descriptive statistics.

Table 3 shows the correlations and variance inflation factors (VIFs) indicating that multicollinearity is unlikely to arise problems in our regression models.

Figure 1 shows the geographic distribution of VC investments in Germany in the years 2011–2015. The maps apply to 96 districts ("Raumordnungsregionen") in Germany. A high number of VC investments with more than 20 VC investments in 2011–2015 exist, for example, in Berlin, Munich, Hamburg, Cologne, Stuttgart, and

Table 2 Descriptive statistics

	Variables	Mean	SD	Min	Max	Skewness	Kurtosis
1	Number of GVC investments	0.75	5.74	0	101	14.62	241.92
2	Log (number of GVC investments)	0.17	0.52	0	4.62	4.38	27.07
3	Number of IVC investments	1.07	11.21	0	214	17.52	327.21
4	Log (number of IVC investments)	0.17	0.55	0	5.37	4.81	33.86
5	Number of CVC investments	0.23	2.09	0	37	15.01	250.67
6	Log (number of CVC investments)	0.07	0.33	0	3.64	6.76	58.47
7	Population density	5.18	6.77	0.37	45.32	2.29	9.00
8	GDP per employed person	61.50	11.16	44.95	127.8	2.20	11.51
9	Technical university (dummy)	0.06	–	0	1	3.63	14.15
10	Student rate	3.26	6.37	0	50.78	3.16	15.85
11	Number of VC firms	0.54	3.56	0	51	11.94	157.48
12	Log (number of VC firms)	0.16	0.48	0	3.95	4.32	26.36
13	Start-up rate	9.18	2.07	3.27	17.21	0.63	3.62
14	Number of granted patents	192.91	690.66	0	11679	12.79	199.36
15	Log (number of granted patents)	4.06	1.51	0	9.37	−0.3	3.34
16	Mining sector	0.00	0.00	0	0.01	5.01	43.75
17	Manufacturing sector	0.07	0.02	0.03	0.20	0.81	4.90
18	Energy sector	0.02	0.02	0.00	0.13	2.33	10.00
19	Transport sector	0.03	0.01	0.01	0.10	1.38	6.39

Notes: N = 402 districts. Source: Authors
SD Standard deviation

Aachen. However, several districts do not show any VC investments (e.g., Bielefeld, Bremen-Umland, Landshut, Main-Rhön, Siegen). Figures 2, 3 and 4 depict the geographic distribution of GVC, IVC, and CVC investments in the years 2011–2015. In general, a large number of both GVC and IVC investments take place in metropolitan areas, such as Berlin, Munich, Hamburg, and Cologne/Düsseldorf. The number of CVC investments, however, is geographically concentrated in Berlin and Munich. In total, only a few districts exist with CVC investments.

Table 3 Correlations and variance inflation factors

	Variables	1	2	3	4	5	6	7	8	9	10	11	VIF
1	Population density												2.28
2	GDP per employed person	0.36*											1.87
3	Technical university (dummy)	0.30*	0.11*										1.15
4	Student rate	0.46*	0.13*	0.27*									1.74
5	Log (number of VC firms)	0.49*	0.38*	0.17*	0.22*								1.51
6	Start-up rate	−0.14*	−0.25*	−0.02*	−0.32*	0.03*							1.53
7	Log (number of granted patents)	0.42*	0.59*	0.20*	0.20*	0.38*	0.59*						2.09
8	Mining sector intensity	−0.34*	−0.11*	−0.10*	−0.24*	−0.18*	−0.11*	−0.15*					1.26
9	Manufacturing sector intensity	−0.48*	−0.20*	−0.21*	−0.39*	−0.33*	−0.20*	0.02*	−0.33*				1.90
10	Energy sector intensity	−0.40*	−0.04*	−0.14*	−0.26*	−0.20*	−0.04*	−0.11*	−0.20*	0.23*			1.42
11	Transport sector intensity	0.03*	0.01*	0.00*	−0.07*	−0.05*	−0.01*	−0.17*	0.05*	−0.09*	−0.13*		1.10

Notes: N = 402 districts. Source: Authors

VIF variance inflation factor

*Coefficients are significant at the 5% level

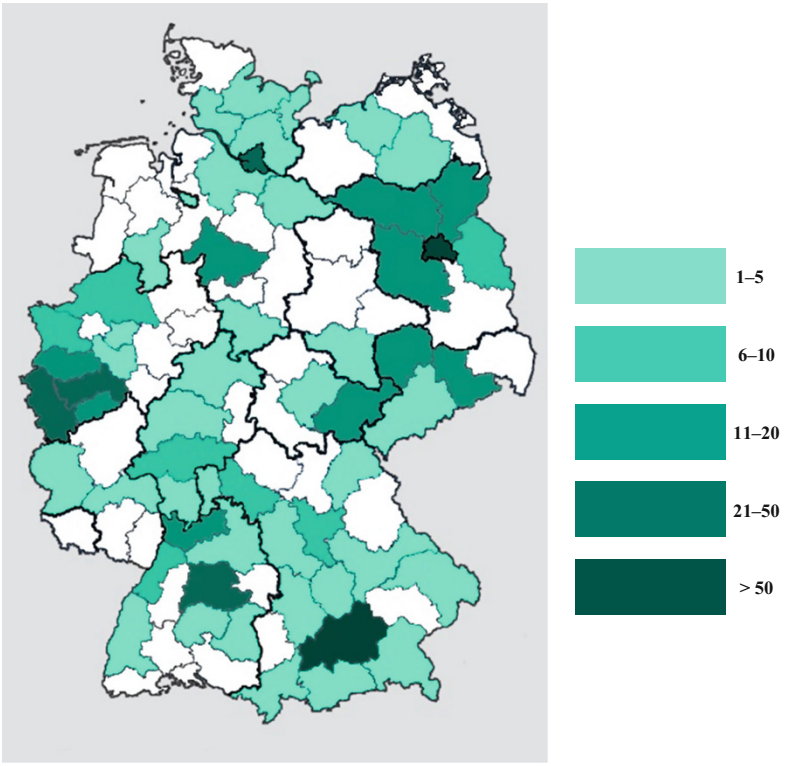

Fig. 1 Number of VC investments in 2011–2015. Notes: N = 96 districts (Raumordnungsregionen). Source: Authors

4 Results

4.1 Method

The variables that capture the number of VC investments (GVC, IVC, and CVC investments) have a count-data character, i.e., the outcome is a nonnegative integer variable. Moreover, a large number of districts do not have any VC investment at all. To address both the count-data character and the excess zeros of our dependent variable, we use a zero-inflated negative binomial regression. The highly significant Vuong statistic supports our approach. We estimate three zero-inflated negative binomial regressions (Table 4): Model 1 includes all GVC investments, whereas Models 2–3 include IVC and CVC investments, respectively. We conduct a seemingly unrelated estimation and a coefficient difference test to check across models for significant differences between the several VC investor types. As a robustness check, we estimate a seemingly unrelated regression (Table 5) using the natural logarithm of number of GVC investments, number of IVC investments, and number of CVC

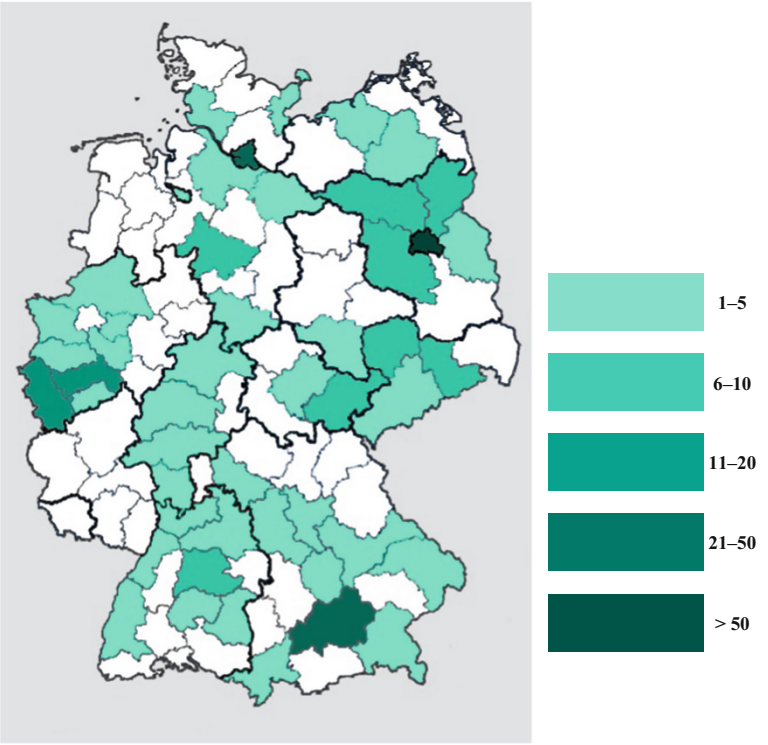

Fig. 2 Number of GVC investments in 2011–2015. Notes: N = 96 districts (Raumordnungsregionen). Source: Authors

investments, since the distribution of each dependent variable is highly skewed. Again, to assess the varying impact of regional determinants on the different VC types, we report the results of coefficient difference tests. We run a seemingly unrelated regression analysis, since the error terms of the different equations could be correlated with each other (Zellner 1962).

4.2 Multivariate Results

Table 4 displays the results of seemingly unrelated estimation based on three zero-inflated negative binomial regressions. H1 states that GVC firms invest more frequently in regions with a low population density than IVC and CVC firms, whereas H2 addresses the investments into economically weak regions. Using the number of GVC investments as the dependent variable (Model 1), the variable *population density* shows a significant negative effect ($p < 0.10$), whereas the variable *GDP per employed person* is insignificant. Moreover, the coefficient

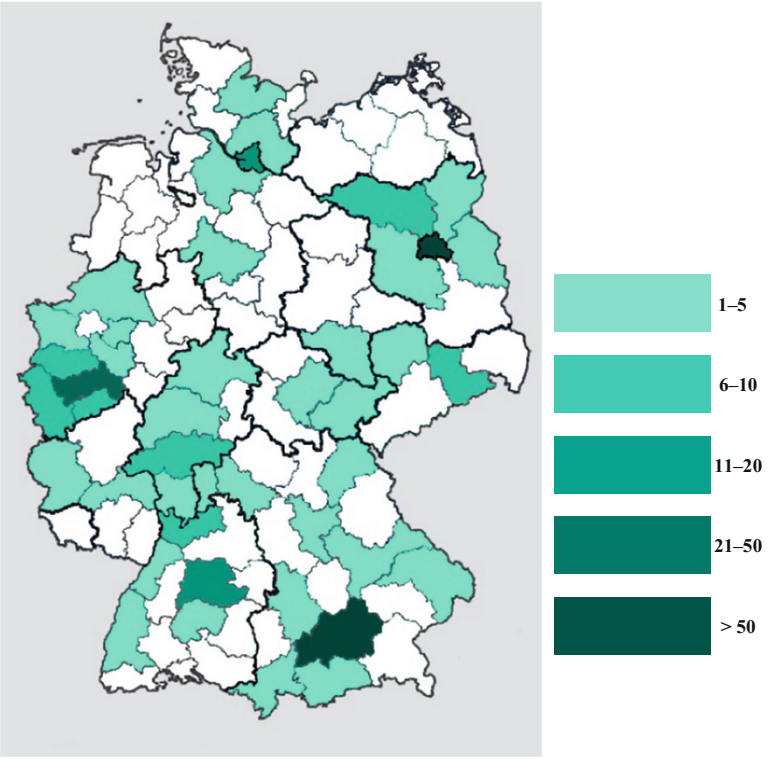

Fig. 3 Number of IVC investments in 2011–2015. Notes: N = 96 districts (Raumordnungsregionen). Source: Authors

difference test (Model 7) reveals that the effects of *population density* on GVC, IVC, and CVC investments significantly differ from each other ($p < 0.05$). In particular, the *population density* has a stronger effect ($p < 0.05$) on GVC than on IVC investments (Model 4). Thus, our results support H1a but we do not find support for H1b. Although there is no statistically significant difference (Model 7) between the effects of *GDP per employed person* on GVC, IVC, and CVC investments, the effect of *GDP per employed person* on GVC and CVC investments ($p < 0.05$) significantly differ from each other (Model 5). Hence, H2b is supported by our data, whereas H2a is not. H3 states that GVC firms invest more often in districts in which a technical university is located than IVC or CVC firms. Our results only show a significant coefficient difference ($p < 0.05$) between GVC and IVC firms (Model 4) and hence support H3a but not H3b. Furthermore, H4 refers to the positive effect of *student rate* on VC investments in a district. The effect is significantly higher ($p < 0.01$) for GVC firms than for CVC firms (Model 5) and for IVC than for CVC firms (Model 6). As a result, the data clearly supports our H4b but not H4a. Moreover, H5 posits whether the local bias of VC investments is more pronounced for GVC firms than for IVC and CVC firms. The coefficient difference test indicates

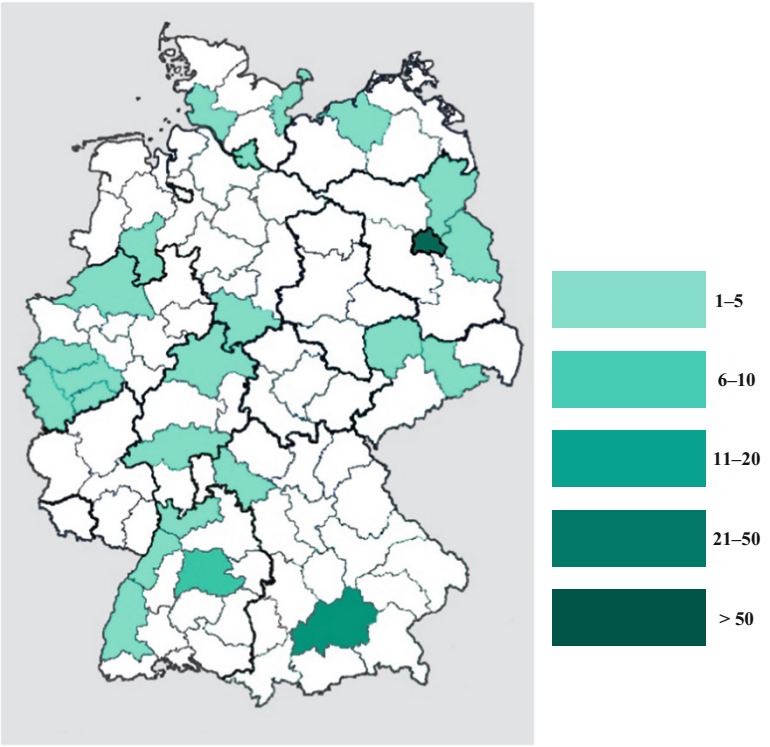

Fig. 4 Number of CVC investments in 2011–2015. Notes: N = 96 districts (Raumordnungsregionen). Source: Authors

that GVC firms invest more frequently in geographical near portfolio companies than IVC firms ($p < 0.05$; Model 4) and thus supports H5a.

A number of control variables show significant results. Using the *number of GVC investments* (Model 1) as dependent variable, both *start-up rate* ($p < 0.01$) and *log (number of granted patents)* ($p < 0.01$) show significant results. In addition, Model 5 reveals that the effect of the start-up rate on VC investments is higher for GVC than for CVC investments ($p < 0.01$). However, the results do not show a significant difference of the effect of patents in a region on the investment behavior of the several VC types (Model 7).

Moreover, we conduct a seemingly unrelated regression as a robustness of the main models to check for differences between VC investor types (Table 5). The majority of our results are confirmed by the robustness check. Various effects show a statistically significant difference between the effects of the regional determinants on VC investments of different VC types (GVC, IVC, and CVC). In particular, the results (Model 7) indicate that the effects of the different VC types regarding *student rate*, *log (number of GVC firms)*, *log (number of IVC firms)*, *log (number of CVC firms)*, *start-up rate*, and *log (number of granted patents)* significantly differ from

Table 4 Zero-inflated negative binomial regressions on VC investments at the district level

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable	Number of GVC investments	Number of IVC investments	Number of CVC investments	Diff. (1) v (2)	Diff. (1) v (3)	Diff. (2) v (3)	Diff. (1) v (2) v (3)
Independent variables							
H1: Population density	−0.103***	−0.020***	−0.120***	**		**	**
	(0.027)	(0.028)	(0.043)				
H2: GDP per employed person	−0.010***	0.011	0.004**		**	*	
	(0.012)	(0.011)	(0.011)				
H3: Technical university (dummy)	1.483***	0.307***	2.045*	**			**
	(0.550)	(0.398)	(1.195)				
H4: Student rate	0.054**	0.009	−0.143**		***	**	***
	(0.023)	(0.031)	(0.068)				
H5: Log (number of GVC firms)	0.679***			**			*
	(0.079)						
H5: Log (number of IVC firms)		0.534***		**			*
		(0.042)					
H5: Log (number of CVC firms)			0.386***	**			*
			(0.073)				
Control variables							
Start-up rate	0.038*****	0.033***	0.017***		***	**	***
	(0.011)	(0.010)	(0.008)				
Log (number of granted patents)	0.057***	0.060***	0.012***				
	(0.018)	(0.016)	(0.013)				
Industry variables	Yes	Yes	Yes				
Years	2011–2015	2011–2015	2011–2015				
Observations	402	402	402				

Notes: Seemingly unrelated estimation based on a zero-inflated negative binomial regression; standard errors are in parentheses. Diff. = Coefficient difference test. Source: Authors

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 5 Seemingly unrelated regression on VC investments at the district level

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable	Log (number of GVC investments)	Log (number of IVC investments)	Log (number of CVC investments)	Diff. (1) v (2)	Diff. (1) v (3)	Diff. (2) v (3)	Diff. (1) v (2) v (3)
Independent variables							
H1: Population density	0.004***	0.005***	0.006*****				
	(0.004)	(0.004)	(0.003)				
H2: GDP per employed person	0.004***	0.003*	0.004****				
	(0.002)	(0.002)	(0.002)				
H3: Technical university (dummy)	0.175***	0.040***	0.054***	*	*		
	(0.083)	(0.075)	(0.062)				
H4: Student rate	0.016***	0.015***	0.001***		***	***	***
	(0.004)	(0.003)	(0.003)				
H5: Log (number of GVC firms)	0.679***			*	***	*	**
	(0.079)						
H5: Log (number of IVC firms)		0.534***		*	***	*	**
		(0.042)					
H5: Log (number of CVC firms)			0.386***	*	***	*	**
			(0.073)				
Control variables							
Start-up rate	0.038*****	0.033***	0.017***		**	*	*
	(0.011)	(0.010)	(0.008)				
Log (number of granted patents)	0.057***	0.060***	0.012***		***	***	***
	(0.018)	(0.016)	(0.013)				
Industry variables	Yes	Yes	Yes				
Years	2011–2015	2011–2015	2011–2015				
Observations	402	402	402				

Notes: Seemingly unrelated estimation; standard errors are in parentheses. Diff. = Coefficient difference test. Source: Authors

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

each other. Moreover, the variable *technical university* has a stronger effect on GVC investments than on IVC or CVC investments ($p < 0.10$) in a German district (Models 4–5). In addition, the coefficients of the *student rate* regarding GVC and CVC investments are statistically different from each other ($p < 0.01$). We also find support for a significantly stronger positive effect of the corresponding number of VC firms on the number of GVC investments (Model 4 and Model 5).

5 Discussion and Conclusion

5.1 Discussion of the Results

Our empirical results indicate significant differences between VC investor types. This finding is in line with arguments put forward in previous research, showing that governmental, independent, and corporate venture capitalists differ in terms of investment objectives and possess different skills and network partners (e.g., Colombo and Murtinu 2017; Guerini and Quas 2016; Luukkonen et al. 2013). Although all VC types invest more frequently in regions in which the VC firm is located, GVC firms appear to be especially influenced by regional characteristics.

Population density (H1) shows a significant negative effect on GVC and CVC investments, which is in line with the objectives of governmental and corporate venture capitalists. In particular, GVC firms regularly consider social payoffs and regional development as a key priority instead of high financial returns (Colombo et al. 2016). Hence, an investment focus on metropolitan areas is less pronounced for GVC than for IVC firms. Also, CVC firms' objectives are not purely of a financial nature, but rather focus on new or complementary technologies with regard to the parent firm's products (Wadhwa et al. 2016; Yang et al. 2014). Interestingly, the variable population density has a negative but insignificant effect on the number of IVC investments. A possible explanation lies in the construction of our independent variable (population density), which considers solely the number of inhabitants per km^2. However, we also measure urban districts/metropolitan areas with two further variables as an additional robustness check. First, we construct a dichotomous variable based on the German statistical office that considers 237 German districts as metropolitan areas. Second, we use the INKAR database, which labels a district as an independent city if the population density is greater than 150 inhabitants per km^2. Both the dichotomous variable and the additional population density measure show either a nonsignificant or a significant negative effect on IVC investments in the corresponding district. Hence, urban districts/metropolitan areas do not have a higher market attractiveness for IVC firms per se. Coordination between several actors in the system at the regional level is essential (Harding 2000), as well as, among other factors, a high potential of VC investment opportunities and (syndication) network partners (e.g., Powell et al. 2002; Sorenson and Stuart 2001).

Prior research has shown that VC is not equally distributed across regions (e.g., Cumming and MacIntosh 2003; Fritsch and Schilder 2008; Sorenson and Stuart

2001) and policymakers want to prevent these regional disparities (Bottazzi et al. 2004). GVC firms, however, do not invest more frequently in economically weak regions (measured by GDP per employed person) than IVC or CVC firms. Hence, H2 is not supported by our results. A possible explanation may be a lack of high-tech firms with entrepreneurial opportunities in these regions for not only IVC and CVC but also GVC firms. This explanation is supported by our first study, since high-tech firms are more likely to be located in metropolitan rather than rural areas. VC firms require entrepreneurs who exploit and commercialize innovative and entrepreneurial opportunities. In other words, VC firms need regions with a supply of entrepreneurs. Although GVC firms often consider job creation and employment growth as one of their key objectives (e.g., Colombo et al. 2016), governmental venture capitalists require potential start-ups in order to invest.

In terms of universities, prior research has shown that universities are a key element in regional innovation systems (e.g., Cooke et al. 1997) and act as network partners to VC firms (e.g., Powell et al. 2002). Our results support the theoretical argumentation that technical universities possess tacit and codified knowledge that leads to locally bound knowledge spillovers (Audretsch and Lehmann 2005) and consequently to a higher number of entrepreneurial opportunities and a higher VC investment in the corresponding district. Interestingly, the existence of a technical university in a district has a positive effect on GVC investments in the corresponding German district and consequently supports H3. This finding is in line with previous research, which argues that GVC firms can add value to portfolio firms by providing and using connections to public institutions or universities (Bertoni and Tykvová 2015). In particular, GVC firms interact more frequently with technical universities that are often players in an innovation system. The results support the findings of Pierrakis and Saridakis (2017), who find that the more publicly dependent a fund is, the more it interacts with the knowledge creation community (e.g., universities, regional R&D institutes, companies of technology parks) in a regional innovation system. Also, the student rate positively influences GVC investments per German district. This is in line with previous research, which argues that GVC fund managers have a positive attitude toward academic entrepreneurship and academic spin-off investments (e.g., Colombo et al. 2016; Knockaert et al. 2010). Therefore, our results support H4.

Furthermore, prior research has investigated the link between the spatial proximity of a VC investor and a portfolio company and the likelihood of a VC investment (e.g., Gompers 1995; Jääskeläinen and Maula 2014; Mason and Harrison 2002). Two lines of argument may explain this phenomenon. On the one hand, network contacts for the identification and appraisal of investment opportunities in the pre-investment phase are likely to decline over distance. On the other hand, VC firms monitor and add value to the portfolio company in the post-investment phase, which is typically more affordable when the geographic distance between VC investor and investee is shorter (Sorenson and Stuart 2001). Although it has been argued that the spatial proximity between VC firm and portfolio company is less pronounced in denser infrastructures such as Germany (Fritsch and Schilder 2008), our results are in line with Lutz et al. (2013). Even in dense infrastructures, the

geographic distance between VC firm and portfolio company positively influences the probability of a VC investment. More importantly, this effect appears to be independent of the VC investor type. A possible explanation for the local bias of VC investments in denser infrastructures may be that VC firms unconsciously decide to invest in close portfolio companies, or asymmetric information and a lack of networks exist that lead to investments near the VC firm's location (e.g., Lutz et al. 2013; Zacharakis and Meyer 1998). Additionally, it is noteworthy that the local bias effect is stronger for GVC firms than for IVC or CVC firms and hence supports H5. Whereas independent and corporate venture capitalists want to have either high financial returns or a window for new technologies, governmental venture capitalists often have objectives that require investments in specific districts.

Furthermore, VC firms require investment opportunities and entrepreneurs who successfully exploit and commercialize entrepreneurial opportunities. Our results show a significant relationship between the start-up rate and VC investments in the corresponding district. In addition, the coefficients of the effect differ significantly according to VC type. A possible explanation lies in the construction of our independent variable (start-up rate). IVC and CVC firms often invest in high-tech industries (e.g., Colombo et al. 2010), but our variable includes all industries/sectors and consequently does not distinguish between low-tech and high-tech start-ups. GVC firms, however, might be more willing to invest in less innovative portfolio firms than other VC types.

5.2 Contributions and Implications for Theory and Practice

Our study has implications for ventures and policymakers. In particular, we contribute to two different research streams in VC literature. First, our study adds to the growing literature distinguishing between VC investor types (e.g., Colombo and Murtinu 2017; Guerini and Quas 2016; Gupta and Sapienza 1992). GVC, IVC, and CVC firms possess various objectives, skills, and acquaintances and consequently invest in different regions (e.g., Colombo and Murtinu 2017; Guerini and Quas 2016; Luukkonen et al. 2013). GVC firms, for instance, invest more often in regions where a technical university exists. GVC firms often provide unique relationships to universities or public institutions as an added value (Bertoni and Tykvová 2015) and consequently prefer investing in these regions. Nevertheless, a local bias exists for all VC types. In other words, GVC, IVC, and CVC firms are more likely to invest in regions in which the VC firm's headquarters or district office is located. This effect, however, is more pronounced for GVC firms than for IVC or CVC firms.

Second, our study contributes to the literature about geographical determinants of VC investments (e.g., Chen et al. 2010; Gupta and Sapienza 1992; Mason and Pierrakis 2013). We confirm that a local bias exists in the sense that VC firms invest in portfolio firms located near the investor. Moreover, technical universities appear to attract regional VC investments, whereas a metropolitan bias does not exist. Hence, knowledge spillovers of universities appear to exist in the context of VC

investments. However, a region requires an entrepreneurial and VC ecosystem in order to attract regional VC investments. A high population density (metropolitan area) itself is not sufficient, but rather a complex regional ecosystem, including innovative start-ups, qualified employees, and a well-developed infrastructure (e.g., Colombo et al. 2010; Harding 2000; Lutz et al. 2013).

The results of our study have implications for both entrepreneurs and regional development policies. We find a strong pattern of spatial concentration in venture capital. Prior research suggests that VC firms often invest in portfolio companies which are located close by (e.g., Powell et al. 2002; Sorenson and Stuart 2001). Although Germany has a dense economy and infrastructure, the geographic distance between investor and investee remains crucial. On the one hand, entrepreneurs should choose the location of their firm carefully. If entrepreneurs consider VC as a source of financing, a relatively close geographical distance of the venture's location to a venture capital cluster may increase the probability of a VC investment (Lutz et al. 2013; Martin et al. 2005). On the other hand, regional policymakers may attract VC firms to their region to foster the regional development of innovative start-ups and regional economic growth. Also, regional policymakers may consider GVC and CVC firms as an instrument for reducing regional disparities, since it appears that GVC and CVC firms are more likely than IVC firms to invest in rural areas.

