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Equity Crowdfunding:
Local Bias, Capital Structure, and Venture Performance

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Preface

The emergence of equity crowdfunding (ECF) as a new source of entrepreneurial finance promises new growth potential for young ventures. ECF can give start-ups better access to capital and can offer an important funding opportunity in entrepreneurial finance. The potential opportunities and threats of ECF motivated me throughout the writing of my dissertation. The aim of this research is to shed light on the characteristics of ECF. I examine investor behavior, the determinants of firms for undertaking ECF, and the outcomes of firms after ECF.

This dissertation could not have been possible without the help of my supervisors, my colleagues, my family, and friends. I would like to take this opportunity to thank those who helped me realize this challenging project.

In particular, I would like to thank Prof. Lars Hornuf, my dissertation advisor. He fully supported me throughout the entire process, and his fascination with academic research was a constant source of inspiration for me. His approachability and prompt responses created a stimulating and supportive environment. I am particularly grateful for his contributions to Chapters 2 and 4. I am also thankful to Prof. Jörn Hendrich Block for his support as second reviewer of my dissertation.

In addition, I discussed the project with other experts in the field. I would thus like to thank my discussion partners during my visits to the Rotman School of Management (University of Toronto) and the Schulich School of Business (York University), as well as the participants at various conferences, for their valuable insights and comments. In particular, I would like to thank Thomas Åstebro, Ajay Agrawal, Christian Catalini, and Douglas Cumming for their advice.

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Finally, I am truly thankful for my family. The love, trust, and support of my family, especially the continuous support and confidence of my parents and my brother, are invaluable to me. Finally, my greatest thanks go to my girlfriend Theresa. Without her never-ending patience, support, and encouragements, this project would not have been possible. I dedicate this work to you.

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List of abbreviations

AFT	Accelerated failure time model
BA	Business angel
BvD	Bureau van Dijk
Corr	Correlation
E.g.	Exempli gratia (for example)
ECF	Equity crowdfunding
Et al.	Et alii (and others)
EUR	Euro
GBP	British pound sterling
GER	Germany
I.e.	Id est (that is)
JOBS	Jumpstart Our Business Startups
LLC	Limited liability company
Ltd.	Limited
No.	Number
POT	Pecking order theory
PSM	Propensity score matching
SME	Small and medium-sized enterprise
SPV	Special purpose vehicle
Std.-dev.	Standard deviation
UK	United Kingdom
US	United States of America
USD	United States dollar
VC	Venture capitalist
Vs.	Versus
W/	With

List of symbols

Age_j	Age of firm *j*
$Capital_{jt}$	Capital structure of firm *j* in year *t*, either equity, debt, total assets, or ratio equity to total assets
ECF_j	Binary variable equals 1 if firm *j* ran an ECF campaign or 0 if not
$Equity_j$	Equity or equity to total assets of firm *j*
d_{ij}	Distance between investor *i* and firms *j*
d_{iM}	Mean distance of the equally weighted benchmark portfolio for investor *i*
d_{jM}	Distance of the benchmark investor base of firm *j*
$Fund_j$	Overall funding volume of firm *j*
i	Investor
I	Number of investors
Inv_{ij}	Amount invested in firm *j* by investor *i*
j	Firm
k	Industry
$LocalBias_{ij}$	Local bias for investor *i* in firm *j*
$LocalBiasIB_j$	Local bias of firm *j*'s investor base
$LocalBiasPF_i$	Weighted portfolio local bias for investor *i*
N	Number of firms
$Post_t$	Binary variable equals 1 if the observation is during or after the year of the ECF campaign and 0 if the observation is before the year of the ECF campaign
t	Year
wd_i	Weighted distance for investor *i*
wd_j	Weighted investor base distance for firm *j*
Z	Number of successful portfolio investments by investor *i*
ε	Error term
ρ_k	Industry fixed effects of industry *k*
τ_t	Year fixed effects in year *t*

Zusammenfassung (German)

Ein Phänomen der letzten Jahrzehnte ist, dass sich digitale Marktplätze im Internet für unterschiedlichste Produkte und Dienstleistungen etablieren. Seit 2011 ist es nun auch möglich, dass sich Privatpersonen online an jungen und innovativen Unternehmen (sogenannte „Start-ups“) finanziell beteiligen. Über Internetportale können potentielle Investoren verschiedene Start-ups begutachten und im Anschluss in ihr auserwähltes Start-up direkt investieren. Die Anleger erhalten im Gegenzug eine Gewinnbeteiligung, während die Unternehmen mit dem zusätzlich gewonnenen Kapital ihre Projekte finanzieren können. Diese neue Möglichkeit nennt sich „Equity Crowdfunding“ (ECF) bzw. „Crowdinvesting“.

Die Relevanz von ECF für die Gründungs- und Wachstumsfinanzierung wird durch die mittlerweile hohen Investitionsvolumen deutlich. Im Jahr 2015 erreichte ECF in Deutschland ein Volumen von 47 Million Euro und in Großbritannien sogar 181 Million Euro. Da es sich hierbei um eine neue Erscheinung handelt, sind Erfahrungswerte und zusätzliche Analysen notwendig, um die Charakteristika von ECF mit ihren Vor- und Nachteilen zu evaluieren. Insbesondere stellt sich die Frage, ob ECF eine Finanzierungslücke bei Unternehmen schließen kann und, falls ja, ob diese neue Finanzierungsform nicht neue und unbekannte Risiken birgt. Obwohl die wissenschaftliche Forschung zu ECF ähnlich rapide wächst wie der Markt selbst, gibt es noch eine ganze Reihe an offenen Fragen. Das Ziel dieser Dissertation ist es mit empirischen Analysen Aufschluss über die Besonderheiten von ECF zu geben. Hierbei analysiere ich insbesondere die Frage, ob ECF in der Lage ist geographische Barrieren zu überwinden, die Interdependenz von ECF und Kapitalstruktur sowie das Risiko des Scheiterns von finanzierten Start-ups und deren Chancen auf eine Anschlussfinanzierung durch traditionelle Risikokapitalgeber wie Business Angels oder Venture Capitalists.

Die Resultate des ersten Teils der Dissertation belegen, dass Anleger im ECF lokale Unternehmen präferieren. Insbesondere Investoren, die höhere Beträge anlegen, haben eine stärkere Tendenz in lokale Start-ups zu investieren. Die Ergebnisse machen zudem deutlich, dass die Ausgestaltung der ECF Plattformen einen starken Einfluss auf dieses Investorenverhalten hat. Zudem weist die Untersuchung nach, dass Investoren, die kleinere Beträge in lokale Unternehmen anlegen, häufiger Start-ups auswählen, die insolvent gehen bzw. ihren Geschäftsbetrieb einstellen. Jedoch zeigen die Ergebnisse auch, dass zwar Anleger häufig lokal investieren, aber die Start-ups die geographischen Finanzierungsbarrieren überwinden und Kapital von allen Distanzen erhalten können.

Die Kapitalstrukturen von Unternehmen werden seit Jahrzehnten untersucht, aber das Aufkommen neuer Finanzierungsformen macht es notwendig, bestehende Theorien anzupassen und neue empirische Erkenntnisse zu gewinnen. Der zweite Teil der Dissertation liefert deshalb erste Hinweise auf die Interdependenzen zwischen Kapitalstruktur und ECF. Die Untersuchung macht deutlich, dass die Kapitalstruktur keine Determinante für die Durchführung einer ECF-Kampagne ist. Die Ergebnisse belegen somit, dass über ECF finanzierte Unternehmen sich hinsichtlich ihrer Kapitalstruktur nicht von anderen Unternehmen unterscheiden. Dies impliziert, dass diese Unternehmen nicht besser oder schlechter aufgestellt sind, wenn es beispielsweise um ihren Verschuldungsgrad geht. Darüber hinaus belegt die Analyse, dass das Eigenkapital nach einer erfolgreichen ECF Kampagne nur geringfügig ansteigt. Außerdem zeigt sich, dass es auch keine positiven Auswirkungen durch ECF auf den Zugriff auf zusätzliches Fremdkapital gibt.

Der dritte Teil der Dissertation analysiert in einem Ländervergleich den Erfolg von über ECF finanzierten Unternehmen. Die Ergebnisse belegen, dass nach einer erfolgreichen ECF Kampagne deutsche Unternehmen im Vergleich zu britischen Unternehmen eine höhere Chance auf eine Folgefinanzierung durch Risikokapitalgeber haben. Die Überlebens-wahrscheinlichkeit ist hingegen für deutsche Unternehmen etwas geringer. Es zeigt sich zudem, dass die Eigenschaften der Gründer, wie z.B. die Alterszusammensetzung des Gründerteams, die Anzahl der aktiven Risikokapitalgeber sowie eingetragene Markenrechte einen signifikanten Einfluss auf den Erfolg des Unternehmens haben.

Die Ergebnisse ergeben relevante Implikationen für Theorie und Praxis. Die bestehende Literatur im Bereich der Gründungs- und Wachstumsfinanzierung wird um Erkenntnisse über das Investorenverhalten, Neuerungen zur Kapitalstrukturtheorie sowie einen Ländervergleich in ECF ergänzt. Für verschiedene Akteure der Praxis werden Implikationen geliefert. Unter anderem werden Investoren irrationale Aspekte ihres Verhaltens aufgezeigt und Start-ups erhalten Informationen über die Vor- und Nachteile von ECF sowie über wichtige Erfolgs-faktoren. Daneben werden für ECF-Plattformbetreiber Identifikationskriterien von erfolg-versprechenden Start-ups abgeleitet, den politischen Entscheidungsträgern die Notwendigkeit des Anlegerschutzes und Chancen zur Verbesserung der Finanzierungsinfrastruktur für Start-ups durch ECF verdeutlicht sowie traditionellen Risikokapitalgeber die Komplementarität zu ECF und die damit verbundenen potentiellen Chancen und Risiken gezeigt.

1 Introduction

In recent years, new financing patterns for early-stage ventures have emerged. One of the novelties beyond accelerators, angel networks, and corporate venture capitalists is crowdfunding (Block et al., 2017a), which enables the funding of new ventures via the Internet with money from the crowd (i.e., a group of individuals often called "backers"). Crowdfunded firms use these funds to realize their innovative projects. As these projects are risky, have small returns, have high transaction costs, and have a large need for capital, traditional players such as banks, business angels (BAs), venture capitalists (VCs), private equity, or family and friends are not always sufficient, suitable, or interested enough to finance those firms. However, the crowd has the ability and potentially will to fund these ventures (Klöhn and Hornuf, 2012). Crowdfunding platforms serve as the intermediary between the firms and investors by facilitating the investment process.

Crowdfunding consists of four different forms with several distinctions in terms of the type of investment crowd investors make: donation-based crowdfunding, reward-based crowdfunding, crowdlending, and crowdinvesting (Bradford, 2012; Dorfleitner et al., 2017). First, donation-based crowdfunding involves donations to mostly charitable or social projects. Here, backers do not receive any financial return, though sometimes a public acknowledgment is made. Individuals or non-governmental organizations run these types of crowdfunding campaigns. Second, reward-based crowdfunding involves a non-monetary reward. In this form, individuals or firms seek investors to fund their products or services. The types of funded projects are various, including art, fashion, music, technology. In return for their investments, backers receive either the right to pre-order the new product or service or other types of rewards, such as having the backer's name in the credits of a funded movie (Bradford, 2012). Kickstarter and Indiegogo are the two leading reward-based crowdfunding platforms worldwide. Third, crowdlending allows individuals and firms to take out a loan financed by the crowd. This form is often called "peer-to-peer lending". For example, individuals can use the loan to finance their vehicle or vacation, to convert their debt, or for other purposes. Firms can use it for instance to finance their operations or new projects. Investors receive a fixed interest rate in return and the loan is always expected to be repaid. Prosper.com and Lending Club are the well-known market players.

The last form of crowdfunding and focus of this dissertation is crowdinvesting, which is often referred as equity crowdfunding (ECF). In ECF, the crowdfunded firms offer investors a

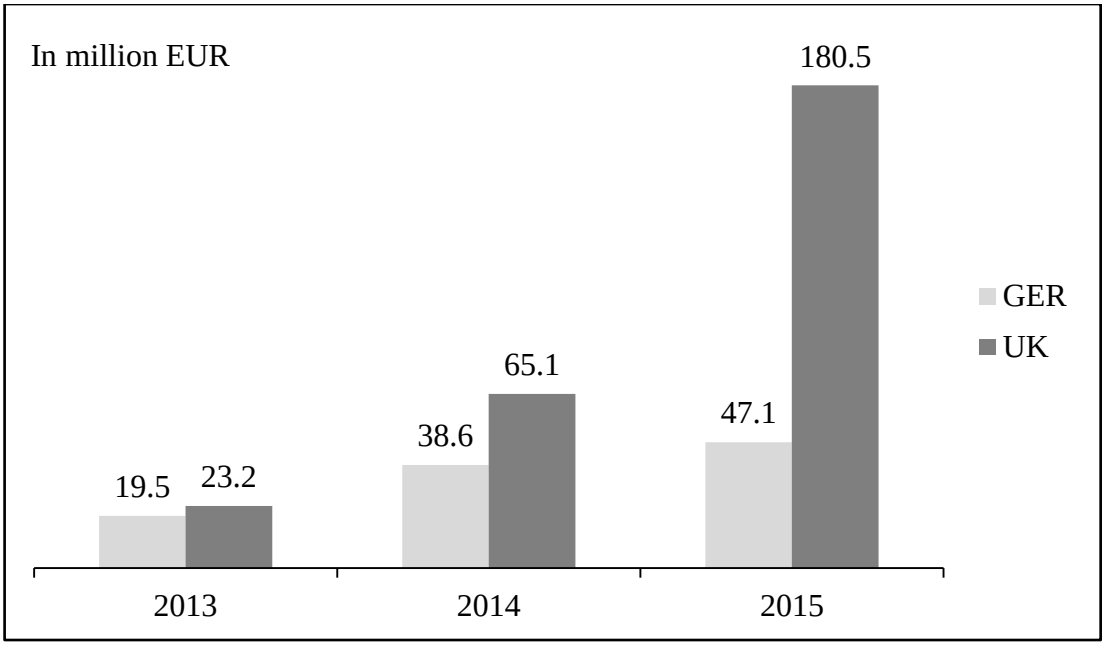
share of any future profits (Bradford, 2012). Most countries' regulations, such as those in the United Kingdom (UK), allow investors to receive ordinary shares in ECF. However, in some countries, such as Germany, issuing shares is associated with costly obligations, such as the need to issue a prospectus (Klöhn and Hornuf, 2012; Klöhn et al., 2016b). In these countries, a mezzanine financial contract without voting rights allows investors to participate in the future cash flows of a firm. This mezzanine instrument is often called "profit-participating loans" or "silent partnership agreements".

ECF works as follows: at first, the start-up and the ECF platform must agree on a valuation of the venture and how much capital they want to raise (i.e., funding goal). In addition, the founders usually allow for the possibility of exceeding investments after reaching the funding goal, but this exceedance is limited to an overall funding limit set by the founders. Regulation forces founders to limit their overall funding in Germany to 2.5 million EUR and in the UK to 5 million GBP to avoid prospectus obligations (Klöhn et al., 2016b). After preparing all the necessary information provided to the crowd during the ECF campaign, the ECF campaign runs for a certain time until the funding limit is reached or the intended campaign duration is over. The campaign website gives mostly information about the business plan, founding team, and product or service, though sometimes it offers a video about the start-up as well. If the previously defined funding goal is not reached, the founders do not receive any money. This is known as the all-or-nothing model of ECF (Cumming et al., 2014), which is the common approach of ECF platforms in Germany and the UK. In the end, every individual investment is mostly allocated on a first-come, first-served basis and is fulfilled through a standardized financial contract.

This dissertation focuses on the markets in Germany and the UK, as they are the largest ECF markets in the world (Dushnitsky et al., 2016). The development of the ECF market began in Germany and the UK in the fall of 2011. Well-known platforms include Companisto, Innovestment, and Seedmatch in Germany and Crowdcube and Seedrs in the UK. From 1 September 2011 to 31 December 2015, 210 campaigns were successfully funded on 22 different equity crowdfunding portals in Germany (Hornuf and Schmitt, 2016b). The German market grew from 19.5 million EUR in 2013 to 47.1 million EUR in 2015 (see Figure 1-1). By comparison, in 2015 alone, the UK's ECF platforms successfully funded 720 firms (Zhang et al., 2016). This growth was supported by the favorable regulatory environment in the UK, which provided investors tax incentives (Vulkan et al., 2016). As such, the UK market outpaced the German market especially in 2015. As Figure 1-1 shows, the UK market

increased from 23.2 million EUR in 2013 to 180.5 million EUR in 2015. A new emerging trend on ECF portals in Germany and the UK is the offer of funding for real estate projects. As these projects mostly pay their investors a fixed interest rate, they should be classified as crowdlending (Hornuf and Schmitt, 2016b).[1] The rapid rise in financing start-ups through ECF might indicate a funding gap and, thus, an interest in receiving funding from individuals. More important, ECF helps firms that faced difficulties in raising external capital after the financial crisis (Kahle and Stulz, 2013). However, the question is whether the emergence of ECF is beneficial for firm welfare or not.

Figure 1-1: Market volume equity crowdfunding in Germany and the UK
Figures are in million EUR. The EUR/GBP yearly average currency exchange rate, provided by Thomson Reuters Eikon, is used to convert the UK market volume in EUR. The source for the German market volume is Dorfleitner et al. (2017) and for the UK is Zhang et al. (2016).



ECF adds another positive opportunity of funding for start-ups, which might also yield additional economic growth. However, regulators cannot expect crowd investors to be as sophisticated as professional investors such as BAs or VCs. ECF investors might suffer from serious information asymmetries and might also lack necessary experience to evaluate investments in start-ups, which are mostly characterized by high risk. Thus, the two key questions are as follows: Where does ECF lead investors? Is ECF able to add value to the economy by helping start-ups?

[1] The dissertation does not consider real estate projects because of my focus on investments in ventures (i.e., start-ups).

The current literature partially addresses these questions. Research interest in new types of funding for start-ups has grown rapidly (Block et al., 2017a; Cumming and Johan, 2017). This might be partially driven by the increasing market volume and rising interest in the public and attention by media. My study contributes to the literature in the field of entrepreneurial finance and especially on crowdfunding. Many recent studies have mainly focused on crowdlending (Duarte et al., 2012; Herzenstein et al., 2011; Lin and Viswanathan, 2015; Lin et al., 2013; Zhang and Liu, 2012) and reward-based crowdfunding (Agrawal et al., 2014, 2015; Belleflamme et al., 2014; Mollick, 2014; Mollick and Nanda, 2015). The interest in equity crowdfunding has grown only recently (Ahlers et al., 2015; Bapna, 2017; Block et al., 2017b; Hornuf and Neuenkirch, 2017; Hornuf and Schwienbacher, 2017a, 2017b, 2018; Vismara, 2016).

However, there are still many questions about ECF that have not been answered. The literature extensively examined crowdlending or reward-based crowdfunding, but the implications of these studies might not hold true for ECF. Furthermore, there is still no study on the impact of geographic proximity in conjunction with ECF portal design. A big advantage of an online ECF portal is to connect potential investors with new ventures by overcoming geographic barriers. However, this belief has to be proven and a potential influence by the ECF portal structure needs to be investigated. Besides that, the current literature cannot disclose whether firms running an ECF campaign differ from others in terms of their capital structure. It might be the case that firms with higher financial constraints or overindebted firms seek financing through ECF. In addition, it is still unknown whether an equity injection by ECF is significantly helping a start-up and which additional effects ECF might have on the firm's capital structure e.g., better access to bank loans. Moreover, the literature is still missing insights on ECF in various countries. Differing national regulation needs to be considered and evaluated, which makes studies with cross-country comparisons necessary. Especially, long-term empirical data is necessary to assess ECF properly. It is still unknown how crowdfunded ventures from different countries perform on the long-run in terms of firm survival or follow-up funding.

The goal of this dissertation is to fill this gap in the literature. The research is motivated by three research questions to shed more light on the characteristics of ECF. These questions address investor behavior, the determinants of firms for undertaking ECF, and the performance of firms after ECF.

The first research question deals with the impact of geographic distance in ECF. The question arises whether ECF can overcome the geographic barrier between founders and investors. Does geographic proximity matter for crowd investors and whether firms can attract distant investors through ECF campaigns?

The second research question involves the interdependencies between a firm's capital structure and ECF. Do only firms with a certain capital structure seek ECF as a new funding opportunity, and what is the impact of ECF on the firm's capital structure (i.e., equity and debt) afterward?

The third research question is whether ECF fills a gap in start-up financing or whether these ventures should not have received funding in the first place. The performance of crowdfunded ventures will be disclosed by evaluating survival rates. Furthermore, what are the chances of receiving follow-up funding after the ECF campaign from BAs and VCs? In this respect, what are the determinants for firm survival and follow-up funding and are there any cross-country differences?

Examining ECF and answering these research questions has both theoretical and practical relevance. With this dissertation, I contribute to the entrepreneurial finance literature. I am able to give insights into investor behavior in ECF and the interdependencies among ECF, capital structure, firm survival, and follow-up funding. The results of this dissertation might be of interest to academics, entrepreneurs, regulators, crowd investors, ECF portal operators, and traditional players in the start-up financing industry, such as BAs and VCs.

To answer the three research questions, this dissertation is structured as illustrated in Figure 1-2. ***Chapter 2*** analyzes the impact of geographic proximity with the aim to answer research question 1. The chapter uses the concept of local bias to measure the tendency of investors to invest in local firms. By changing the perspective to the firms, the geographic diversification of the investor base of each firm is analyzed. Finally, the contributing factors to the local bias are analyzed with regression analysis.

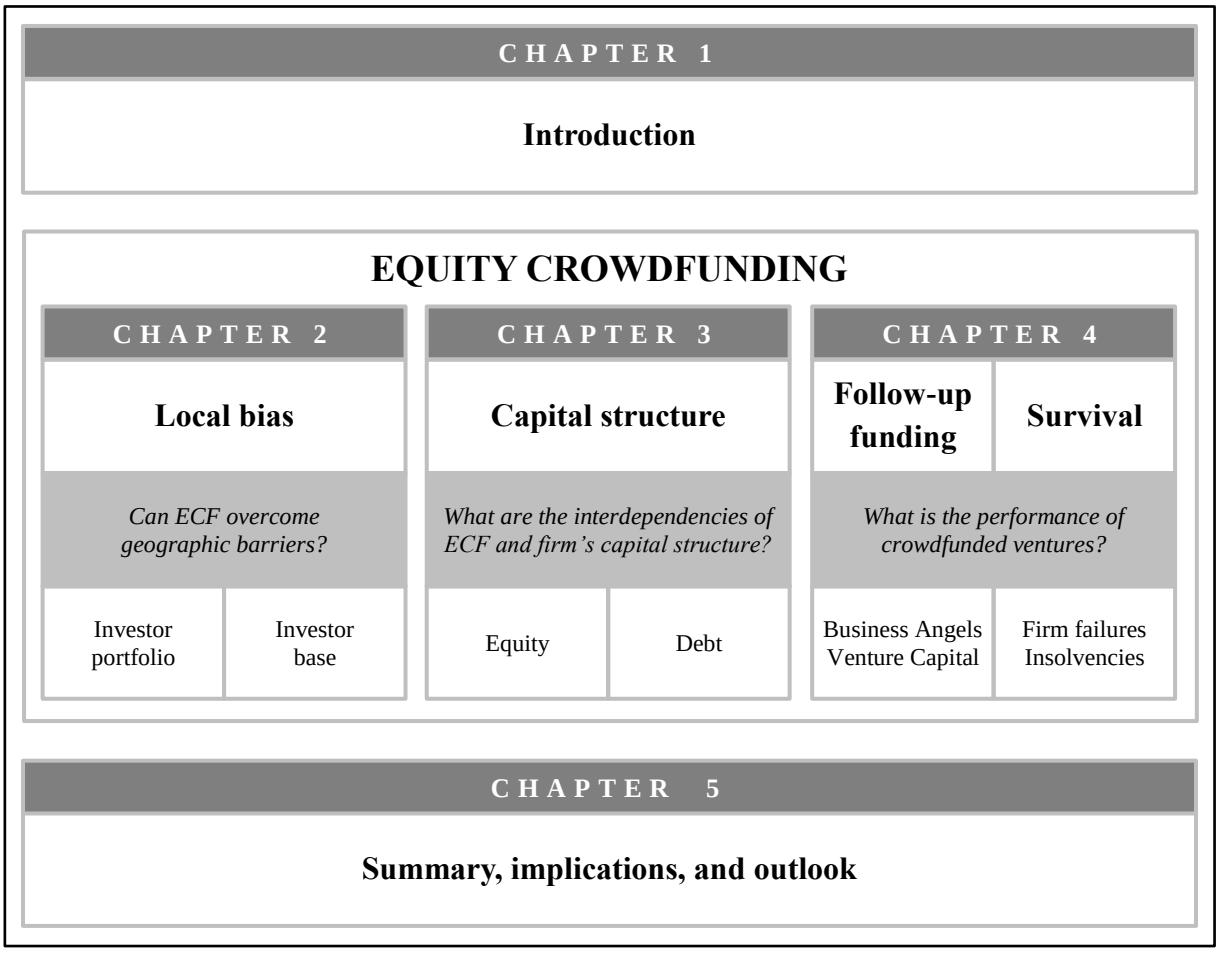
Chapter 3 addresses research question 2 by examining the interdependencies of capital structure and ECF. To test whether capital structure is a determinant for firms to run an ECF campaign, a control sample is added through propensity score matching (PSM). Then, the

treatment effect of ECF on the capital structure is measured by a difference-in-differences regression model.