5.3 Limitations and Future Research

Our study has several limitations that provide guidance for future research. First, we consider 402 districts of Germany as our unit of observation. However, several variables, such as technical university, may have an effect on VC investments in neighboring districts. In other words, a variable that measures the exact location of VC firms (number of GVC, IVC, and CVC firms) or technical universities and a corresponding distance (in km) may be more accurate than matching the location of VC firms or universities to the respective German district. Prior research has shown that, for example, university spillovers on innovation extend over approximately 80 km (Anselin et al. 1997). In addition, it remains unclear whether our finding that GVC and IVC firms invest in innovative regions is based on a selection or treatment effect. In other words, we cannot unequivocally ascertain whether VC firms select innovative regions for their investment patterns or whether VC firms encourage firms to actively innovate. Fifth, we have not explicitly considered syndication effects of VC investments. Prior research has shown that a spatial proximity effect exists between venture capital investors and investees in Germany (e.g., Lutz et al. 2013), but syndication networks expand the radius of VC investments (e.g., Sorenson and Stuart 2001).

Furthermore, our independent variable technical university does not consider nontechnical universities or universities of applied sciences that have prominent faculties with a focus on natural sciences, biotechnology, or similar areas. Future research may match the faculty footprint with the industries of the firms to analyze

knowledge spillovers in a region. Also, we consider the number of investments rather than the investment sum as our dependent variable. Although this measurement has been used in previous research (e.g., Powell et al. 2002), it might lead to a bias effect of VC investments in Germany. As a result, future research could investigate the investment sum and test regional determinants on the VC patterns of different VC firms.

Finally, future research could extend our findings on the geographical patterns of VC investments and their determinants to other forms of entrepreneurial finance, such as business angel investments (e.g., Block et al. 2018a, b), crowdfunding (e.g., Mollick 2014), or initial coin offerings (e.g., Fisch 2019).

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Playing with the Devil? Organizational Voids within Corporate Venture Capital Dyads

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Abstract When acting as an intermediary, corporate venture capital (CVC) units must balance two different institutional settings: the rigid corporate world and the advancing startup ecosystem. As a result, CVC units are faced with multiple voids that influence their organizational orientation toward one environment. This study employs text analysis on a unique sample of 22 CVC dyads to introduce a novel empirical way of measuring isomorphic variation over time. Following a mixed-method approach, the quantitative results are used to shed light on potential drivers of isomorphism, compiled by semi-structured interviews. The findings demonstrate that the degree of isomorphism is not only determined by decisions made during the initial phase of a CVC unit but also from mimetic processes that occur within the life span of such investment vehicles. The study thereby contributes to the ongoing academic discussion by elucidating potential drivers of isomorphism and provides researchers with a novel way to measure isomorphic tendencies based on organizational text excerpts.

Keywords Corporate venture capital · Isomorphism · Competing environments · Mixed-methods

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1 Introduction

When attempting to overcome financial constraints, an innovative startup will, depending on its development stage, often turn to external investors such as independent venture capitalists (IVC), business angels, or a private equity (PE) fund (Sudek 2006; Kollmann and Kuckertz 2010), and established corporations discovered the advantages of backing such startups in the mid-1960s (Gompers and Lerner 2000; CB Insights 2018). In an ideal world, the use of corporate venture capital (CVC) delivers a wide range of benefits for all parties involved. Acting as a broker, a CVC unit supports promising startups with money provided by the corporate mother.[1] This represents the so-called CVC triad (Weber and Weber 2011). Prior research shows that corporate mothers can leverage their innovation rate (e.g., Dushnitsky and Lenox 2005; Schildt et al. 2005; Wadhwa and Kotha 2006) and financial performance (e.g., Zahra and Hayton 2008) through the use of CVC investments and startups can also profit from CVC in terms of enhanced innovation behavior (e.g., Park and Steensma 2012; Alvarez-Garrido and Dushnitsky 2016) and financial performance (Ivanov and Xie 2010; Wang and Wan 2013).

However, there is also a potential downside to the CVC phenomenon. Gompers and Lerner (2000) point out that CVC vehicles have a shorter life span than their independent counterparts. Hence, it is not surprising that data provided by *Dow Jones VentureSource*, one of the two most frequently used databases in the venture capital (VC) field, show that 13.5% of all its recorded CVC units have ceased operations.[2,3]

Neo-institutional theory, which examines the interplay between organizational behavior and organizational environment (e.g., Greenwood and Hinings 1996), suggests the high failure rates could be attributable to the fact that CVC units act in two competing environments simultaneously—the corporate and the startup worlds. Applying the label of isomorphism, Souitaris et al. (2012) showed that CVC units are caught in a continuum between two contradictions, that is, the corporate world with its rigid structures and the startup ecosystem characterized by high levels of autonomy and risk-taking behavior. Consequently, CVC units are forced to either align with the corporate mother's norms (endoisomorphism) or with the norms of the startup ecosystem (exoisomorphism). CVCs with endoisomorphic tendencies tend to develop mechanistic structures with command-like communication, concentrated decision-making, fixed and written procedures, and a clear division of labor in specific tasks. Conversely, CVCs closely aligned with the startup

[1] In some cases, CVC units also raise money (Kollmann et al. 2014; Kuckertz et al. 2015) from outside investors.

[2] Please note that the search considered all CVC units recorded in VentureSource and was not limited to a specific time frame or country.

[3] Researchers blame a lack of commitment (Siegel et al. 1988; Bannock Consulting 2001), unattractive compensation schemes (Bannock Consulting 2001), staffing decisions (Siegel et al. 1988), or unsuitable performance measurements (Teppo and Wüstenhagen 2009).

sphere tend to develop more organic structures characterized by overlapping responsibilities, distributed decision-making, flexible and unwritten procedures, and consultative communication (Burns and Stalker 1961; Souitaris et al. 2012).

Although the seminal work of Souitaris et al. (2012) has the potential to shed light on various unanswered questions regarding the organizational settings of CVC units, the concept of isomorphism has not been further addressed in the academic discourse, which might be attributable to the fact that observing and measuring such tendencies is an arduous task. Therefore, the aim of this study is twofold: First, we discuss and explore a new measure of isomorphism in the CVC context by utilizing content analysis. Second, we go beyond the quantitative observation by qualitatively identifying drivers of isomorphism that could influence a CVC's isomorphic profile over time, thereby extending the work of Souitaris et al. (2012).

The current study has the potential to stimulate and expedite the academic discourse on isomorphic tendencies within the CVC context. The proposed measure considers the overlap of two organizational mission statements, that is, from the corporate mother and its corresponding CVC unit. It can therefore extract organizational tendencies to favor one of the environments by shifting the focus from subjective assessments to a more impartial approach. A further significant benefit of this measure is the fact that it enables the tracking of isomorphic tendencies over time.

2 Literature Review

The concept of isomorphism is grounded in the question of why organizations tend to be homogeneous (DiMaggio and Powell 1983). Isomorphic tendencies in the CVC context have surprisingly rarely been discussed in the finance- and management-related literature (Röhm 2018). In their seminal work, DiMaggio and Powell (1983) observe three mechanisms of isomorphism and the factors that can influence them. The study describes coercive isomorphism as a result of formal and informal pressure on an organization that arises from the interdependence with other organizations and social expectations. In consequence, organizations respond to legislative changes or new regulations, which results in a homogenization of organizational structures. Moreover, organizations facing an uncertain environment try to imitate structures from organizations that have already proved able to resist those circumstances. This behavior is also known as *mimetic isomorphism*. Finally, an increasing standardization of occupational groups can influence the homogenization of organizations. Flowing from a high level of specialization in terms of professional training and education, standards can easily be spread through networks and can change existing procedures.

Souitaris et al. (2012) were the first to observe and document isomorphic tendencies against the backdrop of CVC units. The study conducts six extensive case studies with newly founded CVC units from established corporations. The selected CVCs all share the idea of simultaneously leveraging strategic goals and delivering strong financial returns. Souitaris et al. (2012) draw on the work of DiMaggio and Powell (1983) and Burns and Stalker (1961) to show that CVCs either seek

legitimacy from the corporate world or through the VC ecosystem. Accordingly, CVCs that align themselves with the norms and rules of the corporate mother (i.e., that demonstrate endoisomorphism) tend to develop organizational structures comparable to the structure of their corporate mothers in terms of the formalization of tasks, centralized decision-making processes, and command-style communication methods. CVCs that are closely aligned with the VC ecosystem (i.e., that demonstrate exoisomorphism) tend to decentralize their decisions with a low degree of specialization and employ a consultative communication style and utilize unwritten procedures.

However, with the exception of the seminal work of Souitaris et al. (2012), the existing academic discourse on CVC has focused on only some isolated aspects of the organizational structures. For instance, Dushnitsky (2006) identifies three types of organizational settings: a direct investment setting, in which established corporations manage their investments in technology-oriented startups through internal business units. CVC units can also act independently by operating a fund sponsored by the corporate mother, typically organized as wholly owned subsidiaries. This setting has proved to be a good role model owing to the greater degree of autonomy it confers. Furthermore, established corporations can invest in open or dedicated funds run by independent VCs. In this way corporations can benefit from the IVC's network and experience without the need to build their own capabilities. Owing to the fact that these organizational settings mainly determine the practices of professionals within CVC programs (Maula 2007), the link with isomorphic tendencies is intuitively apparent. With this in mind, Siegel et al. (1988) study how 52 actors from the CVC community organized their activities to maximize success. The paper provides useful insights into several aspects of CVCs' organizational structures such as staffing decisions, compensation aspects, and autonomy. The study's findings suggest that only one in ten CVCs acts completely independently and without approval from the corporate management. Following Souitaris et al. (2012) would suggest this organizational behavior is a potential driver of endoisomorphism.

From a human resource point of view, some articles investigate the influence of the individual experience of managers on the adoption of IVC practices (Dokko and Gaba 2012) and on the longevity of CVC units (Gaba and Dokko 2016). Results indicate that managers with IVC experience tend to emphasize financial goals and therefore contribute positively to the life span of their CVC unit. Beyond those staffing discussions, there are also some articles (e.g., Dushnitsky and Shapira 2010; Yang 2012) that observe the influence of different remuneration schemes on the performance of the CVC unit. According to Souitaris et al. (2012), the staffing of CVC programs is paramount for potential isomorphic tendencies. In this vein, the insights of Gaba and Dokko (2016) and Dokko and Gaba (2012) provide a starting point to examine the interplay of prior work experience of CVC managers and the isomorphic profile of their current corporate investment vehicle.

In general, the academic literature presents a highly fragmented picture. However, the isomorphic tendencies explored by Souitaris et al. (2012) provide a unique framework that can support placing the published insights into a broader theoretical context.

3 Isomorphic Tendencies and the Call for a Mixed-Method Approach

The relative scarcity of organizational research on VC and CVC might prompt researchers to adopt a qualitative design to illuminate a rather opaque phenomenon (Eisenhardt 1989; Eisenhardt and Graebner 2007; Röhm 2018). However, the present study opts for a mixed-method approach to present a more complete picture of the phenomenon (Creswell 2003; Tashakkori and Teddlie 2003). Mixed-method designs involve the combination of "elements of qualitative and quantitative research approaches [...] for the broad purposes of breadth and depth of understanding and corroboration" (Johnson et al. 2007, p. 123). There have been occasional calls for intensified research following this paradigm in entrepreneurship research (e.g., Davidsson 2004; Röhm 2018); applications have—however—remained scarce until today (see Hohenthal 2006 or Bryant 2009 for noteworthy exceptions). Mixed-method designs can be differentiated in terms of the respective dominant paradigm within a given study, that is, they can be classified along the continuum of a purely quantitative focus to a purely qualitative one (Johnson et al. 2007). Moreover, mixed-method designs can be distinguished according to the particular point within the research process at which a certain paradigm dominates (Morse 2003). The method is suggested for researchers testing a theoretical model from the literature—especially if some of the components are not quantifiable.

In the present study, we utilize two distinct samples: first, we quantitatively explore varying isomorphic tendencies of CVCs headquartered in the USA over time. The results mean we can subsequently qualitatively identify several drivers of isomorphic tendencies extracted from four in-depth case studies with experienced investors from the CVC industry in Germany.

4 Making Isomorphic Tendencies Measurable

Owing to the absence of constructs to measure the isomorphism tendencies of CVC units, this study proposes a first approach by drawing on text analysis, a method widely used in the management research community (for an overview see Duriau et al. 2007) and also in finance research (e.g., Jegadeesh and Wu 2013; Röhm et al. 2018). The history of analyzing mission statements is grounded in the idea that an organization's written text is more than the sum of its words and consequently text analysis can reveal the philosophy, perceptions, and beliefs underlying the mission statement (D'Aveni and MacMillan 1990). It is important that the methodology used and the chosen text sources fit the question of interest (Short et al. 2010) and accordingly text analysis has a broad range of applications. In addition to website content (Zachary et al. 2011), IPO prospectuses (Bukh et al. 2005), annual reports (Titus et al. 2017), shutdown messages (Mandl et al. 2016), CEO speeches (Bannier et al. 2017), and even internal data sources (McKenny et al. 2013) can inform

research. This particular method offers a variety of advantages when measuring isomorphic tendencies over time (Duriau et al. 2007; Moss et al. 2014): (1) by drawing on organizational narratives, the isomorphic tendencies can be directly derived from publicly available information, overcoming the typical limitations of personal surveys or interviews; (2) narratives such as annual reports or websites are often available for lengthy periods of time, thus enabling longitudinal analysis; and (3) outcomes can be quantified and serve as a valid starting point for further statistical analysis.

To fully grasp the phenomenon of isomorphism over time, we merge data from multiple sources. To extract CVC-backed transactions occurring in the USA between the year 2000 and 2010, we draw on *Dow Jones VentureSource*. This database is commonly used to investigate the VC and CVC ecosystem (e.g., Benson and Ziedonis 2010) as it provides access to more than 130,000 private companies and 40,000 investors worldwide (VentureSource 2018). To ensure a rigorous theoretical anchoring related to CVC units, we employ the data cleaning process suggested by Röhm et al. (in press). In short, by merging the extracted VC data with information provided by *S&P Capital IQ*, we penetrated beyond the rather vague CVC definition often used by data providers. The cleansing process produced a set of 72 unique CVC investors. To expose those investors' isomorphic tendencies and to examine how they vary over time, we subsequently collected written excerpts from the remaining 72 CVC dyads (i.e., the CVC unit and its associated corporate mother). At this point it is important to note that this study is focusing on the interplay of isomorphism within the CVC dyad; consequently startup-related data were not considered. Accordingly, we adopted two different search strategies: First, we collected all publicly available annual reports from the corporate mothers using the corporate websites, *Bloomberg*, *annualreports.com*, and *annualreportowl.com*. We chose annual reports because they should communicate the relevant corporate mission statement. Because annual reports address a hybrid group of stakeholders, the relevant information must be distilled down and critically reviewed by communication experts, and the resulting information therefore offers a valid starting point for our research (Stanton and Stanton 2002). Second, examining the public websites of each CVC unit offered an opportunity to scrutinize a broader range of statements than offered by corporate websites alone (Zachary et al. 2011; Röhm et al. 2018). To access historic mission statements from the CVC websites, we made use of the *Internet Wayback Machine* (Hackett et al. 2004). To guarantee data quality, we drew on the *Directory of Venture Capital and Private Equity Firms: Domestic and International* (Gottlieb 2008) and historical press releases to identify variances in URL addresses (see Röhm et al. 2018 on this approach). We could find mission statements, contained, for example, in the "*Message from the CEO*," "*About us*," or "*Our Approach*," for 22 CVC units. Missing data meant we had to omit 50 CVC units from our sample.

We combined several text-based software packages to analyze and compare the mission statements gathered from CVCs and their corresponding corporate mothers (Short et al. 2018). Measuring similarity or dissimilarity within documents, sentences, or words is a feature of many scientific disciplines, and there are multiple

measurement approaches available (for an overview see Gomaa and Fahmy 2013). To measure endoisomorphism, that is, the alignment of a CVC unit with the norms of the corporate mother, we used *NVivo* software to extract every single word of a CVC mission statement and compare it with the corresponding text excerpts from its corporate mother in a given year using the Jaccard similarity coefficient. The Jaccard coefficient measures the similarity and/or diversity of two underlying text excerpts by comparing the number of shared words in relation to the total number of words (Huang 2008; Al-Anazi et al. 2016; Gabriel et al. 2018), ranging from 0 (completely dissimilar) to 1 (completely similar).

Compared to other possible measurements of similarity, the Jaccard coefficient automatically accounts for size effects in the underlying text excerpts making it the preferred approach in this study. We argue that this measure of document similarity provides a reliable proxy for the isomorphic tendencies over time (Souitaris et al. 2012). High values represent a greater overlap between the CVC and corporate mission statements indicating that CVCs seek alignment with the corporate world (endoisomorphism), while lower values represent a weaker degree of endoisomorphism, that is, a higher level of exoisomorphism.

The analysis identified several development paths of isomorphism over time. At first sight, the mean values of all 22 CVC dyads indicate that isomorphism appears to a static factor rather than a dynamic one. However, as depictured in Figs. 1 and 2, a detailed analysis of single cases conveys a different picture.

The exemplary development paths of the CVC dyads Alpha, Beta, Gamma, Delta, and Epsilon in particular support the argument that isomorphic tendencies vary over time. While we found a tendency to lean toward the corporate mother in the cases of Alpha, Beta, and Gamma (Fig. 1), other CVC units tended to seek legitimacy from sources other than the corporate mother, for example, from the startup ecosystem (Delta and Epsilon; Fig. 2).

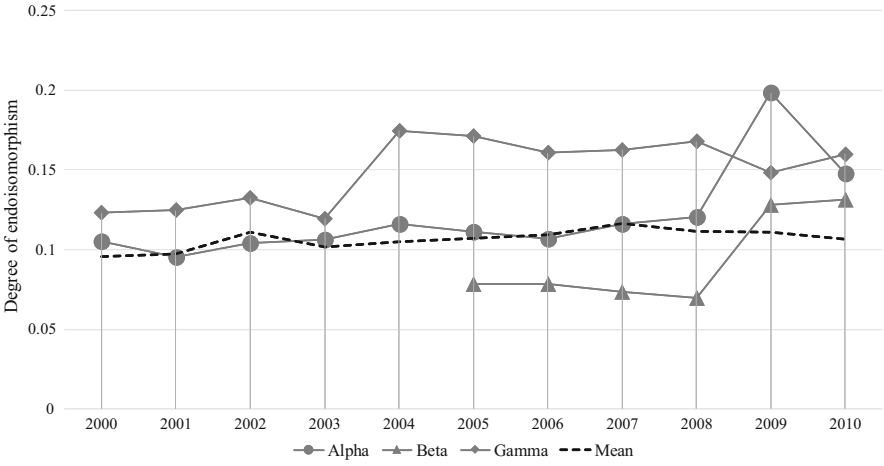

Fig. 1 Examples of CVCs with endoisomorphism tendencies measured as the perceptual overlap of the two underlying mission statements

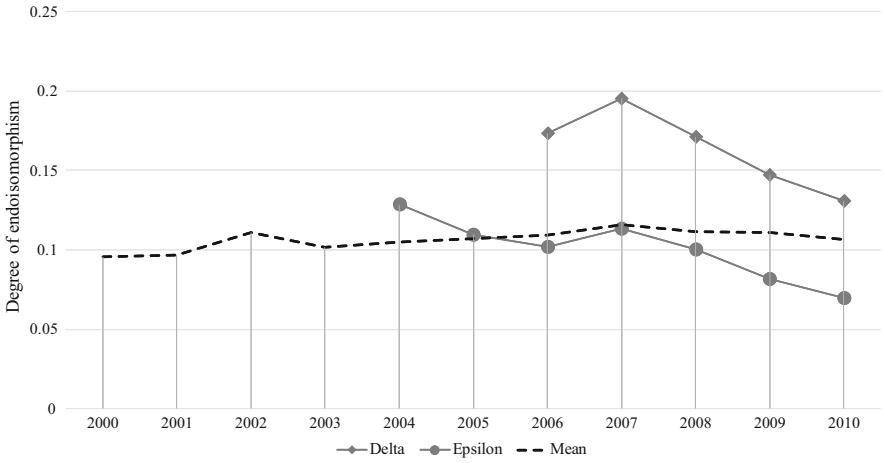

Fig. 2 Examples of CVCs with exoisomorphism tendencies measured as the perceptual overlap of the two underlying mission statements

Overall, we extend the work of Souitaris et al. (2012) by showing that isomorphic tendencies are not static over a given period of time. To shed further light on a CVC's isomorphic profile, the next section deals extensively with the factors that can stimulate or diminish the tendency to favor a given environment over time.

5 Disentangling Potential Drivers of Isomorphism

To paint a holistic picture of isomorphic tendencies over time, we next used a qualitative method to identify drivers that push a CVC unit toward a specific organizational environment. Like Souitaris et al. (2012), we drew on semi-structured interviews, relying on the process proposed by Gioia et al. (2013). That process is based on viewing organizations as social constructs made up of individuals that can serve as informants or knowledge agents. Consequently, the thoughts, intentions, and actions of those individual informants are the core of the research method (Gioia et al. 2013).

We used the work of Burns and Stalker (1961), DiMaggio and Powell (1983), and Souitaris et al. (2012) to compile a semi-structured interview guide. In a subsequent step, as recommended by Silverman (2006) and Eisenhardt and Graebner (2007), we carefully constructed a theoretical sample of appropriate and diverse CVCs. To support generalizability, we did not restrict the pool of potential interview partners by applying criteria relating to the existing governance structure (for an overview see Dushnitsky 2006), the industry of the corporate mother, the maturity stage, or the investment round preferences. The interviews took place in November 2017 and were transcribed. In summary, the transcribed interviews offer between 1354 and 3494 words (mean 2605 words) with a mean value of 14.81 words per sentence.

Similar to Souitaris et al. (2012), we were able to speak with leading representatives of the CVC units, such as vice presidents and managing directors. Reflecting a typical characteristic of the German CVC setting, only one participant had previously worked for an independent VC (for 3.5 years), while no one had acquired entrepreneurial experience as a founder or co-founder of a startup, but instead the qualification for the position was based on extensive experience with the corporate mother (for a mean of 10.25 years). As outlined above, we drew on the work of Gioia et al. (2013) to ensure academic rigor in extracting information regarding the isomorphic tendencies from the interview data. Prior research suggests a three-stage process to identify patterns in the raw data (e.g., Strauss and Corbin 1998). The first step involved setting up a wide range of first-order categories intended to capture all possible drivers of isomorphism in the CVC context. This step is also known as open coding. The second step employed axial coding to categorize second-order themes by their similarities and dissimilarities in relation to the first-order categories resulting from the first step. In a final step, the second-order themes were distilled down to provide more abstract and theoretically anchored dimensions. We conducted the entire coding process utilizing the *MAXQDA* software package. The final data structure is presented in Fig. 3.

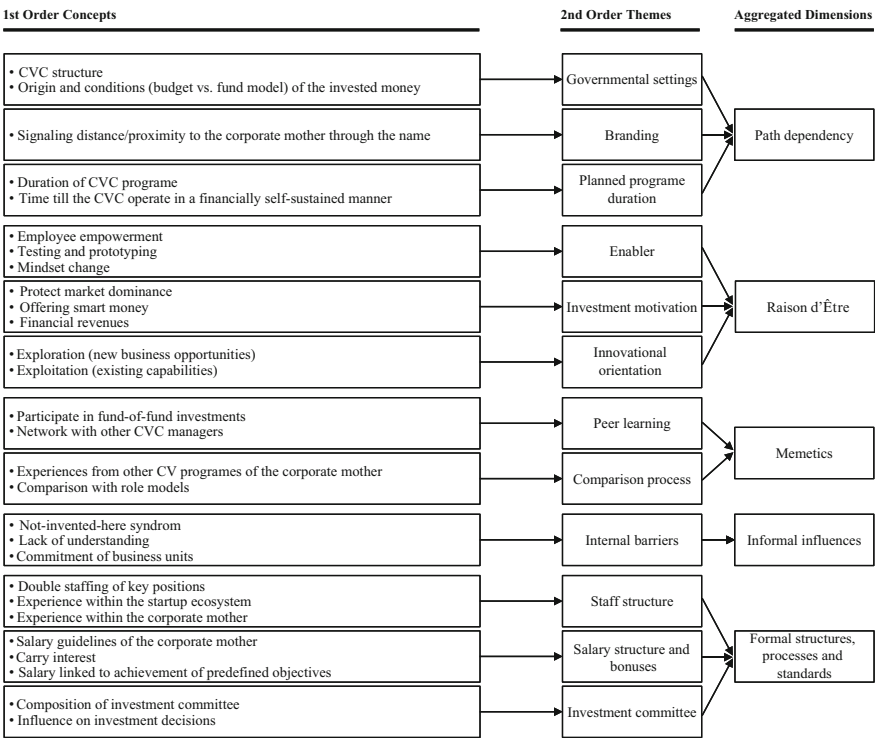

Fig. 3 Data structure, extracted from the conducted interviews

To date, there have been no empirical attempts to statistically validate isomorphism tendencies in the CVC context. Although, this section aims to make those tendencies measurable, an empirical validation exceeds the underlying scope of our research design. Consequently, we present below various propositions directly derived from the first-order categories and second-order themes in Fig. 3. The aim is to stimulate the academic discourse on isomorphic tendencies in the field of CVC.

When they establish a CVC unit, corporations need to balance the initial setup carefully, paying particular attention to the alignment of the underlying objective and the structural organization (Gompers and Lerner 2004). Those initial decisions were discussed by Dushnitsky (2006) and later adopted by Asel et al. (2015). However, the interview data gathered for this research show that some decisions are not retractable or are only partly retractable. Among those decisions the governmental structure, the assigned name of the CVC unit, and the planned program duration can determine the level and direction of isomorphism from the outset. This might lead to a situation where CVC units prefer to preserve the status quo instead of developing a more exoisomorphic profile because of the issue of path dependency.

Proposition 1 *The existence (absence) of path dependency is positively related with endoisomorphic (exoisomorphic) tendencies.*

Corporate mothers incorporate CVC vehicles for reasons well documented in the literature (e.g., Winters and Murfin 1988; Chesbrough 2002; Ernst & Young 2002; Ernst et al. 2005; Weber and Weber 2005; Dushnitsky and Lenox 2006). Two articles with a sole focus on the German CVC market found that besides purely strategically driven and purely financially driven CVCs, 76% (Ernst et al. 2005) and 37%, respectively (Weber and Weber 2005), of the observed CVCs were trying to achieve both objectives. By grouping CVCs' reasons for investment, Röhm et al. (2018) also empirically tested the impact of a CVC's investment motivation on a startup's valuation. However, in addition to the investment motivation of the CVC, the general innovation strategy of the corporate mother can also influence the unit's isomorphic tendencies. For instance, Titus et al. (2017) investigated the effect of exploration on a corporate mother's venturing activities. Drawing on Dokko and Gaba (2012) and Gaba and Dokko (2016), the underlying strategy is also correlated with staffing decisions. While internal hires tend to pursue a strategic investment approach, investment managers with prior IVC experience tend to leverage financial goals by implementing IVC-like structures and decision-making processes. However, our interview data also indicate that as a unit matures, it tends to align more closely with the startup environment. Some of the managing directors interviewed said that the novelty of the CVC concept led them to focus on communicating the strategic benefits of their CVC units. After that introductory stage, financial objectives became more relevant.

Proposition 2 *The existence of strategic goals (financial goals) is positively related to endoisomorphic (exoisomorphic) tendencies.*

Investments through CVC units have traditionally been associated with the concept of learning, and many articles have been published relating to that context

(e.g., Keil 2004; Keil et al. 2008). However, there is also evidence that mimetic processes can affect a CVC's behavior. In general, touching points with other investment vehicles can stimulate the deal flow (Souitaris and Zerbinati 2014), but there are also other mechanisms that could stimulate mimetic processes. For instance, Noyes et al. (2014) presented results from a network perspective, indicating that interlocking boards can stimulate the diffusion of management practices. In addition, Gaba and Meyer (2008) emphasize the importance of a corporate mother's peer group through the adoption of CVC practices. In addition, the syndication of investments with other CVCs or IVCs (e.g., Keil et al. 2010) can bring crucial advantages for the CVC. Based on a network perspective, Anokhin et al. (2011) noted the importance of the network position for CVCs in highly concentrated industries. Accordingly, learning from competitors, IVCs, or other investment vehicles can help CVCs to overcome their liability of newness and the absence of a track record (Anokhin et al. 2011) and therefore can increase the chances of establishing more IVC-like structures. Our interviewees confirmed that the communication with IVCs was especially useful. One managing director noted that before the establishment of the firm's CVC unit, all key decision-makers presented the concept to successful and established players in the IVC industry. However, the object of comparison is crucial to the adoption of isomorphic tendencies. While mimetic processes within the startup ecosystem can push a CVC unit toward an exoisomorphic profile, the learning from other corporate units (i.e., the M&A function) will contribute to enhancing an endoisomorphism profile.

Proposition 3 *The existence (absence) of external mimetic processes is positively related to exoisomorphic (endoisomorphic) tendencies.*

Besides formal barriers such as regulations or written operating procedures (Burns and Stalker 1961), there are also informal barriers or drivers that influence the isomorphic tendencies of CVCs. Teppo and Wüstenhagen (2009) already discussed the importance of there being an entrepreneurial spirit in the corporate mothers' culture for the success of corporate venturing programs. In this regard, most published literature draws on the five dimensions of the entrepreneurial orientation construct. This construct was also linked to the general performance in large- (Miller and Le Breton-Miller 2011) and medium-sized companies (Soininen et al. 2012). This study's qualitative data suggests that "not-invented-here syndrome" particularly hinders fruitful cooperation between CVCs and corporate business units. When undertaking their routine business, employees of the corporate mother primarily need to be "infected" with the startup virus following a change of mindset. All participants in our case studies confirm that the isomorphic tendencies and the general success of the CVC program are associated with the cultural mindset of the corporate mother's staff.

Proposition 4 *The existence (absence) of informal influences is positively related to endoisomorphic (exoisomorphic) tendencies.*

Being located within the corporate mother's organizational boundaries plays an important role in the isomorphic tendencies of CVCs. Souitaris et al. (2012) note that

the presence or absence of formal guidelines and structures influences a CVC's isomorphic profile. Formal structures are a multifaceted topic in the CVC discourse; for instance, the corporate mother's guidelines on remuneration can directly influence the performance of CVCs. Dushnitsky and Shapira (2010) showed that a CVC's compensation scheme is directly related to the performance of its funds. Providing an IVC-like incentive scheme prompts performance improvement and also stimulates IVC-like behavior among the investment managers. Providing an incentive scheme based on the corporate mother's regulations is risky for CVCs because such regulations might incorporate fixed salary scales, leading to the CVC recruiting a high ratio of internal staff, who might favor corporate standards over the IVC working model (Dokko and Gaba 2012). Another aspect concerns the general influence of the corporate mother through the investment committee. Teppo and Wüstenhagen (2009) and Souitaris and Zerbinati (2014) note that the investment committee and the compensation scheme play important roles, something that was confirmed by our interviewees. Investment committees including a high proportion of corporate managers may have endoisomorphic tendencies owing to a lack of experience with the startup ecosystem. Moreover, some managing directors also struggle with the corporate guidelines on the financial remuneration of hired managers, because for them, salary levels are crucial to establish an IVC-like working environment. Accordingly, stringent restrictions hinder the CVC moving toward the startup ecosystem. However, within our sample there was also one CVC providing a carried interest, which can be interpreted as an exoisomorphic signal.

Proposition 5 *The existence (absence) of formal structures is positively related to endoisomorphic (exoisomorphic) tendencies.*

6 Discussion

This study adopts a mixed-method approach to shed light on the isomorphic tendencies of CVCs. In a first step, we proposed and developed a unique method of measurement that takes organizational written excerpts into account. As mentioned above, using text analysis offers several advantages when investigating constructs that are difficult to measure (Short et al. 2010). By creating a unique sample of US-based CVCs, we were able to track the isomorphic tendencies of 22 investment vehicles over a maximum of 11 years of operation (2000–2010). Based on the Jaccard index which measures the overlap between the organizational written mission statements of the corporate mother and the corresponding CVC unit, we were able to identify three groups of isomorphic profiles. One group, depicted in Fig. 1, showed a clear tendency to follow the corporate mother (i.e., endoisomorphism), whereas the second group (examples presented in Fig. 2) seeks legitimacy through the startup ecosystem (i.e., exoisomorphism). Beyond that, the majority of CVC units have a relatively stable profile of isomorphism over time. Interestingly—and as can be observed from the plots in Figs. 1 and 2—the group

converging toward the corporate mother achieves high levels of endoisomorphism by adjusting the positioning at one point in time, whereas CVCs with an exoisomorphic profile seem to separate themselves from the corporate mother in small incremental steps. This could point to endoisomorphic tendencies that might be due to a top-down decision by a corporate mother adjusting its strategy for its CVC unit and exoisomorphism tendencies that might result from a CVC unit that continuously strives for independence from the corporate mother, but which is reluctant to flag those endeavors and therefore opts for an incremental approach to achieving its goal.

It should be noted that we draw on the work of Souitaris et al. (2012) in developing the measurement of isomorphic tendencies. In doing so, we assume that endoisomorphic and exoisomorphic tendencies are two poles of a continuum. Accordingly, a high level of endoisomorphism (exoisomorphism) is associated with a low level of exoisomorphism (endoisomorphism). However, we do acknowledge that presenting the relationship as such might be to oversimplify the concept of isomorphism and that a CVC unit's organizational DNA can be more complex, owing to a multifaceted isomorphic profile. In a situation where CVCs find themselves increasingly moving away from their own corporate mother, the discussion above shows there is a risk involved in playing with the devil.

To explore the driving forces of isomorphism over time, we interviewed experts from the German CVC market and found that isomorphic tendencies are mainly based on mimetic processes. All interviewees pointed out that learning from other CVCs, startups, and IVCs plays a crucial role in their everyday business. One managing director particularly highlighted the value of making comparisons with IVCs and defunct CVC funds as sources of information to influence structuring the activities of the CVC unit. However, as mentioned above, the third group of CVCs with no clear tendencies toward a particular environment indicates that there are also drivers that contribute to the status quo.

The interviews conducted reveal that there are decisions that are not easily reversible and therefore it can be challenging to determine isomorphic tendencies from the beginning. Decisions on the governance structure and the planned program duration are worth mentioning in this regard. Furthermore, we also found drivers of isomorphism that are routed in the raison d'être—the informal and formal influences of the corporate mother. As Souitaris et al. (2012) report, some of the drivers addressed are easy to influence and therefore offer decision-makers the option to adjust and regulate the degree of isomorphism. For instance, our interview data supported the findings of Dokko and Gaba (2012) and Gaba and Dokko (2016) reporting that the staff of a CVC unit shapes its structures and investment behavior. Furthermore, we found a broad consensus in our case studies that the salary of the investment manager poses a challenge. There is a thin line between offering a remuneration package that fits within the corporate mother's scales and simultaneously being attractive enough to hire the right people with experience in the IVC industry. This research thus bridges the gap between isomorphism and studies with a focus on CVC managers' salaries (Hill et al. 2009; Dushnitsky and Shapira 2010; Yang 2012).

We also found that the prevalent entrepreneurial culture can influence not only the survival rate of the CVC, as mentioned by Teppo and Wüstenhagen (2009), but also its isomorphic tendencies. Several statements mentioned the poor relationship between a corporate mother's business unit and the CVC vehicles. Often CVC managers are faced with *not-invented-here syndrome o*r a general absence of motivation to cooperate with a startup. Finally, some of our interviewees reported being forced into endoisomorphic behavior owing to the complexity of the startup ecosystem. It is not only the absence of a track record that impels a CVC unit toward alignment with the corporate mother but also the fact that regular business units manage key functions such as conducting due diligence, ensuring conformity with legal requirements, and sourcing. In one case, the above scenario led to the managing director of a CVC being responsible also for the corporate development unit of the corporate mother.

The results of this study show that isomorphism should be discussed in a broader context, particularly given that it varies over time. Future research should therefore take account of external influences that can temporarily push a CVC in one direction. Our proposed way of measuring isomorphic tendencies also offers a basis to observe the influence of isomorphism on performance, a relationship that is also noted as important by Souitaris et al. (2012). We also call for future research that considers isomorphic tendencies when discussing other aspects of CVCs. By constructing a holistic framework, the tendencies toward one organizational setting can situate published insights in a broader theoretical context. The influence of isomorphism is not limited to the relationships of CVC units but also affects other organizational settings where companies are confronted with two different environments, such as in the case of joint ventures or spin-offs.

7 Conclusion

Through its use of a mixed-method approach, this study provides unique insights into the ongoing discussion of isomorphic tendencies in the CVC context. The study shows that CVCs tend to seek alignment either with their corporate mother or with the startup ecosystem. The tendency to favor one or the other is not only driven by initial decisions made during the starting phase of a CVC unit but also by mimetic processes occurring within the life span of such vehicles. To disentangle the tendencies of 22 CVCs based in the USA, we introduced a unique measure based on the Jaccard index, a textual-based measurement that compares the overlaps of two written organizational excerpts. The results indicate that there are three groups of CVCs with isomorphic profiles that vary over time. Besides endoisomorphic (i.e., aligned with the corporate mother) and exoisomorphic (i.e., aligned with the startup ecosystem) tendencies, we also found investment vehicles that adhere to the status quo. To extend the work of Souitaris et al. (2012), we also conducted interviews with prestigious CVC units from Germany, exploring additional drivers that influence a CVC's decision to favor a particular organizational setting, and found evidence that

mimetic processes, path dependency, and formal and informal influences are all drivers of isomorphism over time. The study therefore extends the work on isomorphism in the CVC context by establishing a measure that is not limited to the field of CVC but is also a potentially useful instrument to stimulate the debate in other related contexts.

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Part III
New Trends in Entrepreneurial Finance

Social Finance in Europe: The Transition from Grants to Follow-Up Financing for Social Enterprises

Mirko Hirschmann and Alexandra Moritz

Abstract A large number of social enterprises (SEs) use grants as early-stage financing to establish their ventures. However, we know little about the requirements for SEs to receive grants and their follow-up financing opportunities. Based on an interview study with 13 European SEs, we show that SEs need to go through a resource-intensive application process to be able to receive a grant. To finally receive a grant, we find that nonfinancial aspects (e.g., involved people's passion) and financial sustainability are the most important factors for convincing possible grant providers to finance an SE's venture. Furthermore, based on signaling theory, we demonstrate that obtaining a grant increases the likelihood of finding follow-up investors. We suggest that further quantitative research should test our conceptual model, which is built on four propositions we formulate.

Keywords Social enterprise · Grants · Social finance · Follow-up financing

1 Introduction

Social entrepreneurship is a recent phenomenon, shifting the focus from traditional, profit-oriented ventures to hybrid forms pursuing financial but also nonfinancial objectives. To be more precise, social enterprises (SEs) are private profit-oriented ventures that follow a mission to create social value by solving environmental or social problems (OECD 1999; Thompson 2002). Hence, in contrast to traditional profit-oriented ventures, SEs follow dual goals that are also reflected in specific financing requirements (e.g., Spiess-Knafl 2012). More traditional financing instruments, such as bank loans or classic venture capital, often do not match SEs' characteristics (Nicholls 2010). Grants provided by the government or other public or private institutions are an alternative that has been argued to fit particularly well to

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SEs' hybrid goals (Teasdale 2010). Although some prior research explored the characteristics of grants (Achleitner et al. 2011) and grant use in the early stages of SEs (Nicholls and Pharoah 2008), we find that this research lacks an in-depth understanding of the implications for SEs as grantees.

We contribute to this research gap by investigating two research questions. First, we aim to understand the specific requirements SEs need to fulfil to receive these grants. Second, we investigate the effect grants have on receiving follow-up financing. To answer our research questions, we conducted an interview study with 13 European SEs from Germany, the UK, France, Finland, and Norway. Our study provides insights into SEs' barriers and requirements to receive grants in their early stages as well as into the signaling value of grants on follow-up financing.

Our results lead to four propositions for SEs using grants to finance their development. First, we find that SEs need to get through a resource-intensive application process to receive a grant. Second, the European grant market seems to lack a clear structure and provides insufficient capital supply. Thus, to convince possible grant funders and finally receive a grant, SEs need to highlight their nonfinancial facts and financial sustainability. Third, we find that due to the reduction of information asymmetries, ventures funded by grants seem to obtain follow-up financing more easily. Finally, we find that SEs desire business angel (BA) investments for later stages to acquire additional financing but also smart capital for their companies.

We provide a number of theoretical contributions with our study. First, our findings add to prior research on grant financing for SEs (e.g., Sunley and Pinch 2012; Scheuerle et al. 2013; Spiess-Knafl 2012). In addition to prior findings, we show that nonfinancial factors and financial sustainability are important to SEs in receiving a grant. Second, our results contribute to the literature analyzing the European grant market (e.g., Bielefeld 2009; Bull and Crompton 2006; Weerawardena and Mort 2006) by showing that this market lacks structure in different places. Third, we add to the literature about asymmetric information in hybrid organizations (e.g., Connelly et al. 2011; Ebrahim et al. 2014; Kickul and Lyons 2012), indicating that being able to receive a grant reduces information asymmetries and therefore increases the likelihood of follow-up financing. Finally, our findings contribute to prior research about the funding types of SEs (e.g., Achleitner et al. 2011; Benedikter 2011; Bryson and Buttle 2005; Spiess-Knafl 2012). We find that SEs seem to prefer equity, for instance, in the form of business angel investments, as follow-up financing after they received a grant.

Our study also provides practical contributions for SEs and policy makers. A better understanding of grant financing can help SEs decide about their financing structure. Knowing the requirements and positive implications of grant funding helps SEs decide whether to apply for a grant. Furthermore, our findings can help policy makers to form a more sophisticated environment for the rise of SEs. A changed grant market structure with better access to information would help SEs to overcome their early-stage financing challenges.

The next section provides a theoretical background of the funding types for SEs as well as the financing challenges they need to overcome. Section 3 outlines the data

collection and sample of interviewees. Furthermore, it provides a description of the interview process and data analysis. Section 4 shows the results of our interview study, based on which we develop four propositions. Finally, in Sect. 5, we propose our conceptual model for the influence of grants on follow-up financing and discuss practical and theoretical implications.

2 Theoretical Background on SE Funding

2.1 Funding Types for SEs

Every type of start-up, independent of its specific business focus, needs financing to develop and grow. However, social entrepreneurs in particular stated that obtaining access to appropriate financial instruments constitutes a major strategic concern for them (Bloom and Chatterji 2009; Bosma and Harding 2007; Torfs and Lupoli 2017). It has been argued that this concern is directly related to their focus on social goals, which needs to be reflected in the structure of the financing instruments used. Thus, conventional financing instruments often do not match the needs of SEs (Nicholls 2010).

Therefore, funders of SEs are often specialized social banks or social investors (SIs). Concurrent with the strong increase of SEs in Europe (Agarwal et al. 2018), the amount and size of social banks have been growing immensely over the years since the financial crisis (Benedikter 2011). One specific customized debt financing instrument for SEs is guaranteed loans. This type of loan is characterized by special conditions, such as zero interest rates. In addition to banks, these types of debt instruments are also provided by foundations (e.g., the Bill & Melinda Gates Foundation) (Bugg-Levine et al. 2012).

In contrast to debt instruments, equity financing options release SEs from typical debt obligations, including fixed repayment schedules or interest rates, but typically involve the allocation of ownership rights. Equity instruments for SEs include relatively new financing instruments, such as social venture capital, and more traditional instruments, such as funding by family and friends or business angels (BAs). In addition, both debt and equity investors often provide mezzanine investments. These instruments contain both debt- and equity-specific characteristics and can be adapted individually to the particular characteristics and needs of the borrowers. While repayments are mandatory and future cash flows are required, the specific repayment schedule can be more flexible. In addition, no ownership rights of the funded companies are allocated, as is the case with equity (Achleitner et al. 2011). Examples of hybrid/mezzanine instruments to finance SEs are forgivable loans or convertible grants that have specific repayment obligations, such as repayment schedules that are linked to specific circumstances or events (Achleitner et al. 2014). In summary, mezzanine financing provides more flexibility because it can be structured in a way that best fits the specific needs of SEs (Achleitner et al. 2011).

Grants are a type of financing that requires special consideration, particularly for SEs with their hybrid nature. The advantages of grants are that they are often provided as nonrepayable subsidies for specific projects, activities, or programs (Wilkinson et al. 2014). Characteristically, SEs use grants in the early stages of their business lifecycle and—due to their specific characteristics—often depend on this kind of funding (Sunley and Pinch 2012). Grants are typically provided as equity (Nicholls and Pharoah 2008), but for SE financing, they can also be structured as hybrid financing instruments, combining traditional investments and grants. Primarily, grants are provided by governments or other public authorities. Historically, grants were the primary source of financial support for SEs, whereas currently, a change is emerging due to government spending restrictions (Moore et al. 2012). This might be a reason for the move of the public sector from unrestricted grants toward contracting, where public institutions pay SEs for the delivery of specific products or services (Bull and Crompton 2006). This, in turn, influences SE's self-perception. The shift from public grant funding toward contracts with public authorities strengthens their identity as profit-oriented organizations while simultaneously providing social value (Pearce 1999). In addition, grants are provided by foundations or specialized investment funds (e.g., the Social Incubator Fund). Foundations providing grants sometimes additionally support SEs with value-adding activities, such as coaching or mentoring.

2.2 Challenges in SE Funding

2.2.1 Investor Relationship-Related Challenges

With the exception of philanthropists, all social investors show return expectations similar to other common business investors (Derwall et al. 2011; Emerson 2003; Wood and Jones 1995). The main distinguishing criterion between the two is that SIs invest in social ventures that highlight social returns in addition to financial ones (Emerson 2003). They want to achieve returns in both areas. The financial return expectation by investors bears the risk that SEs focus too much on financial objectives, neglecting their social goals and the targeted beneficiaries. SEs are then faced with a dilemma: either fulfil the expectations of SIs or pursue their social goals. Furthermore, as customers of SEs are often not able to pay cost-covering or market adequate prices (Spiess-Knafl 2012), SEs can be pressured to grow their commercial activities and neglect to scale their social activities at the same time or rate (Ebrahim et al. 2014).

Furthermore, evaluating the economic performance of an SE is often difficult for SIs due to a lack of financial key data to compare them with other businesses in the same industry (Kickul and Lyons 2012). Hence, SIs will experience a welfare loss if they are profit-oriented, and the funded SE does not strive for profit maximization (Achleitner et al. 2014).

Hence, agency conflicts describe the relationship between SEs (agents) and their investors (principals) (Jensen and Smith 1985). Due to these agency conflicts, Jäger (2010) indicates that SEs have high signaling costs as they need to put high efforts into demonstrating their investors that they follow the right direction through the actions they perform. Similar to commercial ventures, SEs use signals to inform potential investors about their high quality (e.g., Connelly et al. 2011; Fisch 2018). This is particularly important for SEs because they need to inform an often heterogeneous group of investors with different interests (Ebrahim et al. 2014) about their dual goals. For instance, due to a frequent receipt of donations or grants, it is important for SEs to signal investors the appropriate use of these funds. One way to do so is by showing small administrative costs and at the same time demonstrating how they follow social objectives (Spiess-Knafl 2012). However, it might be difficult for SEs to communicate and reason their steps because their impact can be very diverse and is often difficult to measure. As a consequence, SEs often have extremely high signaling costs that may also include personal investments of the entrepreneurs (Spiess-Knafl 2012).

2.2.2 Grant Funding as an Alternative

Several challenges also go along with grant financing for SEs. In particular, the increased competition for grants in recent years demonstrates an immense challenge for SEs (Weerawardena and Mort 2006). Furthermore, an interview study by Sunley and Pinch (2012) with SEs reveals that grants become increasingly demanding and conditional on specific outcomes. The respondents perceive that the differences between debt and grant financing are disappearing. High administrative costs to receive grants constitute one reason for this. In addition, the increasing creative will of grant funders (e.g., interferences in control issues), which can differ from the objectives of the SE, reveals another issue (Scheuerle et al. 2013).

It has been found that the importance of grants and grant dependency differs between venture sizes. Small SEs are often affected by a high grant dependency. One reason for this can be their inability to achieve sufficient debt financing because of their size-related characteristics (e.g., no collaterals, not yet break-even) (Beck and Demirguc-Kunt 2006). Even though size matters, SEs still rely on grants even though the interest in bank financing or VC increased substantially over the last years (Sunley and Pinch 2012). Carrington (2005) states in his paper, dealing with the funding of the voluntary and community sector, that the consequences of a grant dominant financing culture can be immense. He argues that grants are often short-term funding instruments that demand refinancing strategies with unrealistic time limits rather than long-term achievements of social values. Furthermore, a lack of incentives to work efficiently due to the grant structure can have a negative market effect. In particular, short-term funding can harm the performance of funded ventures if grants are the only financial instrument used. This is the case because short-term grant-dependent organizations are constantly under great pressure to find follow-up financing (Palmer and Mornement 2005). The Bank of England (2003)

also emphasizes the problem of grant dependency, stating that grants "may limit the capacity of an organization to operate and expand or to leverage in commercial finance."

Crowding-out effects demonstrate another challenge SEs face with grant and donation financing. The "classical" crowding-out effect describes a decline of other financing sources with an increase of public support (Steinberg 1985). To prevent SEs from crowding-out effects, specifically designed grants for SEs were developed. These grants provide SEs with government support under the prerequisite that private donations are acquired with the same amount and maturity (Spiess-Knafl 2012). However, in the context of SEs, it has also been argued that a "crowding-in" effect exists, meaning that government subsidies even increase private donations (Brooks 2000). The argument is that grants in general or at least in specific forms (e.g., public grants) have a positive signaling effect and attract follow-up investors.

This discussion highlights that knowledge about the effects of grants on the financing of SEs is not yet fully understood. Our study taps into this research gap and examines whether grants decrease information asymmetries and generate follow-up financing.

3 Data and Method

3.1 Data Collection and Sample

The aim of this study is to obtain insights on how SEs move from grant financing to their next funding rounds. To answer this research question, we conducted interviews with 13 SEs across Europe. The interviewed social ventures are located in Germany, France, the UK, and Scandinavia. We used predetermined criteria of SEs and the sampling technique called "criterion sampling" by Patton (1990). All SEs are market participants that define themselves as SEs according to the definition provided in Sect. 1, stating that they are private profit-oriented ventures that follow social or environmental objectives in addition to financial ones. The interview participants were selected by theoretical considerations rather than statistical considerations (Strauss and Corbin 1996). Interviews were conducted until a sufficient amount of different views for each market was reached that showed converged agreement between the participants (Glaser and Strauss 1968). The aim of the interviews was to explore the situation of the European grant market, the challenges and support that go along with grant financing, and the consequences of grant financing for the transition to other financial instruments.

Interview partners were identified online through different search strategies. First, in the UK and Finland, SEs could be determined through national web pages with registered SEs. In other markets, foundations, incubators, and accelerators, as well as social venture competitions, demonstrated the supported SEs (e.g., Social Impact Labs in Germany). All in all, this study contains 13 interviews with SEs across Europe. A total of 69% of the interviewed SEs were located at early company stages

within the first 3 years since their establishment. Eighty-three percent of the interviewees were founders of the respective SE. Nine of the 13 interviewees had a university background. Three SEs try to tackle environmental issues, whereas the others follow social objectives. Except for two SEs, all of them received some kind of grant. Five SEs received public and private grants, four received only private ones, and two received grants only from public authorities. Five of the 13 SEs used other commercial types of financial instruments within their development. Table 1 outlines all characteristics of the SEs and the interviewees.

3.2 Interview Process

The interview guideline was semistructured to give interviewees the possibility to answer freely to open-ended questions (Gläser and Laudel 2010). The developed guideline is based on previous literature in this area and our own market research described in the previous section. The aim of our interviews was to receive information about different grant markets in Europe and SEs' transition from grants to other forms of funding. At the start of the interviews, we investigated the different backgrounds and motivations of our interview partners and their SEs before asking questions about the SEs' financial situation. First, we asked about the financing instruments that had been used by the SE. Second, to obtain a deeper understanding of received and rejected grants, we asked about the grant situation within their home country. These questions aimed to gain insights about the grant amount offered, the structure of different markets, and the application processes. Finally, we asked about their experience with grants, the impact of grant financing on their SE, and their desired follow-up financing.

Except for the three German interviews, all were conducted in English. The German interviews were translated into English afterward. All interview partners were responsible for the financing of their SE. Thus, the two nonfounders could provide the necessary information. The interviews lasted between 20 and 44 min and 32 min on average. Based on the feedback of interviewees, the interview guideline changed slightly over time. The interviews were all conducted by the same interviewer between May and July 2018.