Chapter 4 sheds light on the performance of crowdfunded firms measured by the survival rates and the chances of receiving follow-up funding by BAs and VCs after an ECF campaign. This chapter provides answers to research question 3. Cox semi-parametric proportional hazards models are used to measure the contributing factors for firm survival and follow-up funding of crowdfunded firms and to compare the results in a cross-country comparison.

Chapter 5 summarizes the main results, and presents contributions of the dissertation. Moreover, implications for investors, entrepreneurs, ECF portal operators, policy makers, BAs, and VCs are highlighted. Chapter 5 points out the limitations of the dissertation and closes with promising avenues for future research on entrepreneurial finance and specifically on ECF.

Figure 1-2: Structure of dissertation



2 Local bias in equity crowdfunding[2]

2.1 Introduction

This study analyzes whether investments brokered by equity crowdfunding platforms exhibit a local bias, whether specific investor groups can explain this bias, and whether more local investments generate higher returns to investors. Equity crowdfunding refers to a new source of finance that occurs on the Internet and has recently emerged in many European countries (Hornuf and Schwienbacher, 2018), mostly because existing securities regulation has been benevolent toward issuers of small offerings or suffered from loopholes in its prospectus requirements (Hornuf and Schwienbacher, 2017b). As the financial instruments used by equity crowdfunding issuers vary from one jurisdiction to another, equity crowdfunding[3] can also be referred to as investment-based crowdfunding,[4] securities-based

[2] This chapter is joint work with Lars Hornuf. An earlier version of this paper appeared under the title "Does a Local Bias Exist in Equity Crowdfunding?" in the Max Planck Institute for Innovation & Competition Research Paper Series (Hornuf and Schmitt, 2016a). The authors thank Ajay Agrawal, Thomas Åstebro, Jörn Block, Christian Catalini, Douglas Cumming, Gregor Dorfleitner, Florencio Lopez-de-Silanes, Niclas Rüffer, Armin Schwienbacher, Oscar Stolper, Michael Zaggl, and the participants of the MACIE Research Seminar (Marburg University), the 7th Economic Workshop (University of Trier), the Crowdfunding Konferenz (IfM Bonn), the Workshop Economics of Entrepreneurship and Innovation (University of Trier), the 19th G-Forum (University of Kassel), the 3rd Crowdinvesting Symposium (University of Munich), the 3rd International ZEW Conference on the Dynamics of Entrepreneurship (Mannheim), the TIME Colloqium (Max Planck Institute for Innovation and Competition), the Finance Seminar (Schulich School of Business, York University), the Annual Conference of the Royal Economic Society (University of Bristol), the Annual Meeting of the American Law and Economics Association (Yale University), the Druid Conference (NYU Stern School of Business), the Darden & Cambridge Judge Entrepreneurship and Innovation Research Conference (University of Cambridge), the Workshop on Innovation, Finance, and Growth (Skema Business School), the 5th Workshop Household Finance and Consumption (Banque Centrale du Luxembourg), and the World Finance Conference (Cagliari University) for their helpful comments and suggestions.

[3] See, for example, the JOBS Act, including the term "crowdfunding," which refers to transactions involving the sale of a security. Ahlers et al. (2015, p. 958) define "equity crowdfunding" as an investment model in which investors receive "some form of equity or equity-like arrangements."

[4] See the FCA Consultation Paper CP13/13 titled "The FCA's regulatory approach to crowdfunding (and similar activities)" (available at: https://www.fca.org.uk/publication/consultation/cp13-13.pdf [accessed 10 October 2017]) as well as the European Securities and Markets Authority "Investment-based crowdfunding needs EU-wide common approach" (available at: https://www.esma.europa.eu/sites/default/files/library/2015/11/2014-1568_investment-based_crowdfunding_needs_eu-wide_common_approach.pdf [accessed 10 October 2017]).

crowdfunding,[5] or crowdinvesting.[6] In this study, I refer to the new asset class as equity crowdfunding, as this is the term most frequently used in the literature.

Until recently, equity crowdfunding by non-accredited investors was prohibited in the United States of America (US). This situation was due to delays caused by the Securities and Exchange Commission in implementing Title III of the Jumpstart Our Business Startups (JOBS) Act. The delayed implementation of the equity crowdfunding rules partly stemmed from the lack of a full understanding of the new activity. However, equity crowdfunding activities in various European countries constitute natural experiments, which might inform national securities regulators around the world about how equity crowdfunding takes place in reality. Moreover, the European Commission has recently announced the launch of a Capital Markets Union Action Plan on the supranational level, which among other things aims to diversify the funding sources of firms and make the securities prospectus more affordable for small and medium-sized firms.[7] As legislators are still struggling to balance the need to close the funding gaps of these firms with effective investor protection, a better understanding of how equity crowdfunding actually takes place is urgently required.

Most research investigating Internet-based finance has examined the determinants of funding success in donation- or reward-based crowdfunding as well as peer-to-peer lending. The behavior of individuals engaging in these activities is, however, likely to differ from equity crowdfunding. In regular crowdfunding, individuals make consumption or philanthropic decisions and are concerned with the enactment of a charitable campaign or the delivery of a consumer product, while in equity crowdfunding, investors care about the future cash flows of a firm. In peer-to-peer lending, the future cash flows of an individual or firm are pre-defined by the loan agreement. Moreover, in case of insolvency, lenders are generally preferred to equity or subordinated debt holders and therefore take less risk. Finally, in contrast with equity crowdfunding, peer-to-peer lenders do not participate in changes in the

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[5] See Knight et al. (2012) and the US Securities and Exchange Commission, 17 CFR Parts 200, 227, 232 et al. Crowdfunding; proposed rule (available at: https://www.sec.gov/rules/proposed/2013/33-9470.pdf [accessed 10 October 2017]).

[6] This term is probably the most useful, as it encompasses all financial instruments found in practice, regardless of whether they are classified as securities or investments or lack a legal definition altogether.

[7] Introductory remarks by Commissioner Jonathan Hill at the launch of the Capital Markets Union Action Plan, Brussels, 30 September 2015.

valuation of the firm, as they do not hold an equity or equity-like stake replicating the upside potential of the firm.

A well-known phenomenon in financial markets is the tendency to invest in and overweight securities that are geographically closer (local bias). As investors who exhibit this decision-making anomaly do not build optimally diversified portfolios in the spirit of Markowitz (1952), their behavior could lead to economic inefficiencies, and therefore this phenomenon has received considerable attention in the finance literature. Conversely, investors could also rationally engage in more local firms and earn above-average returns if geographic proximity allows them to obtain private information about the firm or puts them in a better position to exercise their control rights. In this study, I investigate whether a local bias exists in a new and fast-growing asset class, examine what its determinants are, and clarify whether a local bias has positive or negative consequences for investors.

Previous research suggests that US investment managers prefer firms with local headquarters (Coval and Moskowitz, 1999), suggesting that information asymmetries between local and non-local investors explain the regional proximity in investments. Ivkovic and Weisbenner (2005) confirm this hypothesis for individual investors and provide evidence that these investors exploit local knowledge to earn excess returns. Using data from German individual investors, Baltzer et al. (2013) show that the local bias extends beyond national borders, with investors living closer to a foreign country investing more in firms located in a regionally close foreign country. Baik et al. (2010) find that local investment advisers, high local ownership institutions, and high local turnover institutions forecast returns better than non-local institutional investors and that the local advantage is even stronger for firms exhibiting larger information asymmetries.

In the realm of venture capital, Cumming and Dai (2010) find that venture capital funds exhibit a significant local bias, with half the investments located within a 233-mile radius. The local bias was smaller for reputable venture capital funds having a larger syndication network, which alleviates information asymmetries. In a recent article, Agrawal et al. (2015) investigate the role of geographic proximity in a pre-purchase crowdfunding platform. They find that investment patterns over time are related to geographic distance, with local investors engaging much earlier. However, this pattern disappears when the researchers control for family and friend investors. Guenther et al. (2017) present first evidence on how sensitive different investor types are to geographic distance in an equity crowdfunding context.

However, they do not calculate a local bias, and their analysis relies on data from the Australian Small Scale Offerings Board, in which average investments are rather large and contributors are few. Lin and Viswanathan (2015) provide evidence for a home bias in peer-to-peer lending and suggest that this finding is partly due to behavioral reasons.

This study investigates whether a local bias exists in equity crowdfunding and whether it affects investors' returns. Because regulators have consistently regulated investors in this asset class depending on their net worth and income, this study analyzes whether specific investor groups are more or less prone to engage in geographically close investments. Less wealthy investors have legally been restricted in the amount they can invest in equity crowdfunding campaigns (Bradford, 2012; Klöhn et al., 2016a; Hornuf and Schwienbacher, 2017b), so I am particularly interested in the local bias of different investor groups. If investors who provide only small amounts, for example, exhibit a different local bias, this might inform regulators about the effectiveness of regulations such as the JOBS Act that limit the amount that can be sold to a single investor. In line with previous literature and the actual observations in the data, I consider three groups of investors: (1) family and friends, (2) angel-like investors, and (3) diversified investors. I find that both family and friend and angel-like investors exhibit a larger local bias. Investors who have a better-diversified crowdinvesting portfolio and are supposedly financially more literate show a smaller local bias. This finding is in line with the conjecture that the two former groups are in a relatively better position to use their local knowledge to resolve information asymmetries, while diversified investors apparently spread their portfolio without considering the geographic location of the investments. The data further show that portal design is important for attracting investors more prone to having a local bias.

Moreover, I find that firms with a higher valuation exhibit a larger local bias, which indicates that investors might benefit from screening firms locally that request a higher price per share. The results also reveal that investments have a smaller local bias when facing firms located in large cities such as Berlin, Hamburg, and Munich. Furthermore, investments in industries such as entertainment, IT, and finance exhibit a significant, positive local bias, indicating that manufacturing and technical activities can be easily understood from farther away through manuals and technical descriptions. Moreover, the study provides evidence that investments over the weekend show a larger local bias. Finally, I find that investors who direct their investments to local firms pick more often start-ups that run into insolvency or are later dissolved.

The remainder of the chapter proceeds as follows: in Section 2.2, I describe the German equity crowdfunding market and define the investor types I examine herein. Then, I describe the relevant theory and derive testable hypotheses in Section 2.3. Section 2.4 presents the data and methodology. Section 2.5 outlines the empirical results, and Section 2.6 concludes.

2.2 Equity crowdfunding

2.2.1 Defining equity crowdfunding

Crowdfunding was initially developed for philanthropic projects, which is often referred to as the donation model of crowdfunding. In this model, backers donate money to support a project without expecting compensation, potentially leading to the transformation of social capital into economic capital (Lehner, 2014). This is different from the reward-based model of crowdfunding in which backers are promised perks, such as supporter T-shirts or having their name posted on the campaign website. At times, the reward-based crowdfunding model may resemble a pre-purchase, such as when backers finance a product or service they wish to consume and which is still to be developed by the entrepreneur. Popular examples are video games such as Star Citizen or the Pebble smartwatch. Another form of Internet finance is peer-to-peer lending, in which funders receive a pre-determined periodic interest payment and—if the individual or firm is not running into bankruptcy—obtain their original principal investment back by the end of the investment period.

Equity crowdfunding is a sub-category of crowdfunding, in which backers expect a financial compensation in the form of a profit-share arrangement. To encourage the crowd to participate in the future profits of the firm, fundraisers in some jurisdictions offer equity shares in a private limited liability company. In the UK, for example, such is the case on the portals Crowdcube and Seedrs. In Germany, start-ups do not offer common shares in a limited liability company, as transferring them to another investor would require the involvement of a costly notary (Braun et al., 2013). Typically, German start-ups running an equity crowdfunding campaign use mezzanine financial instruments such as non-securitized participation rights, silent partnerships, and subordinated profit participating loans.

Before an ECF campaign goes online, the start-up and the portal must agree on a valuation of the firm, and the founders must decide how much capital they want to raise. Consistent with the valuation and capital needs of the firm, the portal provides a standardized financial contract, which replicates an equity share in the firm, so that the crowd can

participate in the future cash flows of the start-up. These financial instruments are senior to ordinary shares and shareholder loans but rank after all ordinary liabilities. Moreover, they cannot be sold on the secondary market and often have a lifespan of three to seven years. In most cases, investors hold the right to receive a pro-rata payment of the firm's profits but without any of the rights attached to an equity share, such as control and voting rights. Although investors do not participate in the losses of the firm beyond their investments (margin requirements do not exist), there is a high risk that the start-up will not succeed and backers will not receive any financial return from the securities bought. Moreover, in many cases backers might even lose their original principal investment.

2.2.2 Equity crowdfunding portals in Germany

By January 1, 2016, 22 ECF portals were established on the German market, nine of which were still running an active business (Hornuf and Schmitt, 2016b). During the observation period of the study, the two portals I consider here made up 26% of the entire German ECF market in terms of capital raised and 40% when considering the number of start-ups that received funding. ECF portals in Germany largely follow the business model outlined in Section 2.2.1. While the web design and investment process of the two portals I consider are rather similar, some features of the portals exhibit some peculiarities. I exploit this variation in the study, as the differences may affect the type of investors attracted and consequently the local bias of the crowd.

First, after the portal Seedmatch appeared on the stage, Innovestment was the second portal entering the German ECF market in late 2011. Companisto began operating a year later but quickly established a larger user base than Innovestment (Dorfleitner et al., 2017). Until the end of the observation period, Companisto successfully funded 30 campaigns, while Innovestment enabled only 28 firms obtain funding. Another 16 firms at Innovestment were not successfully funded. The slightly larger number of start-ups available over a shorter period allowed investors to diversify their portfolios better on Companisto. This tendency even accelerated because the minimum investment on Companisto ranges from only 4 EUR to 5 EUR compared with from 500 EUR to 25 thousand EUR in the case of Innovestment. The larger the minimum investment, the more difficult it becomes for investors to diversify their portfolio with a given amount of capital and the more important it is to obtain information about the prospects of the firm.

Second, most often investors make a direct investment in the start-up in which they want to participate. This holds true for the financial contracts of Innovestment and all other German ECF portals but not for Companisto. Companisto initially set up a special purpose vehicle (SPV) to pool the investments made in all campaigns that were successfully funded on the portal. The SPV in turn invested the capital raised from the crowd in the start-up in which the investors wanted to participate. Today, Companisto no longer pools the investments through an SPV but offers of a separate pooling contract for each campaign. After crowdfunding has taken place, the pooled investments help venture capital firms negotiate with a single counter-party and make buying out the crowd easier.

Third, under the all-or-nothing model founders set a funding goal and keep nothing unless this goal is achieved (Cumming et al., 2014). All German ECF portals run under this all-or-nothing model. Moreover, all of them allow the crowd to over-subscribe the issue up to a maximum funding limit. Frequently, the funding goal is set at 50 thousand EUR. If the 50 thousand EUR cannot be raised within a pre-specified period, the capital pledged is given back to the investors. Moreover, most German ECF portals operating an all-or-nothing model, including Companisto, also allocate shares on a first-come, first-served basis. Under this model, founders set an overall funding limit and stop selling investment tickets to the crowd when the limit is reached. In the early years, the funding limit was often set at 100 thousand EUR. After this threshold was reached, the funding process stopped before the pre-specified funding period came to an end and shares were no longer sold to the crowd.

Innovestment has deviated from this model by implementing a multi-unit second-price auction in which individual bids are sealed. The auction has three stages and is similar to a Vickrey (1961) auction, except that the portal reveals the applicable second price to everyone. After the start of the auction, investors can make pledges by specifying the number of tickets they want to buy and the price they are willing to pay for each ticket. In line with the other platforms, the portal and the start-up determine a lower threshold for the price of a single ticket. During the first phase of the auction, everyone who pledges money is allotted the desired number of tickets, and the lowest posted price applies to everyone. Thus, there is per se no reason for investors to outbid the lower threshold at this phase, unless they want to avoid the transactions cost of bidding again later.[8] In the second phase, the number of tickets

[8] Introductory remarks by Commissioner Jonathan Hill at the launch of the Capital Markets Union Action Plan, Brussels, 30 September 2015.

is kept constant, and investors can outbid each other by posting even higher prices. Importantly, the second phase is not restricted to investors from the first phase. Everyone who is registered at the portal can still join the bidding process. The second phase continues until the maximum funding limit is reached. For most campaigns on Innovestment, the maximum funding limit is 100 thousand EUR. During the third and last phase, investors can still outbid each other. At this point, however, it is no longer possible to increase the overall sum of funds. Still higher bids therefore result in the overall number of tickets being reduced, thus lowering the number of investment tickets a start-up must sell for a given amount of capital (for a detailed description and analysis of the Innovestment auction mechanism, see Hornuf and Neuenkirch, 2017). In line with Campbell (2006) I presume that less sophisticated investors know their limitations and avoid complex ECF portals for which they feel unqualified. The Innovestment auction might hence have implications for the local bias in the sense that only a financially more sophisticated crowd might engage in a second-price auction.

2.2.3 Investor types

To derive policy implications, I differentiate between three investor groups that engage in ECF next to the regular crowd: family and friends, angel-like investors, and diversified investors. These groups were defined by previous literature and the actual observations in the sample. I investigate them separately because they differ in their capability of evaluating firms' future potential, which could ultimately result in a different local bias.

First, family and friend investors can identify the worthiness of an investment more easily because of their close social ties and the resulting information advantages when evaluating the quality of a founder (Cumming and Johan, 2014). In line with this hypothesis, Agrawal et al. (2015) find that family and friend investors are less responsive to the information posted by founders, because they directly know the entrepreneur. Following their approach, I define investors as family and friends if (1) they invest in the focal start-up before investing in any other start-up (the investor likely joined the portal for the focal start-up), (2) their investment in the focal start-up is their largest investment, and (3) they invest in no more than three other start-ups (the focal start-up remains the key reason for being on the portal). Family and friends could drive the local bias because they often have an offline social relationship with the founder (Agrawal et al., 2015) and social networks are largely local in nature (Hampton and Wellman, 2003).

Second, I observe another group of investors in the data set that invests higher amounts and for which the gathering of information might be worthwhile. This group can be referred to as "angel-like investors." Although I cannot confirm whether these investors actively engage in the start-up, investing higher amounts at least provides them with stronger incentives to do so. Goldfarb et al. (2013) find that 60% of US BAs are located within three hours' driving time from the firms they invested in, and 18% are located within the same zip code region. BAs often conduct due diligence and monitor the progress of the firm, which can provide an important signal and encourage regular crowd investors to invest as well (Hornuf and Schwienbacher, 2017a). Agrawal et al. (2014) find that syndicated BAs are the main drivers of successful deals on Angel List, one of the leading US ECF portals for accredited investors. In their data set, BAs invest a median amount of 2,5 thousand USD. I consider BAs in Germany somewhat more sophisticated[9] and label investors as angel-like investors if they invest at least 5 thousand EUR.

Third, I want to account for the financial literacy of investors. Abreu and Mendes (2010) find evidence that a diversified portfolio is a good proxy for investor education and financial literacy. Moreover, financially more literate investors have been shown to exhibit a lower local bias (Kimball and Shumway, 2010). Diversified ECF investors might thus better evaluate the risk associated with a start-up firm and consequently invest in various firms at varying distances. However, investing in a diversified portfolio also involves higher transaction costs, because including more firms in the portfolio makes screening and monitoring costlier overall for the investor. This is in line with Goetzmann and Kumar (2008) who find that equity portfolio diversification generally correlates with a lower local bias. Diversified ECF investors might therefore refrain from gathering detailed information about individual firms but could try to make a return by diversifying the risk away by spreading investments widely.

2.3 Theory and hypotheses

2.3.1 Theoretical considerations

On capital markets, information is vital but distributed unequally between the parties of a contract. Usually, those who search for capital have better information about the venture

[9] Fryges et al. (2007) report that German business angels that engage in high-tech start-ups typically invest 30 thousand EUR.

than those who provide the funding. As a result, investors must incur significant costs to learn about the prospects of an investment. These costs involve finding a suitable investment target and assessing its expected return (search costs), contracting the terms of the investment (transaction costs), and, finally, monitoring the outcome of the funded project (monitoring costs). To reduce these costs, VCs tend to invest in local firms (Cumming and Dai, 2010) because screening, contracting, and monitoring a local firm is usually easier and cheaper. Therefore, the question arises whether ECF lowers search, transaction, and monitoring costs sufficiently to attract physically distant investors who want to engage in a risky venture.

First, the availability of information on Internet portals reduces the search costs of investors significantly. While traditionally VCs relied on investor networks, such as Silicon Valley or Route 128, today crowd investors can almost costlessly identify new investment opportunities via the Internet. ECF portals provide information on the founder team, business model, and financials. Moreover, interested investors can directly communicate with the founder team through the ECF portal. However, the information provided by the founders might be cheap talk (Cumming et al., 2016), and information asymmetries as defined by Jensen and Meckling (1976) remain.

Assuming that ECF portals are repeat players that serve a two-sided market of firms seeking capital and investors looking for a return, I would expect these platforms to maximize their profits by raising the overall deal flow (Rochet and Tirole, 2003). Portals can only achieve this goal by attracting not only solvent investors but also profitable firms. In the ECF market, portals are still nascent and might not be able to demonstrate that they will act as repeat players that will serve the market in the long run. Yet firms themselves might be able to credibly signal their quality (Spence, 1973). However, most firms that participate in ECF campaigns are start-ups with little validated information like audited financial statements and therefore have limited capacity to signal their quality. Ultimately, a large and diversified crowd might easily be in a position to screen the venture, because the likelihood that one investor coincidentally lives close by the firm is larger than that of a single professional investor being located in one particular region. Nevertheless, when making an investment of as little as 5 EUR, it is barely worthwhile for an individual investor to engage locally in complex information validation and make the effort to communicate lemon market firms in the spirit of Akerlof (1970) to the larger crowd. Moreover, the collection and publication of information in ECF markets constitutes a public good, which makes investors prone to free

ride on its provision. Therefore, it is not clear whether ECF can reduce the search costs related to an investment.

Second, a standardized investment process lowers transaction costs. ECF portals allow firms and investors to use a ready-made platform and a standardized legal process. They also save the contracting parties time and money by providing boilerplate financial contracts. This standardized investment process allows distant investors to invest under similar conditions to local investors, mostly by eliminating the costly process of on-site negotiations. As a result, distant investors using ECF portals should have a cost advantage over venture capital firms that need to engage in a local bargaining process. The downside of eliminating tailor-made contracts, however, is that crowd investors cannot specify particular covenants or stage their investments.

Third, monitoring is difficult in ECF because investors rarely interact directly with the founder team and must rely on information provided by the firm. Information delivered by e-mail or investor relation channels on an ECF portal is less reliable than audited financial statements or getting firsthand information from an insider who serves on the board of directors of the firm. Research on reward-based crowdfunding has shown that creators use fake social information by purchasing Facebook likes or personal friends to attract more backers (Wessel et al., 2015). Cumming et al. (2016) show that in some cases, founders might also engage in outright fraud, by promising backers a product but spending the money on personal expenses.

Moreover, VCs traditionally write tailor-made contracts that include different types of covenants, which serve as an early warning system and control mechanism (Berglöf, 1994; Black and Gilson, 1998; Gompers and Lerner, 1996; Lerner, 1995). Because VCs are in close contact with the firm,[10] they can readily monitor compliance with covenants and punish breaches by the founder. A related mechanism is staged finance, which ensures that venture capital funds stop financing a firm if certain performance targets are not reached (Tian, 2011). In ECF, all these mechanisms are largely absent, due to the boilerplate nature of the contracts, making it more expensive for crowd investors to resolve the agency problem with the firm. This situation is particularly severe because the regular crowd holds a small stake and would rationally rather write off an investment than engage in costly monitoring activities.

[10] VCs are often represented at the board (Camp, 2002).