3.3 Data Analysis

For the purpose of data analysis, all interviews were tape-recorded and transcribed afterward. We used the software MAXQDA for the following coding and categorization of the interviews. This software program was developed for the analysis of qualitative research and has been applied in several interview studies (e.g., Luxford et al. 2011; Moritz et al. 2015). The categorization was based on our initial coding scheme, which was developed before the first interviews were conducted. This

Table 1 Characteristics of social enterprises and related interviewees

Type	Established in (year/country)	Industry	Profession of interviewee	Background of interviewee	Social value	Type of grant	Other financial instruments	Length of the interview (in min)
SE 1	2018/GER	Manufacturing Packaging	Founder	Renewable energies (study)	Waste reduction	Private	Crowdfunding (donation based)	39:37
SE 2	2016/GER	Clothing	Project manager	Culture and economy (study)	Employment and fashion for disabled	Public and private	–	23:57
SE 3	2010/GBR	Food	Founder	Hospitality	Homelessness and work integration	Public and private	Loans (debt)	30:38
SE 4	2013/FRA	Food	Associate	NGOs and microfinance	Work integration	Public and private	Loans (debt)	43:07
SE 5	2016/FRA	Personal service	Founder	Bank and finance (study)	Retirement employment	Public	Loans (debt)	28:43
SE 6	2012/NOR	Waste management	Founder	Political science (study)	Work integration	Public and private	–	40:58
SE 7	2014/NOR	Education	Founder	Education (study)	Prevention of school dropouts	Private	–	20:32
SE 8	2017/FIN	Manufacturing	Founder	Accounting and finance (study)	Work integration	Public	–	28:56
SE 9	2015/GBR	Health care	Founder	Journalism (study)	Hoarding disorder therapy	Private	–	37:18
SE 10	2016/GBR	Clothing	Founder	Photography (study)	Gender equality	–	–	32:59

SE 11	2010/FRA	Building construction	Founder	Business administration (study)	Sustainable construction	Public and private	BA investments (equity) Loans (debt) Crowd-investing (equity)	31:16
SE 12	2016/GBR	Education	Founder	Research	SE research	–	–	42:54
SE 13	2018/GER	Furniture retail	Founder	Philosophy, sociology, and media studies	Reduction of resource consumption	Private	–	27:39

Source: Own illustration

approach forces scholars to focus on the research direction and conceptual interests (Huberman and Miles 1994). As proposed by Huberman and Miles (1994), some parts were redefined to fit into an overall structure so that some relate to each other and some have clear distinctions. Words, short sentences, and whole paragraphs have been assigned to individual codes. Thus, the original context was not changed in any case. During the coding process, the coding scheme was adjusted in some places to ensure matching codes for all important interview parts. In the following, axial coding has been used to identify relationships among several categories. Based on this, higher-order themes could be identified that lead to aggregate dimensions for a framework that will be illustrated in the next section. This process-oriented procedure was followed until clear directions for theoretical relationships could be identified and further interviews did not provide any new insights (Corley and Gioia 2004). To ensure a reliable coding scheme and maximize rigor, it was discussed with experienced researchers and adjusted until a joint agreement was reached. Hence, some parts of the scheme needed to be modified. Finally, research reliability was considered through a discussion of the identified relationships and the interpretation of the data. Based on this research approach, propositions were developed, and a conceptual model was compiled. A theoretical framework is presented through five propositions (Whetten 1989) on the influence of grant receipts on follow-up financing.

4 Results and Discussion

Figure 1 shows the results of a progressive data structure based on a model of Corley and Gioia (2004). We identified four aggregated dimensions. The first one indicates requirements to receive grant funding and combines three second-order themes: SEs need to go through a resource-intensive application process, they need to highlight nonfinancial facts within the process, and their type of solution is often important to fit into the specific grant requirements. The second dimension highlights that the European grant landscape needs to improve. SEs stated that there is a lack of structure in the market, insufficient supply in several areas (e.g., at a particular development stage), and too much competition for grants. The third dimension demonstrates that receiving a grant increases the likelihood of follow-up financing. Therefore, this dimension combines the signaling value of receiving a grant as well as the company development that is achieved through a grant. Finally, the interviewed SEs indicated that after obtaining a grant, they often seek equity as follow-up financing. They are particularly interested in BA funding because as SE 1 expressed, they are "*even more interesting, as they support the company with their know-how*." This is also stated in the second theme of this dimension, stating that the support of social equity investors for their business is a decisive argument for this kind of funding. The following subsections discuss the outlined results and end with several propositions that are connected to grant financing of SEs in Europe.

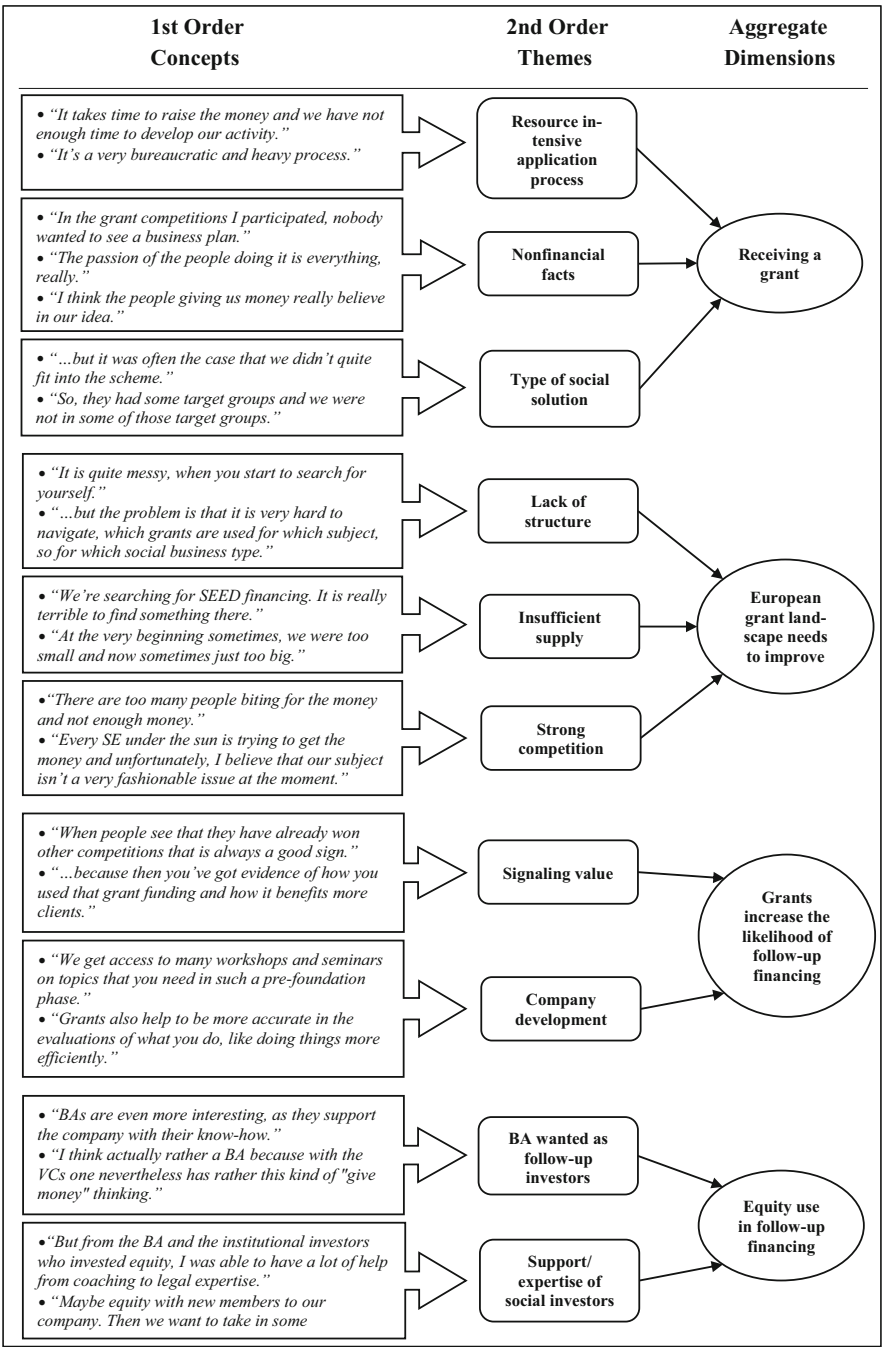

Fig. 1 Data structure (Source: Own illustration)

Table 2 Grant requirement endorsements

Grant requirement	Resource intensive application process	Nonfinancial facts	Financial sustainability	Type of social solution
Number of occurrences	(11/13)	(11/13)	(10/13)	(7/13)

Source: Own illustration

4.1 Requirements to Receive Grant Funding

Similar to the results of the interview study by Sunley and Pinch (2012) that finds that SEs feel that receiving a grant becomes increasingly demanding, interviewees of this study expressed that they had to go through a resource-intensive application process. SEs explained that this process was very time-consuming. Thus, SE 5 argued that it takes "*too much time, they ask us many, many things and figures and objectives for two or five years later*," and SE 12 even stated that grant applications take up all the time that is needed to make money by running your social business. Furthermore, there are also high administration costs that come with resource-intensive applications. SE 10 confirmed this, stating that you have to apply for many grants because it is often not clear which ones fit to your social venture. In addition, there are often bureaucratic obstacles "*because you have to apply first and then write a lot of reports*," as SE 7 noted. All in all, as Table 2 shows, 11 of 13 SEs reported that they had to go through a resource-intensive application process. Nevertheless, some SEs were understanding and mentioned that the application process is as time-consuming and bureaucratic as it has to be because grant investors need to have a sophisticated due diligence process to spend their money wisely. This confirms the argumentation of Frumkin (2003) that philanthropists need to take great care in the form of due diligence before they do grant donations and commit to them.

Regarding the second requirement to receive grants, 11 SEs stated that nonfinancial facts are immensely important. In particular, the innovativeness of the idea, the passion of the people behind the SE, and the urgency of the social issue that the SE is trying to solve were mentioned. Thus, SE 7 noted the following:

> The idea got more and more important [to receive grants] and it was an innovative idea because we didn't have it before here in Norway.

Furthermore, SE 5 argued that if an SE can prove a social innovation, it is easier to receive a grant. However, it needs to be considered that nine SEs of our sample are within their first 3 years of business. From this, we can conclude that nonfinancial facts seem to be particularly important for smaller grants in the start-up phase of SEs. However, the four SEs in their later stage reported that hard facts such as a business plan, financial plans, etc. were important within their grant application. This finding indicates that in later financing rounds, other information might receive the attention of grant investors. SE 3, which was already established in 2010, confirmed this and mentioned that the business plan was important for them because "*the business plan makes you ask questions they want to get answers for*."

Table 2 also shows that financial sustainability seems to be very important for SEs to receive a grant. As SE 1 pointed out:

> I believe this is an extremely important factor in the competitions: that you are also economically sustainable with your idea.

A reason for this might be the hybrid character of SEs. In contrast to NGOs, SEs follow financial objectives next to their social objectives. SEs without a healthy business model that will not become financially sustainable in the foreseeable future will be dependent on grant financing. This was also confirmed in previous research that found that, particularly, small SEs face the risk of grant dependency (Sunley and Pinch 2012). Because the interview sample consists mainly of small ventures, this might explain why grant investors highlight the focus on financial sustainability. In later stages, financial information such as turnover and first profits of SEs already prove their sustainability, whereas, at the beginning, the idea and its implications are the main focus. SE 2 supports this finding and argues that it is essential for the project to "*be able to support itself, that one is not permanently dependent on other donations or competitions, but it is real start-up financing to get the project running*." This highlights that grant investors seem to pay attention to the risk of grant dependency.

A question to the SEs, asking for the reasons why their grant applications were rejected, revealed that the type of social solution in many cases has been the decisive factor. This is highlighted by the interview partner of SE 4, who argued:

> Sometimes the persons who are judging the project prefer something more social or something more like coming from community, it depends.

Hence, SEs facing unconventional issues might sometimes not fit into the scheme of grant investors that focus on a particular social area or issue. Scheuerle et al. (2013) already indicated this discrepancy, showing that grant providers can have their own creative wills, which they want the supported SEs to follow. This might explain why they refuse SEs with other focus areas.

All in all, the presented results show that SEs need to fulfil several requirements to receive grant funding. Thus, this study confirms the argument that grants cause high fundraising costs (Heinecke et al. 2011). Based on the previously illustrated results, the following propositions are indicated:

Proposition 1a SEs need to go through a resource-intensive application process to receive a grant.

Proposition 1b Nonfinancial facts, long-term financial sustainability, and the type of social solution are the most important factors for receiving a grant.

4.2 Challenges Within the European Grant Landscape

The first challenge SEs face to acquire a grant in Europe is navigating within a market that lacks a clear structure. As the quotations in Fig. 1 illustrate, the grant market is very complex and confusing. SEs need to make substantial efforts to find grant competitions with grants fitting their business stage and their field of activity. One SE suggested that instead of SEs looking for matching grants from private or government grant providers, they "*should look for people who they want to support and work with*." However, this might only be a possible solution at later company stages, as in the early stage there is often no real alternative to grant financing due to the specific characteristics of SEs discussed in Sect. 2.2 but also due to nontransparent markets for social investors. Some SEs mentioned that a solution to the latter problem could be an authority or institution that gathers and provides information about grant providers in a country or even the entire European market. This would reduce the time and resources required to identify suitable grant investors and competitions in the market. Our own research for private grant providers within Europe confirms this lack of structure perceived by SEs. In none of the investigated countries was information about grant providers available online. Without knowing the exact names of foundations active in this market or specific grant programs, it is rather impossible to identify all suitable grant investors in a market.

Another challenge in the European grant market is the insufficient supply in different areas. Eleven of the 13 interviewed SEs mentioned that this insufficient supply can have two main reasons: the overall limited grant supply by public authorities and the missing supply of different social areas or business stages. The latter point was specifically mentioned for companies in the preseed or seed stage but also in the growth stage. First, SE 4 argued:

> I think the more difficult part is when you just have the idea. Getting the first people to fund you is quite difficult.

This statement shows that acquiring the first grant seems to be particularly hard, which is supported by SE 13: "*We are in the seed financing stage and that is just very bad. It's really terrible to find something there*." The other stage with a lack of funding mentioned by SEs exists after the start-up phase, when they want to expand their business but do not need really large amounts of funding. SE 11 describes the situation as follows: "*So basically when you start to need 100.000 € for your business, there is a bit of a gap*." The same point has been made by SE 4. The interview partner explained that they are in the situation of being too large for some grants and too small for others. The gap in governmental grants has been particularly mentioned by SEs in countries with no specific legal status for SEs, such as Germany (in comparison to, e.g., England or France). Hence, a German SE explained that it is difficult for public authorities to fund an SE without a specific SE legal status because they are not an NGO and they would have to establish a subsidy. Furthermore, it has been mentioned that getting tax-privileged status is quite difficult in some countries because SEs are not given any specific consideration. For example,

SE 1 creates an environmental value by reducing waste through recycling. This company did not get the status of an NGO because the public authority could not connect it to environmental protection. This example also indicates a third gap in the form of a lack of grant funding for specific social areas. SEs tackling "nonfamous" social issues seem to experience this gap the most, as SE 5 highlighted:

> It is very different for us to obtain grants because our activity is about prevention. People who will benefit are not dependent or sick or experiencing real problems yet.

The last and possibly strongest challenge SEs need to resolve to receive a grant within Europe is competition with other SEs. As previous research has shown, competition for grants is growing substantially (e.g., Bielefeld 2009; Bull and Crompton 2006; Weerawardena and Mort 2006). SEs perceive the European grant market as highly competitive. As stated at the beginning of this section, they feel like "*every SE under the sun is trying to get the money*" (SE 9) and describe that the way to receive grants is going through a contest against a great number of competitors. Reasons for high pressure might be due to a significant increase in new SEs and nonprofits in previous years (Bielefeld 2009). Altogether, this highly competitive and constraint market pressures SEs to act more like conventional start-ups, such as becoming more efficient and commercial (Bull and Crompton 2006).

Overall, these results illustrate several issues impeding SEs to receive grants within Europe. Most situations, such as the lack of supply and strong competition, are connected with each other and could be mitigated through appropriate measures such as an increased grant supply and better access to information easing SEs access to grants. This leads to the second proposition:

Proposition 2 The European grant landscape is characterized by a lack of structure, insufficient supply, and strong competition.

4.3 The Influence of Grants on Follow-Up Financing

Our interviews highlight the advantages of grant funding for SEs and their impact on follow-up financing. Table 3 illustrates that most grants are monetary. Nine of 11 SEs that already received a grant reported monetary support through them. The SEs explained that the money provided helped them to progress with their business development or, in the very early stages, to establish their business. This result confirms the argument of Nicholls and Pharoah (2008), who emphasized the monetary advantages of grants for ventures with social purposes looking for early-stage financing. SE 5 explained: "*We received a grant to develop a new function on our*

Table 3 Grant advantages endorsements

Grant advantage	Monetary support	Nonmonetary support	Signaling value
Number of occurrences	(9/13)	(8/13)	(12/13)

Source: Own illustration

website. We covered 70% of the development costs." This indicates that such grants help SEs to develop their businesses further, which is necessary to receive more and higher funding in next financing stages.

However, Table 3 indicates that many grants also provide SEs with nonmonetary support. Two SEs even referred to grants that only provided nonmonetary support. One example is a social lab where the winning SEs are provided with a working space in the accelerator and "*many workshops and coaching for different things such as marketing know-how*" (SE 13). SEs that participated in such an accelerator program explained that it was quite helpful for them to establish and develop as an SE. Moreover, some SEs particularly looked for grant programs that provided administrative support in addition to financial support and declared "*the support and consultative skills from some people involved are more important than the money*" (SE 3). Moore et al. (2012) explain that foundations such as private grant investors often support SEs through mentoring, coaching, etc. in contrast to governmental grants, which mainly focus on monetary support. This difference is also highlighted by interviewed SEs that received government as well as private grants. They argued that the support depends on from whom the grant is received. SE 6 had such an experience and pointed out the following:

> I think it depends, if you see the governmental grant, they don't have that at all. We can't go to them for help, they don't know anything about this.

Overall, receiving nonmonetary support was perceived as entirely positive by the SEs. They stated that this support helped them to progress with their businesses, which in turn enhanced their chances to find follow-up financing. This is reinforced by the access to networks of some private grant funders that also helped to find new investors. Some SEs explained that through their first grant, they got into contact with BAs as possible future equity providers. Some grant programs even had a specialized financial department that tried to connect them to other financiers.

As Table 3 demonstrates, 12 of 13 SEs are convinced that receiving a grant has a signaling value. According to them, reasons for this signaling value are the enhanced reputation and legitimation through the proof-of-concept and due diligence process of a grant provider and the higher visibility of their SE. Thus, SE 7 reported that they "*got visible because of the award*," and SE 10 mentioned that it shows "*how you spent the money of the grant so that you can show that you are well-managing your financing*." Signaling theory, which we explained in Sect. 3 regarding the investor-related challenges in SEs' financing, explains how investees can reduce information asymmetries for investors. Thus, reducing information asymmetries is extremely relevant for SEs to find external funders (Jäger 2010). Grants can be understood as a signal, which reduces information asymmetries between SEs and their investors. An effective signal must fulfil two main characteristics. First, it must be observable, which means that outsiders must be able to notice the signal (Connelly et al. 2011). For grants, this is the case because they are often provided through competitions making the winning SEs visible. SEs typically use this information and report on their websites about obtained grants. The second criterion is that a signal must be costly. These costs are not necessarily monetary; they can also be time-consuming or

require high efforts. This criterion is also matched by grants because SEs need to go through a resource-intensive application process to acquire grants. As discussed in Sect. 4.1, grants differ regarding the amount of effort and time required for the application process. This illustrates different cost levels, which SEs need to raise to finally receive a grant that can be used as a signal (Connelly et al. 2011). Therefore, the results of our study suggest that SEs across Europe receive a positive signaling value from grants that can be used to convince follow-up investors. Moreover, this is highlighted by the fact that 10 of 13 SEs recommended using grants as the first financial instrument because "*it's a big help, if you already have someone, it makes it easier to find a new one [investor]*" (SE 4). Previous research demonstrates similar findings. Heutel (2014) found that government grants illustrate signals of high quality for charities and thus crowd-in private donations. Lehner and Nicholls (2014) argue that successful crowdfunding, tax relief, and guarantees are incentives for social banks to provide debt capital. All these aspects increase a firm's legitimacy, which provides a positive signal to follow-up investors. Based on these arguments and our findings, we assume that as grants seem to have a similar signaling value, they might offer the same incentives for follow-up investors.

Our results indicate that receiving a grant has several advantages for SEs with a positive impact on the chance of finding follow-up financing. These advantages of grants result from monetary and nonmonetary support as well as a signaling value that is achieved through obtaining grants. Thus, we propose the following:

Proposition 3 Receiving a grant increases the likelihood of finding follow-up financing.

4.4 Equity as a Follow-Up Financing Source for SEs

In this interview study, ten SEs mentioned equity as an interesting funding source they are looking for in the future. Figure 1 demonstrates that there are two second-order themes indicating why SEs are looking for equity investments after they received a grant. SEs particularly seem to search for additional support and expertise for their businesses from social equity investors. This is confirmed by SE 11, which had already acquired equity, and the founder experienced that:

> I was able to have a lot of help, from coaching to legal expertise. I'm always able to ring one of my shareholders if I have any issue. They will find a solution with me.

SEs reported that they are particularly interested in BAs, preferably socially orientated ones. SE 1 stated that it prefers a BA over VC "*because VCs rather have the aim that the money provided must grow as rapidly as possible and that is just not possible in a social start-up*." This finding is underlined by several studies analyzing the nonfinancial resources that BAs offer (e.g., Ardichvili et al. 2002; Brettel 2003; Politis 2008). Nevertheless, there are some challenges, which have been explained in Sect. 2.2, related to equity funding. However, our results show that

the advantages seem to convince SEs to search for equity instead of debt. Based on these findings, we suggest proposition 4:

Proposition 4 After receiving a grant, SEs prefer to use equity as follow-up financing to acquire additional expertise for their companies.

5 Conclusion

5.1 Summary and Conceptual Model

The aim of this study was twofold. First, we wanted to understand the requirements SEs need to fulfil to receive grant financing in Europe. Second, our aim was to identify whether grants support SEs in receiving follow-up financing. Our findings indicate that the European grant market for SEs lacks structure and provides insufficient supply (e.g., at specific development stages) combined with strong competition for grants. SEs must undergo a resource-intensive application process, which is highly bureaucratic, time-consuming, and costly (Heinecke et al. 2011). In their application, SEs need to stress their nonfinancial values and provide convincing arguments regarding their financial sustainability. Nonfinancial values include the entrepreneur's passion and the innovativeness of the idea, whereas financial sustainability expresses that the SE is able to make profits in the foreseeable future and will not be dependent on ongoing grant financing, as is often the case with charities. Finally, to receive a grant, SEs need to find grant providers supporting their specific social solution. If SEs are able to obtain a grant, they can obtain monetary and nonmonetary support, depending on the grant provider. In addition, receiving a grant provides a signaling value that seems to increase the likelihood of follow-up financing.

The signaling value is particularly important for SEs because information asymmetries between investors and entrepreneurs are even higher for SEs than for commercial businesses. Due to the SE's hybrid structure that follows financial and social objectives simultaneously, SEs actions are more difficult to observe because conflicting goals are likely to occur. As Jäger (2010) argues, it is immensely important for SEs to reduce these asymmetries to receive funding. The positive signals of grants can be used for this purpose. In their search for follow-up financing, SEs seem to be particularly interested in equity financing, which can provide their venture with additional know-how through the investors. Therefore, many SEs in the interviews reported that they are trying to get social BAs involved. The specified results of the process from receiving a grant to finding follow-up financing are summarized and illustrated in the conceptual model in Fig. 2.

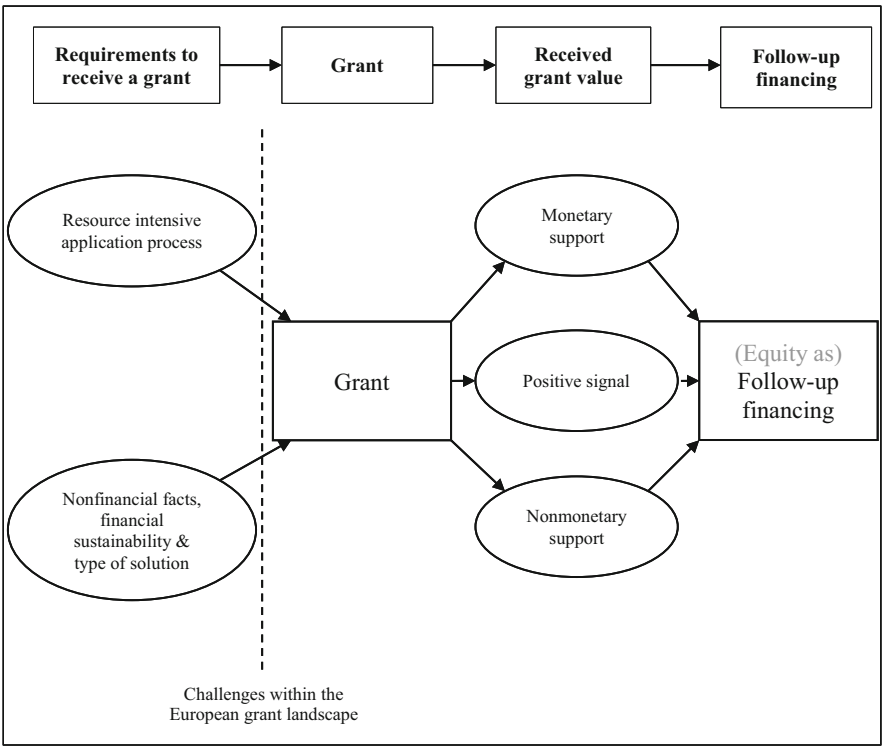

Fig. 2 Conceptual model for the impact of grants on follow-up financing. Source: Own illustration

5.2 Implications for Theory and Practice

5.2.1 Theoretical Implications

With this study, we provide four contributions to prior research on grant funding for SEs (Achleitner et al. 2011; Alter 2007; Chell 2007; Dees 2008; Scheuerle et al. 2013; Spiess-Knafl 2012; Spiess-Knafl and Aschari-Lincoln 2015; Sunley and Pinch 2012; Thompson and Doherty 2006; Weerawardena and Mort 2006).

First, this study contributes to previous research analyzing the different obstacles that SEs need to overcome to receive grant funding. This confirms the findings of previous studies indicating a resource-intensive application process that is highly bureaucratic and time-consuming (e.g., Sunley and Pinch 2012; Scheuerle et al. 2013). Furthermore, our results highlight the importance of long-term financial sustainability to finding grant investors. As Spiess-Knafl (2012) indicates, the behavior of SEs, including their financial situation, is often hardly observable and controllable. This might be the reason why SEs often focus on their profit orientation and financing model in the grant application process. In addition, we extend the existing literature by illustrating the importance of different nonfinancial facts in

early-stage grant funding, as well as the type of social solution, as influencing factors for obtaining grant funding. The latter aspect is in line with findings that investors often have their own creative will that they follow with their investments (Scheuerle et al. 2013).

Second, this study reveals several challenges SEs need to tackle within the European grant funding market. A major challenge highlighted in the interviews, but which has also been demonstrated in previous research, is the strong competition for grants that SEs face in Europe (e.g., Bielefeld 2009; Bull and Crompton 2006; Weerawardena and Mort 2006). The findings add to the existing literature by showing a lack of structure within the European grant landscape, which makes it difficult for SEs to find grants suitable for their venture. In addition, we find that specific social objectives have even more problems in finding matching grant funding. Furthermore, SEs that surpassed the start-up phase report a lack of grant supply at the next development stage. The latter finding confirms Defourny and Nyssens (2008), who describe that grants or subsidies are often provided temporarily in the launching process of an initiative.

Third, our findings show that receiving grant funding helps SEs to find follow-up financing. Monetary and nonmonetary supports are grant characteristics that have already been highlighted in previous literature (e.g., Achleitner et al. 2011; Moore et al. 2012), but they have not been connected to an increased likelihood of receiving follow-up financing. Thus, this result extends the current state of this specific research field. Furthermore, the positive signaling value of grants identified within this paper contributes to the literature examining SEs and information asymmetries (e.g., Connelly et al. 2011; Ebrahim et al. 2014; Kickul and Lyons 2012). The finding is directly related to Heutel (2014), showing that governmental grants demonstrate a positive signal. Furthermore, it complements Lehner and Nicholls (2014), who already identified other signals such as successful crowdfunding campaigns, tax reliefs, or guarantees as positive signals for follow-up investors. The findings are also tied to research about crowding-in or crowding-out effects (e.g., Andreoni and Payne 2011; Brooks 2000; Steinberg 1985). Our results indicate that grants do not have a crowding-out effect but rather the opposite seems to be the case; grants act as positive signals crowding in additional investors.