Therefore, angel-like crowd investors might need to compensate for the low level of tailor-made financial contracting by monitoring the local firm more closely. However, ECF usually does not provide for a direct engagement of investors with the investment target, and active local monitoring is not an option for the regular crowd.

2.3.2 Hypotheses

From this situation, I develop five hypotheses. Overall, I expect a local bias to exist in ECF. Despite the lower *ex ante* search costs, I conjecture that Internet portals cannot deliver credible information about the firms, making it worthwhile for some investor groups to collect additional information that is more cheaply obtained when living close by the venture. In addition, influencing the firm *ex post* via the Internet is not feasible with the current ECF portals because their structures do not allow investors to engage directly with the founders. Consequently, local investors could benefit from superior information and have more scope to actively monitor the founders.

Moreover, I expect investors to be more concerned about their investment if they invest a considerable amount. The design of some ECF portals forces investors to invest more, by stipulating a certain minimum investment. The key difference between the two portals in the sample is the size of the minimum ticket, which varies from 4 to 5 EUR for Companisto and from 500 to 25,000 EUR for Innovestment. This is the main variation in portal design the study aims to exploit for the analysis. By setting a low minimum investment ticket, Companisto allows private investors to invest in several firms and to better diversify their portfolio. By contrast, the high minimum investment ticket at Innovestment should attract more angel-like investors and high-income individuals (Haliassos and Bertaut, 1995) who might be willing to conduct on-site due diligence to evaluate the risk of the venture. I therefore posit that Innovestment investors will exhibit a larger local bias.

H1: The larger the minimum investment, the larger is the local bias.

Analyzing crowdfunding campaigns by artists on the portal Sellaband, Agrawal et al. (2015) provide evidence that family and friends largely explain the existing local bias. In line with their results, I hypothesize that family and friends will show a larger local bias.

H2: The local bias is larger for investors with personal ties to the entrepreneur (family and friends).

In comparison with the regular crowd, angel-like tend to invest larger amounts and therefore are more likely to engage in due diligence. Living close by the firm facilitates the screening and monitoring of the business (Chen et al., 2010; Cumming and Dai, 2010). I therefore hypothesize the following:

H3: Angel-like investors who make large investments exhibit a larger local bias.

According to Markowitz (1952), investors maximize their expected returns by maintaining a well-diversified portfolio. One important aspect of diversification is the regional dispersion of investments. The overweighting of local securities can expose investors to clustered risks, which in turn might decrease expected returns. Crowd-lending portals such as Lending Club, Prosper, and Funding Circle therefore offer automated tools that allow the investor to pledge pre-defined amounts in each campaign independent of the respective target.[11] I hypothesize that financially literate investors maintain a well-diversified crowdfunding portfolio and diversify their investments beyond geographic borders (Abreu and Mendes, 2010; Goetzmann and Kumar, 2008). In the context of this article, I proxy for financial literacy by looking at investors who have previous investment experience in other asset classes, diversify their ECF portfolio better, have fewer spelling errors in stating their location, and maintain an overall larger portfolio.

H4: The more financially literate the investor, the smaller is the degree of local bias.

On most European ECF portals, investors can see previous investments by other investors, the amount their peers have pledged, and sometimes where other investors are located. Such a portal design allows for information cascades and can trigger herding behavior among the crowd (Hornuf and Schwienbacher, 2017a; Vismara, 2017a). Thus, investors might no longer engage in a careful screening process and invest without considering the geographic location of the firm. Thus, herding should reduce the local bias. Moreover, the timing of the day has important implication for investors' biases (Coval and Shumway, 2005). Timing also matters in crowdfunding campaigns, with most investments on reward-based crowdfunding taking place on weekends (Mollick, 2014). I expect the investors who invest on the weekend to be less professional, as they probably consider these

[11] See also LendingRobot (https://www.lendingrobot.com/), which automatically invests in Lending Club, Prosper, and Funding Circle.

investments a free-time activity. Less professional investors are also less likely to use local knowledge or engage in extensive on-site screening. To this end, I would anticipate weekend investments to show no local bias. I can also transfer this conjecture to the timing of investments during the day. I expect that professional investors are active during the workday, while less sophisticated investors invest as a free-time activity during the evening or at night.

H5: Herding behavior, weekend and late-night investments reduce the local bias.

Another way to look at the local bias is through the firm's perspective. Founders might find the Internet-based funding channel attractive because it helps them overcome geographic barriers. However, even if none of the individual investors exhibit a local bias, the firm could, from its own perspective, attract solely local investors. Such a local investor base at the firm level could theoretically occur even if investors hold portfolios in line with an optimal geographic diversification. A local investor base at the firm level could arise, for example, because the firm's product has greater appeal to the local crowd or the campaign is promoted at local investment events (Cable, 2010). If local proximity is relevant for investors of some of the firms, relying on ECF might not attract different investors from those whom founders could attract by using purely offline funding channels. If ECF does attract investors at any distance, however, firms might obtain larger amounts of funding that could be decisive in funding and carrying out a project.

2.4 Data and method

2.4.1 Data

For the period from November 6, 2011, to August 25, 2014, I collected data on 21,416 individual investment decisions from two German ECF portals: Companisto and Innovestment. I was able to obtain data on all the campaigns run on the two portals during the observation period. For Companisto, I hand-collected data on 30 campaigns, while Innovestment provided data on 44 campaigns. Information on the location of the firms running the ECF campaigns came from the German company register *(Bundesanzeiger Verlag)*. To identify the investor location, Innovestment provided zip codes of investors' place of residence. Companisto allows investors to post their current location when making an investment; because providing the location is not compulsory, investors had no incentive to misrepresent their place of living. I needed to exclude 956 individual investments from the analysis because no location was provided or the location could not be uniquely identified,

leaving me with 20,460 investment decisions. On Companisto, 65.6% of the investments disclosed a city name, and 34.4% revealed either the country or federal state *(Bundesland)*. I assigned investors who only indicated the state to the city with the largest population in the respective state.[12] Furthermore, I assigned foreign investors who only indicated the country to the city with the largest population in the respective country. Table 2-1 (Panel A) provides an overview of the data I use in the empirical analysis. To learn more about the financial literacy of the investor, I also obtained survey data from Innovestment about the previous investment experience of the crowd in various investment categories. Table 2-1 (Panel B) shows the mean investment amounts by different distance categories for each of the two portals. It reveals that investors living within a range of less than 100 km from the firms invest higher amounts on average than investors living within a range of 100 km to 300 km from firms (Innovestment: $p = 0.057$; Companisto: $p = 0.065$). However, while regionally close investors invest the overall highest amounts on Innovestment, the largest amounts come from distant investors living more than 700 km away for Companisto campaigns. Table 2-1 (Panel C) sets out descriptive statistics for the dependent and explanatory variables.

Table 2-1: Summary statistics
Panel A provides summary statistics of sampled portals, firms, investors, and investments. The sample consists of 74 equity crowdfunding campaigns by firms headquartered in Germany that received 20,460 investments by 6,599 investors between November 6, 2011, and August 25, 2014. Panel B provides summary statistics of mean investments in EUR for different distance categories. Panel C presents summary statistics for the main explanatory variables. Column 'Yes' indicates that a dummy variable takes the value of 1. Column 'Corr' shows bivariate correlations with the local bias for individual investments. ***, **, and * indicate significance at the 1%, 5%, and 10% level. Variables reported are defined in Appendix 1, Table A1-1.

PANEL A: Data sample

	Portal		Location		Total
	Companisto	Innovestment	Germany	Foreign	
Firms	30	44	74	-	74
Investors	6,167	432	5,948	651	6,599
Investments (#)	18,837	1,623	18,898	1,562	20,460
Investments (EUR)	6,250,590	4,512,152	9,755,644	1,007,098	10,762,742

[12] In Appendix 2, Table A2-1 and Table A2-2 report the results restricting the sample to investors providing their exact location (Companisto) and those from the portal that directly provided the location of the investors to me (Innovestment).

PANEL B: Investments by distance categories

Distance	Investment (EUR)								
	Companisto			Innovestment			Total		
	N	Mean	Std.-dev	N	Mean	Std.-dev	N	Mean	Std.-dev
<100 km	3,430	320	944	286	3,434	6,378	3,716	560	2,152
100 km - 300 km	3,912	281	864	436	2,733	3,451	4,348	527	1,551
300 km - 500 km	6,331	314	1,013	608	2,643	3,637	6,939	518	1,590
500 km - 700 km	4,811	387	1,131	259	2,586	2,705	5,070	500	1,350
>700 km	353	570	1,661	34	1,818	1,087	387	680	1,656
Total	18,837	332	1,021	1,623	2,780	4,073	20,460	526	1,647

PANEL C: Variables

	N	Mean	Std.-dev	Min.	Max.	Yes	Corr
Local bias							
Lb_investment	20,460	0.01	0.53	-4.65	1.00		
Lb_portfolio	6,599	0.10	0.43	-4.97	1.00		
Lb_investorbase	74	-0.20	0.94	-5.01	0.96		
Portal and campaign characteristics							
Campaign_days	20,460	69.80	38.94	7	128		0.01***
Campaign_fundingratio	20,460	4.70	4.62	0.00	19.37		-0.01***
Campaign_Innovestment	20,460	0.08	0.27			1623	0.05
Campaign_success	20,460	0.99	0.10			20234	-0.02
Firm characteristics							
Firm_Berlin	20,460	0.67	0.47			13802	0.07
Firm_Hamburg	20,460	0.13	0.34			2689	-0.11
Firm_Munich	20,460	0.03	0.18			677	-0.02
Firm_valuation	20,460	1,763,050	854,350	420,000	10,000,000		-0.11
Industry_entertainment	20,460	0.06	0.24			1201	0.03
Industry_finance	20,460	0.06	0.23			1158	-0.01***
Industry_IT	20,460	0.37	0.48			7515	0.02
Industry_manufacturing	20,460	0.26	0.44			5309	0.02***
Industry_otherservice	20,460	0.01	0.10			223	0.02***
Industry_techservice	20,460	0.03	0.16			557	0.04***
Industry_trading	20,460	0.20	0.40			4041	-0.08
Industry_translogist	20,460	0.02	0.15			456	0.02
Investor characteristics							
Exper_commodity	1,623	0.24	0.43			396	-0.06***
Exper_deposits	1,623	0.43	0.50			698	-0.02***
Exper_fixedincome	1,623	0.31	0.46			505	-0.04***
Exper_fundscertif	1,623	0.42	0.49			680	-0.03***
Exper_othercorporate	1,623	0.30	0.46			495	0.00***
Exper_realestate	1,623	0.31	0.46			503	-0.02***
Exper_stocks	1,623	0.46	0.50			751	-0.05***
Investor_averageinvestment	20,253	523.15	1,488.97	4.00	50,000.00		0.03
Investor_#investments	20,460	11.25	14.51	0	83		-0.04***
Investor_bigcity	20,460	0.31	0.46			6402	-0.04***
Investor_familyfriends	20,460	0.23	0.42			4704	0.04***
Investor_female	18,594	0.13	0.34			2416	-0.01***
Investor_portfolioamount	20,460	4,339.99	8,497.66	0.00	103,191.00		-0.02
Investor_typo	18,837	0.01	0.07			101	0.01***
Region_GDPperP	17,533	43,873.26	16,688.15	14,776	107,142		-0.01***
Investment characteristics							
Investment_#earlier	20,460	28.51	53.35	0	375		-0.06
Investment_5k	20,460	0.02	0.15			446	0.02
Investment_amount	20,460	526.04	1,647.18	4	50,000		0.02
Investment_early	20,460	0.37	0.48			7511	-0.03
Investment_evening	1,623	0.36	0.48			587	-0.07
Investment_night	1,623	0.08	0.26			123	0.00***
Investment_weekend	20,460	0.15	0.35			3009	-0.02

Figure 2-1 depicts a heat map of all 20,460 investments and shows that most investments come from major urban areas such as Berlin, Munich, Frankfurt, and the Ruhr region (see Figure 2-2 for Companisto and Figure 2-3 for Innovestment). Figure 2-4 shows that most of the funding comes from Berlin, Munich, and Stuttgart. Foreign funds come primarily from the two German-speaking neighbor countries Austria and Switzerland (see Figure 2-5 for Companisto and Figure 2-6 for Innovestment). Figure 2-7 provides an overview of the connections between investors and firms, which reveals that funding links are spread throughout Germany (see Figure 2-8 for Companisto and Figure 2-9 for Innovestment).

Figure 2-1: Heat map number of investments (Total)
Heat map of Germany and neighbor countries showing the number of investments. The red dots indicate firm locations.

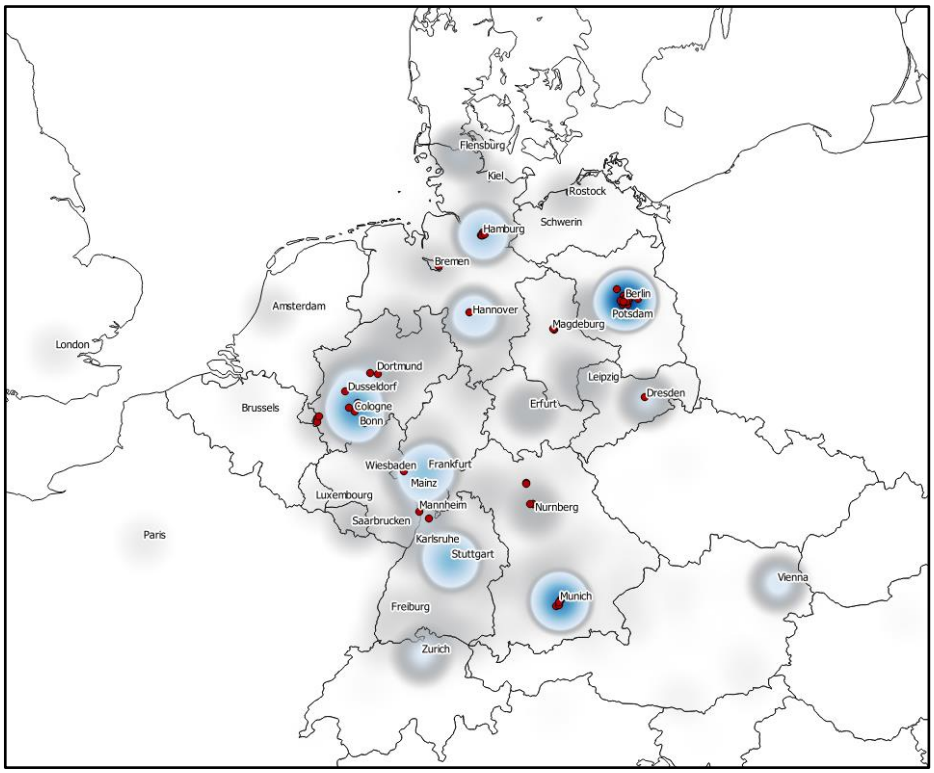


Figure 2-2: Heat map number of investments (Companisto)
Heat map of Germany and neighbor countries showing the number of investments. The red dots indicate firm locations.

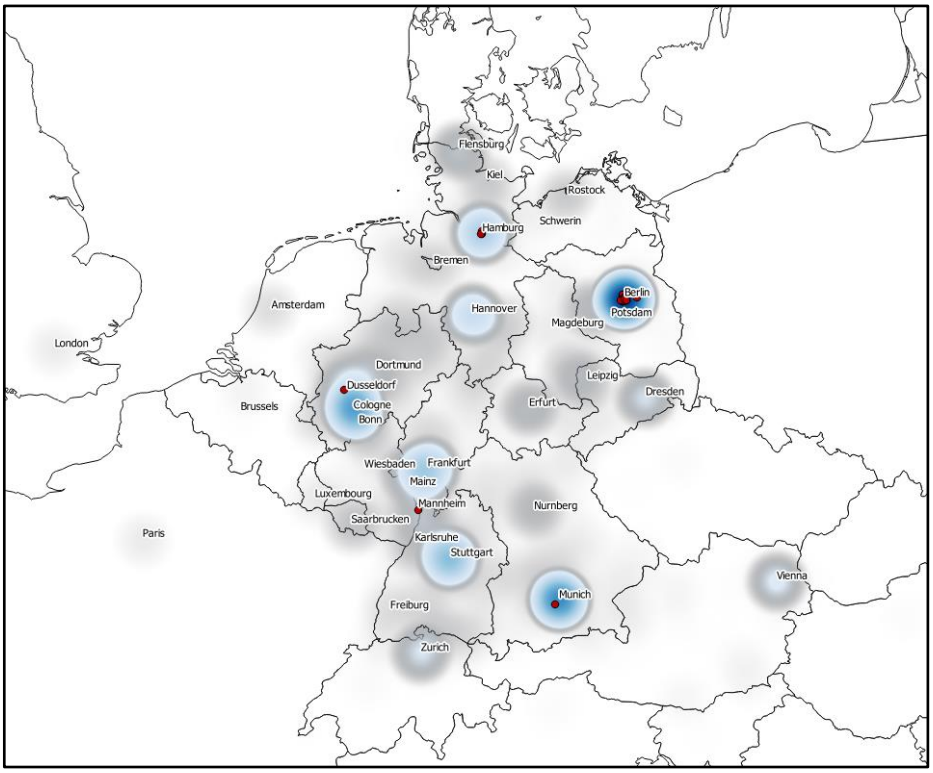


Figure 2-3: Heat map number of investments (Innovestment)
Heat map of Germany and neighbor countries showing the number of investments. The red dots indicate firm locations.

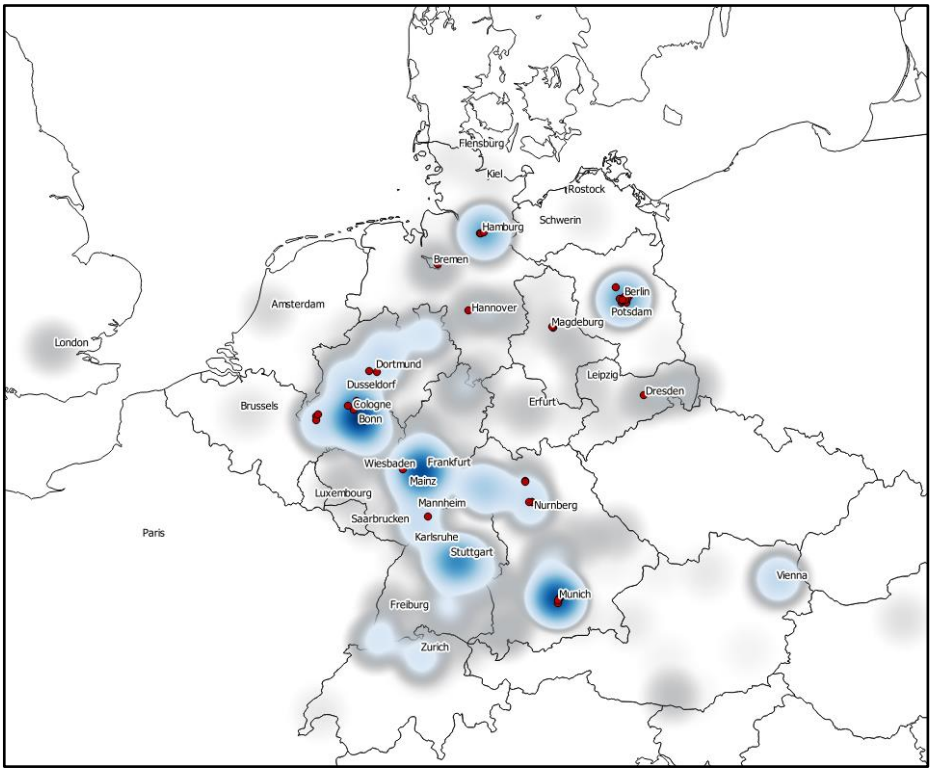


Figure 2-4: Heat map investment amounts (Total)
Heat map of Germany and neighbor countries showing the investment amounts. The red dots indicate firm locations.

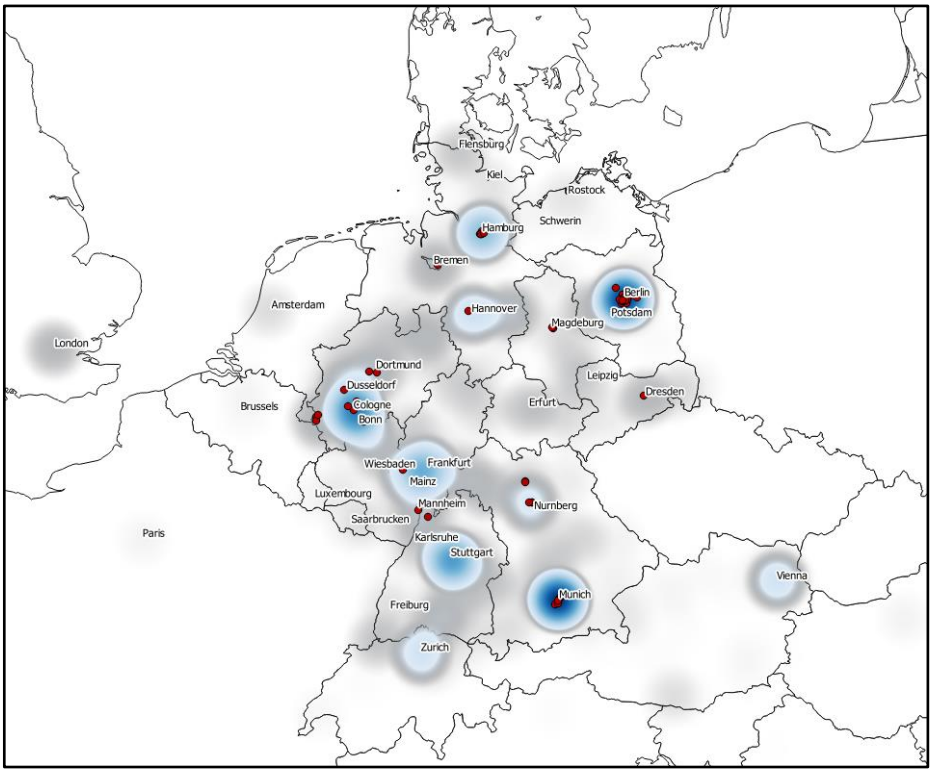


Figure 2-5: Heat map investment amounts (Companisto)
Heat map of Germany and neighbor countries showing the investment amounts. The red dots indicate firm locations.

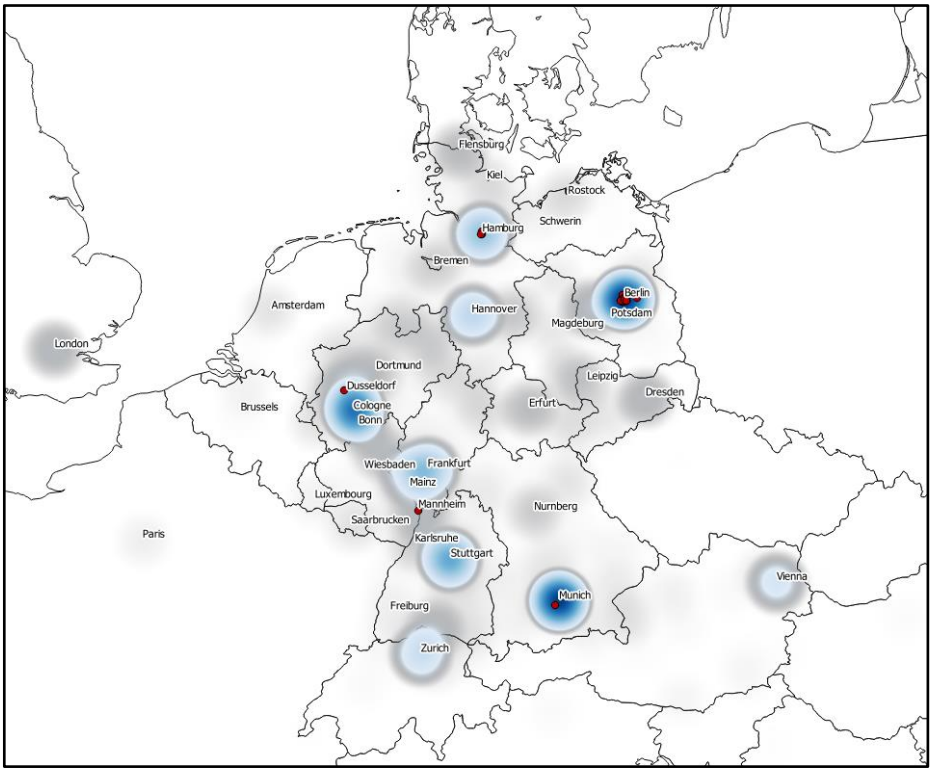


Figure 2-6: Heat map investment amounts (Innovestment)
Heat map of Germany and neighbor countries showing the investment amounts. The red dots indicate firm locations.