Finally, the last finding contributes to research that analyzes which funding types SEs use (e.g., Achleitner et al. 2011; Benedikter 2011; Bryson and Buttle 2005; Spiess-Knafl 2012). The results of the interview study show that SEs seem to prefer equity, particularly from BAs, after their use of grants, with the objective of acquiring additional expertise for the ventures. However, this objective might be most important for SEs receiving grants in an early company stage because they typically suffer from liability of newness and smallness and require know-how, networks, and access to resources that can be provided by BAs (Stinchcombe 1965; Zimmerman and Zeitz 2002; Block et al. 2018).

5.2.2 Implications for Practice

The findings of our study are particularly insightful for SEs at early stages searching for grant and follow-up financing. The results highlight the positive impact of grant funding on follow-up financing for SEs. However, to fulfil the requirements of grant investors, SEs need to consider some main requirements. First, they should search for grant providers appropriate for the social target area in which they operate. However, this may not be an easy task because the European grant market lacks a clear structure, making it difficult to target the appropriate investors. Second, within their application process for first and/or smaller grants, which can consist of written applications, pitches, etc., our findings suggest that SEs need to highlight their profit orientation and nonfinancial facts. The long-term financial sustainability seems to be important to receiving a grant because it shows independence from grant funding in the future. Nonfinancial facts that seem to be perceived as positive by grant investors are, for instance, the innovativeness of the company idea and the passion of the entrepreneurs. Altogether, we find that overcoming the resource-intensive application process might have additional positive effects later as it increases the likelihood that the SEs will find follow-up financing. Our results indicate that the reasons for this are the monetary and/or nonmonetary support they receive through the grant, as well as the positive signal that is sent to future investors through the obtainment of the grant. Finally, the findings propose that SEs are interested in specific equity forms (e.g., social BAs) as future funding sources to gain additional expertise and network access.

Our results could also have implications for policy makers. First, the findings demonstrate that a better grant market structure within the European member states and the entire European context could help SEs in their further development. The UK tried to support SEs with a special company status (CIC) that has been shown to support SEs in obtaining financing (Ridley-Duff 2009). This initiative could set an example for other European countries to follow. Furthermore, policy makers could meet the demand of SEs and build a specific authority or institution where SEs would find all relevant funding information and possibilities in the market.

5.3 Limitations and Future Research

The interview study has several limitations. First, our results are limited by the explorative and qualitative research design. Although we provide a first overview of the SE grant market in Europe, additional research is required to provide generalizable results for the complete European market. Second, as mentioned before, most SEs we interviewed are in the start-up phase within their first 3 years. Although grants have been found to be particularly important in the early stage (Nicholls and Pharoah 2008), more research in different company stages could provide a deeper understanding of the overall grant market, including its challenges. Therefore, the

findings of this study fit to SEs in early stages but are probably not alienable to SEs in later funding stages. Further research could investigate SE funding in different company stages and the respective grant markets. Highlighting possible differences in the grant market for different life cycle stages of SEs would be of great importance for SEs to better prepare for their further development. A third limitation is that the analysis does not explicitly distinguish between governmental and private grants due to the relatively small number of interviews. However, some SEs mentioned particular characteristics of the different types of grant providers (e.g., no nonmonetary support from governmental grants), demonstrating that it might be worthwhile to dig deeper into the different characteristics of grants from different investor types. Detecting possible differences such as nonmonetary versus monetary support could help SEs identify suitable grants and use their resources efficiently by only applying for specific types of grants matching their requirements. Finally, our study does not provide information on how strongly grants influence the likelihood for SEs to find follow-up financing. Future research could investigate this and test the conceptual model with its propositions through a quantitative research approach.

Overall, our study provides a better understanding of the European SE financing market. The beginning of this paper showed that SEs are different from conventional start-ups and that this results in specific challenges regarding their financing. Based on our interview study, we identified grants as a way for SEs to reduce asymmetric information and hence overcome one funding challenge. Our research provides new insights into the financing of SEs, as it shows requirements to receive grants and the implications of grant funding for the future development of SEs.

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Democratising Entrepreneurial Finance: The Impact of Crowdfunding and Initial Coin Offerings (ICOs)

Erik Ackermann, Carolin Bock, and Robin Bürger

Abstract Our article sheds light on two recent phenomena in the area of entrepreneurial financing, namely, crowdfunding and Initial Coin Offerings (ICOs). We investigate the main characteristics of the two alternative forms of entrepreneurial financing, their differences and coherences, reasons leading to their occurrence, their market relevance and legal aspects. Furthermore, we provide both an overview of the different motivations backers of the two phenomena have to support campaigns as well as the success factors for the campaigns. Due to their newness, both types are not devoid of risks and limitations which are also discussed. We state that crowdfunding and ICOs have many aspects in common and that a combination of both concepts may be optimal in their future development to overcome the current inefficiencies of crowdfunding or the shortcomings of ICOs. In summary, entrepreneurial financing is positively influenced by the two phenomena leading to a democratisation of financial possibilities for both entrepreneurs and backers.

Keywords Entrepreneurial finance · Crowdfunding · Initial Coin Offering · Blockchain

1 Introduction

> ICOs are here to stay as we transition towards blockchain-based applications and a token economy. Therefore, every start-up, entrepreneur and company needs to understand the marketing, technical, legal and regulatory rules of this new funding tool.
>
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While an *Initial Coin Offering* (ICO)[1] may represent a component of the future entrepreneurial finance landscape, entrepreneurs already have the opportunity to make use of an alternative financing instrument that is still young but far more established. *Crowdfunding*[2] is a phenomenon that mainly appeared in the aftermath of the financial crisis when companies had to struggle to receive external financing provided via debt capital. This effect was particularly prevalent for start-ups and entrepreneurial initiatives (Bruton et al. 2015). During this time, start-up initiatives, mainly from the creative and non-profit sector, started to collect money from individual investors, the so-called crowd, to realise their projects (Agrawal et al. 2014; Ahlers et al. 2015).

This phenomenon was facilitated by the ongoing process of *crowdsourcing* and *open innovation* initiatives by established companies, a process which is mainly based on the thought that the needs and the early feedback of the crowd can be integrated into product development processes (Belleflamme et al. 2014; Kleemann et al. 2008).

While the basic idea of crowdfunding is not entirely new and relies on cooperative approaches, the development and establishment of modern crowdfunding platforms can be observed between 2006 and 2010 (Dushnitsky et al. 2016). During this time, the development of crowdfunding was significantly influenced by technological, social and financial market developments like the increasingly dynamic use of the Internet (web 2.0), the increased emergence of joint consumption and collaborative production (the sharing economy) as well as evolved customer requirements resulting in new consumer groups (digital natives) (Bruton et al. 2015).

These developments have equally influenced the emergence of entirely new technologies and concepts. By publishing *Bitcoin*[3]*: A Peer-to-Peer Electronic Cash System* in November 2008 by the pseudonym "Satoshi Nakamoto" (Nakamoto 2008), the world's first *blockchain* application for digital payment processing was made available on the Internet as open source (Meinel et al. 2018). With the increasing awareness and adaptation of *bitcoin* and the technology behind it, blockchain-based financing through an ICO could also reach new heights in 2017. At the peak, the question for blockchain entrepreneurs when raising capital was not

[1] *Initial Coin Offering* (ICO) also token sale or token generating event refers to a new form of capital raising for financing entrepreneurial activities. By combining different approaches from the fields of peer-to-peer networks, cryptography and game theory (consensus mechanisms), financiers are enabled to contribute to entrepreneurial projects on a global scale without a central entity (Boreiko and Sahdev 2018).

[2] *Crowdfunding* is a relatively new form of seed- and early-stage funding for start-ups that collect small amounts from a large group of individuals through the use of online platforms acting as intermediaries (Schwienbacher and Larralde 2010).

[3] *Bitcoin* with a capital "B" means the peer-to-peer network, the open-source software, the decentralised general ledger (*blockchain*), the software development platform and the transaction platform. The term *bitcoin* written with the lowercase letter "b" refers to the unit of the crypto asset (well known as *cryptocurrency*) (Sixt 2017).

which venture capitalists they have to address but how high they should set the funding limit in an ICO (Siegel and Gramatke 2018).

PricewaterhouseCoopers recently analysed the ICO market and concluded that almost USD 7 billion were raised globally in 2017 (Diemers et al. 2018). In contrast, the best-known crowdfunding platform Kickstarter has been able to provide about half of that capital to project initiators since its inception in 2009 (Fisch 2018).

In the first half of 2018, nearly USD 14 billion were raised through these so-called token sales. If we assume that ICOs are more like a digital IPO than crowdfunding, we find that Facebook's IPO was able to collect that amount in just 1 day. Accordingly, the still young ICO market could be considered as having a huge growth potential (Cohney et al. 2018).

In summary, the ICO market of the recent years resembles in many ways the "New Economy" and the resulting dot-com bubble (Internet bubble) around 2000 (Cohney et al. 2018). Token sales have reached a market relevance and transaction size that make further research in the context of entrepreneurial finance inevitable.

With this in mind, this article is intended to illustrate current developments concerning the ICO phenomenon and to relate them to crowdfunding as a contemporary and comparable form of entrepreneurial financing. Using selected comparison criteria, it should be clarified in which points both overlap and to what extent this can lead to displacement effects. Since ICO research is still in its infancy stage, the comparisons made between crowdfunding and ICO concerning different aspects are by no means conclusive but rather follow the intention to provide an overview and to be useful for further research impulses.

2 Appearance and Characteristics

Crowdfunding has its origin in crowdsourcing where entrepreneurial initiatives and established firms try to collect early feedback from the crowd on product ideas and developments in order to adapt the products to the users' needs and interests (Belleflamme et al. 2014; Kleemann et al. 2008). In the case of crowdfunding, the crowd typically provides money for product ideas or entrepreneurial initiatives via Internet-based crowdfunding platforms acting as intermediaries (Agrawal et al. 2014; Ahlers et al. 2015).

The oldest and most popular type of crowdfunding is *reward-based crowdfunding* (Cholakova and Clarysse 2015). In this type, the crowd gives money for projects or entrepreneurial initiatives and receives the product or another form of reward in return (Xu et al. 2014). Hence, the crowdfunding backers in this type can be considered as first customers, product testers or providers of feedback that help to improve and establish the crowdfunding project. Projects seeking reward-based crowdfunding are often in a pre-commercialisation stage and use the money raised via crowdfunding to develop the product or to establish their initiative (Antonenko et al. 2014).

Another type is *donation-based crowdfunding*, in which backers provide financial means for interesting product developments or projects without expecting something in return. It is therefore rather similar to certain arts and humanitarian projects as it can be characterised as a classical charitable donation.

Lending-based crowdfunding is a third type. Projects using lending-based crowdfunding collect money from crowdfunding backers through debt-like instruments, i.e. they typically offer a repayment of the invested amount after a specified time with a typically fixed interest payment on top (Koch and Cheng 2016).

Equity-based crowdfunding is the fourth type, often also referred to as *crowdinvesting* as it typically grants backer's stakes or bond-like shares in the equity of the crowdfunded project (Ahlers et al. 2015). Hornuf and Neuenkirch (2016) state, however, that most equity-based crowdfunding projects do not offer common shares due to legal obligations and rather use structures like profit participating loans, cooperative certificates or silent partnerships.

The type of crowdfunding chosen has implications on firms' governance issues. The distribution of rewards for campaign backers does not affect governance since no ownership rights are associated with it. The same applies to donation-based crowdfunding. Most forms of lending-based crowdfunding offer subordinated short-term debt instruments so that the influence on firms' governance is as well limited. If equity crowdfunding is used, however, and the instrument is structured in a way that voting rights are distributed to the crowd, a large group of new equity holders may affect the firms' governance structures (Bruton et al. 2015). Some campaigns therefore try to use equity-like financial instruments restricting voting rights to circumvent this issue. Drover and Busenitz (2017) state that the advantage of equity crowdfunding versus traditional venture capital funding is that firms using crowdfunding have a large group of dispersed shareholders which can be easier to govern than a few venture capitalists getting very involved in the strategy. Often, the type of crowdfunding elements also occur in a mixed form so that, e.g. equity crowdfunding is used along with rewards granted but excluding voting rights (Belleflamme et al. 2014).

If we now take a look at the ICO phenomenon (also token sale, *token generating event*), we can distinguish between two main forms. In contrast to crowdfunding, financiers do not receive a product, equity share or interest payment in return for their support but a *digital unit* in form of a *token* (similar to a voucher, coupon) or a digital unit commonly referred to as a *cryptocurrency* or *coin* (also *payment token*, currency token).

While a token is based on an existing blockchain such as Ethereum (Siegel and Gramatke 2018), the issuing of a cryptocurrency creates an independent blockchain ecosystem of various stakeholders (including, for instance, developers, nodes, users, miners). Both digital units can be structured differently and may include, for example, participation in decision-making, a right to profit-sharing/dividend distribution and the use of a product/service or no claim at all (Aschenbeck and Drefke 2018).

Considering the dynamic developments within the ICO market, a clear distinction between different types of tokens is neither binding nor conclusive.[4] The frequent existence of hybrid models due to the functionality of a token also makes a regulatory classification difficult (Weitnauer 2018). However, over time, the following four main types can be observed.

A *utility token* is typically a form of voucher for accessing a blockchain-based platform (Mironov and Campbell 2018). Once the project to be financed has been implemented, it enables, for example, the use of storage space on a decentralised storage service; it is a means of payment for digital services on the platform or simply grants discounts. Quite often, the non-subscribed tokens are made useless (*burning*) after the completion of an ICO to cause an artificial shortage, which can ultimately lead to rising prices without any functionality of the token.

A *payment token* (also cryptocurrency, coin or currency token) is generally used as a money substitute in decentralised networks for the payment of goods and services without any further functionality. The term cryptocurrency is ubiquitous but misleading in so far as its suitability as a (legal) means of payment fails due to its stability of value and representativeness.

A *security token* (also equity token or investment token) represents assets and can be structured both as debt or equity capital. This type of token sale often takes place for entrepreneurial financing in the blockchain sector and is often referred to as *Security Token Offering* (STO)[5] for demarcation purposes. These tokens may include a liability-based claim against the token issuer on future earnings or an equity-based membership right in the form of participation in decision-making processes (Aschenbeck and Drefke 2018; Nyffenegger and Schär 2018).

An *asset-backed token* (also *stable coin*) is linked to an underlying asset and represents a claim to the particular asset (e.g. commodities like gold or real estate) (Hahn and Wons 2018). The connection of a physical good and a token is described as *tokenisation* or *unitisation* and increases liquidity in previously less liquid markets (Frank 2018). As a result, assets not previously represented in the banking system (non-bankable assets) can be integrated into the financial system. Table 1 gives an overview of the different types of crowdfunding and their main characteristics in comparing the types of tokens which can be issued during an ICO.

[4]In order to support regulators, entrepreneurs, investors and researchers, the International Token Standardization Association (ITSA) is working on a framework for classifying cryptographic tokens and increased market transparency. The framework allows to correctly identify (International Token Identification Number, ITIN), classify (International Token Classification, ITC) and analyse (International Token Database, TOKENBASE) every major token that exists on the market (International Token Standardization Association 2018).

[5]The term *Security Token Offering* (STO) has been used increasingly since 2018 and is often referred to as the follow-up to the ICO (Blockchainwelt 2018). An STO could help the entire market to become more stable and mature but does not necessarily have to follow blockchain-based business models. In theory, company shares could also be issued independently of the business model on the basis of a blockchain through an STO.

Table 1 Overview of the different types of crowdfunding and tokens in terms of backers' motivation

Crowdfunding	Purpose	Motivation	Token type	Purpose
Equity-based	Finance in exchange for ownership stake	**Return on investment**	Security Token	Ownership stake, co-determination rights
Lending-based	Finance in exchange for interest rate and principal repayment		Asset-backed Token	Ownership of asset
Reward-based	Finance in exchange for goods or services	**Lead users**	Utility Token	Access to platform (services), protocol
Donation-based	Finance in exchange for the "cause" (good feeling)	**Realisation of an idea**	Payment Token	Payment of goods and services within decentralised networks

Own illustration

Appearance and Characteristics: Strong Overlaps

Both alternative forms of financing occur mainly in four types, while tokens often take hybrid forms. Hybrid models can occasionally be observed in crowdfunding (e.g. combination of donation- and reward-based crowdfunding). Basically, tokens are a kind of reward for the contribution.

3 Market Relevance

The importance of crowdfunding and ICOs in the area of entrepreneurial financing in terms of market volumes is substantial. Crowdfunding can be considered as a global phenomenon since regulatory conditions largely allow it to be pursued worldwide, with the exception of equity crowdfunding (Bruton et al. 2015). It is of growing importance referring to market volumes with an increase of funds invested globally of about USD 5.24 billion in 2015 and USD 14.61 billion in 2017 (reward- and equity-based crowdfunding, Fig. 1). Furthermore, there are no particular borders prevalent so that those interested can often contribute to any crowdfunding project they wish to through Internet-based crowdfunding platforms, without being restricted to national borders if they meet the platform's regulatory requirements for registration.

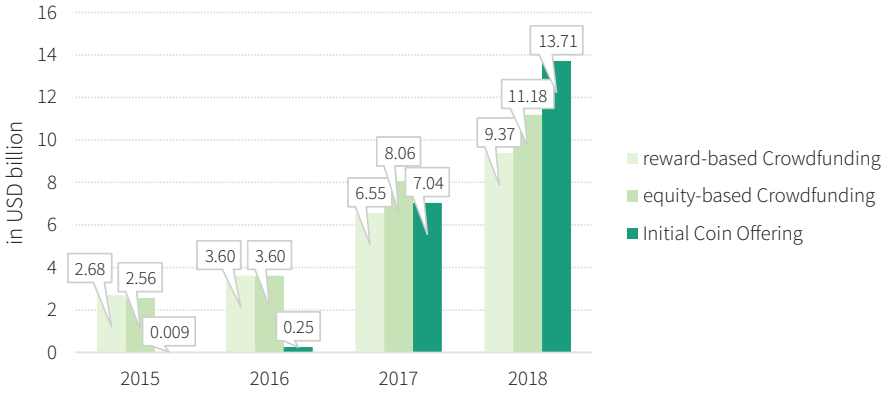

Fig. 1 Global ICO market compared to developments in crowdfunding market since 2015 in billion USD (Own illustration based on Diemers et al. 2018; Statista 2018a, b, c; Wegener 2018; Mehta and Striapunina 2017)

Crowdfunding appeared in the aftermath of the financial crisis which led to an even more increasing constraint in the provision of financial means for entrepreneurial initiatives and projects. By bundling the offer of different crowdfunding-seeking projects and potentially interested investors on platforms via the Internet, the phenomenon occurred at the same time in different developed economies (Bruton et al. 2015).

Reward-based crowdfunding was the first and dominant form of crowdfunding, and its success is ascribed to the fact that campaign backers draw personal utility out of their intrinsic motivations having contributed to the development of an aspired product or self-identification with the project (Cholakova and Clarysse 2015). Concerning the different crowdfunding types, donation-based crowdfunding is not the most important type of crowdfunding in terms of financing start-ups as it is often conducted for single projects and lending-based crowdfunding involves rather developed processes within the start-up (Agrawal et al. 2014; Ahlers et al. 2015). Equity crowdfunding developed only recently after the occurrence of reward-based crowdfunding. Mainly due to legal restrictions, it was not as dominant in terms of market volume as, e.g. reward-based or lending-based crowdfunding, in the first years of its occurrence but is now gaining in importance (Bruton et al. 2015; Cholakova and Clarysse 2015).

Compared to the continuously growing financing volumes in reward- and equity-based crowdfunding, we can observe a rapid increase in financing via an ICO in the last 5 years. Although or perhaps precisely because of no consistent regulation across the world as in the stock market, the ICO market developed from small-scale project financing within a certain community in 2013 to a multibillion dollar industry in 2018 (Boreiko and Sahdev 2018). Since there is currently no legally binding classification of tokens, we assume that the documented ICO volumes primarily serve to stimulate entrepreneurial activity. As just outlined, a comparison with reward- and equity-based crowdfunding is most likely to be made. Figure 1

illustrates the transaction volumes of ICOs compared to reward-based and equity-based crowdfunding since 2015.

In this context, the enormous increase in both the number and the volume of ICO financing is striking (Nyffenegger and Schär 2018). While in 2014 eight ICOs raised more than USD 30 million, both the number and the volume rose to 537 token sales and USD 13.7 billion already in the first half of 2018, which is more than all pre-2018 ICOs combined. This corresponds to a capital increase of almost 45,000% within a period of less than 5 years.

This rapid growth can partly be ascribed to an increased coverage of bitcoin and the underlying blockchain technology in mainstream media. The successful ICO of Ethereum (USD 18.4 million raised in 2014) is of central importance as well as the following development of the decentralised, blockchain-based platform, which has established itself as a de facto industry standard for issuing tokens since 2014 (Fenu et al. 2018).

The *ERC20* (Ethereum Request for Comments) standard allows the tokens to be interchanged and includes additional functions such as voting rights (Siegel and Gramatke 2018). In fact, only 8 blockchain projects out of the top 100 tokens on www.coinmarketcap.com are not based on the Ethereum platform (CoinMarketCap 2018a). In particular, ICOs have seen an explosion in project financing since May 2017. With several outliers, who were able to raise significantly more than USD 100 million, two big players have emerged in the still young ICO market: Telegram (USD 1700 million) and EOS (USD 4100 million) (Diemers et al. 2018). As a result, ICOs were able to raise twice as much money as venture capital investments in blockchain projects by 2017 (EYGM Limited 2018).

Market Relevance: Strong Overlaps

Depending on the type of crowdfunding and token type, different growth rates can be observed. In the context of entrepreneurial financing, reward- and equity-based crowdfunding as well as their counterparts utility and security tokens (assuming a legal regulation) are particularly important. For the first time in 2017, both alternative financing instruments recorded similarly high transaction volumes.

4 Project Focus

Crowdfunding and ICOs occurred in their beginning phases in similar industries. Crowdfunding became prominent through projects from the video gaming, music and film industry seeking financing from the crowd (Agrawal et al. 2014). The new form of financing emerged particularly in those industries since project initiators were interested in receiving both feedback from the crowd and money for being able to realise the projects. In addition, they were able to market their projects and gain

visibility. Nowadays, crowdfunding projects are still dominant in industries like design, film or gaming, but projects stem from a whole variety of industries making it an alternative for early-stage projects to receive funding (Cholakova and Clarysse 2015).

On the prominent reward-based platform Kickstarter, the highest cumulated investment volumes until May 2018 were in the categories gaming, design and technology with around USD 700–800 million each followed by the categories film and video, music and fashion with less than half of the cumulated investment amounts each (Statista 2018d). Donation-based crowdfunding is typical for projects in the domain of arts and humanities, and lending-based crowdfunding is often used by established start-ups for financing new investments or growth. Concerning the type of equity-based crowdfunding, this type is mainly used by established start-ups. The financed projects predominantly occur in industries such as "Greentech", energy and real estate (Belleflamme et al. 2014; Cholakova and Clarysse 2015).

In contrast, a clear distinction of sectors in which ICOs are used to finance blockchain-based projects is inaccurate in so far as the current hype around the technology leads to projects often being "blockchainised", although the use of conventional technologies would be more effective and cheaper. In general, the use of blockchain can be beneficial wherever:

- The documentation of activities and transactions is relevant.
- Distributed databases or peer-to-peer networks are to make a central authority obsolete.
- Certain actions are to be executed automatically upon the occurrence of if-then conditions.

Predestined areas of application are especially finance, supply chains and logistics, healthcare, identity management, cloud computing, Internet of things (IoT), energy supply, advertising and media, booking and rental and retail and e-commerce (Tait et al. 2018).

Based on empirical studies and scientific research, some of these assumptions are reflected in financing through a token sale. Mironov and Campbell (2018) show that the most popular industries for staging an ICO come from the areas exchanges and wallets, financial services, gaming and blockchain infrastructure (in more than 300 reviewed or rated projects since September 2016).

In addition to Mironov and Campbell (2018), the consulting company Ernst & Young also confirms that in particular blockchain infrastructure, finance and gaming platforms are the leading segments for the amount of money raised during a token sale (collected data on 372 projects that have conducted an ICO from 2015 to 2017) (EYGM Limited 2018). Compared to 2017, only minor changes can be observed within the most popular segments by number of projects staging an ICO (Mironov and Campbell 2018). The majority of ICOs consider themselves to be a platform for decentralised businesses (Adhami et al. 2018; Fenu et al. 2018).

Project Focus: Strong Overlaps

Generally, a large variety of projects but certain sectors enjoy equal popularity in both crowdfunding and ICO campaigns. The main difference is that ICO projects are always based on a *distributed ledger technology* (DLT)[6] such as blockchain.

5 Project Development Stage

Concerning the project status in crowdfunding campaigns, it can be stated that the project status of campaigns seeking crowdfunding has become more and more advanced over the course of time. In early times, often only a description of the envisioned product was presented, and projects were in their seed stage in the best case. Nowadays, many campaigns have developed prototypes presented in a professional video or have already founded a start-up. Platform providers for equity crowdfunding often demand campaign initiators to disclose specific information on their company and to present a business plan and financial forecast (Agrawal et al. 2014; Décarre and Wetterhag 2014; Signori and Vismara 2016).

Mollick and Kuppuswamy (2014) report, e.g. that about 90% of successfully reward-based crowdfunded projects continue their entrepreneurial initiative within 1–4 years after the campaign. Colombo and Shafi (2016) also find evidence that firms seeking reward-based crowdfunding often had prior external financing before the campaign or acquired business angel or venture capital financing after the campaign.

With this in mind, we note that the initial developments in crowdfunding are reflected in the current development of the ICO market. In general, a token sale can be done before the entrepreneurial project has launched a product (pre-seed/seed stage), to further develop a product/prototype[7] (start-up stage) or to expand the business model/tokenisation/launch of new products and utilities (expansion stage) (Hahn and Wons 2018).

Since an ICO usually takes place on dedicated websites and no platforms have been developed to date that preselect projects as in crowdfunding, investors must determine the development stage of an ICO project based on the information provided on the website and in particular through a so-called white paper.

[6] *Distributed ledger technologies* (DLTs) can be seen as a generic term for emerging technologies based on decentralised and distributed structures. Instead of a central entity that collects and verifies all data, participants trust the network, which derives its integrity from a specific consensus and validation system (Yates et al. 2018). In addition to blockchain, tangle (e.g. IOTA) or hashgraph should also be mentioned as forms of DLT.

[7] A minimum viable product (MVP) fulfils the basic requirements and properties.

However, in examining 450 white papers, Zetzsche et al. (2018) found that in more than a half, no valid postal address was provided, and about a quarter did not include any information about the token issuer at all. Less than a third mentions the law applicable to the ICO, while the vast majority omits the issue of regulation at all. Moreover, the majority of white papers does not provide the financial information necessary to take an investment decision, and none of them used an external auditor to ensure the quality of the information given (Fiedler et al. 2018).

The most frequently used phrases in white papers such as "Next-generation platform", "Decentralized network that puts users in the driver's seat" or "We are creating a community/ecosystem/economy" do not provide any information about the development stage but rather serve to attract inexperienced investors (EYGM Limited 2018). Furthermore, the reasons for using blockchain technology or a token ecosystem are often not given. In most cases, the tokens acquired serve as a means of payment within a blockchain ecosystem. However, this ecosystem or platform is mostly under development at the time of the ICO. The road from prototype status to final launch is usually expected after 1 year or more (EYGM Limited 2018).