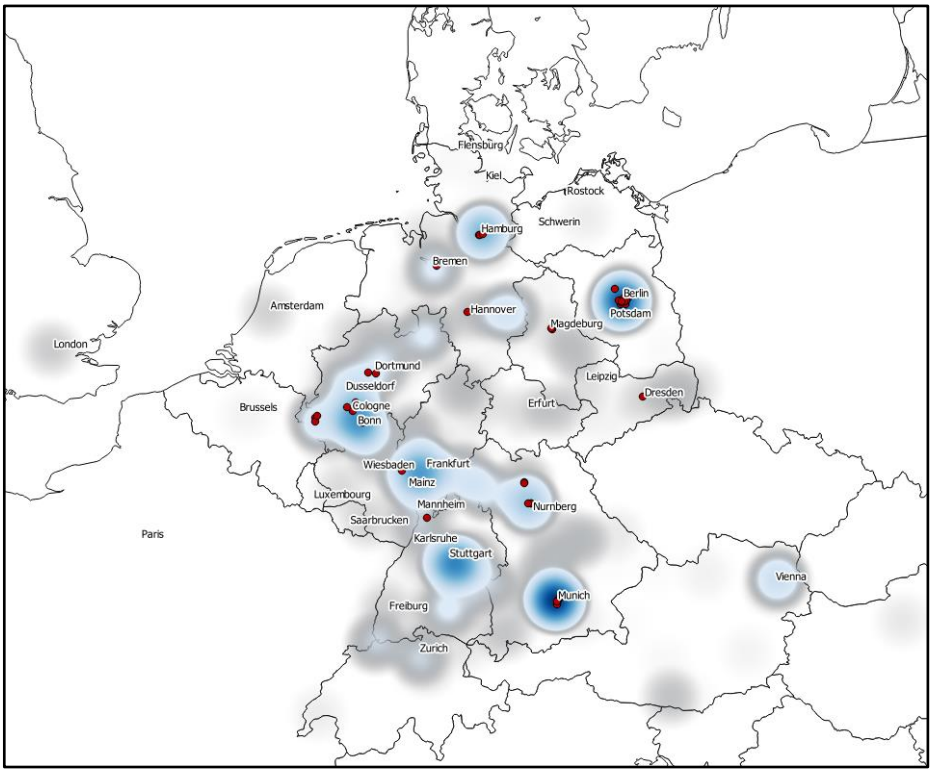


Figure 2-7: Network map firm and investor connection (Total)
Network map of Germany and neighbor countries showing connection between firms and investors (blue lines). The red dots indicate firm locations.

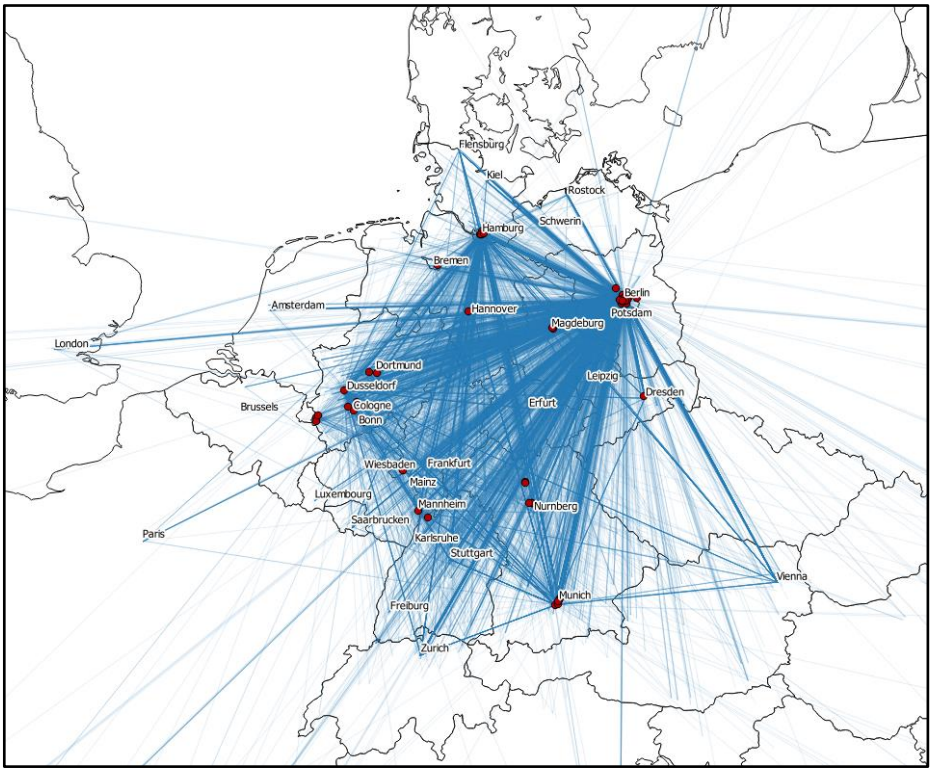


Figure 2-8: Network map firm and investor connection (Companisto)
Network map of Germany and neighbor countries showing connection between firms and investors (blue lines). The red dots indicate firm locations.

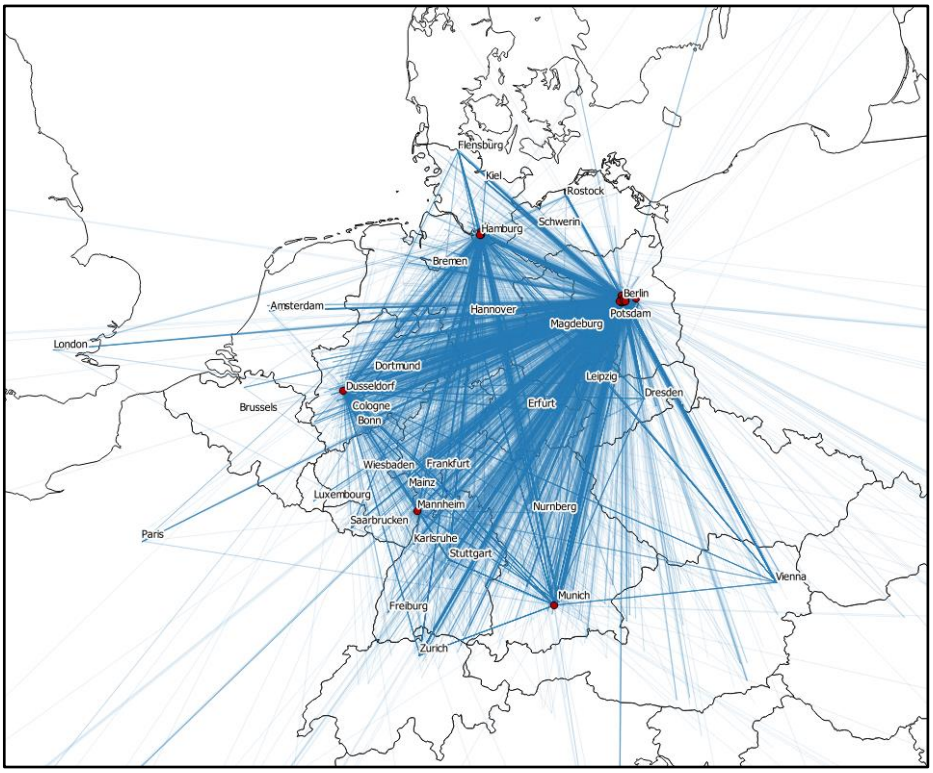
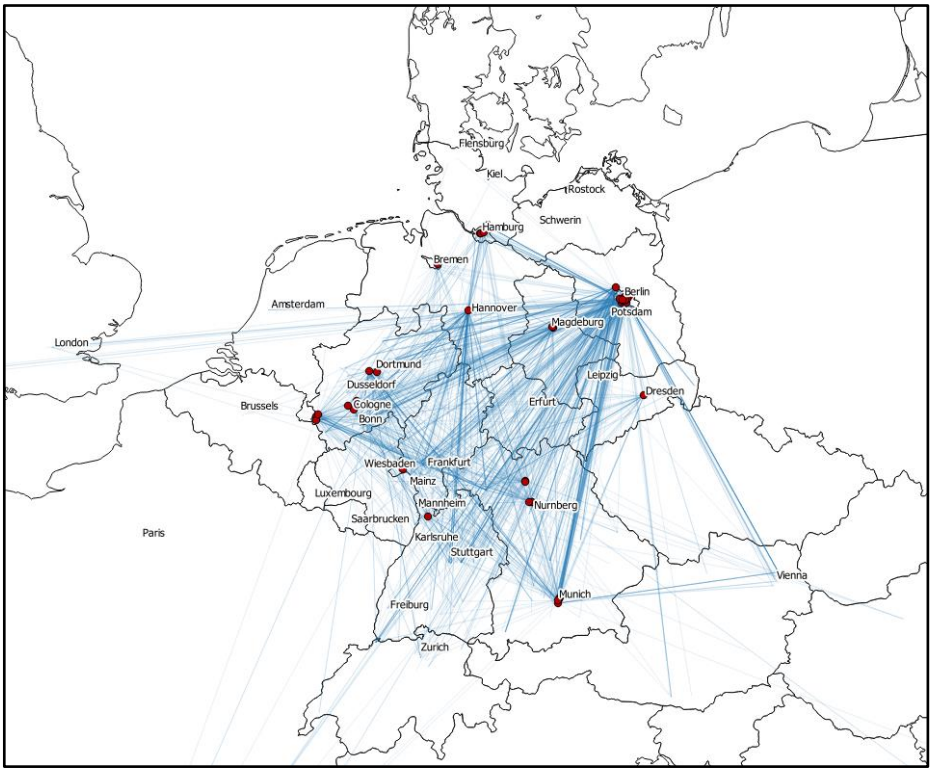


Figure 2-9: Network map firm and investor connection (Innovestment)
Network map of Germany and neighbor countries showing connection between firms and investors (blue lines). The red dots indicate firm locations.



2.4.2 Method

Individual investment perspective

To measure the local bias, I first derive the distance between investors and firms following Vincenty (1975), who calculates the distance between two points on the surface of a spheroid. The location points of investors and firms are specified by longitude and latitude. I then measure the local bias following Coval and Moskowitz (1999). To analyze the effect of firm and campaign-specific characteristics, I first calculate the local bias for individual investment decisions rather than investment portfolios.

To determine whether a crowd investor skews investments toward more local or more distant firms, I must define the distance of a relative benchmark portfolio. Because portals inform investors about their upcoming campaigns on the portal websites or in investor newsletters, I consider not only investment opportunities at the time of the investments decision for this benchmark portfolio but also campaigns that are upcoming in a couple of days or weeks. Moreover, because of these early campaign announcements, investors could have decided to invest in the focal firm even before the respective firm accepts investments, and the geographic proximity of previous investment opportunities might also have influenced the investment decision. Assuming that engagements in start-up firms are usually not made in an ad hoc manner and only few ECF campaigns are run in parallel on a given day, I consider for the benchmark portfolio a time frame of four weeks before and after the actual investment decision is made.

Suppose investors *i* can invest in *N* different firms on an ECF portal. Under the assumption that the investor could potentially have invested in all available firms during the stated time frame, I define the investment weight for each available firm as $\frac{1}{N}$. Let d_{ij} denote the distance between investor *i* and firms *j*; then, I can define the mean distance of the equally weighted benchmark portfolio for the investment of investor *i* as

(1) $$d_{iM} = \frac{1}{N}\sum_{j=1}^{N} d_{ij}.$$

The local bias of investor *i* investing in firm *j* is

(2) $$LocalBias_{ij} = \frac{d_{iM} - d_{ij}}{d_{iM}}.$$

The local bias therefore runs from minus infinity to plus one. A local bias of zero indicates that the investor invested in a firm that is of a comparable distance to the neutral benchmark portfolio. I interpret a positive local bias as a tendency to invest in local firms. A negative local bias indicates that investors prefer firms that are further away.

Investor portfolio perspective

In a second step, I analyze the local bias for the portfolio of each investor on a given ECF portal. This enables me to evaluate the aggregate investment decisions of crowd investors. For Innovestment, I identify investors from a unique user identifier the portal provided to me. For Companisto, I assume that the name and location combination as indicated by the investor provides a good proxy to identify a unique investor. However, because I cannot entirely rule out that there are two users investing on the portal with a popular name such as "Michael," who both live in a large city such as Munich, I report all results excluding investments by users with the 20 most popular German names in the Appendix 2 Table A2-3.[13] Moreover, because I do not expect that two investors from one region using the same name tend to systematically exhibit opposing local biases that cancel each other out, nothing is lost by adding these two investors up in a single portfolio.

Following Seasholes and Zhu (2010), I adjust the distance of the investor portfolio for the amount invested in each portfolio firm. Equation (3) therefore considers the number of successful portfolio investments Z by investor i adjusted for the amount Inv_{ij} invested in firms j. The denominator PF_i is the total amount of investor i's portfolio on August 25, 2014. The weighted distances wd_i of investor i in the overall portfolio is therefore

$$(3) \qquad wd_i = \sum_{j=1}^{Z} \frac{Inv_{ij} * d_{ij}}{PF_i}.$$

Again, the calculation of the overall distance of the benchmark portfolio d_{iM} considers all available firms four weeks before the first investments. Because investors could have included any firm in their portfolio after they identified ECF as a new asset class, I calculate the local bias, considering all available campaigns after the first investment of investor i until the end of the sample period. The weighted portfolio local bias is as follows:

[13] Source: Institute for Employment Research (IAB). Male and female names 1990 to 2011 from German employees.

(4) $LocalBiasPF_i = \frac{d_{iM} - wd_i}{d_{iM}}$.

Firm investor base perspective

Finally, I change the perspective to the investor base of the firm *j*. I apply this approach because research has often argued that ECF via the Internet overcomes geographic barriers between investors and firms (Agrawal et al., 2015). However, the presence or absence of a local bias by individual investors does not necessarily mean that a firm also has a more local or distant investor base. The investor base of a particular firm could be quite local because investors find a particular local start-up worthwhile to engage in even though they generally diversify their portfolio well. To calculate the benchmark investor base of the firm, I consider all investors who have ever invested on a given portal from its start until four weeks after the end of the focal campaign. The distance of the benchmark investor base is therefore

(5) $d_{jM} = \frac{1}{N} \sum_{j=1}^{I} d_{ij}$,

where *I* is the total number of investors who invested on a given portal until four weeks after the focal campaign was completed. To consider a weight for the amounts pledged by the investors of the focal firm, I weight the distance of the overall funding volume $Fund_j$ by the investment amounts Inv_{ij} of investor *i* in firm *j*. The weighted investor base distance is therefore

(6) $wd_j = \sum_{i=1}^{C} \frac{Inv_{ij} * d_{ij}}{Fund_i}$.

I calculate the local bias of firm *j*'s investor base as follows:

(7) $LocalBiasIB_j = \frac{d_{jM} - wd_j}{d_{jM}}$.

2.5 Results

2.5.1 Local bias in equity crowdfunding

Table 2-2 (Panel A) show that investments in ECF have a local bias. The average distance of actual crowd investments is 1.2% closer than the average distance of the benchmark portfolio, and this difference is statistically significant. However, this finding is mainly driven by investments on the portal Innovestment, on which the average distance of

actual investments is 10.6% closer than the benchmark portfolio; on Companisto, it is only 0.4% closer. The difference in the local bias between Innovestment and Companisto investments is statistically significant (difference of means t-test, p = 0.009). Moreover, the local bias on Innovestment exists only for investments from investors located in Germany. Foreign crowd investors do not skew their investments toward more close firms. After I exclude family and friends from the analysis, which represent 16.3% of the investments, the local bias becomes smaller for investments on both portals, which indicates that this investor group explains the behavioral anomaly, at least partly. However, for Innovestment the average distance of actual investments is still 8.2% closer than the distance of the respective benchmark investments. This result remains statistically significant at the 1% level.

Table 2-2 (Panel B) shows the results for investor portfolios. When considering portfolios instead of individual investments, I find an overall stronger local bias, with the average distance of actual portfolios being 10.1% closer than that for the respective benchmark portfolios. Moreover, the local bias of investment portfolios now holds for both portals, with Innovestment again showing a higher local bias of 18.1% and Companisto of 9.5%. The local bias for both portals is statistically different from zero. Moreover, the difference between the two portals is statistically significant (difference of means t-test, p = 0.001). Furthermore, I find that German investors on both portals show a significant local bias while foreign investors do not. Excluding family and friends from the analysis again reduces the local bias. The local bias, however, remains positive and significant at the 1% level for both portals.

In summary, I find strong evidence for a local bias in ECF. The differences between the two portals Companisto and Innovestment indicate that portal design affects the local bias of crowd investors. I therefore also cannot reject H1. By requiring a higher minimum investment and running a second-price auction mechanism, Innovestment potentially attracts more sophisticated investors who tend to invest in more local firms. By contrast, investors on the portal Companisto, which requires a much lower minimum investment and runs a simple first-come, first-served auction mechanism to allocate shares, exhibit a much smaller local bias. One explanation for this difference could be that Companisto investors can diversify their portfolio better because of the lower minimum investment ticket and, as a result, do not direct their investments to more local firms. I investigate this question further in the regression analysis in Section 2.5.2.

By changing the view to the firm's perspective, I do not find a statistically significant local bias with regard to the investor base. If anything, the investor base of the firm is farther away than the benchmark investor base (see Table 2-2, Panel C). This suggests that the new asset class of ECF indeed helps firms overcome geographic barriers when reaching investors via the Internet.

Table 2-2: Local bias

The table provides the Local bias for individual investments (Panel A), investor portfolios (Panel B), and firm investor base (Panel C) in percentages. The table categorizes the local bias according to portals and the location of the investor. Furthermore, local biases are calculated by excluding family and friend investors. In line with Agrawal et al. (2015), I define investors as family and friends if (1) they invest in the focal start-up before investing in any other start-up, (2) their investment in the focal start-up is their largest investment, and (3) the investor invests in no more than three other start-ups. I report a one-sample, two-tailed t-test for the null hypotheses that local biases are zero. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level. Variables reported are defined in Appendix 1, Table A1-1.

PANEL A: Local bias individual investments

	N	Mean	Std.-dev	Minimum	25th	Median	75th	Maximum
By portal								
Companisto	18,837	0.4	53.3	-464.8	-13.1	-0.2	8.2	99.7
German investors	17,431	0.5	55.2	-464.8	-13.1	-0.2	9.2	99.7
Foreign investors	1,406	-0.6	18.4	-46.6	-12.5	-0.1	3.2	80.9
Innovestment	1,623	10.6***	45.3	-283.8	-8.8	1.0	33.9	99.8
German investors	1,467	11.6***	47.0	-283.8	-8.8	1.1	39.1	99.8
Foreign investors	156	1.0	22.0	-59.9	-8.4	-0.2	11.6	67.2
By country								
German investors	18,898	1.3***	54.7	-464.8	-12.7	-0.1	10.8	99.8
Foreign investors	1,562	-0.5	18.8	-59.9	-12.4	-0.1	4.0	80.9
Without family and friends								
All portals	15,761	0.0	54.8	-464.8	-13.4	-0.2	9.2	99.7
Companisto	14,506	-0.7	55.7	-464.8	-13.5	-0.2	7.4	99.7
Innovestment	1,255	8.2***	42.1	-149.3	-8.3	0.7	28.0	99.7
Total	20,460	1.2***	52.8	-464.8	-12.6	-0.1	9.6	99.8

PANEL B: Local bias investor portfolio

	N	Mean	Std.-dev	Minimum	25th	Median	75th	Maximum
By portal								
Companisto	6,167	9.5***	42.0	-497.4	-8.5	-2.5	18.4	99.7
German investors	5,559	10.7***	43.8	-497.4	-8.4	-2.4	21.6	99.7
Foreign investors	608	-1.4**	15.8	-38.3	-9.5	-2.5	4.3	68.5
Innovestment	432	18.1***	48.9	-113.6	-24.4	11.1	50.5	99.9
German investors	389	19.5***	50.6	-113.6	-25.3	15.6	62.3	99.9
Foreign investors	43	4.8	25.8	-32.4	-14.3	0.3	29.8	78.8
By country								
German investors	5,948	11.3***	44.3	-497.4	-8.6	-2.2	24.9	99.9
Foreign investors	651	-1.0	16.7	-38.3	-9.9	-2.3	5.5	78.8
Without family and friends								
All portals	3,010	6.2***	39.2	-497.4	-8.7	-1.9	13.8	99.8
Companisto	2,786	5.5***	38.8	-497.4	-8.3	-2.2	12.0	99.7
Innovestment	224	14.6***	43.2	-87.3	-21.6	7.7	38.8	99.8
Total	6,599	10.1***	42.6	-497.4	-8.7	-2.2	21.1	99.9

PANEL C: Local bias firm investor base

	N	Mean	Std.-dev	Minimum	25th	Median	75th	Maximum
By portal								
Companisto	30	-11.9*	0.3	-1.4	-0.2	-0.1	0.1	0.4
Innovestment	44	-24.8	1.2	-5.0	-0.1	0.1	0.3	1.0
Total	74	-19.6*	0.9	-5.0	-0.2	0.0	0.2	1.0

2.5.2 Contributing factors to the local bias in equity crowdfunding

In this section, I examine important factors that may affect the local bias in ECF. The dependent variable is the local bias of individual investments as outlined in Section 2.4.2, which allows me to identify the effect of campaign-specific factors on the geographic biasedness of investment decisions. In the baseline specification, I include firm characteristics next to campaign dummies to control for the specific effects of each campaign. I include the baseline regression in each subsequent regression but do not report it again as the results remain similar in terms of magnitude and significance. First, after including firm dummies that help me control for unobserved campaign-specific effects, such as the particular contract design of the investments, the founder team, or the business plan of the firm, which could simultaneously affect the campaign duration and the geographic structure of the investments, the findings suggest that the local bias occurs mostly in short campaigns. Second, a higher firm valuation is associated with the campaign attracting investments with a higher local bias. This effect might result from a higher price per share, making it necessary for investors to examine more closely the activities of the start-up firm. Third, the specific industry of the firm also affects the local bias. The base category industry is manufacturing, which exhibits a lower local bias than all other industries except for professional, scientific, and technical activities *(industry_techservice)*.

In Table 2-3 (Panel A), I examine the impact of different types of investors. In line with the descriptive statistics, the regression results reveal that family and friend investors have a significantly larger local bias than the regular crowd. This is also in line with Agrawal et al.'s (2015) finding that this investor group matters most with regard to local proximity in reward-based crowdfunding. Moreover, I find that angel-like investors who invest more than 5 thousand EUR exhibit a positive and statistically significant local bias. While early investments during the first three days of the campaign do not affect the local bias, the combination of early investments and angel-like investors significantly and positively affects

the local bias. This interaction term remains significant even when I control for family and friend investors. I therefore can reject neither H2 nor H3.

Table 2-3 (Panel B) accounts for the financial literacy of investors by employing various proxy variables. First, I consider the ECF portfolio diversification, as measured by the number of investments, and the total portfolio amount as indicators of financial literacy. In line with the conjecture that financially more literate investors are also more detached and consequently exhibit lesser behavioral anomalies, I find that both the number of investments and the total portfolio amount reduce the local bias, which is statistically significant. Regional characteristics might be another proxy variable for financial literacy. Earning a higher income and living in larger cities, which might only be affordable to individuals of a certain income class, constitute proxies for a greater necessity to deal with financial matters. The gross regional domestic product and the size of the investors' hometown may therefore be valid proxies for financial literacy. In the sample, large cities are those with more than one million inhabitants. I find that the average gross domestic product per person in the region where the investor lives decreases the local bias. Likewise, investors who live in large cities also exhibit a statistically significant smaller local bias. This is particularly notable because most of the firms are located in large cities, which indicates that investors must also invest in start-ups outside their hometown.

As a more direct measure of financial literacy, I use survey data on previous investor experience, which is available for Innovestment investors only. The results show that previous investment experience has consistently no effect on the local bias, except for investor who invested in real estate projects exhibiting a somewhat larger local bias. However, this finding is only weakly significant at the 10% level. Previous investment experience in fixed-term deposits, other fixed-income products, stocks, commodities, funds, certificates, and other corporate investments did not affect the local bias of crowd investors. Furthermore, I found no effect for the gender of the investor or whether he or she misspelled the location of origin, the latter of which might have been a good proxy for how diligently the investment decision was made. Overall, the evidence for H4 is mixed. While the direct measures on investment experience show no significant effect, the proxy variables of portfolio diversification and portfolio amount negatively affect the local bias. Responses to the survey on previous investment experience might, however, indicate stated experience on capital markets, while the crowdfunding portfolio diversification provides a revealed measure of financial literacy.