Another empirical study confirms these assumptions, but from the investor's point of view. Investors should sell their tokens within the first 4 months, as the majority of ICO projects have very low to no entrepreneurial activity after this period, resulting in a price loss of nearly 100% of the issued tokens (Benedetti and Kostovetsky 2018). As a result, many projects are either not implemented at all or are poorly executed. Successfully implemented projects later often accept fiat currency in return for a product/service, which negatively affects the token value (EYGM Limited 2018).

This development is also reflected in recent studies, in which almost half of the ICOs examined in the first quarter of 2018 can only present the idea at the time of the ICO. Barely 0.5% can rely on a programme code (Mironov and Campbell 2018). Aside from the richness of information provided by a white paper, in some cases the team only consists of economic and marketing experts who developed the business case. Only after a successful ICO, developers will be engaged to implement the project (Fenu et al. 2018).

Project Development Stage: Strong Overlaps

The development stage of current ICO projects reminds one of the early days of crowdfunding. At the same time, it must be stated that rating websites are not exactly comparable to crowdfunding platforms in terms of preselection and quality assurance of projects. This fundamental difference may show more coherence in the future since a sort of evaluation or quality assessment (as it is provided by crowdfunding platforms) may be demanded.

6 Campaign Procedure

As already indicated, crowdfunding platforms take on a fundamental role in the development of the crowdfunding market and accordingly shape the course of a campaign. The typical procedure of a crowdfunding campaign is as follows: Campaign initiators need to register on a crowdfunding platform and need to prepare comprehensive documents about their project or product idea usually with the help of specified consultants and advisors (Ahlers et al. 2015). The information provided for all different types of crowdfunding campaigns includes material about the founding team, key information about the envisioned project, milestones that have already been achieved as well as future milestones to be reached, information about the business model, a market analysis, financial information and forecasts and terms and conditions concerning the investment (Ahlers et al. 2015; Colombo et al. 2015).

Moreover, the provision of a campaign video explaining further details, giving a deeper impression about the founding team or presenting the functioning of a prototype is advisable (Mollick 2014). Also, the funding goal, the funding period, potential minimum contribution thresholds and characteristics of the financial instrument used such as repayment dates or interest rates need to be determined (Koch and Cheng 2016). Based on that, the crowdfunding campaign can typically be launched if all the platform's requirements are met. During the campaign lifetime, the initiators can post updates for important information. The duration of typical campaigns lasted up to 90 days in the early development phases of crowdfunding. However, nowadays, a campaign duration of about 30 days is common and recommended (Mollick 2014). During crowdfunding campaigns, the status of the contributions, the number of backers, the amount collected as well as the days left of the campaign can be tracked in real-time (Colombo et al. 2015).

Basically, there are two different models for crowdfunding campaigns to collect financing. In the "all-or-nothing" approach, the crowdfunding projects receive the financial means if they collect at least a prespecified target amount. This is currently the dominant model. In the "keep-it-all" approach, crowdfunded projects receive the amount they collect from the crowd without having to reach a specific threshold (Koch and Cheng 2016; Lukkarinen et al. 2016; Mollick 2014).

People interested in supporting reward- or donation-based crowdfunding campaigns mostly have to register on the respective platforms with basic information such as name and postal address. In equity and typically also in lending-based crowdfunding, campaign backers need to provide further information such as their intended amount to invest, information on their personal income and wealth status, and they must confirm that they are aware of the risks associated with the investment in equity crowdfunding (Ahlers et al. 2015). They can then browse the information of different campaigns and make their personal contributions via a platform-specific payment system (Colombo et al. 2015).

In contrast, the digital units generated during an ICO are usually sold to interested investors in a non-standardised sale accessible through the Internet. The purchase price is typically paid in the cryptocurrencies bitcoin or *ether* (necessary element for

operating the distributed platform *Ethereum*) and sometimes in a legal currency (fiat currency) (Aschenbeck and Drefke 2018). According to the decentralised nature of an ICO, there are no platforms that cumulate projects as in crowdfunding. Additionally, there is no registration requirement, making it difficult to track the entire ICO market (Fisch 2018). Nevertheless, several platforms (e.g. ICORating, ICObench, Coinschedule) have been established which monitor the market and rate selected projects according to their own criteria (Hartmann et al. 2018).

Since the publication of the Bitcoin white paper in 2008, blockchain technology has gained worldwide attention. Following this example, many token issuers use white papers as the foundation for marketing their project (Fisch 2018). The token issuer normally describes his project in detail and provides explanations and information regarding the ICO such as token economics, development roadmaps and procedures of the token sale (Heck 2017). In contrast to standardised prospectuses in the stock market or the required documents in crowdfunding mentioned above, there is no regulation for white papers resulting in a very heterogeneous design in terms of length (1-pagers, 100-pagers), quality (badly formatted documents, professional brochures) and content (business plans, technical documents, financial outlooks) (Adhami et al. 2018; Fisch 2018). In addition to a white paper and a website, the terms and conditions are a third key component of a token sale.

Compared to a crowdfunding campaign, a token sale can take very different courses. In the simplest case, a fixed price and a fixed offer duration or token quantity can be set. However, this is a rather unusual procedure (Nyffenegger and Schär 2018). With respect to the limited scope of this article, the forms of structuring an ICO are visualised in Fig. 2.

The token price is based on the evaluation of the current project development stage by the issuer. The issuer usually keeps a part of the tokens for the future project development and business financing (Chen 2018). Moreover, it is typical that the single phases of token sales have varying and significant discounts (Benedetti and Kostovetsky 2018) to create investment incentives for the increased willingness to

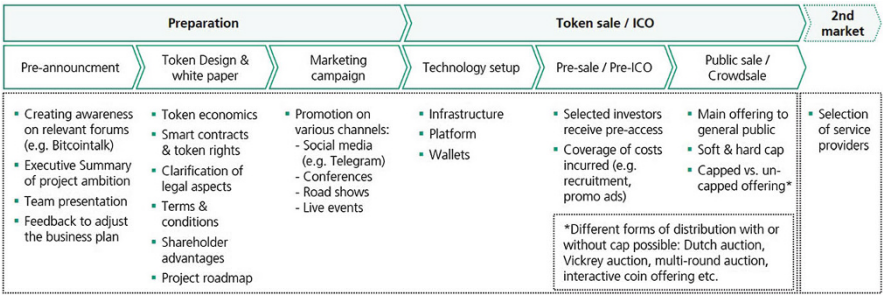

Fig. 2 Conceptual design and execution of an ICO (Own illustration based on Hahn and Wons 2018; Siegel and Gramatke 2018; Nyffenegger and Schär 2018)

take risks in the early stage. Ideally, the underlying *smart contract*[8] should also implement a mechanism for returning funds in case of a failed ICO (Siegel and Gramatke 2018). In the past, token sales could be observed in terms of length from a few hours or a day up to a whole year. According to Mironov and Campbell (2018), the average period increased from 30 days to 2 months in the first quarter of 2018.

Campaign Procedure: Medium Overlaps

Even if the campaign process can be designed very individually (especially for token sales), both alternative forms of financing are essentially based on a digital backend and use the extensive possibilities of web 2.0 to market the fundraising on a global scale with the exception of equity crowdfunding due to legal restrictions.

7 Backer's Motivation

Crowdfunding backers are not primarily looking for a financial return—this may be a backer's motive mainly in lending-based and equity financing—but often invest due to intrinsic motivations, such as personal interest in the product to be developed, the feeling of being connected and part of a community or general preference for projects in a specific sector (Cholakova and Clarysse 2015; Lukkarinen et al. 2016). So, the patronage model was the origin of crowdfunding to establish itself and is still relevant for the ongoing success of crowdfunding (Mollick 2014).

Backers often have a high willingness to pay for receiving a finalised product as a reward for supporting a crowdfunding campaign since they feel privileged about contributing to the successful realisation of specific products (lead users) (Belleflamme et al. 2014; Gerber et al. 2012; Kaminski et al. 2016). So, whereas the motivation of reward-based crowdfunding backers rather rely on intrinsic values, a potential financial gain is of higher importance for a lending-based and equity crowdfunding backers (Collins and Pierrakis 2012; Lukkarinen et al. 2016).

Due to the use of Internet-based platforms for promoting campaigns and for contributing, crowdfunding, with the exception of equity crowdfunding, is suited to overcome traditional national borders. Agrawal et al. (2014) state, for example, that 86% of the campaigns' capital stems from people that are more than 60 miles away from campaign initiators and that the average distance between campaign initiators and backers is about 3000 miles. However, Mollick (2014) also finds that many reward-based projects on the platform Kickstarter have a local component which

[8] *Smart contracts* are programmes for automating human interactions in the form of a digital, rule-based transaction log that can independently check and document defined if-then conditions and execute or inhibit transactions accordingly (Swan 2015).

may be explained by a local cultural connectedness being a motivation for campaign backers to contribute.

Unlike lending-based and equity crowdfunding, ICO investors should ideally acquire highly liquid assets in the form of tokens that can be actively traded on various crypto asset exchanges or (over the counter) with other investors (Chen 2018). For this purpose, Benedetti and Kostovetsky (2018) investigated a dataset of more than 4000 planned and executed ICOs. However, only 25% of the projects were able to list their tokens on a crypto asset exchange. Conversely, three quarters of the ICO investors own an illiquid token, which has no function until the completion of the planned project and is purely a speculative object. These investors can be considered as highly risk-oriented lead users or speculators.

In 2017 in particular, many investors were attracted by breath-taking returns of up to 32,000% (CoinMarketCap 2018b) and an average return of investment for the representative ICO investor of 82% (Benedetti and Kostovetsky 2018). Currently, Mironov and Campbell (2018) assume that 83% of the tokens listed after completion of the ICO were traded below their selling price in the first quarter of 2018. Moreover, many tokens are overpriced and finally decline in value (Benedetti and Kostovetsky 2018). In this context, many investment decisions may have been based less on rational and fundamental criteria or motives than on the "*fear of missing out* (FOMO)" investment opportunities.

It may also be assumed that smart money such as venture capital firms (Preuß et al. 2017), hedge funds and family offices as well as so-called whales[9] drive part of the ICO demand. These investor groups seem to be most likely to evaluate ICOs according to fundamental criteria and to assess the underlying smart contracts (Cohney et al. 2018) and could therefore serve as a credible signal for further investors. In addition, ICO tokens allow professional investors to diversify their portfolio, as there is little correlation with the performance of conventional asset classes at the moment (Chen 2018).

Finally, early-stage projects are generally limited to a small geographical area and are restricted to professional investors. An ICO allows small investors and early adopters, similar to crowdfunding, the same opportunities to participate in early-stage projects, with the increased risk of default, however (Chen 2018).

Backer's Motivation: Weak Overlaps

Some motives overlap. In principle, however, crowdfunding contributors want to support the realisation of an idea in order to get early access (lead users), while ICO investors are supposed to have more profit-oriented motives in mind.

[9]Large-scale investors who have been active in the crypto market since the very beginning (long-term investors). Due to the high concentration of capital on a few *whales* in the Bitcoin network (4% hold 96% of all bitcoins), market manipulation cannot be ruled out (Preuß et al. 2018a).

8 Campaigns' Success Factors

A lot of applied research so far has tried to disentangle crowdfunding campaigns' success factors. Since large information asymmetries exist between campaign initiators and backers as the information can only be provided through online platforms, the quality of the information given plays a decisive role. In general, it seems to hold that the better and the more detailed the information provided, the better the investors' judgement of the project's quality (Ahlers et al. 2015). Duarte et al. (2012) find that campaigns with trustworthy photographs from the initiators default less often. A higher quantity of explanations on the project's idea as well as an explanatory video seems to increase the success rate for campaigns (Koch and Cheng 2016).

Moreover, a good social network of the campaign initiators, a high amount of early contributions, a further developed project status, having run a successful crowdfunding campaign before and giving project updates during the campaign are said to be factors which increase the campaign's success rate (Moritz and Block 2015; Colombo et al. 2015; Koch and Cheng 2016; Kuppuswamy and Bayus 2015; Lin et al. 2013).

Factors like gender, race and personal characteristics also seem to play a role (Marom et al. 2015). However, a long duration of the funding period is said to negatively affect a campaign's success which potentially is ascribed to the campaign initiators' lack of confidence in being able to reach the funding goal fast (Mollick 2014).

Typically, in the initial phase of a crowdfunding campaign, people personally known to the campaign initiators are of high importance (Colombo et al. 2015; Ordanini et al. 2011). These investments often trigger word of mouth as a new phenomenon of crowdfunding being particularly important since social networks play an increasing role for crowdfunding campaigns and their success (Colombo et al. 2015; Mollick 2014).

Another aspect detected so far found that in reward-based crowdfunding, most project backers are one-time backers who may stem from the personal network of the campaign initiators, whereas in donation-, lending- and equity-based crowdfunding, more "serial backers" can be found (Kuppuswamy and Bayus 2015).

Block et al. (2018) provide a coherent overview of prior findings on relevant signals in equity crowdfunding campaigns and their effects on campaigns' success. They find themselves that particularly positive information on new developments of the start-up provided in updates leads to a higher number of investments in equity crowdfunding campaigns.

Some platforms such as Kickstarter initiated campaigns like "kicking it forward" which comprises the rule that 5% of the campaign's profit should be invested in other campaigns (Colombo et al. 2015).

Since no ICO platforms exist that cumulate projects and link these with potential supporters, ICO research does not focus on platform properties as in crowdfunding

but on the investigation of project characteristics or attributes of token issuers (Adhami et al. 2018).

As one result, there are usually no entry barriers for the launch of an ICO, such as a due diligence process or the request for a prototype by crowdfunding platforms. In addition, the projects are mostly in the idea stage combined with a complex technology that is at the very beginning of its development. Therefore, Amsden and Schweizer (2018) refer to the listing of a token on a marketplace (tradability) and its trading frequency to measure the likelihood of ICO success.

First, the marketplaces seek to maintain their reputation by undertaking due diligence similar to crowdfunding platforms. Second, the tradability of tokens is directly linked to the ongoing existence of ICO projects. In the case of security tokens, investors can monetise their tokens afterwards, while the token issuers can liquidate unsold tokens at a later stage for additional capital. Utility tokens often allow access to a blockchain-based platform or serve as a means of payment for the use of products and services at the same. Therefore, the tradability for the token issuer is of huge importance to increase the community around the platform (Amsden and Schweizer 2018).

Adhami et al. (2018) came to the remarkable conclusion that despite the great heterogeneity of projects and often predominant information asymmetries, the success rate of token sales is very high at 81%. The general availability of a whitepaper does not affect this but rather the information provided if there is any (Fisch 2018). Nevertheless, and with regard to missing standards or audits for white papers, Fisch (2018) implies that white papers are not as important for the evaluation of a token sale as they may first suggest.

Lines of code (e.g. smart contracts) are much more important. The availability of complete code or code parts seems to be like a proof of concept and has a strong positive influence on the likelihood of ICO success (Adhami et al. 2018). Furthermore, Adhami et al. (2018) determine that market movements of the native tokens of underlying blockchains have no influence on investment decisions and thus on the ICO success. Finally, Benedetti and Kostovetsky (2018) also show that ICO investors tend to spot and underfund fraudulent projects.

Campaigns' Success Factors: Medium Overlaps

ICO research is still in its infancy stage, but it can be concluded that the quality of the information provided through code, code parts or a white paper in token sales and a description text and/or campaign video in crowdfunding have a positive influence on the probability of success.

9 Risks and Limitations

According to Agrawal et al. (2014), crowdfunding backers have to deal with three main risks. Firstly, campaign initiators can be incompetent so that the promised reward or product or other remuneration is not delivered. Secondly, fraud may occur which means that campaign initiators do not intend to deliver a reward, a product or any financial return to their backers. Thirdly, project risk is a relevant threat as projects may not turn out the way crowdfunding initiators and backers envisioned them. One factor inherent in all three situations increases the threat associated with those risks. This factor is the high degree of information asymmetry between the initiators of crowdfunding campaigns and the backers.

Agrawal et al. (2014) project potential future developments resulting from the high risks associated with crowdfunding and suggest that either social welfare will be diminished to a great extent by the exploitation of crowdfunding backers or we will perceive a market consolidation consisting of reduced market volumes. Both aspects are in principle also valid for the further potential development of the ICO market. Mollick (2014) finds, however, in his analysis of more than 48,000 Kickstarter campaigns that the risk of fraud is quite limited in reward-based crowdfunding.

Mollick (2014) shows that about a quarter of reward-based campaigns deliver their promised product on time and from the remaining campaigns about 75% deliver later than promised. Agrawal et al. (2014) state that many crowdfunding backers had to adapt their expectations downwards. However, according to Kickstarter, more than 80% of the failed campaigns that were not able to target the envisioned funding amount clearly failed since they collected less than 20% of their envisioned funding amount (Statista 2018d). Some performance data on equity crowdfunding investments in the UK report that more than 80% of the companies that raised equity crowdfunding between 2011 and 2013 were still active in 2015. Concerning a cohort of companies founded in 2013, about one third of them either went bankrupt or showed signs of having difficulties (Weeks 2015).

Regarding equity crowdfunding, information asymmetries play an even greater role as the investors in those campaigns typically expect a financial return but cannot really judge the campaign initiators' ability to increase the equity value of a venture (Agrawal et al. 2014; Thies et al. 2018; Vismara 2016). Common reporting requirements in other security types which reduce information asymmetry problems are often not standard in equity crowdfunding settings. Equity crowdfunding is therefore not as common as other types of crowdfunding in many countries due to the issue of investor protection. The expansion of equity crowdfunding platforms into different jurisdictions is problematic as security regulations vary (Bruton et al. 2015; Vismara 2016).

At the same time, an ICO is by no means devoid of risks and limitations, and many of the outlined risks for crowdfunding backers and initiators are relevant for ICO investors and token issuers as well. Especially in view of the partly dark history

Table 2 Specific risks associated with token sales

Investor (backer, contributor)	Token issuer (project initiator)
• Fraud and scam due to a lack of law and regulation (e.g. disappearing issuers after successful token sale, one to one copies of white papers) (Hartmann et al. 2018)	• Utility tokens that are only used as payment for goods and services are becoming impractical for users as the number of different tokens increases (Mironov and Campbell 2018)
• Hacks of crypto exchanges and online wallet providers, phishing attacks on ICO websites (Hönig 2018)	• ICOs may be tax inefficient compared to equity financing if the funds raised are treated as revenue or deferred revenue (Chen 2018)
• Risk of total loss of investment due to high risk in the early stage (Chen 2018) and lack of investor protection	• ICOs can be unfavourable compared to venture capital if more than half of the tokens are issued in the case of security tokens (Chen 2018)
• Pump and dump schemes by manipulation of large-scale investors (whales), insiders, cartels and advisors (Cohney et al. 2018)	• Regulatory uncertainty regarding token sales, notably in the differentiation and treatment of security tokens (Chen 2018)
• Information asymmetries regarding project and need for own due diligence before investment (Chen 2018)	
• Strong differences in evaluation and transparency between ICO evaluation websites; often a technical analysis (e.g. token economics, smart contract code) is missing (Hartmann et al. 2018); operating on a "pay to be rated" model is common practice (Cohney et al. 2018)	
• Market liquidity (trading volume) and technical infrastructure regarding secure storage of crypto assets currently insufficient for institutional investors and often lack expertise (Labetzsch 2018)	

Own illustration

of bitcoin (e.g. Silk Road[10]) (Rosenberger 2018) and complex cryptocurrency issues (cyber security, scalability, use of resources, volatility, etc.) (Sixt 2017), further specific risks and limitations emerge concerning an ICO for both investors and issuers. Table 2 shows a summary of the specific risks associated with a token sale.

In this context, it is not surprising that Benedetti and Kostovetsky (2018) estimate that the survival rate for projects 120 days after completion of the token sale is only about 44%. Yates et al. (2018) finally come to the conclusion that the current ICO market represents a self-fulfilling prophecy, since the tokens issued are usually traded in return for bitcoin or ether. This increased demand of bitcoin and ether drives the price of both leading crypto assets upwards, affecting the market as a whole as bitcoin and ether pairs (e.g. BTC/XRP, ETH/EOS) are often traded on crypto asset exchanges. The resulting increase in market capitalization in the overall

[10]Silk Road was an anonymous marketplace for primarily illegal products and services in the so-called darknet with integrated bitcoin payment function (Rosenberger 2018).

market leads to new investors and speculators as well as new token issuers looking for a lucrative business. And here the cycle starts again (Yates et al. 2018).

Risks and Limitations: Medium Overlaps

In general, there are very similar risks to money exchange between certain parties, with the difference that there are specific threats to ICOs due to a low level of regulation and the lack of professional platforms (such as crowdfunding) to ensure higher quality projects. However, in both cases a total loss of money invested is possible (Tokenguru 2017).

10 Secondary Market

A crucial difference between any reward and return in crowdfunding and tokens issued in an ICO is the tradability on a secondary market. Typically, investing in a crowdfunding campaign does not offer trading possibilities during the investment time on secondary markets since crowdfunding is not a liquid investment (Hornuf and Neuenkirch 2016; Mollick and Nanda 2016). In this vein, Ahlers et al. (2015) state that secondary sales for crowdfunding investments on their analysed Australian platform rarely occur. They only count five secondary market transactions until February 2014.

The establishment of secondary markets for crowdfunding is complicated by legal hurdles due to investor protection and since volumes that would be tradable are rather small (Signori and Vismara 2016). However, some crowdfunding platforms already launched secondary market share trades in 2017 where investors could trade a prior investment (Crowdcube 2017; Prosser 2017).

In contrast, tokens are tradable by design, even if only a few ICO projects are currently able to list their tokens on a secondary market. Mironov and Campbell (2018) show that not all tokens issued necessarily receive a listing on a marketplace. Thus, 89 tokens of 412 ICO could be traded on a secondary market in the first quarter of 2018 which is very similar to the investigations of Benedetti and Kostovetsky (2018). On average, the tokens are listed and tradable 21 days after the end of the ICO.

Nevertheless, tokens offer a degree of liquidity that is not possible in regular crowdfunding. At the beginning of August 2018, 1768 crypto assets existed, which could be traded on 12,362 marketplaces (CoinMarketCap 2018c). The purchase and exchange of crypto assets are possible on crypto asset exchanges, trading platforms (between private individuals) and online brokers. Tokens can normally be traded 24/7. Many marketplaces allow users to switch crypto assets among themselves as well as against fiat currencies such as dollars, euros or yuan (Hönig 2018).

Albeit, the secondary market has its downsides especially because it is not fully regulated. Due to arrangements between whales, the abuse of inside information

(insider trading) or so-called advisory deals[11] (Preuß et al. 2018b), pump and dump schemes can be frequently observed (Cohney et al. 2018).

Secondary Market: Weak Overlaps

With respect to a secondary market, there are fundamental differences in the tradability and transferability of assets within crowdfunding and ICOs. Nevertheless, first efforts can be observed that individual investments of equity crowdfunding campaigns can be traded on a kind of secondary market (Crowdcube 2017; Prosser 2017).

11 Legal Framework

The legal regulation for the three types of crowdfunding, reward-, donation- and lending-based, is not a huge issue since no general restrictions apply to potential crowdfunding backers (Belleflamme et al. 2014). A crowdfunding platform, however, typically needs to be registered with a securities' commission in a country and needs to take steps to instruct investors and try to limit fraud by campaign initiators (Agrawal et al. 2014). In the early days of crowdfunding, some countries followed a rather liberal approach, e.g. Australia, which helped a widespread acceptance of crowdfunding in those markets, e.g. for equity crowdfunding in the UK (Ahlers et al. 2015; Bruton et al. 2015; Steinhoff 2014; Vismara 2016). In the USA, using the Internet for collecting money through private placements was extremely restricted before the introduction of the Jumpstart Our Business Startups (JOBS) Act under President Obama in 2012 (Kaminski et al. 2016).

Concerning equity crowdfunding, legal obligations are stricter. Many countries banned equity crowdfunding completely in the beginning phase which led to a slower development of equity crowdfunding compared to the other three types (Bruton et al. 2015). In the USA equity crowdfunding was only allowed for accredited investors, and it was basically one of the first countries to regulate equity crowdfunding (Hornuf and Neuenkirch 2016). The SEC introduced a special "regulation crowdfunding" to implement the Title III JOBS Act provisions for crowdfunding (Agrawal et al. 2014; Lukkarinen et al. 2016; Securities and Exchange Commission 2016).

It regulates that the general public is also allowed to invest in equity crowdfunding under specific individual investment restrictions and that companies can raise up to USD 1,000,000 (Agrawal et al. 2014). Most countries have

[11]These advisors are more engaged in marketing the project and less in consulting. It is not uncommon for those consultants to receive the tokens at an 80–90% discount. Such a market power can allow price manipulation and result in pump and dump schemes (Preuß et al. 2018b).

restrictions concerning the maximum number of investors a company can have (Griffin 2012).

In Germany, equity crowdfunding has always been possible for the general public. The European Union regulation applies for European nations which can be specified by the national states. Up to a total investment amount of EUR 100,000, equity crowdfunding has always been possible for project initiatives too. The Small Investor Protection Act (*Kleinanlegerschutzgesetz*, *KlAnSG*) amended in 2015 regulates equity crowdfunding more specifically. It now outlines that companies can raise up to EUR 2,500,000 in equity crowdfunding without having to file for a prospectus. But companies raising equity crowdfunding have to deposit an information sheet (*Vermögensanlagen-Informationsblatt*, *VIB*) about their project with the Federal Financial Supervisory Authority (*Bundesanstalt für Finanzdienstleistungsaufsicht*, *BaFin*). The investment amount by a single investor in a campaign should not exceed EUR 1000, but investors can invest a maximum amount of EUR 10,000 in a single campaign if they personally own more than EUR 100,000 (Hornuf and Schwienbacher 2014). However, it is important to note that those regulations concerning equity crowdfunding only apply to specific securities under German law. One form of subordinated loan as a debt-like instrument, participating loans, is, for example, exempted from filing for a prospectus if not more than EUR 2,500,000 are raised. Therefore, campaign initiators dispose of different options for structuring the financial instrument used in their crowdfunding campaign and can choose an instrument for which equity crowdfunding restrictions do not apply (Hornuf and Schwienbacher 2014; Klöhn et al. 2016).

Applied research on the effect of regulation on crowdfunding has been scarce so far. Some studies, however, suggest investigating this aspect more deeply since regulation seems to influence the acceptance of crowdfunding compared to other forms of entrepreneurial financing (Bruton et al. 2015; Colombo and Shafi 2016).

In comparison, an international review of the legal framework for token sales is essential due to the decentralised nature of crypto assets. In order to understand how an ICO can be legally classified, it is useful to look at the international regulations regarding the leading crypto asset bitcoin (Fig. 3). Nevertheless, it should be noted that bitcoin regulations do not have to apply to altcoins (alternative coins) and even less to an ICO.

In Germany, the Federal Financial Supervisory Authority *BaFin* has classified bitcoin as a unit of account according to § 1 para. 11, line 1 German Banking Act (*Kreditwesengesetz*, *KWG*).[12] Since there is no central issuer, the classification as a digital currency or electronic money (*E-Geld*) in the sense of the Payment Services Supervision Act (*Zahlungsdiensteaufsichtsgesetz*, *ZAG*) does not apply either. As a result, a classification as legal tender, respectively, foreign currency (*Devise*) or sort

[12]Reference should be made to the judgement of a Berlin Court of Appeal on 25 September 2018, in which bitcoin is not classified as a financial instrument within the meaning of the KWG. It remains to be seen to what extent this will have consequences for bitcoin trading in Germany (Online and Recht 2018).