Consequently, I have somewhat more confidence that financial literacy negatively affects the local bias.

Finally, I test the effect of herding and timing on the tendency for a local bias. The herding variable consists of the number of investments pledged earlier that day (see Hornuf and Neuenkirch, 2017, who use the same measure). Table 2-3 (Panel C) shows that there is no significant effect for this variable. Furthermore, the number of angel-like investors who invested 5 thousand EUR and more in the focal campaign does not affect the local bias of other investors. Finally, investors who invest during the weekend and at night have a relatively lower local bias, which is in line with H5. The same result does not hold for the time of the day, with evening and nightly investments having no significant impact on the local bias.

Table 2-3: Local bias regression results
The table shows the results of the baseline regression. The dependent variable is the individual investment local bias as defined in Section 2.4.2. The first column in the baseline regression shows ordinary least squares regression results for the sample of 20,460 investments. The second column shows results for the sample in which I winsorize the data at the bottom 10% to correct for outliers. The baseline category for the industry dummies is manufacturing and is not included in the regressions. All regressions include dummy variables to control for firm fixed effects at the campaign level. In each subsequent regression in Panel A, B, and C, the baseline is included. P-values are in parentheses; standard errors are clustered by investor. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level. Variables reported are defined in Appendix 1, Table A1-1.

Baseline regression

			(win -0.1)	
Campaign_Innovestment	0.131	(0.322)	0.114	(0.298)
Campaign_fundingratio	0.000	(0.892)	-0.001	(0.485)
Campaign_success	0.161	(0.257)	0.080	(0.555)
Campaign_days	-0.013***	(0.000)	-0.012***	(0.000)
Firm_valuation	0.089***	(0.000)	0.089***	(0.000)
Firm_Berlin	-0.989***	(0.000)	-0.792***	(0.000)
Firm_Hamburg	-0.545***	(0.000)	-0.335**	(0.012)
Firm_Munich	-0.606*	(0.076)	-0.492	(0.141)
Industry_trading	0.414*	(0.052)	0.305	(0.118)
Industry_IT	0.562***	(0.000)	0.447***	(0.000)
Industry_finance	0.324***	(0.000)	0.274***	(0.000)
Industry_techservice	-0.428**	(0.050)	-0.340	(0.111)
Industry_otherservice	0.557***	(0.001)	0.361**	(0.019)
Industry_entertainment	0.625***	(0.000)	0.496***	(0.000)
Constant	0.225	(0.472)	0.240	(0.431)
Firm fixed effects	Yes		Yes	
No. of observations	20,460		20,460	
Adjusted-R-square	0.061		0.075	

PANEL A: Family, friends, and angels

	(1)	(2)	(3)	(4)
Investor_familyfriends	0.059***			0.058***
	(0.000)			(0.000)
Investment_early		-0.004		-0.001
		(0.648)		(0.861)
Investment_5k		0.051**		0.009
		(0.048)		(0.724)
Investment_early*5k			0.141***	0.134***
			(0.002)	(0.005)
Firm fixed effects	Yes	Yes	Yes	Yes
No. of observations	20,460	20,460	20,460	20,460
Adjusted-R-square	0.063	0.061	0.061	0.063

PANEL B: Investor characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Investor_#investments	-0.013***						-0.001
	(0.001)						(0.864)
Investor_portfolioamount		-0.002***					-0.003***
		(0.000)					(0.001)
Investor_averageinvestment			0.002				0.010*
			(0.654)				(0.098)
Investment_amount				0.001			0.002
				(0.751)			(0.760)
Region_GDPperP					-0.001***		-0.001***
					(0.004)		(0.007)
Investor_bigcity						-0.037***	-0.034***
						(0.000)	(0.001)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	20,460	20,460	20,253	20,460	17,533	20,460	17,363
Adjusted-R-square	0.062	0.062	0.062	0.061	0.064	0.062	0.068

PANEL B: Investor characteristics (continued)

	(7)	(8)	(9)
	Innovestment	Companisto	
Exper_deposits	0.062		
	(0.318)		
Exper_stocks	-0.098		
	(0.168)		
Exper_fundscertif	-0.015		
	(0.844)		
Exper_fixedincome	-0.026		
	(0.622)		
Exper_commodity	-0.046		
	(0.331)		
Exper_realestate	0.075*		
	(0.095)		
Exper_othercorporate	0.030		
	(0.371)		
Investor_typo		0.025	
		(0.564)	
Investor_female			0.000
			(0.980)
Firm fixed effects	Yes	Yes	Yes
No. of observations	1,623	18,837	18,594
Adjusted-R-square	0.207	0.050	0.050

PANEL C: Herding and timing

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
						Innovestment		
Investment_#earlier	-0.001			-0.001				
	(0.335)			(0.227)				
Investment_#earlier5k		0.007			-0.000			
		(0.851)			(0.993)			
Investment_weekend			-0.021**	-0.025**	-0.021**			
			(0.039)	(0.015)	(0.037)			
Investment_evening						-0.020		-0.021
						(0.353)		(0.340)
Investment_night							-0.003	-0.010
							(0.938)	(0.765)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	20,460	20,460	20,460	20,460	20,460	1,623	1,623	1,623
Adjusted-R-square	0.061	0.061	0.061	0.061	0.061	0.202	0.202	0.202

2.5.3 Robustness check

First, I check for the robustness of the results by winsorizing the data. I find the coefficients of the baseline regression to hold except for the professional, scientific, and technical activities dummy (*industry_techservice*), which is no longer significant. Second, as discussed in Section 2.4.1., I restrict the Companisto sample to investors that provided their exact location. Table A2-1 (Panel A) in Appendix 2 shows that the average distance of actual crowd investments is 1.3% closer than the average distance of the benchmark portfolio, and

this difference is now statistically significant. When considering portfolios instead of individual investments, I find an overall stronger local bias, with the average distance of actual portfolios being 13.3% closer than that for the respective Companisto benchmark portfolio (Appendix 2, Table A2-1, Panel B). By changing the view to the firm's perspective, I again find no statistically significant local bias at conventional levels. For the regression results I observe qualitatively and significantly similar results, except that campaigns that were successfully funded *(campaign_success)* are now strongly significant and the duration of the campaign *(campaign_days)* is no longer significant. Furthermore, for the restricted sample I find no significant effect for investments during the weekend. Finally, by excluding investments by users with the 20 most popular German names (Appendix 2, Table A2-3) I observe slightly stronger effects than before.

2.5.4 Local bias and firm failure

In a final step, I investigate whether ECF investors who direct their investments to local firms realize higher, lower, or the same returns as investors not prone to this behavioral anomaly. In total, I consider 74 campaigns of 68 unique firms in the sample. Until June 30, 2016 a total of 19 of these firms went into insolvency or were dissolved. None of them experienced an exit event in form of a buy-out through a venture capital fund. Hence, until now investors solely realized losses but none of them realized returns in form of a cash-payout. I do not report returns on investment because the recovery rates are unknown. However, hardly anything is lost by reporting firm failure rates because recovery rates are expected to be close to 0%, given the start-ups often have no significant assets and the financial instruments used in ECF are subordinated to ordinary debt. Table 2-4 shows that investors who directed their investments towards local firms lost their investments significantly more often relative to other investors (20.4% vs. 14.7%). This result is driven by investors that choose to invest on Companisto. For Innovestment, I find evidence that local investments, which might be associated with more screening or monitoring activities, lead to a somewhat lower insolvency rate for the portfolio companies (19.7%) relative to more distant firms (29.0%). This finding might be the result of Innovestment being able to attract a more sophisticated crowd.

Furthermore, one can presume that firms having a more local investor base should also be controlled more closely. I therefore test whether a more local investor base leads to less

firms running into insolvency or being dissolved. The results show that a more local investor base is not associated with a higher survival rate.

Table 2-4: Local investments and firm failure
The table shows the percentage of failed firms according to the local bias. I report a two-sample t-test for testing the equality of the means. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level.

	Individual investment				Investor base			
	N	Mean	Std.-dev.	*t*-statistics	N	Mean	Std.-dev.	*t*-statistics
By local bias								
Positive (>0)	9,830	0.204	0.403	-10.796***	41	0.317	0.471	-1.322
Negative (≤0)	10,632	0.147	0.354		33	0.182	0.392	
By portal								
Companisto								
By local bias								
Positive (>0)	8,952	0.205	0.403	-12.626***	11	0.182	0.405	0.183
Negative (≤0)	9,885	0.136	0.343		19	0.211	0.419	
Innovestment								
By local bias								
Positive (>0)	878	0.197	0.398	4.420***	30	0.367	0.490	-1.521
Negative (≤0)	747	0.290	0.454		14	0.143	0.363	

2.6 Discussion and conclusion

This study contributes to the nascent and scarce literature on investor behavior in ECF (Block et al., 2017b; Vismara, 2017a; Vulkan et al., 2016). This literature has examined determinants of funding success and investment dynamics as well as the crowd's willingness to pay for cash flow rights. Although Guenther et al. (2017) find that geographic distance is negatively correlated with investment probability, they do not consider benchmark portfolios or behavioral anomalies. The perspective is different in that I investigate what determines the local bias of individual investments and investor portfolios.

I began with the question whether a local bias occurs in ECF. The results reveal that a local bias exists for individual investments and investment portfolios. I show that the average distance of actual crowd investments is 1.2% closer for individual investments and 10.1% for investor portfolios than the average distance of the respective benchmark portfolios. However, I find that the effect varies significantly for portals, with investors on Innovestment showing a significantly larger local bias. This finding is most likely due to Innovestment's higher minimum investment tickets and its second-price auction mechanism, which presumably attracts more sophisticated investors. Although in general family and friends show a larger local bias, I find that the remaining investors still exhibit a local bias even when controlling for this specific investor group. Investors with large investments also have a larger local bias,

which might result from their engaging in more on-site screening. Assuming that financially more literate investors have a better diversified and larger portfolio, I find that this group suffers less from the behavioral anomaly. Changing the perspective to the firm level, I show that firms do not have a more local investor base, suggesting that ECF indeed overcomes geographic barriers.

Research on reward-based crowdfunding shows that backers who identify themselves with projects in social networks have a larger pledge to backer ratio (Kromidha and Robson, 2016). I therefore investigated whether the firms in the sample develop products or services that have an obvious local appeal. However, there was not a single craft brewery or community related service firm in the sample, which would have indicated such a local product focus. The firms in the sample, for example, have developed a laser based process to produce nanoparticle or offer a nationwide subscription service for toys and games. The study nevertheless has clear limitations, which provide fruitful avenues for further research. First, while a local bias constitutes a decision-making anomaly that deviates from an optimally diversified portfolio in the spirit of Markowitz (1952), investing in more local firms might well be profitable for investors if they can extract important information through on-site screening and monitoring. The analysis provides first evidence that portal design plays a crucial role in attracting a more sophisticated crowd. On Companisto—which requires a lower minimum investment and runs a simple first-come, first-served auction—local investors more often choose firms that later went into insolvency or were dissolved. In contrast, local investors on Innovestment—where the minimum investment is relatively higher and tickets are allocated through a second-price auction—less often choose firms that went into insolvency or were dissolved. Future research should thus investigate different types of portals and analyze which portal characteristics attract a more sophisticated crowd. Furthermore, whether portfolios directed to more local firms outperform the benchmark portfolio in the long run is a matter that should be investigated empirically when data are available on the performance of these investments. Second, the study shows that portal design matters. However, although the features I have identified are clearly dominant in the portals I investigate, I can only speculate that they drive the differences. Additional research might therefore investigate data on more portals to unpack the exact features of portal designs that determine the local bias.

3 Capital structure and equity crowdfunding

3.1 Introduction

New ventures need capital, and for a long time, this was primarily provided by family and friends, BAs, or VCs. In the past few decades however, new ways of financing have emerged and widely expanded an entrepreneur's choice of financing. Whether entrepreneurs are participating in start-up competitions, working side by side in an incubator, or receiving specialized mentorship in an accelerator program, combined with financial benefits such as grants or free office space, venture debt and mini bonds are consistently becoming part of the regular financing choices of modern start-ups (Block et al., 2017a). Coherent with the social media boom, certain Internet platforms also allow the exploitation of the crowd to raise money. As a special case of crowdfunding, ECF enables every user to obtain an equity share from the new venture. With this finance method gaining popularity only recently, most of its dynamics and effects have scarcely been investigated.

A significant research gap lies at the intersection of capital structure theory and ECF. Capital structure itself has been subject to a significant amount of research in the past century, begun by the work of Modigliani and Miller (1958) suggesting that in a perfect market[14] the value of a firm is not affected by its capital structure choice. Subsequent research arrived, with several theories explaining capital structure determinants in a more comprehensive way. Yet only a small portion of this research is dedicated to young firms, and an even smaller fraction differentiates between financing methods. Considering that the right choice of capital structure can positively affect businesses, most of the theories strive for an optimal level of equity and debt. Moreover, the emergence of new ways to fund ventures, such as ECF, requires adjusting existing theories and acknowledging new empirical findings. The goal of this study is to add new empirical findings to the literature on capital structure.

That being said, especially two aspects of capital structure in an ECF environment deserve closer attention. First, the study aims to further investigate whether *ex ante* capital structure is a determinant for the decision of firms to launch an ECF campaign. ECF can confront several adverse selection problems because, for example, only firms unable to attract

[14] In a perfect market, "any two commodities which are perfect substitutes for each other must sell, in equilibrium, at the same price" (Modigliani and Miller, 1958, p. 268).

VCs or other financing institutions tend to rely on these financing methods.[15] A comparison of the financials of start-ups using ECF with matched firms outside the ECF environment might prove that the capital structure of a firm (e.g., high debt) does not drive the firm to use ECF, and thus other explanations must be considered.

A second step more closely examines the impact of ECF on a firms' capital structure. As a successful ECF campaign should give firms an equity injection, at the end of the funding, it might be obvious to assume that the ratio of equity to total assets would also increase. However, a stagnant equity ratio and the respective growth in total assets would indicate an increase in debt and, respectively, follow-up debt funding. This second part is of particular relevance as there is only limited research focusing on start-ups after the campaign. Of note, Mollick and Kuppuswamy (2014) investigate the overall outcomes of reward-based crowdfunding, Signori and Vismara (2016) evaluate the returns of ECF, and Colombo and Shafi (2016), as well as Hornuf and Schmitt (2017) examine the survival rates and chances for follow-up equity funding after a successful ECF campaign. The current work extends these works by analyzing follow-up debt funding.

To provide first evidence on the interdependencies of ECF and capital structure, I evaluate a hand-collected data set of 198 UK firms that ran a successful ECF campaign on one of the two market leader platforms Seedrs and Crowdcube. By adding a control sample through a one-to-one PSM, I find that the capital structure, measured either by equity or the ratio of equity to total assets, is not a determinant of undertaking an ECF campaign. Furthermore, compared with the control group, the equity of crowdfunded firms rises only weakly significantly in the year of the ECF campaign. However, in the subsequent year, there is no effect left. In addition, there is no significant impact on a firm's debt. This finding is confirmed by a short survey that shows that firms do not benefit from the equity injection by ECF in terms of subsequent debt funding. In summary, firms that undertake ECF do not differ in their capital structure from non-crowdfunded firms before the campaign. This finding indicates that crowdfunded firms are not worse or better off than non-crowdfunded firms. However, crowdfunded firms should not expect ECF to bring them significantly more capital in the medium term compared to other firms. This is true for equity and debt. Overall, the study provides first insight into the relationship between capital structure and ECF. The

[15] For various recent adverse selection claims and discussions, see Ahlers et al. (2015), Colombo and Shafi (2016), Hornuf and Schwienbacher (2016), Kortleben and Vollmar (2012), Strausz (2017), Tomboc (2013), and Vismara (2017ab).

findings enrich the knowledge about the determinants of ECF campaigns and disclose the consequences for crowdfunded firms.

The remainder of this chapter proceeds as follows: Section 3.2 gives an overview of capital structure theories and empirical findings. Section 3.3 describes sources of funding for start-ups and, specifically, how this funding interacts with the capital structure of start-ups. Section 3.4 describes the development of the hypotheses, after which Section 3.5 presents the data and depicts the used methods. Section 3.6 reports the results. Finally, Section 3.7 concludes with a discussion and implications of the results.

3.2 Capital structure determinants

3.2.1 Conventional theories of capital structure

How successful businesses are financed is a fundamental question in the management and finance research field and has been widely discussed.[16] An early advocate of different capital structure theories is Stewart C. Myers. Myers (1984) arrives at two major hypotheses: the pecking-order theory and the static-trade-off theory. Myers seems to be the prime eponym for the pecking-order theory, although he states, that the pecking-order theory "comes through loud and clear" (Myers, 1984, p. 581) in the early work of Donaldson (1961).

The static-trade-off theory originated in the debate that arose from the Modigliani and Miller (1963) theory of irrelevance. Converting this idea to the real world, debt should always be the first, best option as soon as firms are exposed to the beneficial effects of debt finance on their tax liability. The tax benefits should lead enterprises to use debt excessively. As this was not the case, Kraus and Litzenberger (1973) arrived at the assumption that firms face a trade-off between the tax benefits of debt and the bankruptcy costs of debt. The latter is primarily based on the risk of financial distress every venture carries.[17]

Another problem, other than market imperfection that occurs in the original theory of irrelevance by Modigliani and Miller (1963), was the conflict with the observed debt use before tax relief of debt was available to companies. Jensen and Meckling (1976) and Myers

[16] For a comprehensive overview on capital structure theories with a focus on SMEs also see Moritz (2015).

[17] Cassar (2004) differentiates between direct bankruptcy costs, affecting liquidation (Harris and Raviv, 1991), and indirect bankruptcy costs, meaning, for example, that stakeholders lose faith in the business's likelihood of survival (Titman and Wessels, 1988).

(1977) suggested agency costs to explain why debt was used extensively as a financing practice even before it offered any tax advantage over equity financing. Agency costs in this scenario include the costs stemming from a principal–agent relationship between owners/investors and managers and also between the company and its creditors (Stiglitz and Weiss, 1981).

Thus, a firm can be portrayed as juggling the values of tax benefits, the costs of bankruptcy, and agency costs, while substituting debt for equity or equity for debt, until the value of the firm is maximized (Myers, 1984). Incorporating recapitalization costs, time effects, and expectations, Fischer et al. (1989) finally arrived at a dynamic trade-off theory, in which firms inertly adapt their capital structure and thus follow a range of optimal capital structures.

Myers and Majluf (1984) laid the foundation for the pecking-order theory (POT). Information asymmetries between firm insiders and the capital market result in different financing strategies to minimize the collateral costs. To overcome existing information asymmetries managers use debt as a signal for confidence in the firm, while the use of equity would suggest that they want to profit from overvalued stocks. More specifically, Myers (1984) argues that the POT performs at least as well as the static-trade-off theory in explaining the observed financing choices and their effects on stock prices. Broadly speaking, the POT proposes that firms should prefer internal to external financing—or debt to equity (Berger and Udell, 1998).

A more recent theory by Baker and Wurgler (2002) suggests that firms issue equity at times when their market value is higher than the book value and repurchase otherwise. This theory is called “market-timing theory.” In this theory, financing risk does have an impact; this risk is caused by the assumption that firms return to the financial markets at regular intervals. Because the availability of funding can change over time and even successful projects face difficulties in raising capital, this risk might be reduced by seeking funding less frequently or timing ECF campaigns accordingly (in the context of new ventures see Nanda and Rhodes-Kropf, 2013, 2017).

3.2.2 Empirical literature

Conventional theories of capital structure originated in ideas from the last century. Since then, the financing market has been subject to substantial changes caused by new

technologies, economic shocks, and related regulations and policies (Block et al., 2017a). Many studies investigated the empirical robustness of the mentioned theories during that time, but Graham and Leary (2011) argue that the crucial problem in research on capital structure is the challenge to exactly measure capital structure, regardless of whether this stems from a lack of theories or difficulties with empirical estimations. An empirical evaluation of the capital structure theories is not only time dependent and difficult but also indispensable to apply the theories in a modern context.

Again, beginning with the static-trade-off theory, Frank and Goyal (2009) test factors for explaining market leverage and find evidence supporting the theory. However, when comparing the static-trade-off theory with the POT directly, the latter would be more accurate in describing a firms' issue decisions (De Jong et al., 2011). In addition, a large amount of empirical evidence supports this advantage of POT over the static-trade-off theory. For example, Shyam-Sunder and Myers (1999) identify the POT as a suitable descriptor of corporate finance behavior.[18] In a sample of 556 manufacturing firms of the Indian corporate sector, Bhaduri (2015) finds strong empirical evidence for the POT. Using a "constrained" POT, Holmes and Kent (1991) show that some firms do not even consider external equity funding, partly because of its scarcity and their ambition to retain power. Recent studies have focused on proving static-trade-off theory and POT in certain areas and markets (Allini et al., 2017; Bhama et al., 2016; Serrasqueiro and Caetano, 2015; Zeidan et al., 2017).

On the other side, researchers have also challenged certain aspects of the POT. Brennan and Kraus (1987), Constantinides and Grundy (1990), and Noe (1989) use a similar model to that of Myers and Majluf (1984) but argue that the POT fails if firms are not restricted in their financing choices. In addition, Dong et al. (2012) examine market timing and POT in a sample of Canadian firms and find that firms issue equity only when they are overvalued and repurchase equity when they are undervalued, a notion that conflicts with POT.

[18] Using only a sample of 157 firms, however, Shyam-Sunder and Myers (1999, p. 242) state that the "pecking order is an excellent first-order descriptor of corporate financing behaviour, at least for our sample of mature corporations."

3.3 Sources of funding for start-ups

3.3.1 Introduction to start-up financing

According to Cumming and Johan (2017), the emerging field of entrepreneurial finance began in the 1970s with several new journals. In this field, multiple studies have investigated the financing decisions of start-ups. However, finance is mostly linked to fast-paced innovation, which is why research commonly lags behind the regularly arising new ways of finance. Examining the financing choices of start-ups seems an adequate approach because of the particularities of new ventures. In this section, I distinguish between equity and debt financing. I present specialties in capital structure and financing of start-ups, followed by a brief overview of equity and debt financing for start-ups and a discussion on the interactions and order of different sources of funding.

First, I need to evaluate whether the mentioned traditional theories on capital structure are applicable to small and medium-sized enterprises (SMEs). Similar to the general criticism of capital structure research, Cassar (2004) complains about the lack of empirical testing of finance theories associated with start-ups and SMEs. However, several studies have theoretically acknowledged the POT as particularly relevant for SMEs, due to the typical features of start-ups and their limited access to external finance (Holmes and Kent, 1991; Pettit and Singer, 1985). While Cassar and Holmes (2003) generally support both static-trade-off theory and POT for SMEs, Michaelas et al. (1999) and Sogorb-Mira (2005) only confirm the latter. SMEs often behave like larger firms in capital structure decision making because their capital structure also hinges on business-line characteristics and asset structure (Scherr et al., 1993). However, most determinants of SME financing are still valid for start-ups. For example, SME size and debt have a positive relationship (Bhaird and Lucey, 2010; Michaelas et al., 1999; Sogorb-Mira, 2005), which coincides with the proposal that larger start-ups generate a higher proportion of debt (Cassar, 2004).

Beyond the mentioned theories, significant empirical evidence supports other determinants of capital structure choice for start-ups. Probably the most obvious determinant is the industry. The agriculture, foresting and mining industry differ substantially from the trade, communication and finance industry in terms of financing (Hall et al., 2000; Michaelas et al., 1999). Accordingly in one of the most innovative and start-up-driven industries, the technology industry, start-ups differ strongly from other start-ups in their capital structure

decision (Coleman and Robb, 2012). They show that these firms raised a substantially higher ratio of external equity financing compared to non-technology-based firms.

Abundant empirical evidence also shows that the characteristics of the firm (e.g. size, ownership structure, profitability, asset structure) are crucial determinants of capital structure choice (Bhaird and Lucey, 2010; Cassar and Holmes, 2003; Chittenden et al., 1996; Michaelas et al., 1999; Psillaki and Daskalakis, 2009; Romano et al., 2001). Psillaki and Daskalakis (2009) also confirm that size has a positive effect on the leverage, while profitability and asset structure have a negative influence. Using a sample of 3630 SMEs from France, Greece, Italy, and Portugal, they remove country effects and base differences in capital structure on firm specifics. Start-ups also experience discrepancies in capital structure from specific owner characteristics. There is a negative relationship between owners' age and debt (Scherr et al., 1993), while owner gender also affects capital structure (Verheul and Thurik, 2001).[19] Another unique determinant of start-up capital structure is the expected size of the venture. The future growth of a start-up positively influences the willingness to raise debt (Cassar, 2004; Scherr et al., 1993).

3.3.2 Equity

Regarding equity financing options, Drover et al.'s (2017a) literature review delivers a broad overview of studies in entrepreneurial equity financing. Investors trade their money against shares of the company, which grants them participation in profits and firm growth. While equity financing is often associated with initial public offerings (IPOs) and stock markets, the options to issue equity for start-ups are very different. This brief summary of equity funding sources for start-ups begins with the most obvious means of financing: founder, family and friends. It continues with VC, as the most well-known funding source for new ventures. Afterward, attention is paid to BAs, as a second big player of equity funding, and how they differ from VCs. Then, a brief description about the newly emerging funding source by accelerators is given. Last, I conclude with distinctions of ECF.

The first steps of a start-up are generally financed by the owner him- or herself (Ang, 1992; Berger and Udell, 1998; Robb and Robinson, 2014). This internal financing can be

[19] While Scherr et al. (1993) specifically note, that male owners as use higher debt than female owners, Verheul and Thurik (2001) only find female owners having lower amount of capital. In accordance, Muravyev, Talavera and Schäfer (2009) find that female-managed firms are actually less likely to obtain a bank loan.

either debt or equity financing (Robb and Robinson, 2014) and can also come from friends and family (Ang, 1992; Lee and Persson, 2016). Given the high risk, people who invest in start-ups are often referred to as family, friends, and fools (Kotha and George, 2012).

Venture capital has gained noteworthy popularity in the past decades. The venture capital–backed computer technology giants Apple, Google, and Microsoft have proved that venture capital bears great potential to generate firm value. These firms are considered the three most valuable brands in the world,[20] and thus it is highly important to determine how they became so successful. Many entrepreneurs have great visions and ideas, but even so, there is no guarantee that they also possess the ability to competently manage the start-up, which makes venture capital essential to enhance management skills and add managerial talent (Hellmann and Puri, 2002; Jeng and Wells, 2000). Roure and Maidique (1986) report that the high motivation of both the owner and VCs is a driving force of success. VCs are professional investors that fund selected projects and firms.[21] Venture capital could also be provided by corporations wanting to invest in start-ups and, in this way, to commit to innovation. This type of venture capital is called corporate venture capital (Dushnitsky and Lenox, 2005). Either way, these groups grant expertise, business experience, and, most of all, a high amount of capital. Compared to other start-up financing methods, VC provides the largest amount of money, heavily weakening any monetary restraints and allowing firms to start their businesses at a relatively large scale (Bhaird and Lucey, 2010; Jeng and Wells, 2000).[22]

Although the project-funding size can be relatively large, the overall amount of money VCs invest has always been small in relation to angel investing (Fenn and Liang, 1998). Angels are usually wealthy individuals who invest in companies in early stages of development, as their budgets are limited by their personal wealth (Gompers, 1994). BAs are more likely to form a personal bond and usually build stronger social ties with the

[20] Millward Brown (http://wppbaz.com/charting/19 [accessed September 28, 2017]) and Interbrand (http://interbrand.com/best-brands/best-global-brands/2016/ranking/ [accessed September 28, 2017]) rank them as the top three most valuable brands.

[21] Cumming (2005) analyzes the way VCs invest their money. He challenges the long-held position that convertible-preferred equity is the optimal form of venture capital and argues that the fondness of this investment type relies on US policy. Accordingly, in 3083 Canadian venture capital equity acquisitions, only 10.87% were classified as convertible-preferred equity, while commonly used equity makes up 36.33% of all investments.

[22] Bhaird and Lucey (2010) also find a positive relationship between size and use of VCs and argue that their size grants them this external equity.

entrepreneurs they invest in and maintain a less meticulous level of control (Goldfarb et al., 2013). Fairchild (2011) argues that this is why BAs are preferred to VCs in start-up financing; that is, the entrepreneur considers behavioral aspects, such as empathy and trust, as well as economic factors. Multiple studies have confirmed that the amount that BAs and BA networks invest in start-ups at least reaches, if not exceeds, the amount invested by VC firms (Chemmanur and Chen, 2006; Hellmann and Thiele, 2015; Wong et al., 2009); by contrast, research on BAs makes up only a small portion (10%) of the studies in entrepreneurial finance (Drover et al., 2017a). Chemmanur and Chen (2006) argue that VCs and BAs differ in two crucial points: (1) VCs are scarce compared to BAs[23] and (2) BAs do not add significant value to the firm beyond their money (Hochberg, 2012; Prowse, 1998; Wong et al., 2009). This does not include BA networks, however. These networks help BAs to improve their investment strategies and grant major networking benefits (Bonini et al., 2016). As noted previously, VCs exert several beneficial effects on a start-up as single investors.

Accelerators are another financing type for start-ups (e.g., Y Combinator, Tech Star). They add noteworthy value to early-stage start-ups but invest with relatively small amounts of capital. As only a handful start-ups receive venture capital investments (Cosh et al., 2009; Robb and Robinson, 2014), accelerators act as a substitute as well as a stepping stone on the way to for venture capital (Winston-Smith et al., 2013).

Having laid out the characteristics of the main traditional sources of equity for start-ups, the following introduces a rather new form of equity financing: ECF. ECF is a subcategory of crowdfunding.[24] The common ground of all crowdfunding models is that they are mainly directed to a huge mass of people. In contrast to crowdlending, reward-based crowdfunding, and donation-based crowdfunding, ECF grants investors access to future profits in the form of shares. Crowdfunding is often titled as a democratization of entrepreneurial finance (Colombo and Shafi, 2016; Mollick, 2013; Mollick and Nanda, 2015; Vismara, 2017b); yet, in a certain way, the power is centralized and transferred from the investors to the entrepreneur, as the latter does no longer face few sponsors holding a major part of the assets but a large crowd of

[23] Wong et al. (2009) provides empirical evidence that the business angel market is larger than the venture capital market.

[24] For extensive literature reviews on crowdfunding, see Feller et al. (2015) and Moritz and Block (2016).

people, each holding only a small portion.[25] Crowdfunding itself helps to close a substantial funding gap; many ECF projects would not have been funded otherwise, as they offered too small returns along with high transaction costs for other equity financing methods, suggesting that there actually is a financial gap to fill (Klöhn and Hornuf, 2012). The UK ECF market, which is the focus of this study, is the fastest-growing market for ECF in the world. This strong growth is probably caused by the regulatory frameworks and notable tax benefits[26] (Vulkan et al., 2016). In contrast to the early adaptation of the ECF framework in the UK, Title III of the JOBS Act went into effect in the US in 2016.

For the current research, ECF introduces various novelties to the financing world. For example, ECF opens investing in start-ups to a new type of investor; more accurately, it makes virtually everyone a possible investor, and therefore many researchers have tried to evaluate the respective chances and dangers of investing (Ahlers et al., 2015; Belleflamme et al., 2014; Greenberg and Mollick, 2017; Hagedorn and Pinkwart, 2016; Lin et al., 2014). Ample research has also focused on the motivation of firms using ECF, supporting various reasons for entrepreneurs to engage with the crowd. The prime motivation for start-ups to use the crowd is financially driven (Hagedorn and Pinkwart, 2016), meaning that start-ups adopting an ECF campaign are likely to be financially constrained.[27] Besides those financial aspects there are non-financial motives as well, such as promotional benefits (Belleflamme et al., 2014, 2015; Colombo and Shafi, 2016; Miller et al., 2009).

3.3.3 Debt

In contrast to equity financing, the second type is debt financing. In general, start-ups rely heavily on debt (Robb, 2002; Robb and Robinson, 2014), which is largely provided by financial intermediaries and highly associated with bank loans. The largest source of debt for

[25] In ECF, the UK platforms Seedrs and Crowdcube try to tackle this problem by employing a nominee structure. The nominee is the de facto owner of the shares, transferring the profits as well as the tax benefits to the investors. That gives the investors the chance to coordinate their behavior and reclaim the power.

[26] Namely, the SEIS (Seed Enterprise Investment Scheme) and EIS (Enterprise Investment Scheme), see https://www.gov.uk/topic/business-tax/investment-schemes under *Venture Capital Schemes* [accessed 24 September 2017].

[27] Constraints themselves are a problematic topic because of the difficulty of finding a convincing measurement. The Kaplan-Zingales index (Kaplan and Zingales, 1997; Lamont et al., 2001) and Whited-Wu index (Whited and Wu, 2006) incorporate different variables (e.g., ratio of debt and total capital); the Hadlock-Pierce index (Hadlock and Pierce, 2010) and the work of Hoberg and Maksimovic (2014) use a text-based approach investigating the 10-K forms of firms. All are more or less criticized by others (Farre-Mensa and Ljungqvist, 2016).

start-ups is indeed a bank (Scherr et al., 1993). Robb (2002) uses data from the Survey of Small Business Finances[28] and finds that more than half the financial capital of small businesses was held in debt in 1998. Yet there are certain problems for start-ups when accessing debt through bank loans. One is that debt-based financing might tie up the start-up from a cash management perspective (Jeng and Wells, 2000). Another, more dominant problem is that most start-ups do not have access to debt financing in the first place. More precisely, debt financing is subject to a substantial funding gap (Colombo and Grilli, 2007, Robb, 2002). Most start-ups do not even obtain access to bank loans (Cosh et al., 2009), and if they do, the amount of the loan is usually too small (Colombo and Grilli, 2007). Not every venture should be funded of course, and considering the recent financial crisis, banks should definitely not hand out money to everyone who applies for it (Ho et al., 2016). Robb (2002) notes that even some creditworthy start-ups had no access to bank loans before the dot-com bubble burst. Similarly, Casey and O'Toole (2014) and Mills and McCarthy (2014) show that SMEs were hit even harder than larger firms by the recent financial crisis in 2007 and the years after, but the credit gap for SMEs means that access to bank loans had declined already before the crisis and continued to do so afterward.

One reason for restricted access to bank loans may be related to gender. Banks discriminate between male- and female-managed firms, with female entrepreneurs being less likely to receive bank loans, and if they do, the amount does not reach the same level that male entrepreneurs achieve (Muravyev et al., 2009). If this is the case, some start-ups would be left with insufficient funds or even entirely without bank loans. Despite this issue, a major concern for banks lies in the collateral risk of start-ups. Most start-ups are not obligated to publish annual reports, which creates high information asymmetries, leaving lenders with either high monitoring costs or the need for collateral. Start-ups themselves tend to lack sufficient tangible assets and securities to attract banks that would typically avoid such risk (Hubbard, 1998; Jeng and Wells, 2000). The smaller a start-up, the more difficult it is to apply for long-term debt, which is why small start-ups seldom use external financing (Masiak et al., 2017).

Instead, start-ups tend to seek other ways of debt financing. Another recently evolving type of lender are venture debt lenders. As professional financial institutions, these lenders are

[28] The survey contains data of a nationally representative sample of more than 3,500 for-profit, non-governmental, and non-agricultural businesses, each employing fewer than 500 people, for the fiscal year 1998.

specialists in their field (Block et al., 2017a) and thus are able to value patents just as good as tangible assets, giving young start-ups a better chance of funding (Rassenfosse and Fischer, 2016). However, as with its counterpart, the VC, the market for venture debt lenders is relatively small and thus cannot fill the funding gap in full.[29] Beyond long-term debt, start-ups also regularly rely on short-term debt, such as credit card and bank overdrafts (Block et al., 2017a, Hutchinson, 1995; Masiak et al., 2017). By taking advantage of their growing network, SMEs also use suppliers for short-term debt in the form of trade credits (Casey and O'Toole, 2014; Huyghebaert et al., 2007), if their prospects for a bank loan are low (Cassia and Vismara, 2009). This kind of debt financing also cannot close the funding gap, so start-ups will likely prefer bank loans to these sources of debt because they are usually cheaper (Wilson and Summers, 2002).[30] Accordingly, the vast majority of the firms using non-bank sources of debt are start-ups with low credit quality (Denis and Mihov, 2003). Last, most early-stage start-ups also rely on personal loans from owners or friends and families, which builds a higher internal debt level (Åstebro and Bernhardt, 2003; Cassar, 2004; Coleman et al., 2016; Masiak et al., 2017; Robb, 2002).

The funding gap regarding bank loans is considerably large, leading to a fear of rejection among entrepreneurs, such that many do not even apply for a bank loan despite their need for money (Robb, 2002). Coleman and Robb (2012) confirm that some start-ups are able to overcome these information asymmetries by signaling the existence of creditworthy intellectual property or their potential for high growth.

3.3.4 Combining different sources of financing: The financial-growth-cycle

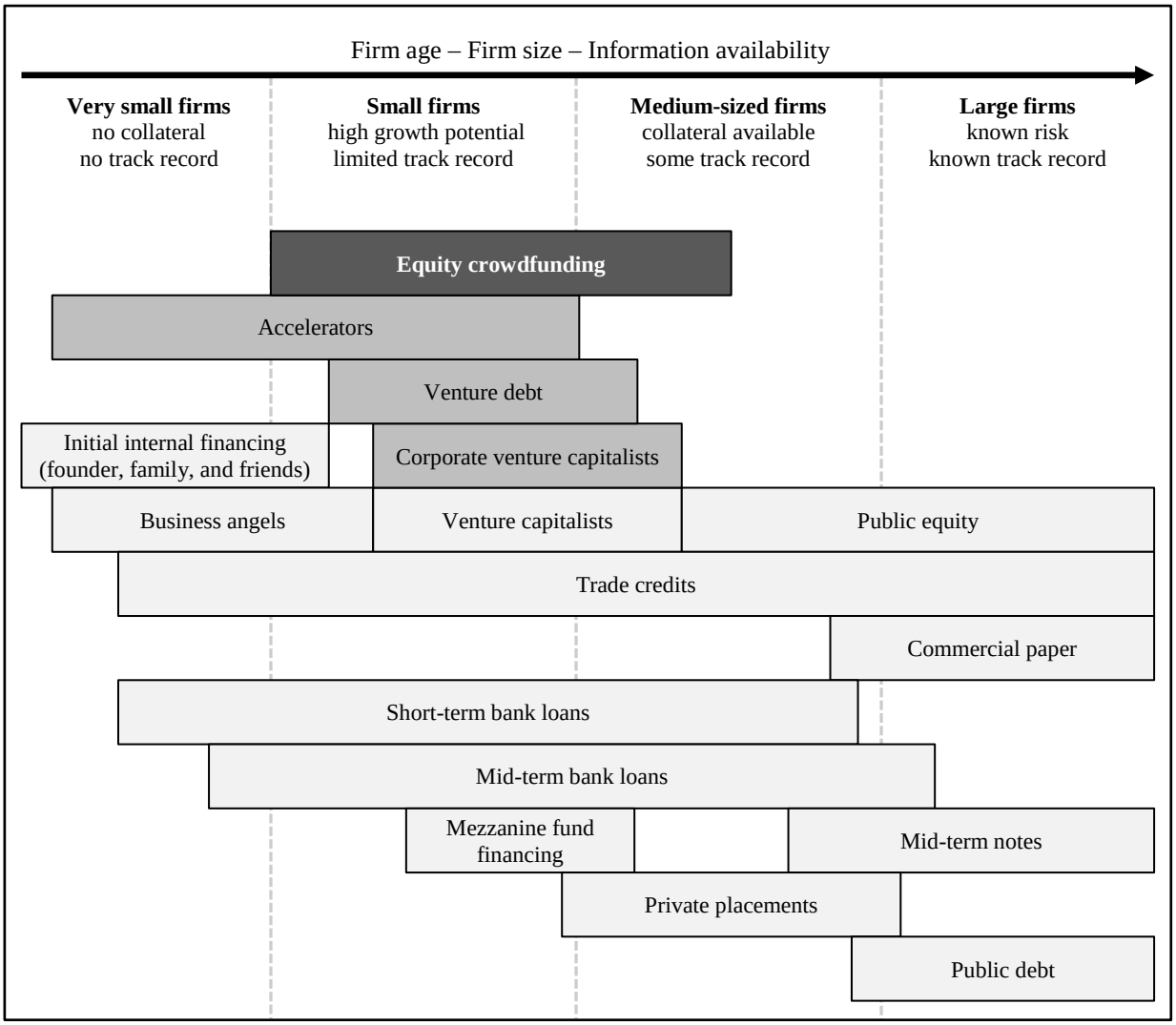
Many theories, the empirical evidence on determinants of capital structure, and various sources of equity and debt seem to cast doubt on the proposition that one theory can eventually explain the observed variation in financing decisions. However, the financial-growth-cycle model as proposed by Berger and Udell (1998) provides a compelling argument. The theory essentially relies on two aspects. First, it integrates other determinants of capital structure: firm age, firm size, and information availability. Many researchers have found evidence of a correlation between age of the firm and leverage (Bhaird and Lucey, 2010;

[29] In their study of the US market, Rassenfosse and Fischer (2016) find that venture debt lending is not even one-seventh of the capital provided by VCs.

[30] In a more detailed study, Huyghebaert et al. (2007) describe the entrepreneurs decision between trade credits and bank loans as a trade-off between the cheaper price of the latter and the strict liquidation policies of banks.

Michaelas et al., 1999; Robb and Robinson, 2014). This relationship between age and leverage is already proposed by followers of the POT (Chittenden et al., 1996). Even the conventional capital structure theories rely on a changing capital structure for different stages of a firm's maturity. Second, Berger and Udell (1998) also discriminate between the different sources of start-up financing, suggesting that a firm should use different financing methods at different stages during their period of growth, as Figure 3-1 shows. Thus, the model bridges the gap between capital structure theory (Section 3.2.1) and the existence of various providers of equity and debt (Section 3.3.2 and 3.3.3).

Figure 3-1: Financial-growth-cycle model
This figure illustrates a general idea of the stages of firms and the available funding sources. The beginning and ending of each funding source are not intended to be definitive. The figure is based on Berger and Odell (1998) and Moritz (2015).



Breaking the theory down to the different stages, the findings are backed by numerous studies.[31] The first step of successful start-ups is generally self-financing through personal savings (Cassar, 2004; Holmes and Kent, 1991), family and friends (Ang, 1992; Kotha and George, 2012), or to obtain an owner-backed loan or a personal loan from friends and families (Åstebro and Bernhardt, 2003; Robb and Robinson, 2014). This is called initial internal financing. Young firms are usually opaque, which is why the high information asymmetry i.e., no firm's track record, causes that most start-ups at this stage will not yet have access to external finance (as seen in the POT, Section 3.2.1). Advancing towards the subsequent stage

[31] A significant number of studies approved the financial-growth-cycle theory e.g., Coleman and Robb (2012) or Freear and Wetzel (1990).

at the beginning of external finance, the entry of a BA or an accelerator will have a positive impact, adding both capital and advisory services. This addition paves the way for the next stage with a simultaneous entry of VCs, corporate venture capitalists, and banks (Chemmanur and Chen, 2006; Dushnitsky and Lenox, 2005; Sapienza et al., 1996). However, venture debt, a recent novelty, is slightly earlier available for start-ups (Rassenfosse and Fischer, 2016). The previous appearance of a BA or an accelerator at the start-up also serves as a signal for VCs (Winston-Smith et al., 2013) as well as other financial intermediaries, such as banks. Empirical evidence supports the proposition that the earlier stages of a start-up, similar to the growth stage, rely heavily on short- and mid-term debt provided by banks and suppliers.[32] Considering that young start-ups face the problem of accessing bank loans even more, the bank's entrance usually takes place at the late stage. The investments finally lead the firms to take advantage of the long-term-debt and private equity, with IPOs toward the maturity stage.

ECF can be set within the context of the financial-growth-cycle model by considering the funding size, the industry, and the possibility of advice by investors. In the following, a comparison of ECF, VC, and BA is provided. In terms of its funding size, ECF ranges at the same level as the amount invested by BAs (Wilson and Testoni, 2014). When considering relevant industries, there is a big difference between VCs, BAs, and ECF. VCs are often present in technology-based environments, whereas BAs tend to invest in less-technology-based firms, in which the financier tends to add less value (Chemmanur and Chen, 2006). However, ECF provides capital in nearly all industries, including IT, sports, journalism, and movies (Schwienbacher and Larralde, 2017). Another difference between VCs, BAs, and ECF resides in the guidance and advisory role of an investor. Because most of the value in a start-up lies in its future growth rather than its tangible assets, only investors that are capable to conduct the necessary financial monitoring are 'active investors' (Jeng and Wells, 2000). Jensen (1993) describes active investors as equity holders that participate at the strategic decision-making stage of the venture; thus, they have an appropriate interest in the firm, while retaining an impartial view. VCs and BAs are evidently 'active investors'. Though, ECF is less able to provide this type of interference due to feasibility constraints caused by the amount of investors e.g., in the sample of this study the average number of investor per ECF campaign is 212 and it might be difficult for a firm to handle 212 advises. Thus, ECF investors could be considered less active investors. In addition, to run an ECF campaign, the

[32] This is supported by POT as well as for bank loans by Bhaird and Lucey (2010) and Michaelas et al. (1999), and for trade credits from suppliers by Huyghebaert et al. (2007).

start-up needs to prepare sufficient and credible information for convincing potential ECF investors. However, this might be only feasible for firms with a certain track record. Furthermore, medium-sized firms, with enough alternative funding opportunities, might still want to use an ECF campaign to promote their product or service. In summary, financing through ECF might start during the phase of small firms and last until medium-sized firms in the financial-growth-cycle model. But it is necessary to emphasize that ECF is fundamentally different from both VC and BA and thus is not likely to replace them but rather to expand the current sources of funding.

But some empirical evidence contradicts the financial-growth-cycle model. According to Gregory et al. (2005), who tested with a sample of 954 SMEs in the US, younger firms are more likely to use long-term debt and private equity than venture capital and mid-term debt. Furthermore, Åstebro and Bernhardt (2003) confirm that having a loan from family or friends is positively related to survival, but they argue that having a bank loan in a later stage would lower the chances of survival. Last, Goldfarb et al. (2013) assert that a co-investment of BAs and VCs is possible, but not as successful as a sole VC investment. Harrison and Mason (2000) argue that both groups can profitably co-invest.

In conclusion, the determination of capital structure in SMEs likely follows a combination of the mentioned theories and other determinants of capital structure, including firm age and size (Cotei and Farhat, 2017; Fraser et al., 2013). Romano et al. (2001) contend however that the combined theories can explain only approximately 59% of the observed variation. To explain this, Ang et al. (2010) and Coleman et al. (2016) suggest that current research underestimates the effects of information asymmetry, credit rationing, and owner preferences on financing choice. The financial-growth-cycle model provides two major insights. First, the capital structure choice is not only time dependent but also hinges on the growth of the respective start-up. This is especially relevant to the motivation of firms engaging in ECF. Second, the model shows that entrepreneurial finance resembles a complex machinery with various interacting pieces (McCahery and Vermeulen, 2016) that can be either ‘friends or foes’ (Hellmann and Thiele, 2015). Evaluating the impact of these on each other would glean major insight into the capital structure decisions of firms.

3.4 Hypotheses

The goal of this research is to further understand the firms engaging in ECF by comparing their capital structure when deciding to launch an ECF campaign with other firms not involving the crowd. Furthermore, I investigate how campaigns affect firms in terms of their capital structure and, more specifically, if they lead to growth in equity or debt. In this respect, my focus is on the capital structure development of start-ups one year before to one year after the campaign. This development is compared with a sample of firms not using ECF, to evaluate the impact of a successful ECF campaign on the capital structure of a firm.

In line with this motivation, the first area of interest is the comparison between start-ups launching an ECF campaign and other firms with the same characteristics, such as age and industry. More understanding of the *ex ante* differences in the capital structure between these two groups would provide major insights into the motivation of firms using ECF. On the one hand, firms might be high in debt and misuse the potential unsophisticated crowd to cope with their imperfect capital structure, resulting in a possible adverse selection problem (Ibrahim, 2015; Tomboc, 2013; Vismara, 2017b). ECF platforms lower the barriers for start-ups and listing requirements (Hornuf and Schwienbacher, 2016), which could eventually lead to a market of 'lemons' (Akerlof, 1970) and therefore attract only financially tarnished businesses. On the other hand, ECF platforms might attract firms that are in a financially fair situation. The selection criteria in the pre-selection of ECF platforms might lead to good-quality firms overall (see Section 2.3.1 and Löher, 2017). Furthermore, it might very well be the case that there is no difference in the financial constitution of the firms or their business figures. Instead, the difference between firms could lie within their prospects. Most start-ups turn to the crowd to finance or promote their innovations, which enables them to elevate their business and start new projects. Setting this into the context of the financial-growth-cycle model, the firms should have the same capital structure as other firms at the respective stage. As a result, the interaction between a firm's age, as a proxy for the funding stage, and the capital structure should not influence the decision to run an ECF campaign. This discussion leads to the first hypothesis:

H1: Firms' *ex ante* capital structure does not determine their decision to run an ECF campaign.