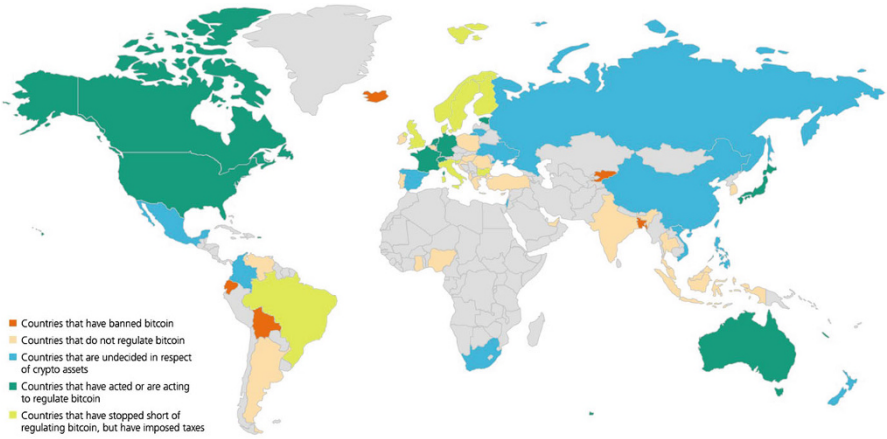

Fig. 3 Global regulation (or non-regulation) of bitcoin (Own illustration based on Anderson et al. 2017)

(*Sorte*), also fails. Rather, bitcoin should be regarded as a surrogate currency or complementary currency (Münzer 2014). An international perspective is even more complicated as there are often significant differences in legal terms such as currency or security (Siedler 2018). To avoid misunderstandings, we have chosen the term crypto assets.

Although there is no independent ICO law yet, token sales do not occur in an unregulated area (Birkholz 2017). Depending on the design of the tokens, an ICO rather has to follow the existing regulatory requirements. Even today, a large number of norms can be applied, which are indicated here. Tokens can be classified as:

- Securities in accordance with the German Securities Trading Act (*Wertpapierhandelsgesetz*, *WphG*) and the German Securities Prospectus Act (*Wertpapierprospektgesetz*, *WpPG*)
- A share in an investment fund as defined by the German Capital Investment Act (*Kapitalanlagegesetzbuch*, *KAGB*)
- An investment under the German Capital Investment Act (*Vermögensanlagengesetz*, *VermAnlG*).

This entails corresponding legal implications such as prospectus obligations, licencing obligations under the German Banking Act (*KWG*) or even personal criminal sanctions in the case of infringements. In addition, further regulations are applicable such as e-commerce obligations, requirements on money laundering, guidelines on the accounting and tax treatment of tokens or privacy policy (Weitnauer 2018).

Besides existing regulations, national (Federal Financial Supervisory Authority, *Bundesbank*) and European authorities (European Central Bank, European Banking Authority, European Securities and Markets Authority) have repeatedly provided their assessments, warnings and advice on ICOs (Hönig 2018). While South Korean

and Chinese authorities have in the meanwhile banned token sales (Aschenbeck and Drefke 2018), the less restrictive approach in European areas is certainly to be appreciated for the development of the crypto scene.

In summary, it can be stated that in particular, the rights linked to a token must be meticulously checked to determine a regulatory classification (Weitnauer 2018). This corresponds to the individual case assessments already made by the *BaFin* in Germany. Nevertheless, an individual ICO law and specifically the regulation of the secondary market (e.g. insider trading) can ensure an improved legal certainty and a more stable development of the entire market.

Legal Framework: Weak Overlaps

The decentralised nature and therefore the worldwide presence of token sales ideally require a global legal framework. Even though equity crowdfunding was also banned in the early days, crowdfunding in general has already passed the regulatory wave (Aschenbeck-Florange and Dlouhy 2015).

12 Summary

In the preceding text, it becomes clear that not all crowdfunding types are equally suitable for entrepreneurial financing. Similarly, not every ICO aims to finance start-ups. Table 3 therefore includes in particular reward- and equity-based crowdfunding as well as the corresponding ICO types in the context of entrepreneurial finance.

13 Conclusion

Initial Coin Offerings (ICOs) are more comparable to crowdfunding than to an Initial Public Offering (IPO) in terms of the reasons for their emergence—Table 3 shows a comparative summary of crowdfunding and token sales. With this in mind, it becomes clear how similar token sales are to crowdfunding, especially in terms of the main characteristics such as appearance, project development stage and community involvement. The decisive aspect here is above all the stage of development when entrepreneurial projects choose a certain financing instrument in the corporate life cycle. Furthermore, some patterns of the early days of crowdfunding can be recognised in the development of ICOs (e.g. treatment by regulatory authorities). Overall, a comparison with an IPO is therefore not applicable, as an ICO has neither legal nor technical similarity (Bundesanstalt für Finanzdienstleistungsaufsicht 2017). What ultimately remains is the similarity between the two terms IPO and ICO, which leads to misunderstandings and wrong expectations.

Table 3 Overview of the comparisons made between crowdfunding and token sales

Criteria	Crowdfunding	Initial Coin Offering
Appearance and characteristics	• Four main types of crowdfunding with occasional hybrid forms	• Four main types of tokens so far with hybrid models in most cases
Market relevance	• Small transaction size, different growth rates depending on the crowdfunding type	• Small to medium transaction size, rapid growth since 2017
Project focus	• Design, gaming, music and film and technology in the early days • Large variety of industries now	• Blockchain infrastructure (including platforms, exchanges and wallets), finance and gaming • Generally large variety of industries
Project development stage	• Projects in early development stages, often prototypes exist or start-ups are already founded • Crowdfunding platforms cumulate projects and select due to certain requirements (e.g. legal form)	• Tokens usually serve as a means of payment within a blockchain ecosystem which is mostly under development • ICOs are conducted on dedicated websites and partly evaluated by independent rating websites
Campaign procedure		
Representation	• Standardised project pages on crowdfunding platforms with a campaign video showing further details	• Dedicated websites, usually with white papers containing the main information about the token sale
Phases and length	• "All-or-nothing" or "keep-it-all" approach with an average length of around 40 to 80 days and a recommended length of around 30 days	• Partly complex auction procedures with an average length of 2 months (first quarter 2018)
Promotion	• Social media channels, in particular Facebook	• Social media channels, relevant forums, e.g. Bitcointalk
Requirements for contributing	• Registration on the crowdfunding platform often required, self-disclosure on income conditions (in case of crowdinvesting)	• Occasional KYC processes[a], without verification of suitability as an investor
Backer's motivation	• Intrinsically motivated backers (family and friends, personal interests, lead user) outweigh extrinsically motivated backers (return on investment in equity crowdfunding) • Backer's lists often available	• Extrinsically motivated backers (speculators, "FOMO") seem to outweigh intrinsically motivated backers ("believers"/long-term investors, early adopters) • Backers rarely known by name (pseudoanonymity)
Campaigns' success factors	• Quality of information provided, good social network of the campaign initiators, a high amount of early contributions, a further developed project status, giving project updates during the campaign affects a campaign positively, a long duration affects a campaign negatively	• Tradability of a token, code or code parts (e.g. smart contracts) • Content of a white paper, but not its mere existence

(continued)

Table 3 (continued)

Criteria	Crowdfunding	Initial Coin Offering
Risks and limitations	• Incompetence of project initiators, fraud, failure to reach the goal	• Risk of "blockchainising" every project, fraud, failure to reach the goal, lack of investor protection, cyber security lacks • Participation conditions for institutional investors largely not given at the moment
Secondary market (transferability, tradability)	• Secondary markets for crowdfunding are complicated by legal hurdles and small transaction sizes and therefore do not de facto exist	• Secondary market with its specific downsides (e.g. illiquid tokens, transaction volumes too small for institutional investors), lack of regulation (e.g. insider trading)
Legal framework	• Generally independent laws at an international level, Small Investor Protection Act (*KlAnSG*) in Germany	• Existing laws can be applied as far as possible, independent ICO laws rarely exist, individual decisions by the *BaFin* in Germany

Own illustration

[a]Know-your-customer (KYC) processes are legitimacy checks of new customers to prevent money laundering, especially in the financial sector (Cumming and Hornuf 2018)

ICOs can take the form of more than one financing instrument—Token sales vastly expand the financing opportunities for entrepreneurs. Theoretically, ICOs can take the form of different financing instruments, allowing them to be a perfect substitute for reward-, donation-, lending- or equity-based crowdfunding, security issuance and to some extent venture capital (Amsden and Schweizer 2018). Security Token Offerings (STOs) can represent a next development step but are not limited to the existence of blockchain or distributed ledger technology (DLT)-based business models. The actual innovations made possible by token economies should not be forgotten when considering ICOs as a (mere) form of financing. By tokenising assets, for example, it would become possible to trade units of real estate tokenised in square metres around the world (Frank 2018).

Crowdfunding and token sales combined could create added value and overcome inefficiencies—Inefficiencies in crowdfunding, such as the transfer of ownership (transferability, tradability), partial ownership or the possibility for investors to cash out immediately (liquidity), could be eliminated through the issuance of tokens (Amsden and Schweizer 2018). When (equity) crowdfunding investments were tradable on specific exchanges, their integration into the broader financial system would be facilitated making them a more viable alternative for traditional forms of entrepreneurial financing like venture capital or business angel financing (World Economic Forum 2017). Also from an investors' point of view, completely new possibilities for portfolio diversification arise. Finally, valuable feedback from the crowd or development work may be incentivised more strongly with the help of tokens. In the context of open innovation, the potential to provide decentralised financing for teams working across borders or to compensate the core developers to

retain the financial independence of open-source projects becomes apparent (Chen 2018; Adhami et al. 2018).

Displacement effects between crowdfunding and ICOs are not to be expected—Displacement effects especially of ICOs on crowdfunding cannot be identified yet as the underlying technology of token sales, or the projects themselves to some extent represent a barrier for the participation of retail investors and thus only address a specific target group of tech-savvy people. In addition, a distinction can be made between predominantly intrinsic motives for crowdfunding backers and assumed extrinsic motives for ICO investors. Overall, the crowdfunding market has not yet reached a stage of saturation in many countries, especially in Germany.

Democratising entrepreneurial finance through crowdfunding and ICOs—Finally, the progressive development of crowdfunding and ICOs or the emergence of a combined form contributes to reshaping the landscape of entrepreneurial finance (Boreiko and Sahdev 2018). On the one hand, entrepreneurs are enabled to raise funds directly from contributors worldwide, and, on the other hand, interested investors have the opportunity to support the realisation of early-stage projects around the globe (Chen 2018). In summary, the access to capital as well as the access to investment opportunities is highly democratised through ICOs and the more established crowdfunding. Given the necessary time for further technical development, a full regulatory embedding (ideally worldwide) and the adaptation by a broad mass, both alternative forms of financing can contribute to a democratisation of entrepreneurial finance.

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Is Crowdfunding Suitable for Financing German Public Research Organization (PRO) Projects?

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Abstract So far, public research organizations (PROs) and universities in Germany are not benefiting from the manifold opportunities of crowdsourcing platforms and crowdfunding in particular. Crowdfunding may not only provide complementary financial resources for scientific projects, but it can also enhance the spectrum of science communication and facilitate the knowledge and technology transfer process. Consequently, scientists can use crowdfunding activities to stimulate the transfer of their knowledge to business and/or society to stimulate innovation. Nevertheless, it is a challenging task to apply the full spectrum of crowdsourcing instruments in PROs and universities. The crowdfunding literature rarely covers the untapped potential and challenges associated with crowdfunding for scientific institutions. In this conceptual paper, we provide approaches how PROs and universities can successfully acquire alternative financing, in particular from crowdfunding, and use it strategically. The aim is to provide solutions to pitfalls that may prevent researchers from exploiting crowdfunding in their "funding journey." We introduce a model called "scientific cooperative crowdfunding" as a field for further research to explore how PROs and universities can use crowdfunding in a more comprehensive way during different stages of the knowledge and technology transfer process.

Keywords PROs · Universities · Knowledge and technology transfer · Spin-off creation · Funding gap · Open innovation · Crowdsourcing · Crowdfunding · Crowd building · Crowd management

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1 Current Situation

Crowdsourcing has become an integral instrument of innovation management practices. Since the introduction of concepts that coined the popular terms "open innovation" (Chesbrough 2003a, b) and "crowdsourcing" (Howe 2006), digital platforms using "the crowd" as a source of knowledge and/or funding have become a widely known and important part of the innovation landscape (Füller et al. 2006; Ebner 2008; Bonabeau 2009). Scientists are quite often part of a crowd, which function as "problem-solver" (Du et al. 2014; Lifshitz-Assaf 2017). However, research organizations itself, like public research organizations (PROs) or universities, have been less involved in using a crowd themselves, e.g., for problem-solving or identification of application options.

The financial side of crowdsourcing, crowdfunding, has also gained vital importance as alternative financing instrument during the last 5 years (Baeck et al. 2016; European Commission 2017; European Parliamentary Research Service 2017). Nevertheless, the German crowdfunding market has not developed as fast as expected (Siu et al. 2010; Ziegler et al. 2018; European Commission 2017). This also seems to be true for the use of crowdfunding by scientific institutions. German PROs and universities seem to have little experience or incentives for funding scientific research by a crowd. In Germany, science crowdfunding platforms like Sciencestarter were established right after Experiment.com in the USA. Nevertheless, until today, crowdfunding campaigns initiated by German PROs or universities for research projects or even their potential spin-off companies remain an exception (Sauerhammer 2015; European Commission 2017; BMWi 2018a, b). What are the actual reasons that this potential source of funding for research projects could not gain momentum in Germany? Relatively small funding sums could be one reason for the restraint, but available studies usually do not dig deeper to elaborate on this topic. There is little systematic evidence for the potential of scientific crowdfunding for PROs and universities (Sauermann et al. 2018).

Unlike in Germany, several papers have been published in the last 5 years in the USA and UK that discuss scientific crowdfunding or even design crowdfunding guidelines for researchers (Vachelard et al. 2016). Most articles that are discussing science crowdfunding topics were published between 2013 and 2015 (Byrnes et al. 2014; Li and Pryer 2014; Cha 2015; Hui and Gerber 2015; Kessler 2015; Marlett 2015; Vachelard et al. 2016; Schäfer et al. 2018). Since there is mainly literature with focus on universities and their crowdfunding options, we use it as a basis to draw parallels for PROs. Individual science crowdfunding platforms have been tested at universities in cooperation with their surrounding ecosystem (Cha 2015; Hui and Gerber 2015; Kessler 2015; Marlett 2015; Schäfer et al. 2018). Especially health projects have been tested for crowdfunding campaigns (Fumagalli and Gouw 2015; Snyder et al. 2016). New scientific crowdfunding platforms did not appear in the market in the last 3–5 years. According to previous research findings, German PROs and universities are currently not pursuing own crowdfunding initiatives. The available literature names several possible reasons why research institutions are

still hesitating to use crowdfunding: lack of resources, missing awareness and incentives, and bureaucratic barriers to overcome (Jäger and Mathes 2015; Sauerhammer 2015; Busch and Matuschka (2016); European Commission 2017; Lipusch et al. 2017). We could not find real propositions for solutions on how to overcome these barriers. The other side of the coin is that the available literature seems to overlook the aspect that crowdfunding could offer other benefits than just funding to a scientific institution: a channel for science communication (compare concept of *Wissenschaft im Dialog* 2018) and the facilitation of knowledge and technology transfer processes. Here, research is still in its infancy.

Even PROs spin-off companies mainly do not use crowdfunding as a funding source although they command the legal preconditions and capabilities to execute a campaign (Fraunhofer IMW 2018). Consequently, it is not clear whether they do not use crowdfunding because they have good access to other sources of financing or if there is no strategic value of crowdfunding for them—or if they have just never considered it. However, academic high-tech startups using crowdfunding might also use crowdfunding for other reasons than just funding—e.g., for market validation or marketing.

However, what could be possible solutions to overcome the barriers of PROs, universities, and their spin-offs to exploit the potential that crowdfunding might still offer?

We elaborate in this conceptual paper:

- Why business and society might have an interest in additional funding resources for scientific projects and enabling knowledge and technology transfer
- If and how crowdfunding is used so far for funding scientific projects and academic spin-off creation
- If there might be untapped potential for science crowdfunding and why
- To explore possible solutions that could lead to more comprehensive strategies for enabling successful research funding using crowdsourcing instruments
- To suggest how a comprehensive strategic way of integrating crowdfunding into the financing strategy could be of use for PROs and their (applied) research projects to stimulate knowledge and technology transfer and spin-off creation

We base our conclusions and suggestions for further research on a literature review as well as semi-structured interviews and focus group sessions with representatives of PROs, researchers, and selected crowdfunding platforms in Germany.

2 Rising Expectations: From Research to Knowledge and Technology Transfer

Four major PROs, namely, the Max Planck Society, Fraunhofer Society, Helmholtz Association, and Leibniz Association, characterize the German research landscape. They are registered nonprofit entities and granted substantial amounts of public

research funding (BMBF 2014). The Fraunhofer Society builds an important bridge between basic and applied industrial research and development and receives significant amounts of nonpublic funding mainly from industry (approximately one-third of the overall funding). Alternative financial instruments do not play any role (Fraunhofer-Gesellschaft 2017). The importance of PROs is increasing as a strategic element for the decision-making process of public authorities. PROs are providing innovative answers and solutions to global challenges such as climate change and environmental issues and demographic or energy-related topics. Due to the broad research spectrum, PROs are capable of developing future system solutions needed to solve current economic and social issues. Consequently, the continuous development of the research strategy of PROs like Fraunhofer stimulates a demand-oriented growth of research topics that benefit society and the economy. PROs can set an impetus for the development of entirely new markets and in areas like health, production, energy, mobility and communication, and security (Behlau 2017). However, should not a change in the significance of PROs for solving economic and societal challenges lead to new ways of using alternative financial instruments that could involve a broader spectrum of the public?

In a world of increasing complexity and subsequently value chains, it is essential for PROs to position themselves interdisciplinary and in a competitive manner (Gemeinsame Wissenschaftskonferenz 2015). PROs in Europe are generally facing these challenges (Loikkanen et al. 2011). Thus, the ability of PROs and universities to transfer knowledge from research to business has become a competitive key element during the last two decades. Until today, education of scientists and publications are the very common ways to transfer knowledge from scientific institutions. Other ways to transfer knowledge and technology like licensing or spin-off creation need structured processes and demand additional resources. In case researchers are not collaborating with external users (e.g., companies or institutions) during a research project, the application and transfer of knowledge and technology to society and businesses afterwards is a challenging task. Therefore, many scientific results, knowledge, and technological solutions never enter the market to become innovations or unfold social impact. A structured process for collaboration within the ecosystem of science, business, and society might give further impulses (Siegel et al. 2003)—also for the acquisition of funding. A stronger interaction could stimulate the social discourse to contribute to the economic value creation or solution of societal challenges (Etzkowitz and Leydesdorff 2000; Etzkowitz 2013). International competition in technology development is accelerating, e.g., with the rising importance of digitization, including the application of artificial intelligence (AI). Especially many Asian countries, led by China, invested heavily in public research and relevant key enabling technologies in the last decade, such as AI, to enable companies to climb up the innovation ladder (Guo et al. 2016; Economist 2018; Liu and Huang 2018). Therefore, governments in Europe also try to set incentives for accelerating knowledge and technology transfer for the benefit of society and economy with corresponding funding support. Thus, PROs' impact on the innovation capability of SMEs is increasing (Dornbusch et al. 2016; Frietsch et al. 2016;

Comin et al. 2018). Nevertheless, the lack of capital for the step from research to application still remains a major challenge (Baeck et al. 2016; Ziegler et al. 2018).

3 The Funding Gap

Knowledge and technology transfer is challenging because of financial constraints and often missing incentives: Research projects are subject to funding policy requirements and characterized by a limited project duration. Scientists are often unaware of the entire range of potential applications and possible exploitation of their research results during project implementation—not only in a business but also in a social context. Besides, scientists often lack suitable cooperation partners who are interested in implementation and have the financial capacity to support the goal (Fraunhofer IMW 2018). Mostly, additional financial resources for transferring research results into the next technology readiness level (Mankins 1995) are needed, e.g., for constructing a prototype. Not only startups in the growth phase but also research organizations face a financial "valley of death" before they are able to transfer and scale results to really create an impact (Barr et al. 2013; Nemet et al. 2018). The analysis of exemplary public funding programs in Germany like VIP (validation of the technological and social innovation potential of scientific research) shows that the approval rate is approx. 20% (Daimer et al. 2014). It is not clear if scientists continue research projects that funding agencies did not take into account. The VIP program offered up to 1,500,000 EUR of funding, but 50% of the projects stated that they only need 500,000 EUR or less (15% less than 100,000 EUR). Alternative options are often missing for smaller research projects. Private capital is usually not available in early research phases. Thus, the establishment and perpetuation of many scientific projects with potential impact remain difficult.

What are the possible reasons that private or alternative funding options are often unavailable? Why are scientists mainly considering public funding? One reason is the nature of research projects: in early research phases, the (commercial) exploitation potential stays a fuzzy option for later stages if potential applications are unclear and private funders cannot evaluate the risk and potential returns. Moreover, scientific projects contain complex knowledge and technologies the scientists need to explain—in particular, their possible impact on society or business. Science education and communication are essential elements to reveal the value of research results and unlock their potential. Awareness creation in the broader strata of the population can be an important building block for the diffusion of research results—or even for the creation of new ideas for application. Larger companies tend to allocate a significant amount of resources to look or scout for available technologies and analyze the potential value for their business. On the contrary, SMEs often lack these capabilities (Dornbusch et al. 2016). As a result, inventions and technological application knowledge with relevance to a social or cultural context is often only transferable if scientists show strong commitment. The incentives for scientists to engage in technology transfer and spin-off creation depend on the institutional

setting and several other factors (Lam 2010, 2011; Bijedic et al. 2015; Hachmeister et al. 2015; Chlosta et al. 2017). Consequently, many research results remain without visible or noticeable effects or impacts on society or the economy.

For PROs and universities, overcoming the described hurdles could open up a whole range of additional potential for knowledge and technology transfer. Since there still seems to be a funding gap, traditional government-funding schemes cannot close; we try to elaborate in which direction further research has to go to find practical solutions for PROs' scientists to use alternative funding schemes.

4 Crowdfunding as a Financing Instrument for Research and Spin-Off Creation

4.1 Crowdfunding for Scientific Research and Technology

Crowdfunding can be described as "a collective effort by people who network and pool their money together, usually via the Internet, to invest in and support efforts initiated by other people or organizations" (Ordanini et al. 2011). Crowdfunding started to become popular a decade ago, with the establishment of the global reward-based crowdfunding leaders like Indiegogo in 2008 and Kickstarter in 2009. German platforms like Startnext and VisionBakery started shortly afterward (both in 2010).

Platforms that focus explicitly on research projects appeared 5 years after the first "classical" crowdfunding platforms: Experiment.com started in 2012 in the USA. In the same year, Sciencestarter entered the German market for science crowdfunding (using the Startnext partner platform).

Of course, scientific-oriented platforms seem to offer many advantages for scientists at first glance (Vachelard et al. 2016):

1. They provide support when scientists need extra funds, e.g., in the middle of their study for laboratory materials on a short-term basis.
2. Crowdfunding campaigns can be tailored to the project needs—government programs often do not fit to the immediate needs for a scientific project.
3. Digital platforms provide a way to share current research in an easy way to understand format with the public.
4. Platforms allow the public to influence future research directions by directly providing funds and ideas.

Most scientific crowdfunding campaigns collect relatively small amounts so far. Successfully funded projects on the German platform Sciencestarter range from a couple of hundred euros up to almost 70,000 EUR. Similar volumes are possible in the USA through the platform Experiment.com. A study initiated by the European Commission estimates an average project funding of about 24,000 EUR for research and innovation (close to market) projects (European Commission 2017). Research projects that rely on high-tech or laboratory equipment and that need time for testing

results consequently need higher funding amounts. German crowd-investing platforms allow a range from a funding volume between 100,000 EUR and 2.5 million EUR. We discuss later how at least academic spin-off companies might use this potential.

The market for crowdfunding platforms consolidated in the last years. Additionally, lessons learned from the success and failure of research projects on platforms like Experiment.com reveal that managing a crowd is not an easy task (Belleflamme et al. 2014). Several specialized platforms have disappeared since building and sustaining dedicated crowds over a long period is not easy (e.g., German platforms like CrowdPatent just existed from 2015 to 2017). The entry costs to establish and maintain an own platform are very high since crowd building is a resource-intensive process and has often been underestimated. Also, many donation- and reward-based crowdfunding platforms struggle to establish a sustainable business model (European Commission 2017). Only a few campaigns with universities as the main initiating actor have been undertaken in Germany (Jäger and Mathes 2015; Sauerhammer 2015; Busch and Matuschka 2016; BMWi 2018a, b). PROs and universities that have established initiatives like the KITcrowd (Karlsruhe) or UNIKAT (Kassel) use existing platforms (like Startnext) and promote the campaign in favor of their projects and spin-offs. Also, several universities in the USA and UK have tested crowdfunding platforms (Cha 2015; Gray 2015; Hui and Gerber 2015; Kessler 2015; Sauermann et al. 2018).

Due to network effects, established platforms might still offer a greater funding range—also for scientific and technology transfer projects or academic spin-offs: The success rate for technology projects on the Kickstarter platform is about 20% (Kickstarter 2018). Technology projects account for only about 5% of all successfully funded projects, but the funding levels are above average: over a third (36.02%) of the more than US$1 million projects are technology projects. A short explorative study (Hopp and Kaminski 2018) reveals that approximately 22% of the technology projects include terms like "grant," "Ph.D.," "science," "university," "research," "master," or "collective." On average, these campaigns collected amounts of about US$120,000, some more than US$200,000. Science-related projects have a likelihood of success of about 50% and are about 20% above the average for a successful campaign. Thus, reward-based crowdfunding is also conceivable for technology projects with a financing requirement of up to US$1–2 million. Financing through established platforms with a high number of registered users tends to promise more financing success than niche platforms, but several barriers to research projects have to be considered to exploit this potential. Studies like the EU report on alternative finance confirm that research and innovation projects profit from crowdfunding (European Commission 2017). This finding is especially evident for donation-based (early phases/basic research) and equity crowdfunding (startups). Reward-based crowdfunding provides a "reward" or gift for backing a project and/or a financial contribution. Therefore, crowdfunding science through these platforms differs from traditional ways to acquire funding sources including a pre-sale contract that might be a challenge for nonprofit organizations (we discuss this later). Equity crowdfunding is based on the issue of shares or subordinated or profit participating

loans. This precondition excludes research projects (they are not a legal entity). However, using crowd investing for later phases of the innovation process which involves a spin-off company or SMEs that raises money for R&D projects together with a research organization is a possible option for the funding strategy.

Crowdfunding could enable the acquisition of private capital for knowledge and technology transfer in socially relevant and strategic projects. Public funds may also optionally supplement or leverage capital from private sources. Despite many possible advantages when acquiring more private funding, there are concerns that private capital could put additional (commercial-oriented) pressure on the PROs and universities. On the contrary, it has to be considered that alternative monetary resources could also support the public in getting access to untapped research and knowledge and technology transfer potential. Instruments like crowdfunding already imply a particular transfer of knowledge by communicating the aim and potential impact of a research project to attract funders. Therefore, considering the different phases of a knowledge and technology transfer process from invention to innovation, we need to reflect mainly on projects whose main aim is scientific research to create value for a societal or business context and, e.g., in subsequent initiatives aimed at transfer or spin-off generation.