Then I compare the pre- and post-funding capital structure employed. Considering the purpose of an ECF, a successful campaign should increase the firm's equity. Again, by

matching the start-ups with comparable firms, I want to show that firms using ECF have significant growth in equity even when compared with firms that might have been funded or gained equity in another way. A positive result would give credence to the effectiveness of an ECF campaign as an equity-funding method and subtly elucidate its role in the financial-growth-cycle model. The second part therefore presents the following hypothesis:

H2a: A successful ECF significantly increases the equity of start-ups.

The last point of interest involves the reaction of the start-up to this equity injection. Hornuf and Schmitt (2017) show the circumstances under which start-ups are able to attract further funding by BAs or VCs. Recent studies also support the theory that VCs and ECF are complementary or that ECF can even help firms gain access to venture capital funding (Drover et al., 2017b; Kaminski et al., 2016; Kuppuswamy and Roth, 2016). In a similar fashion, Ryu and Kim (2017) confirm a positive impact of ECF on follow-up CVC funding (not on venture capital funding). Yet these studies all have one thing in common—they focus on follow-up equity funding mostly from VCs. Only limited research has investigated the interaction and coexistence of ECF with debt financing in start-ups, though it is well known that start-ups access debt, albeit in various ways (Cassia and Vismara, 2009; Hanssens et al., 2016; Robb and Robinson, 2014). When taking the successful ECF campaign as a treatment, the ratio of equity to total assets should increase because of the gain in equity. Yet start-ups will likely balance the ratio by gaining further debt during the funding process. This is because the ECF campaign could just be the kick-off of further effort to raise capital and thus could lead to further external financing also in the form of debt.

Another reason involves the availability of debt and the sending of signals, in the sense of signaling theory (Spence, 1973, 2002). When start-ups have sufficient assets, banks or other lenders will have more security when passing on external financing. Their motivation to issue debt during or after a successful ECF campaign will be simply determined by the entrepreneur's ability to provide sufficient collaterals. In another perspective, successful campaigns might also lead to other signals. ECF campaigns could, on the one hand, give lenders certainty that the entrepreneur is adequately motivated to achieve business growth and, on the other hand, signal the consumers' interest in the business, in terms of its future potential (Belleflamme et al., 2015; Rahaman, 2011). Accordingly in every scenario, the debtholders would follow a certain 'wisdom of the crowd', as portrayed in Mollick and Nanda (2015).

Last, it might be that start-ups follow the aforementioned theories of capital structure, in which new ventures determine their optimal level of debt according to the new equity level, thus allowing them to return to their initial ratio of equity to total assets. It seems striking that entrepreneurs would have the insight into capital structure theory to pursue an optimal financing plan, but because of the descriptive nature of those theories, it appears only plausible to assume that these are also relevant for the ECF environment.[33] Another explanation for why young firms adapt to these schemes is that they react to the availability of loans issued by banks, while banks themselves only grant external financing in a way that the firm can optimize its capital structure.

Regardless of which explanation is chosen, the result is that there is no significant difference in the ratio of equity to total assets pre- and post-funding but rather a significant gain in total assets. Together, the implications of ECF for the equity ratio of a firm (as indicated in H1) and the interaction between different funding types are essential to fully understand the role of ECF in the financial-growth-cycle model. This leads to the following:

H2b: Additional equity by ECF helps start-ups obtain significantly more debt.

Testing for these hypotheses should give major insights into the influence of ECF on capital structure. It is also worth noting that because the ratio of equity to total assets is under observation, the debt of start-ups must rise with the same percentage in equity; that is, the gain in debt rises with its fraction of the total assets, which would generate a major benefit for the start-up, in light of the problems in debt financing for start-ups.

3.5 Data and method

3.5.1 Data

From September 24, 2011, to June 30, 2016, I hand-collected data on 409 firms that ran a successful ECF campaign in the UK on the portals Crowdcube and Seedrs. I collected the data directly from the ECF portal websites. My initial data set consists of information about the ECF campaign characteristics. I merged this data set with additional information on firm characteristics and financials from the Bureau van Dijk (BvD) Orbis databases. Furthermore, I enhanced the information about firm's debt and the impact of ECF on the availability of debt for start-ups through a survey.

[33] In the model of Colombo and Shafi (2016), their assumptions follow the POT.

To identify the impact of capital structure on the decision to run an ECF, I match a non-crowdfunded firm control group with similar firm characteristics to the crowdfunded firm sample. I apply a PSM algorithm to obtain a one-to-one matching. The PSM technique was introduced by Rosenbaum and Rubin (1983). With this approach, a pseudo-control group is created to solve the selection bias problem (Caliendo and Kopeinig, 2008). The total PSM sample consists of all available active and inactive, private and public limited UK companies in the BvD Orbis database as of June 30, 2017. The sample counts 7,068,754 firms (including crowdfunded firms, which are identified in the PSM sample). The vector of control variables includes a firms' status of activity, age, and industry.[34] To avoid any impact of the sorting of the PSM sample on the matching algorithm, I used a random uniform function to choose one match among all the non-crowdfunded matches with identical propensity scores. The resulting sample consists of 409 crowdfunded firms and 409 matched non-crowdfunded firms.

To evaluate the matching quality of the PSM, I run a probit regression on the treatment, with crowdfunding as the dependent variable and the PSM variables as the independent variables. Table 3-1 reports the results. I find that no variable has a significant impact on the treatment variable. Furthermore, a mean comparison test between the crowdfunded sample and the control sample shows that the variables are perfectly balanced between the samples, as there are no statistically significant differences. Therefore, none of the results are driven by the differences of matching variables.

[34] To measure capital structure as a determinant for running an ECF campaign, I do not include variables for capital structure (e.g., equity) as control variable for the PSM. Otherwise, I would not be able to identify the impact of capital structure on the ECF campaign, if treated and control groups are similar in terms of capital structure.

Table 3-1: Propensity score matching quality

The table provides the result of a probit regression to measure the quality of the PSM. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level. *z*-statistics are in parentheses. Mean comparison test between the crowdfunded and the control sample is provided by a t-test.

	Probit	Mean		Difference test
		Crowdfunded	Control	*t*-statistics
Firm characteristics and financials				
Active firm	0.666	0.990	0.990	1.000
	(0.984)			
Firm age	0.025	6.413	6.413	1.000
	(0.846)			
Industry				
Agriculture, forestry, and fishing		0.015	0.015	1.000
Manufacturing	0.537	0.172	0.167	0.894
	(0.957)			
Construction	0.627	0.030	0.030	1.000
	(1.000)			
Wholesale and retail trade	0.534	0.187	0.182	0.897
	(0.961)			
Transportation and storage	0.648	0.025	0.025	1.000
	(0.991)			
Accommodation and food service activities	0.633	0.030	0.030	1.000
	(0.978)			
Information and communication	0.530	0.242	0.247	0.907
	(0.997)			
Financial and insurance activities	0.641	0.030	0.025	0.760
	(0.841)			
Real estate activities	0.677	0.020	0.020	1.000
	(1.000)			
Professional, scientific, and technical activities	0.566	0.071	0.071	1.000
	(0.985)			
Administrative and support service activities	0.551	0.101	0.106	0.869
	(0.973)			
Education	0.667	0.025	0.025	1.000
	(0.976)			
Human health and social work activities	0.931	0.005	0.010	0.563
	(0.614)			
Arts, entertainment, and recreation	1.030	0.005	0.005	1.000
	(0.982)			
Other service activities	0.602	0.040	0.040	1.000
	(0.987)			
Constant	0.869			
	(0.951)			
No. of observations	396	198	198	
Pseudo-R-square	0.001			

The availability of financial information about start-ups is limited. However, under the Companies Act 2006, small firms must send an abbreviated balance sheet to the Companies House.[35] The UK government defines small companies as firms that have any two of the following: a turnover of 10.2 million GBP or less, 5.1 million GBP or less on its balance sheet, or 50 employees or fewer.[36] The abbreviated accounts give information about equity and debt.[37] Therefore, the information provided is sufficient enough to identify the capital structure. To test the relationship between capital structure and ECF, I need at least two periods. This means that I consider only the firms with available data for the year before the ECF campaign and the fiscal year of the ECF campaign. Therefore, the total sample of crowdfunded firms contains 198 firms, with an additional 198 non-crowdfunded firms in the control sample. For further analysis, three periods (the years before, during, and after the ECF campaign) are available for 150 crowdfunded firms and also 150 firms in the control sample.

Considering the lack of detailed information about the explicit debt structure, I extended the data set through a survey on crowdfunded firms and their capital structure. I surveyed all 409 firms in the data set that ran a successful ECF campaign on Seedrs or Crowdcube. I asked the firms three questions about their finance. First, I inquired about their share of long-term debt in the year of the ECF campaign and in the subsequent year. With this information, I was able to calculate the short-term debt because I already had the information of the total amount of debt. Second, I asked them whether the ECF helped them obtain short-term (second question) or long-term (third question) debt. The detailed questions of the survey are shown in Appendix 3. Approximately 20% (i.e., 81 firms) of all the firms no longer have active businesses. I was therefore not able to contact them. Of the remaining 328 firms, 3.3% (i.e., 11 firms) completely answered the three questions of the survey.

The summary statistics appear in Table 3-2. Panel A shows the total sample, Panel B the crowdfunded sample, and Panel C the matched control sample. Regarding the crowdfunded sample, firms were able to raise on average of 396 thousand GBP from about 212 investors. The funding target of the ECF campaign was approximately 264 thousand GBP on average.

[35] See https://www.legislation.gov.uk/ukpga/2006/46/contents [accessed 30 September 2017].
[36] See https://www.gov.uk/annual-accounts/microentities-small-and-dormant-companies [accessed 30 September 2017].
[37] See https://www.gov.uk/government/publications/life-of-a-company-annual-requirements/life-of-a-company-part-1-accounts [accessed 30 September 2017].

The average age of the crowdfunded firms is 3.7 years, which is similar to the mean age of the control sample in Panel C.

Table 3-2: Summary statistics
Panels provide summary statistics of 396 firms. Financial figures are in thousand GBP. Panel B shows the sample of firms that ran an ECF campaign. Panel C shows the control sample with the matched firms.

PANEL A: Total sample

Variable	N	Mean	Std.-dev.	Minimum	Median	Maximum
Firm characteristics and financials						
Firm age in years	396	3.72	2.63	0.73	2.81	17.88
Equity						
Before ECF	396	151.88	1806.81	-1703.41	1.27	34698.00
During ECF	396	269.76	2301.48	-1292.57	12.80	43957.00
After ECF	250	172.07	869.34	-2103.86	13.16	11290.00
Debt						
Before ECF	396	412.13	3745.58	0.00	34.10	70986.00
During ECF	396	469.08	3599.18	0.00	45.07	64546.00
After ECF	250	367.30	1922.18	0.00	43.75	27326.00
Total assets						
Before ECF	396	564.01	5458.20	0.00	39.03	105684.00
During ECF	396	738.85	5729.83	0.00	75.32	108503.00
After ECF	250	539.37	2172.23	0.00	85.22	28344.00
Ratio equity to total assets						
Before ECF	396	-3.09	25.73	-457.81	0.16	1.00
During ECF	396	-328.41	6526.29	-129872.00	0.28	1.00
After ECF	250	-0.39	3.74	-47.94	0.30	1.00
Adjusted equity						
Before ECF	394	73.88	482.70	-1423.01	1.27	7022.05
During ECF	394	153.72	673.09	-1292.57	12.80	9883.00
After ECF	250	166.11	873.00	-2103.86	12.65	11290.00
Adjusted debt						
Before ECF	394	212.91	1157.39	0.00	34.10	18764.00
During ECF	394	293.52	1590.35	0.00	42.33	27548.00
After ECF	250	371.26	1921.70	0.00	42.40	27326.00
Adjusted total assets						
Before ECF	394	286.79	1315.24	0.00	37.47	19333.00
During ECF	394	447.25	1828.01	0.00	68.12	28615.00
After ECF	250	537.37	2174.26	0.00	77.45	28344.00
Adjusted ratio equity to total assets						
Before ECF	394	-27.76	518.42	-10290.00	0.16	1.00
During ECF	394	-329.83	6542.85	-129872.00	0.29	1.00
After ECF	250	-12.21	184.75	-2921.00	0.28	1.00
Industry						
Agriculture, forestry, and fishing	396	0.02	0.12	0	0	1
Manufacturing	396	0.17	0.38	0	0	1
Construction	396	0.03	0.17	0	0	1
Wholesale and retail trade	396	0.18	0.39	0	0	1
Transportation and storage	396	0.03	0.16	0	0	1
Accommodation and food service activities	396	0.03	0.17	0	0	1
Information and communication	396	0.24	0.43	0	0	1
Financial and insurance activities	396	0.03	0.16	0	0	1
Real estate activities	396	0.02	0.14	0	0	1
Professional, scientific, and technical activities	396	0.07	0.26	0	0	1
Administrative and support service activities	396	0.10	0.31	0	0	1
Education	396	0.03	0.16	0	0	1
Human health and social work activities	396	0.01	0.09	0	0	1
Arts, entertainment, and recreation	396	0.01	0.07	0	0	1
Other service activities	396	0.04	0.20	0	0	1

PANEL B: Crowdfunded sample

Variable	N	Mean	Std.-dev.	Minimum	Median	Maximum
Campaign characteristics						
Amount raised in GBP	198	395853.92	576434.50	12000.00	179740.00	3514110.00
Funding target in GBP	198	264286.22	324278.18	10000.00	150000.00	2000000.00
Number of investors	198	212.10	297.17	1.00	144.00	2702.00
Firm characteristics and financials						
Firm age in years	198	3.72	2.64	0.73	2.81	17.88
Equity						
Before ECF	198	81.51	661.17	-1703.41	0.00	7022.05
During ECF	198	253.98	916.23	-1292.57	48.28	9883.00
After ECF	125	255.66	1199.85	-2103.86	38.20	11290.00
Debt						
Before ECF	198	205.49	580.97	0.00	54.06	4838.10
During ECF	198	265.23	607.20	0.00	89.94	5112.92
After ECF	125	278.71	613.62	0.00	115.46	5523.16
Total assets						
Before ECF	198	287.00	941.67	0.00	47.73	9010.48
During ECF	198	519.21	1281.96	0.00	149.60	12663.00
After ECF	125	534.37	1385.18	6.76	198.41	11396.00
Ratio equity to total assets						
Before ECF	198	-3.45	15.81	-162.14	0.02	1.00
During ECF	198	-656.45	9229.56	-129872.00	0.41	1.00
After ECF	125	-0.28	2.07	-13.33	0.34	1.00
Adjusted equity						
Before ECF	197	95.21	653.47	-1423.01	0.00	7022.05
During ECF	197	238.75	915.06	-1292.57	45.88	9883.00
After ECF	125	240.28	1197.60	-2103.86	31.38	11290.00
Adjusted debt						
Before ECF	197	168.87	491.22	0.00	58.36	4838.10
During ECF	197	243.22	581.42	0.00	90.47	5112.92
After ECF	125	289.64	613.10	0.00	118.57	5523.16
Adjusted total assets						
Before ECF	197	264.08	920.17	0.00	44.86	9010.48
During ECF	197	481.97	1258.32	0.00	141.89	12663.00
After ECF	125	529.92	1379.47	3.92	208.26	11396.00
Adjusted ratio equity to total assets						
Before ECF	197	-2.83	13.18	-162.14	0.02	1.00
During ECF	197	-659.50	9252.98	-129872.00	0.41	1.00
After ECF	125	-0.53	2.96	-23.80	0.20	1.00
Industry						
Agriculture, forestry, and fishing	198	0.02	0.12	0	0	1
Manufacturing	198	0.17	0.38	0	0	1
Construction	198	0.03	0.17	0	0	1
Wholesale and retail trade	198	0.19	0.39	0	0	1
Transportation and storage	198	0.03	0.16	0	0	1
Accommodation and food service activities	198	0.03	0.17	0	0	1
Information and communication	198	0.24	0.43	0	0	1
Financial and insurance activities	198	0.03	0.17	0	0	1
Real estate activities	198	0.02	0.14	0	0	1
Professional, scientific, and technical activities	198	0.07	0.26	0	0	1
Administrative and support service activities	198	0.10	0.30	0	0	1
Education	198	0.03	0.16	0	0	1
Human health and social work activities	198	0.01	0.07	0	0	1
Arts, entertainment, and recreation	198	0.01	0.07	0	0	1
Other service activities	198	0.04	0.20	0	0	1

PANEL C: Control sample

Variable	N	Mean	Std.-dev.	Minimum	Median	Maximum
Firm characteristics and financials						
Firm age in years	198	3.72	2.64	0.73	2.81	17.88
Equity						
Before ECF	198	222.25	2469.53	-362.63	4.41	34698.00
During ECF	198	285.54	3127.39	-387.74	4.47	43957.00
After ECF	125	88.48	252.72	-92.26	9.58	1729.37
Debt						
Before ECF	198	618.78	5263.70	0.00	21.31	70986.00
During ECF	198	672.94	5051.90	0.00	22.14	64546.00
After ECF	125	455.89	2650.84	0.00	19.23	27326.00
Total assets						
Before ECF	198	841.03	7661.21	0.00	31.91	105684.00
During ECF	198	958.49	8005.51	0.00	36.40	108503.00
After ECF	125	544.37	2748.89	0.00	32.85	28344.00
Ratio equity to total assets						
Before ECF	198	-2.73	32.82	-457.81	0.24	1.00
During ECF	198	-0.38	4.12	-47.94	0.20	1.00
After ECF	125	-0.50	4.88	-47.94	0.29	1.00
Adjusted equity						
Before ECF	197	52.55	198.12	-152.78	4.17	1773.01
During ECF	197	68.70	237.75	-91.06	3.25	1779.56
After ECF	125	91.95	291.66	-92.26	8.15	2372.90
Adjusted debt						
Before ECF	197	256.94	1562.28	0.00	19.43	18764.00
During ECF	197	343.83	2174.45	0.00	20.95	27548.00
After ECF	125	452.87	2650.73	0.00	18.57	27326.00
Adjusted total assets						
Before ECF	197	309.49	1618.88	0.00	31.76	19333.00
During ECF	197	412.53	2261.53	0.00	33.53	28615.00
After ECF	125	544.82	2754.98	0.00	31.04	28344.00
Adjusted ratio equity to total assets						
Before ECF	197	-52.70	733.11	-10290.00	0.25	1.00
During ECF	197	-0.16	3.60	-47.94	0.18	1.00
After ECF	125	-23.89	261.26	-2921.00	0.29	1.00
Industry						
Agriculture, forestry, and fishing	198	0.02	0.12	0	0	1
Manufacturing	198	0.17	0.37	0	0	1
Construction	198	0.03	0.17	0	0	1
Wholesale and retail trade	198	0.18	0.39	0	0	1
Transportation and storage	198	0.03	0.16	0	0	1
Accommodation and food service activities	198	0.03	0.17	0	0	1
Information and communication	198	0.25	0.43	0	0	1
Financial and insurance activities	198	0.03	0.16	0	0	1
Real estate activities	198	0.02	0.14	0	0	1
Professional, scientific, and technical activities	198	0.07	0.26	0	0	1
Administrative and support service activities	198	0.11	0.31	0	0	1
Education	198	0.03	0.16	0	0	1
Human health and social work activities	198	0.01	0.10	0	0	1
Arts, entertainment, and recreation	198	0.01	0.07	0	0	1
Other service activities	198	0.04	0.20	0	0	1

The financials cover the years before, during, and after the ECF campaign. Owing to data limitations, the number of observations is lower for the year after the ECF campaign. On average, a crowdfunded firm has 82 thousand GBP of equity before the ECF campaign; this increases to 254 thousand GBP in the year of the ECF campaign and stays roughly the same the year after, at 255 thousand GBP. Comparable increases occur for debt and total assets. The median ratio of equity to total assets is 0.02 (i.e., equity is only 2% of total assets). However, equity increases to a share of 41% in the year of the ECF campaign. In the subsequent year, the share drops to 20%. However, this might also be due to the drop of observations.

As 33 of the 198 crowdfunded firms ended their ECF campaign in November and December, the equity capital inflow might not be undertaken in the same fiscal year as the end of the campaign. As a robustness check and to consider this notion in empirical analysis, I created a subsample with adjusted timing. Thus, in the adjusted sample, the considered capital structure variables of the fiscal year for the crowdfunded firms with ECF campaigns ending in November and December are the financials of the subsequent year. I undertake this adjustment also for the matched firms if the corresponding crowdfunded firms run their campaigns in these months.

Furthermore, the firms' industries are classified according to the first level of the NACE Rev. 2 code. Most of the crowdfunded firms (24%) are active in the information and communication sector, followed by the wholesale and retail trade (19%) and the manufacturing sectors (17%). The industry distribution of the control sample is quite similar because of the PSM: information and communication (25%), wholesale and retail trade (18%), and manufacturing (17%).

3.5.2 Method

In the empirical analysis, I use two regression approaches to test H1 and H2. First, to answer the question whether the capital structure determines the decision to run an ECF campaign, the undertaken approach is a probit model. The models are estimated using maximum likelihood. The main estimation equation I use to examine the impact of capital structure on ECF campaign is

$$(1) \qquad \Pr(ECF_j = 1) = \Phi(\beta_1 Equity_j + \beta_2 Age_j + \beta_3 (Equity_j \times Age_j) + \rho_k + \tau_t),$$

where the binary dependent variable ECF equals 1 if the firm ran an ECF campaign and 0 if not. $Equity_j$ is the variable for considering the capital structure of firm *j*—this is equity in the first model and the ratio of equity to total assets in the second model. The interaction term of the capital structure $Equity_j$ and the firm's age Age_j allows for measuring the effect of firm stage and the corresponding financing decision as described by the financial-growth-cycle model. Finally, ρ_k controls for industry k and τ_t for year t fixed effects.[38] I use robust standard errors in the estimation.

Second, to measure the effect of the ECF 'treatment' on firm's capital structure, I apply a difference-in-differences analysis. I compare the average change in the capital structure after ECF for the crowdfunded sample with the average change at the same time for the non-crowdfunded control group. Therefore, the treatment (ECF) effect is the difference of the observed outcome (capital structure) less the expected outcome without treatment, which the firm would manifest if it were exposed to the control group. The estimation equation is as follows:

$$(2) \qquad Capital_{jt} = \alpha + \beta_2 ECF_j + \beta_3 Post_t + \beta_4 \left(ECF_j \times Post_t\right) + \beta_5 Age_i + \rho_k + \tau_t + \varepsilon,$$

where the dependent variable $Capital_{jt}$ is the capital structure of firm *j* in year *t*. $Capital_{jt}$ is measured differently in separate estimated models. The capital structure measure is either equity, debt, total assets, or ratio equity to total assets. The variable ECF_j again indicates whether the firm j ran an ECF campaign. $Post_t$ is equal to 1 if the observation is during or after the year of the ECF campaign and 0 if the observation is before the year of the ECF campaign. For non-crowdfunded firms, the considered year is set equal to the matched crowdfunded firm. The interaction of both dummy variables specifies the treatment effect. I included controls for industry k and year τ_t fixed effects. Furthermore, the robust standard errors are clustered at the firm level.

[38] Greene (2004) suggests that including fixed effects in non-linear models such as probit regressions can bias the results. As a robustness check, I run every regression without the fixed effects, and the findings are robust.

3.6 Results

3.6.1 Capital structure as a determinant for equity crowdfunding

To analyze the impact of the capital structure on ECF and to test H1, I use a probit regression to evaluate the contributing factors of doing ECF. Table 3-3 reports the results. Overall, there is no significant result that proves that capital structure is a determinant of the decision to engage in ECF. In detail, I test the hypotheses in four different ways. I use the ratio of equity to total assets as an explanatory variable in regression (1). In regression (2), I use the time-adjusted value of the ratio, in regression (3), the total amount of equity, and in regression (4), the time-adjusted equity. Furthermore, with regard to the financial-growth-cycle concept, I interact the capital structure variable with the firm age. However, interpretation of an interaction term in probit models is more difficult (Ai and Norton, 2003). To evaluate the interaction effect of capital structure and age, Figures 3-2 to 3-5 show the margins of the interaction effect depending on firm age of 0 to 6 years and the corresponding confidence intervals. It appears that age does not change the effect of capital structure on the decision to run an ECF campaign. This holds true for regression models (1)–(4). In addition, a firm's industry does not exert any impact. Consequently, H1 is supported.

Table 3-3: Probit regression results
The table provides the probit regression results on the dependent dummy variable ECF. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level. *z*-statistics are in parentheses. Standard errors are robust.