4.2 Research Approach

We have decided to take a grounded theory approach to identify solutions for representatives of technology transfer organizations (TTOs) and researchers working in PROs to use options like crowdfunding. The study aims to identify challenges, to find measures to deal with them, and to suggest new crowdfunding options for PROs' scientific projects. Therefore, we need to integrate the perspective of the institution, scientists' incentives to transfer knowledge and technology, and lessons learned of established crowdfunding platforms. We have conducted semi-structured interviews with TTO representatives, scientists, and crowdfunding platforms to build categories to elaborate if there are conditions, potential, and willingness to use crowdsourcing instruments for the further development and funding of research projects.

We conducted the interviews in person or telephone and transcribed them shortly afterward. All interviews with crowdfunding platforms have been recorded and transcribed to derive further insights by coding and then clustering relevant topics. We have translated quotes for this study into English, ensuring the tone and structures of the interviewees' statements as far as possible.

For our sample, we have selected representatives of three different groups (Table 1):

Group 1 The group includes representatives of German PROs or experts close to PROs working in the field of knowledge and technology transfer. They cover the institutional view with insights into pitfalls to a successful technology transfer and

Table 1 Interviews related to scientific crowdfunding potential

Respondent	TTO representatives	Scientists	CF platforms
Number of interviews	8	25	11

Fraunhofer IMW (2018)

the application of alternative financing instruments like crowdfunding. The responsible department is usually the TTO of a PRO including tasks like research funding, patenting, licensing, or spin-off creation. The PROs include Fraunhofer Society, Helmholtz Association, Leibniz Association, and Max Planck Society. We have selected them by recommendation or contacted them directly since they needed to be experts in their field.

Group 2 The group includes scientists of German PROs that see potential to transfer their research results into applications in society or business but lack funding and/or cooperation partners for the next steps. For Group 2 also a selection process took place. We have selected them by recommendation, a mailing among participants of a business ideation workshop and media reports. Selection criteria included that a research project is or has been managed with a specific transfer potential, but an open funding perspective—therefore, experts in Group 1 recommended cases.

Group 3 The group includes representatives of leading German crowdfunding platforms offering donation-based, reward-based, or equity-based crowdfunding and one crowdfunding expert. They bring in the crowdfunding experience and an estimation of how scientific projects and spin-offs could profit by using the instrument. We have chosen experts of three crowdfunding categories (3–4 each), starting with popular and representative crowdfunding platforms in Germany.

Apart from personal (with experts) or telephone interviews (mainly with scientists), we have integrated insights of focus group sessions. The aim was to discuss relevant topics among groups of 4–6 experts to generate more profound insights.

We have structured the sessions around topics that we had already identified in the literature and during the first interviews:

- **Status quo:** Funding needs for scientific projects and services the PROs can provide (Group 1)
- **Crowdfunding and regulation** in PROs and for their **spin-offs** (Group 1)
- **Characteristics of scientific projects**: Two sessions to get in-depth information on scientific projects with transfer potential and their barriers to acquiring funding (Group 2)
- Workshop to define **scientists' characteristics** and incentives to act in one or the other way to transfer research results (Group 1 and scientists)

Therefore, we used an iterative process to identify challenges and the way the focus groups deal with them. The second step was to cross-check which aspects or challenges the literature already recognized and which possible solutions are

discussed. We have clustered the main topics and challenges to derive conclusions for further steps that are necessary to extract new insights (that we need test in upcoming field studies).

4.3 Analysis of Preconditions for Scientific Crowdfunding

Table 2 summarizes the topics and related challenges raised during the interviews and focus group sessions. We mirror the problems identified by an exemplary literature review in the suggested categories and indicate the need for further research.

For the current situation (status quo), we could observe a broad consensus that a funding gap exists so that research results cannot be transferred in a way they should be entitled. Experts in TTOs consider crowdfunding or other alternative sources of funding as a possible solution for several cases but lack experience and also resources to accompany such initiatives. They experienced various barriers.

Experts and researchers agree that characteristics of scientific projects and spin-offs vary. There cannot be a single solution that fits all—which indicates a resource-intensive process to accompany the projects adequately. They also agree that "typical" scientists are not keen to leave their position and build a company. Therefore, building a spin-off company is usually not the "first choice." Other bridges for transferring knowledge and technology are needed. Especially with Group 3, the crowdfunding representatives, we discussed possible success criteria for scientific projects or technology-based companies like PRO spin-offs.

4.4 Exemplary Challenges and Propositions for Further Research

4.4.1 Research Project Characteristics: A Barrier for Funding?

Most research projects of PROs still face various challenges when considering crowdfunding as an option: They are complex, mainly technology-oriented, (financial) resource-intensive, and often far from creating a real consumer experience or the emotional impact needed to activate a crowd during a creation process or funding campaign. Researchers lack experience in explaining the benefits of their projects to a broader audience—and thus engaging a crowd during a campaign (Fraunhofer IMW 2018). The same applies to spin-off with a scientific background: Their character is of a strong technology focus, and they are mainly building B2B business models. For companies with B2C business models, it is more obvious to use crowdfunding as an alternative way of financing.

Quotes (representatives CF platform): "(. . .) no project failed in terms of complexity. (. . .) the technology is not an exclusion criterion"; "our crowd is very much

Table 2 Categories for further research

Category	Problems identified	Example	Exemplary ref.	Conclusion
Status quo	• Scientific valley of death remains an issue • Lack of experience and awareness (scientists with crowdfunding, platforms with scientific projects) • Regulations identified as barrier	• Scientist unclear about application potential • Partner and timing for funding activities not included in a comprehensive strategy • Few case examples for science crowdfunding in Germany	Saguy (2011), Fischer and Pohle (2018), Fraunhofer IMW (2018), Nemet et al. (2018)	• Comprehensive funding strategies incl. ecosystem design needed • Alternative funding sources for scientific projects have to be considered and tested
Research project characteristics	• Research phase/TRL • Complexity • Sensitive information and IP	• Market application unclear • Often no physical result/prototype • Needed funding cannot be covered by crowdfunding (e.g., life science)	Fraunhofer IMW (2018)	• Mechanisms to identify and select suitable projects needed • Possible market returns vs. resources for training, communication strategy, etc.
Spin-off companies characteristics	• Technology-based • B2B business models • Capital-intensive	• Specialized product for small target group • No user experience for crowd • Access to venture capital	Javier Miranda et al. (n.d.), Müller (2010), Bijedic et al. (2015), Soetanto and Van Geenhuizen (2015), Chlosta et al. (2017)	• Cooperative CF might offer new options for storytelling (e.g., application in social context by research partner) • CF for market validation and marketing purposes
Incentives for scientists	• Incentives to transfer results vary (reputation, money, low risk) • In general, low incentives to start a company	• Traditional scientist • Hybrid • Entrepreneurial scientist	Lam (2010, 2011), Lam and Lambermont-Ford (2010), Bijedic et al. (2017)	• Enabling transfer without forcing scientists into roles they do not want to fill by setting incentives for cooperative models

(continued)

Table 2 (continued)

Category	Problems identified	Example	Exemplary ref.	Conclusion
Regulation	• Crowdfunding type has to be carefully chosen • Legal entity requirements • Cost structure of PROs	• Only donation-based CF possible but administrative costs for PRO relatively high • High overhead costs: less incentives for donors • Reward-based CF difficult for PROs • No equity CF possible for PROs (but often high funding amounts required)	Baeck et al. (2016), Tröger (2017), Ziegler et al. (2018)	• Application of cooperative crowdfunding model and field tests with PROs needed
Success criteria—communication	• Value proposition • Crowd size and involvement/platform • Science communication • Trust	• Local, emotional, societal relevant, consumer experience • Access to large crowd via established platforms needed • Science communication skills have to be trained (resource-intensive) • Scientists have to be authentic and convincing	Byrnes et al. (2014), Lagazio and Querci (2018), Sauermann et al. (2018), Wehnert et al. (2018)	• Designing partnerships with established platforms most promising • Selection and training process for scientific teams • Broader understanding for CF as science communication vehicle
Crowd/ecosystem	• Definition of the crowd • Crowd building • Crowd management	• Peers/scientists • Companies • Citizens (citizen science) • Undefined	Poetz and Schreier (2012), Solemon et al. (2013), Belleflamme et al. (2014), Althoff and Leskovec (2015), Gray (2015), Sauermann and Franzoni (2015)	• Combining existing crowds/platforms with potential outreach of PROs to be tested • Awareness creation and training for ecosystem/crowd management

interested in new technologies, anything that can lead to a significant change or innovation is of interest (...)."

Nevertheless, PROs spin-off companies rarely use crowdfunding as a financing instrument (Fraunhofer IMW 2018). A reason might be that academic spin-offs have better access to other preferred financing options like venture capital. So far, it is not clear what influences the decision-making process to favor one funding option to the other. Crowdfunding might be a "funding source of last resort" (Ahlers et al. 2015) for many startups. The perception of crowdfunding functions for business development among startups and SMEs in Germany is changing. Several German startups acquired venture capital before they opt for an equity crowdfunding campaign. According to Crunchbase database, four in six startups that were successfully funded using Seedmatch platform in the first 8 months of 2018 had already acquired venture capital before (seed capital and series A investment rounds), in 2017 one out of nine. Crowdfunding terms and conditions might be more advantageous to the company than venture capital. If individual investors, e.g., business angels, are already involved, this might have a positive signaling effect. The decision to use crowdfunding depends on what the startup or company needs. An integrated communication and funding strategy for research projects might lead the way for bridging the valley of death in publicly funded research for more impact in the long end.

4.4.2 Regulation

Regulations are important prerequisites to consider for further discussions about scientific crowdfunding. Only some universities tested initiatives for donation-based crowdfunding. Interestingly enough, it is rarely analyzed how universities or research institutions are realizing crowdfunding campaigns and why the majority chose not to do so. Some studies explain the small number of crowdfunding cases in research institutions with an awareness gap or missing incentives (Jäger and Mathes 2015; European Commission 2017). However, institutional preconditions are often unrecognized as significant limitations for PROs and universities. A representative of a crowdfunding platform confirmed: "The academic institutions have a lot of regulatory challenges. There should be a way to change the regulations."

Pledges for a change of regulations often neglect the fact that reward-based and equity crowdfunding are commercial activities that imply challenges to public-funded nonprofit institutions in general. That explains why selected scientists or startup teams only receive consulting and training by the PRO or university. Private persons, startups, or institutions such as NGOs execute the actual campaign. Nevertheless, it is an established model to use partner websites at crowdfunding platforms to acquire funding for research projects (BMWi 2018a, b). One example here is Startnext: Often a business entity, foundation, or a cooperation partner is the primary contact for the crowdfunding platform—not the PRO or university itself.

Generally, in the current situation, it is easier for scientists as private persons or spin-offs to carry out a crowdfunding campaign without the direct involvement of a

research institution. Our interviews confirmed that many scientists know the term "crowdfunding" and consider crowdfunding as a funding source. However, missing incentives for individual action and uncertainty about the institutional and legal framework seem to limit crowdfunding activities, as one scientist mentioned: "We have considered crowdfunding as an option, but in the end, we have not realized the campaign for several reasons."

Our research shows that, even if teams of scientists would have received resources that enabled them to pursue a campaign, they did not finish it. Hence, we identified the following limitations to crowdfunding campaigns, which PROs face:

- Donations are applicable with relatively high administrative costs. Unfavorable cost structure of PROs with relatively high overhead costs may act as the deterrent to donors.
- PROs are usually obliged to act in the nonprofit and noncommercial area, but "reward crowdfunders" receive units of a product (pre-sale contract)—these projects might in some cases be classified as contract research. PROs operate on limited experience with these models so far—the innovative nature of research makes the preselling model impossible.
- "Equity" crowdfunding is only applicable for spin-offs—but not every scientist takes the risk of founding a company.
- Lack of experience and cases with respect to issues like IP management: how much has to be revealed to the crowd? How to deal with IP generated in open innovation and funding processes?

In conclusion, crowdfunding is a complex problem for PROs—especially concerning regulation.

To find a solution to the challenge that the regulatory framework is not easily changed ("a given factor"), we consider ways to integrate research projects into an ecosystem that leads to a new financing perspective. Members of a research ecosystem like SMEs and NGOs might have better opportunities to execute the campaign in cooperation with a PRO. Therefore, we suggest a cooperative crowdfunding model for PROs and universities (see Fig. 1): In this model, a research organization agrees to cooperate with a company (e.g., startup or SME) or other institutions to solve a research problem. The advantage is that the name of the company and the research institution might be displayed during the campaign, but only the company will get funding from the crowd. Another financial instrument could leverage this funding, e.g., grants or additional investments. After the successful crowdfunding campaign, the company or institution assigns the PRO that will start the research in cooperation with the cooperation partner(s). An interesting case in that context is the biotech startup Oncgnostics that already used equity crowdfunding twice to fund company growth but also to realize further research projects. Oncgnostics has been founded in 2012 as an academic spin-off company and started with a seed financing in 2012 led by the German High-Tech Gründerfonds, series A, followed by a second one in 2014 (lead: bm-t). Series B integrated a crowdfunding campaign in 2016. The funding amount of 500,000 EUR was leveraged (doubled) by additional funding of a

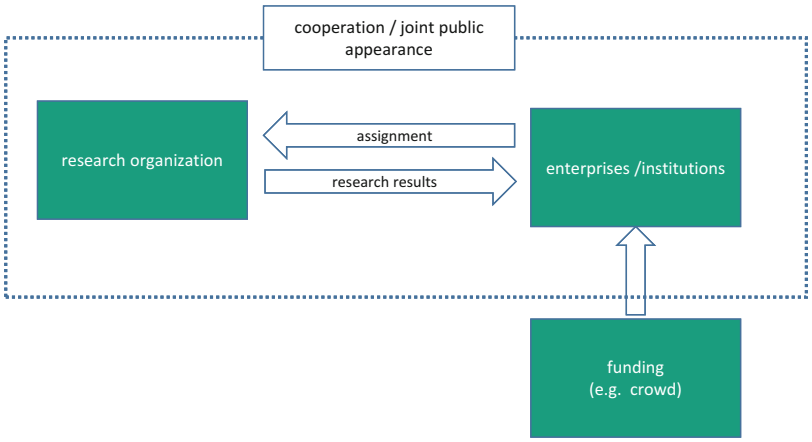

Fig. 1 Cooperative crowdfunding model suggested (own illustration)

local state investment company (bm-t). A second successful campaign followed in 2017/2018 on Seedmatch (Seedmatch 2017). Since the company is doing research in cooperation with research partners and aims to develop further and validate a cancer diagnostics test, the campaign had the purpose of creating awareness for the topic and the product—not only funding. At the same time, the funding can be used to initiate further research with partners within their cooperative ecosystem.

The cooperative model increases the chance to fund substantial amounts since all kinds of crowdfunding are available. So far, it is unclear whether a known research brand could affect the funding success of a company that aims to fund R&D activities with a specific PRO or university. It could send positive signals toward business angels and venture capitalists for the successful transfer of an idea or technology into an innovation. Representatives of German crowdfunding platforms mainly see it as an additional benefit for projects to communicate in cooperation with known "research brands." A representative of a CF platform indicated similarities: "(. . .) projects from the pool of a PRO are signaling a high level of quality."

Therefore, PROs could use the branding and public image in that context more strategically. Research on trust factors influencing cooperation in interorganizational projects and the funding success shows some parallels (Maurer 2010; Hagedorn and Pinkwart 2013; Moritz et al. 2015; Liang et al. 2019). Our proposition for further research is that the suggested cooperative model fits especially for consortia that deal with social, local, or environmental challenges to activate an existing community.

Quote representative CF platform: "Basically everything can be financed insofar as the right target group can be addressed wither with emotionally occupied topics or projects that solve problems and generate social benefits."

Therefore, we predict that the concept of "cooperative crowdfunding" may offer the following advantages for the cooperation partners of a fund-seeking institution like a PRO:

– By including a PRO already during a funding campaign, the assessment of the research project and general motivation might access another level than in general contract or cooperative research.
– PRO's reputation can send a positive signal toward investors and might increase funding success.
– All kinds of crowdfunding are possible.
– It offers an opportunity for market validation and product acceptance of the target group.
– Crowdfunding might have a positive branding effect for the whole consortium in case it addresses emotional or social topics.

When corporate and PRO communicate in cooperation, aspects like liability issues should be considered. Figure 2 summarizes the findings on how the different funding models are considered. Donation-based crowdfunding is mostly suitable for basic (and applied) research or early technology readiness levels (TRLs), while reward and equity crowdfunding applies at later stages and closer to market. For PROs, reward-based crowdfunding can be applied by using cooperative models at best.

4.4.3 Crowdfunding as a Channel for Science Communication

One of the critical success factors of campaigns is attributed to the strength of the communication skills and strategy (Harzer 2013; Hui et al. 2014; Moritz et al. 2015; Wang 2016; Kaminski et al. 2017; Block et al. 2018). This includes depth of project description, frequency of project updates, provision of attractive video material and graphical visuals, which are examples that can influence success. The scientists need to prepare information in a process that is resource-intensive. Regardless of the

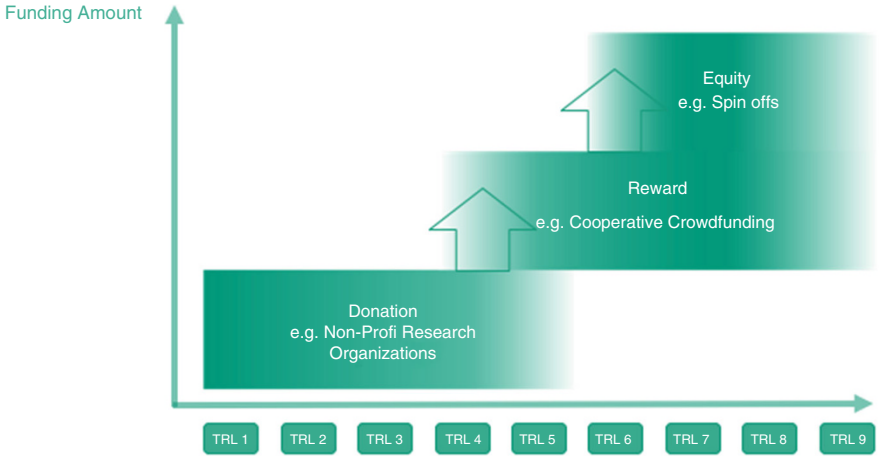

Fig. 2 Options to use crowdfunding in a research project (own illustration)

complexity of a technology, an essential prerequisite for crowdfunding success is the ability of the team to communicate the benefits of the research findings to a crowd and to generate appropriate media feedback for the projects.

Quote (representative crowdfunding platform): "Startups do not fail because of funding, they fail to create interest and market acceptance. They fail because the team cannot communicate: they do not know who the target group is or what media to use for a campaign."

Hui and Gerber (2015) found evidence that visual artists or musicians struggled less to communicate their message through social media compared to scientists and engineers. Popular reward-based crowdfunding platforms like Kickstarter focus on later phases close to a prototype or a final product that is also tangible for consumers and more accessible to communicate. In later stages and technology readiness levels (Mankins 1995), even the scientific teams have often already undergone a transformation process and are more open and experienced in communicating and explaining the value proposition of their project or product.

Some scientists do not have any incentives or interest to present their research to a broader target group or to find a company (Lam 2010; Bijedic et al. 2015; Chlosta et al. 2017). In these cases, crowdfunding campaigns should be executed by cooperation partners; otherwise they do not have much perspective to succeed. The credibility of the scientists behind the project is crucial.

Quote (representative CF platform): "if someone prefers to focus on his/her research and not to build a company or to interact with the crowd or the public then you have to address that very clearly. Because a false expectation at this point threatens the project which is implemented with much effort. (...) In the end, you have to be authentic and transparent and that's also the exciting thing about crowdfunding."

The interaction with the crowd is a feedback process that scientists usually do not experience during their research process. Therefore, crowdfunding campaigns for science projects offer more advantages than purely financial funding. Scientists have to learn a new language and open up to an audience that differs from the expert groups they are used to and to understand which story they need to tell to attract a crowd (Wheat et al. 2013; Byrnes et al. 2014; Schäfer et al. 2018). They need to clarify how their research results or concepts offer a benefit either in the society or business.

A study initiated by the European Commission is proposing projects suitable for crowd-based solutions which should obtain the following characteristics (European Commission 2017):

(a) Innovation-orientation: projects should already reach later stages of the innovation cycle so that the results are more accessible to anticipate and evaluate by the "crowd."
(b) Topic-related, e.g., an improvement of life conditions: it is easier to involve and convince a crowd using topics like energy, environment, food, and health.
(c) Less capital-intensive projects.

PROs could use crowdfunding as an incentive for an interactive science communication process with the public. This process could support the identification of projects that are interesting to the public and suitable for a crowdfunding campaign. The PROs and projects need to understand how to manage the right timing. An additional side effect could lead to better applicability of research results through early information and the involvement of interested groups of the population. An improvement in communication skills of PROs and their scientists might also increase the potential for social innovation to solve societal issues and challenges with the help of PRO research. Formats like science slams already use a similar concept. This "pressure" could also support Ph.D. students to understand who their potential target groups outside the academic research landscape are and increase their insights on how to shape a professional career outside a PRO or university. Until today, German higher education institutions offer not enough possibilities for younger scientists to use their insights and creativity to stimulate a knowledge and technology transfer process aside from the traditional structures and hierarchies. Crowdfunding could be a way, but without an understanding of its benefits, it is a difficult task to establish such a process. Further research in (applied) science communication is needed to achieve this goal (Bonfadelli et al. 2017). The effects of science communication for building an additional bridge for knowledge and technology transfer are currently rarely discussed although, in Germany, initiatives like "Wissenschaft im Dialog" (Science in Dialogue) exist and push forward platforms like "Sciencestarter" (*Wissenschaft im Dialog* 2018). These initiatives are supported by the Federal Ministry of Education and Research—and by most German PROs. So far, the initiatives might not create as much awareness as needed to give scientists an incentive to stronger engage with the topic.

4.4.4 Crowd Management

Overall, the debate on transfer practice shows that there are different needs and potentials for crowdsourcing and crowdfunding. It becomes obvious that "the crowd" should ideally be involved in different stages of the innovation process. However, PROs struggle to solve the "chicken or egg" problem, i.e., they need to overcome institutional boundaries for more "open innovation," manage intellectual property rights, and establish the needed legal framework (West et al. 2006; Felin and Zenger 2014). The PROs need a critical mass of suitable research projects for public campaigns, resources to prepare and conduct them with cooperation partners, and, last but not least, active followers and interested investors.

A feedback process generated with a suitable research ecosystem could be a first step that allows insights into the application options of research results and thus the acquisition of financial resources. Digitization offers ways for expanding a cooperation ecosystem and inclusion of other sections of the population in scientific projects to find potential new areas for application of knowledge and technology with a relatively low threshold. The new platform models allow the participation of individuals who are not institutionally bound in the field of

science, in scientific processes—a concept called "citizen science" (Solemon et al. 2013; Franzoni and Sauermann 2014; Sauermann and Franzoni 2015). Rather than simply sharing information with the public, citizen science allows members of the public to participate in the scientific investigation. They perform relatively simple tasks such as data collection, image coding, or observations. The German government is setting incentives for German PROs and universities to engage in citizen science processes and engage the public as research helpers (Bürger schaffen Wissen 2016; BMBF 2018; Helmholtz-Gemeinschaft 2018). With this trend, new possibilities of communication are opened up and, thus, also alternative ways of financing during different stages of a research project. In particular, stimulating innovation by integrating a crowd seems also appealing to "lead users." They can be described as innovators who have a high level of self-motivation to contribute to the solution of a problem—often years in advance of the general market (von Hippel 1986; Urban and von Hippel 1988; Franke et al. 2006; Goldstein and Hazy 2006; Hopp and Kaminski 2016). They can be involved in innovation processes via feedback loops or workshops. Such innovators, who can thrive in both, in the private or scientific environment, often have a strong research and domain expertise, as well as a product-centered drive. In this context, early market feedback and marketing aspects gain more importance for researchers and creators than the purely financial benefits of crowdfunding (Mollick 2014). Nevertheless, co-creators could also become potential investors in the future or make a successfully funding more likely (Ordanini et al. 2011; Roma et al. 2017). PROs could apply the concepts of crowdsourcing and crowdfunding for decision-making and funding allocation processes and offer it as an incentive in research project guidelines: the project proposals with the best reception in an internal crowdfunding process receive additional funding. Some companies have established internal idea contests that are potential role models. Besides an increasingly dense coupling and co-creation with an external crowd like Procter & Gamble which has been executing for more than a decade or German companies like BMW which are testing for quite a while (Chesbrough 2003a, b; Adamczyk 2012; Füller et al. 2017; Jovanović et al. 2017), many companies also started to initiate internal idea contests and funding campaigns (Zuchowski et al. 2016). They use virtual or even real money to identify and evaluate ideas and solutions by involving employees or cooperating partners. Financial resources to develop new products are allocated in a quite effective way. In sum, PROs and/or their scientists have to develop capabilities in crowd management rather than crowdfunding. In that case, also a pipeline and selection process for suitable projects for crowdfunding might evolve systematically to lead to a comprehensive funding strategy.

5 Conclusion

By considering and systematically integrating already implemented programs within PROs with external funding resources and alternative financing instruments like crowdfunding, the innovation process could be redesigned in an optimized way. An important aim should be to anticipate and to close funding gaps between technology readiness levels to transfer knowledge and technologies to an application in business and society. The development of novel financing concepts and the extension of existing co-financing schemes could pave the way for ideas and inventions that are not in the current research focus, and funding scheme of the respective government and/or PROs might have a chance to be realized. Including and managing a crowd to build a feasible ecosystem over a whole project cycle could support to turn knowledge and technological inventions into social innovations. More research needs to be conducted to elaborate on how researchers and their research projects can be accompanied most effectively. However, we conclude that:

- Crowdfunding can be an additional channel for communicating science to the public. This is increasingly essential in today's society—both for acceptance and exploiting application potentials of scientific findings.
- Crowdfunding science might work for projects that involve a crowd emotionally, which might create social impact or a direct value to the user (e.g., local/emotional affectedness, attractive rewards, or returns).
- Crowdfunding is a matter of cooperation and timing—there are windows of opportunity for applying crowdfunding campaigns to achieve different project-related goals.
- Building an ecosystem for cooperative crowdfunding models with different partners increases the probability that one of the partners can lead a crowdfunding campaign.

Different incentives already promote the collaboration of PROs with SMEs, startups, associations, or societal stakeholders. They should facilitate faster and more efficient access to the market, especially for socially relevant projects (such as those in the field of medical technology, healthcare, information technology). Nevertheless, a lot of potential remains unrealized. Additional research has to be performed to find out how a comprehensive financing strategy for research projects can stimulate the knowledge and technology transfer process by integrating measures like public research funding incentives, ecosystem design, and the usage of crowdsourcing platforms for the acquisition of alternative finance.

Further research and case studies might reveal how the acceptance of the population—as a mirror of the public interest—can be included for the justification of the promotion need: crowdfunding as a market mirror or expression of public interest in scientific research.

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