	(1)	(2)	(3)	(4)
		adjusted		adjusted
Firm characteristics and financials				
Ratio equity to total assets before ECF	0.013	0.006		
	(1.403)	(1.470)		
Equity before ECF			-0.000	-0.000
			(-0.634)	(-0.082)
Firm age	-0.004	-0.004	0.004	-0.000
	(-0.156)	(-0.150)	(0.161)	(-0.009)
Interaction terms				
Ratio equity to total assets before ECF x Firm age	-0.007	-0.007		
	(-1.535)	(-1.413)		
Equity before ECF x Firm age			0.000	0.000
			(0.513)	(0.547)
Constant	0.025	0.021	-0.031	0.008
	(0.032)	(0.019)	(-0.038)	(0.008)
Industry fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
No. of observations	396	394	396	394
Pseudo-R-square	0.007	0.011	0.003	0.003

Figure 3-2: Margins plot regression (1)
Margins plot of the interaction effect of ratio equity to total assets and firm age depending on firm age of 0 to 6 years and the corresponding confidence intervals for regression (1) of Table 3-3.

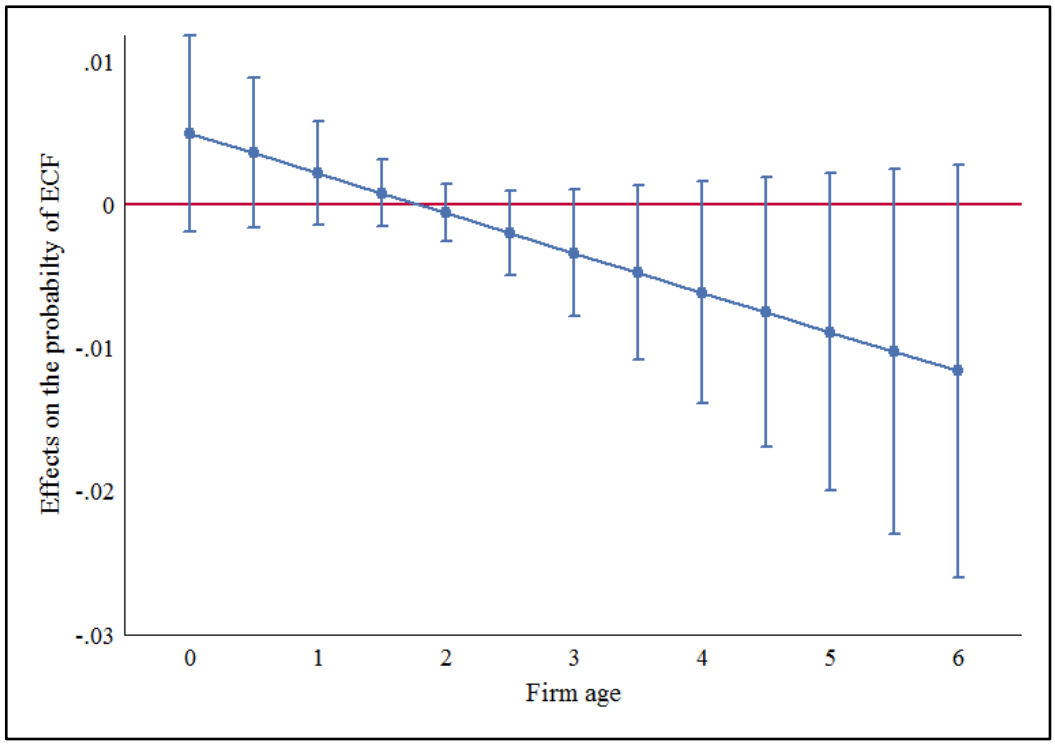


Figure 3-3: Margins plot regression (2)
Margins plot of the interaction effect of time-adjusted ratio equity to total assets and firm age depending on firm age of 0 to 6 years and the corresponding confidence intervals for regression (2) of Table 3-3.

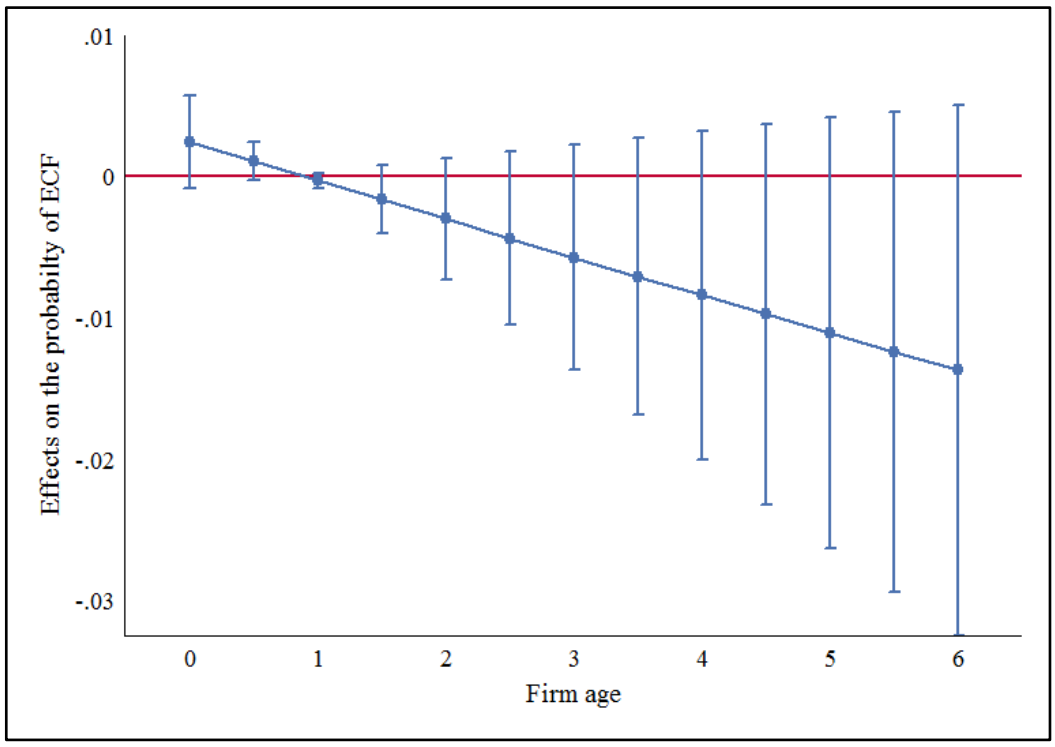


Figure 3-4: Margins plot regression (3)
Margins plot of the interaction effect of equity and firm age depending on firm age of 0 to 6 years and the corresponding confidence intervals for regression (3) of Table 3-3.

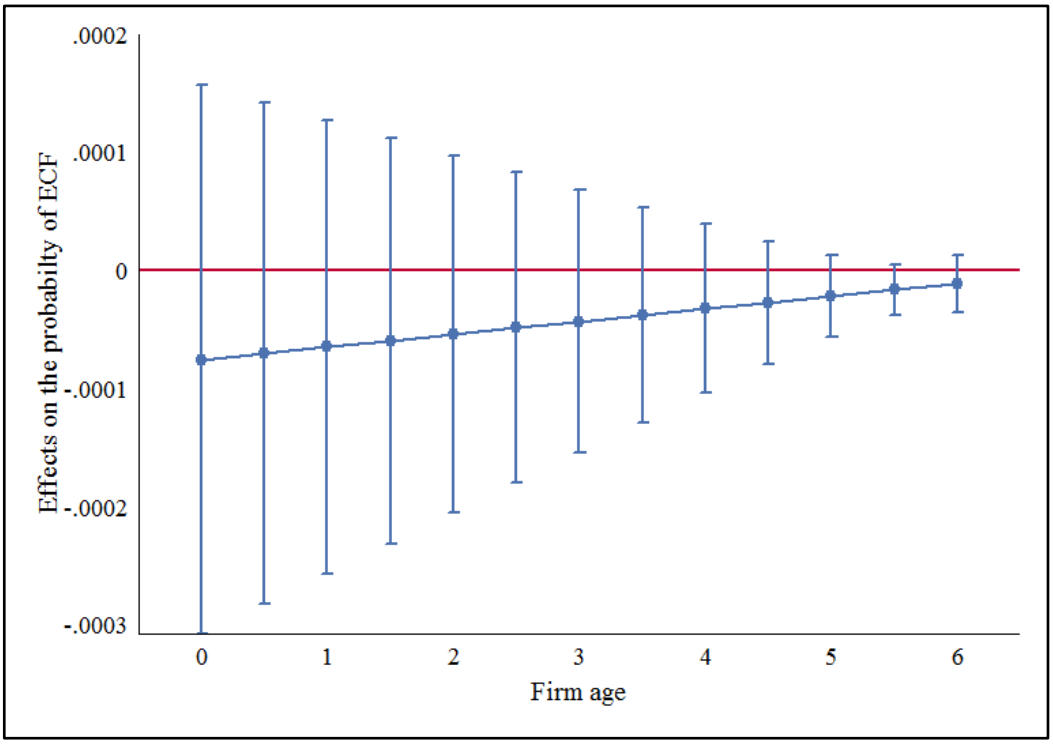
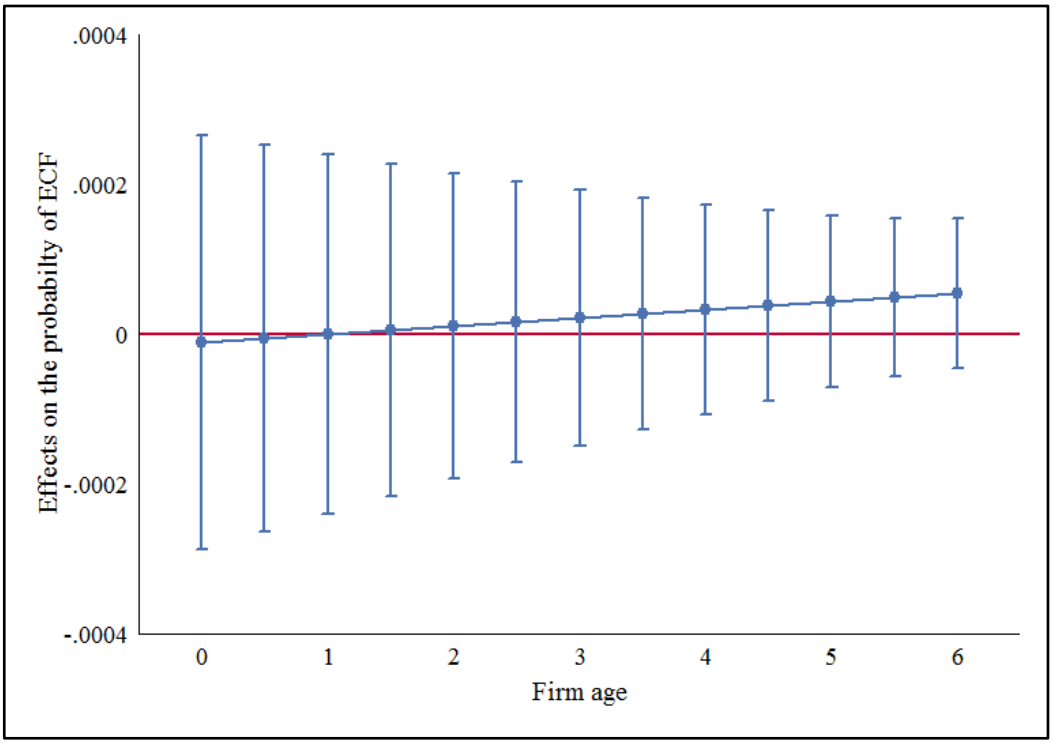


Figure 3-5: Margins plot regression (4)
Margins plot of the interaction effect of time-adjusted equity and firm age depending on firm age of 0 to 6 years and the corresponding confidence intervals for regression (4) of Table 3-3.



3.6.2 Effect of ECF on the capital structure

To determine the impact of ECF on the capital structure and to test H2, I run several difference-in-differences regressions. Table 3-4 reports the results. Panel A considers the impact in the year of the ECF campaign, and Panel B considers the impact in the year after the ECF campaign. For the regressions (1)–(4), the dependent variable is equity, debt, total assets, and the ratio of equity to total assets. The regressions (5)–(8) include the time-adjusted financial variables. Overall, in the year of the ECF campaign, there is a weak significant treatment effect on equity. However, the time-adjusted equity is significantly higher after an ECF campaign. In addition, age matters for equity. Especially for the time-adjusted equity, equity is higher for older firms. However, there is no significant, positive effect on debt in the year of the ECF campaign. Therefore, H2a cannot be rejected on the short-term effect, but H2b can be. By enlarging the time frame to the year after the ECF campaign, further insights into the medium term effect might be gleaned. Panel B of Table 3-4 shows the corresponding results. However, there is no medium-term effect on equity or debt. Only total assets is weakly significant higher after an ECF campaign. Again, equity is higher for older firms and industry does not play a large role in that. Consequently, H2a and H2b are rejected on the medium-term perspective.

Table 3-4: Difference-in-differences regression results
Panel A provides the difference-in-differences regression results on the treatment effect in the year of the ECF campaign. Panel B provides the difference-in-differences regression results on the treatment effect in the year after the ECF campaign. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level. *t*-statistics are in parentheses. Robust standard errors are clustered at the firm level.

PANEL A: During ECF

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Equity	Debt	Total assets	Ratio equity/ Total assets	Equity	Debt	Total assets	Ratio equity/ Total assets
					adjusted			
ECF	-145.529	-417.125	-8.630	-562.654	42.722	-84.425	46.737	-41.704
	(-0.781)	(-1.093)	(-0.154)	(-1.006)	(0.884)	(-0.788)	(0.613)	(-0.340)
Post ECF	63.297	54.163	2.352	117.459**	16.151***	86.886	52.536	103.036*
	(1.330)	(0.858)	(0.997)	(2.046)	(3.108)	(1.620)	(0.993)	(1.843)
Interaction term								
ECF x Post ECF	109.178*	5.578	-655.353	114.756	127.390***	-12.540	-709.205	114.850*
	(1.830)	(0.083)	(-0.986)	(1.638)	(3.887)	(-0.219)	(-1.059)	(1.682)
Firm characteristics								
Firm age	71.073*	80.927	-42.616	152.001	41.765**	3.311	-42.591	45.075
	(1.726)	(1.179)	(-0.979)	(1.441)	(2.009)	(0.092)	(-0.908)	(1.027)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of firms	396	396	396	396	394	394	394	394
No. of observations	792	792	792	792	788	788	788	788
R-square	0.028	0.043	0.018	0.034	0.082	0.155	0.016	0.150

PANEL B: After ECF

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Equity	Debt	Total Assets	Ratio equity/ Total assets	Equity	Debt	Total Assets	Ratio equity/ Total assets
					adjusted			
ECF	3.506	-173.965	-3.936**	-170.459	17.263	-171.181	-2.954	-153.918
	(0.078)	(-1.065)	(-2.211)	(-0.947)	(0.371)	(-1.050)	(-1.036)	(-0.856)
Post ECF	37.369***	133.331	-0.136	170.699**	34.400***	132.333	-23.407	166.734*
	(3.011)	(1.637)	(-0.430)	(2.006)	(2.697)	(1.631)	(-0.982)	(1.959)
Interaction term								
ECF x Post ECF	157.201	1.775	4.203**	158.976	126.105	13.385	26.380	139.490
	(1.581)	(0.020)	(2.369)	(1.242)	(1.285)	(0.153)	(1.105)	(1.090)
Firm characteristics								
Firm age	31.753**	8.532	-0.126	40.285	35.998***	-17.289	-0.031	18.710
	(2.457)	(0.196)	(-0.551)	(0.848)	(2.623)	(-0.294)	(-0.074)	(0.299)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of firms	250	250	250	250	250	250	250	250
No. of observations	500	500	500	500	500	500	500	500
R-square	0.101	0.164	0.060	0.150	0.095	0.152	0.027	0.142

To gain further insights into the debt structure of crowdfunded firms and to test H2b, the survey might give some direction on how crowdfunded might have benefited. Considering the low number of respondents (11 firms), the results need to be carefully interpreted. However, the statements of these firms are 100% identical. Every firm stated that they had and have no long-term debt and that ECF was not helpful in gaining additional short- or long-term debt. These findings support the results of my difference-in-differences approach that H2b is rejected.

3.7 Discussion and conclusion

The aim of this study was to provide first insight into the relationship between capital structure and ECF. To do so, I evaluated the capital structure of start-ups as a determinant for the decision to launch an ECF campaign and evaluated the overall impact of a successful campaign on the capital structure development. The literature has long investigated firms' capital structures; however, the rapidly developing environment for financing corporations makes it necessary to adjust existing theories and acknowledge new empirical findings. The emergence of new financing opportunities for new ventures (i.e., start-ups) is a recent trend. ECF is a growing market, and it has already helped many new ventures to finance their projects. Therefore, it is important to understand the determinants of ECF campaigns and to analyze the outcomes of crowdfunded firms. The focus in this study is on ECF in UK, which allows me to measure directly the effect on the growth of equity and the subsequent impact on the firm's debt. This is important because ECF is handled differently in other countries. For

example, in Germany the new capital by ECF is considered a mezzanine investment, and therefore it is accounted as debt with profit participation.

The empirical analysis discloses that capital structure is not a determinant of running an ECF campaign. With a PSM control sample, the study shows that crowdfunded firms' equity or the ratio of equity to total assets was not a driver for running an ECF campaign. Furthermore, a difference-in-differences model reveals the effect of ECF on the capital structure. The analysis shows that equity is only weakly significantly rising in the short run compared with the control sample. In addition, there is no significant, positive effect on debt.

The results have important implications for ECF investors, policy makers, and entrepreneurs. First, ECF investors now have first evidence that ECF firms do not differ from other firms in terms of capital structure. For example, ECF firms are not better or worse off when it comes to excessive debt. The same information is notable for policy makers. They should consider this finding and not excessively regulate ECF to protect investors just because of the assumption that there are only financially unsound firms. Nevertheless, there is still the need to communicate the risk involved in investing in new ventures. For entrepreneurs, they should not expect that ECF will give them significantly more equity than other firms at the same stage that do not run an ECF campaign. Moreover, entrepreneurs should not expect that the equity injection by ECF will be followed by additional debt in the mid-term. It seems that ECF does not help firms to obtain more debt by banks or other creditors.

Further research is necessary to analyze the long-term impact of ECF on the capital structure. The time frame of this study covers three years and, in some cases, two years. To fully understand the impact of ECF on capital structure in the long run, further studies with longer time frames need to be undertaken. In addition, a more detailed investigation into the type of debt might give more insights. The differentiation between short- and long-term debt is necessary to further identify the impact of ECF on debt.

4 Follow-up funding and firm survival in equity crowdfunding[39]

4.1 Introduction

ECF has recently received considerable attention in the academic literature. While only a few years ago this new way of financing was largely considered a niche phenomenon, in many countries it has now become an ordinary source of early-stage financing for start-up firms. In the UK, for example, the ECF market has even approached the size of the early-stage BA and venture capital market (Zhang et al., 2016). Until now, most research has focused on the success factors of ECF campaigns (Ahlers et al., 2015; Hornuf and Schwienbacher, 2017a, 2018; Ralcheva and Roosenboom, 2016; Vismara, 2017a; Vulkan et al., 2016) and the determinants of crowd engagement (Agrawal et al., 2015; Block et al., 2017b; Hornuf and Neuenkirch, 2017; Vismara, 2016). Little is known, however, about the propensity of crowdfunded firms to build an enduring business. In this study, I address this important gap in the literature by analyzing the determinants of follow-up financing and ultimate firm failure.

In an early contribution, Signori and Vismara (2016) investigate firm success and failure in the UK by calculating the return on investments for 212 successfully funded ECF campaigns that obtained financing on Crowdcube. They find that 10% of the firms failed, while 30% obtained one or more seasoned equity offerings, from either a private equity injection or another ECF round on Crowdcube or by being the target of a merger or acquisition transaction. The evidence shows that the presence of non-executives, patents, and tax incentives are associated with post-campaign success. Moreover, the presence of professional investors was a good predictor of firm survival. Hornuf and Schmitt (2016b) analyze the success and failure of crowdfunded firms in Germany and the UK and find that more firms in Germany managed a crowd exit through a significant VC round while somewhat fewer firms ultimately failed in the UK.

[39] This chapter is joint work with Lars Hornuf. An earlier version of this paper appeared under the title “Equity Crowdfunding in Germany and the UK: Follow-Up Funding and Firm Survival” in the Max Planck Institute for Innovation & Competition Research Paper Series and in the CESifo Working Paper Series (Hornuf and Schmitt, 2017). The authors thank Ajay Agrawal, Thomas Åstebro, Christian Catalini, Douglas Cumming, Stefan Wagner, and the participants of the 4th Crowdinvesting Symposium (Max Planck Institute for Innovation and Competition), Max Planck Institute for Innovation and Competition Research Seminar (Bernried), and the 5th Crowdinvesting Symposium (Humboldt University of Berlin) for their helpful comments and suggestions.

The current study takes a double-sided approach by investigating the determinants of follow-up funding and firm failure after an ECF campaign. Moreover, the study analyzes campaigns on 36 ECF portals in Germany and on two leading portals in the UK. The findings should thus provide significant external validity regarding the determinants that help firms build an enduring business. Moreover, follow-up funding and especially firm survival are important factors that help policy makers evaluate whether ECF is an efficient and worthwhile form of financing. I investigate several potential determinants of follow-up funding and firm failure: firm characteristics such as registered trademarks; the size, age, and gender composition of the management team; filed and granted patents; different ECF campaign characteristics; and the current financial situation of the firm. Furthermore, I analyze the differential effect of these determinants in a cross-country comparison between Germany and the UK.

To provide evidence on the research questions, I hand-collected data for 656 firms that ran at least one successful ECF campaign. The study finds a negative effect of firm age, the average age of the management team, and excessive funding during the ECF campaign on the likelihood of receiving follow-up funding after a successful ECF campaign. The number of senior managers, registered trademarks, subsequent successful ECF campaigns, crowd exits, and the amount of the funding target had a positive effect on follow-up funding. Existing BAs and VCs attracted even more peers after a successful ECF campaign. Not surprisingly, firms that did not obtain capital as part of an ECF campaign performed rather poorly in obtaining other forms of follow-up funding. The capital structure of the firm as measured by the ratio of equity to total assets had no effect on follow-up funding.

Subsequent successful ECF campaigns, crowd exits, and the number of VCs were also significant predictors reducing firm failure. Firms that did not obtain ECF were more likely to fail. This result might be considered a noisy indicator for an efficient selection process and the wisdom of the crowd. Conversely, firms that did not obtain ECF might be in a relatively worse financial condition and therefore should not be compared with firms that raised capital on an ECF portal.

In line with Hornuf and Schmitt's (2016b) study, I find that UK firms had somewhat fewer crowd exits, but their survival rates were slightly higher on average. Moreover, evidence shows that the number of senior management team members, granted patents, crowd exits, and the total amount of capital raised during the ECF campaign have a differential

effect on follow-up funding in Germany and the UK. By contrast, the age of the firm at the end of the first campaign, the share of female senior management team members, and the total number of ECF investors differently affect firm survival in the two countries. While older firms increase the likelihood of failure in the UK, female senior managers and the number of ECF investors increase the likelihood of firm failure in Germany. The latter result might be because ECF portals in Germany broker mezzanine financial instruments such as subordinated profit-participating loans (*partiarische Darlehen*), silent partnerships (*stille Beteiligungen*), and non-securitized participation rights (*Genussrechte*). These contracts mimic the returns of equity shares but come with little or no control rights that could have an impact on the management of the start-up (Klöhn et al., 2016a). If such control by the crowd is important for firm performance, the start-ups on UK portals that broker real equity shares might have a comparative advantage.

By identifying selection criteria for crowd and professional investors such as BAs and VCs, which invest in this new asset class for the first time, the study adds to the recent literature in entrepreneurial finance (Block et al., 2017a). Moreover, by reducing the degree of uncertainty of ECF investments and allowing investors to base their investment decisions on empirical evidence, the research reduces prejudices among traditional investors. Making the factors that contribute to the success and failure in ECF more salient not only benefits various investor types but also helps stabilize and establish a new market segment of entrepreneurial finance. If firms that have a positive net present value now for the first time receive capital through the crowd, ECF is a potentially welfare-enhancing activity. Helping portal managers and investors differentiate lemons from potentially enduring businesses thus fosters economic growth and employment.

The remainder of this chapter proceeds as follows: in the next section, I provide a brief definition of ECF. Section 4.3 provides the theoretical framework of the study and develops hypotheses. Section 4.4 introduces the variables used in the regression, describes the data sources, and explains the method applied to identify the determinants of follow-up funding and firm failure. From this, Section 4.5 outlines the descriptive and multivariate results. Section 4.6 discusses the findings, links them to the existing literature streams, and summarizes the contributions to the relevant policy debate.

4.2 Equity crowdfunding

ECF is a sub-category of crowdfunding, which differs substantially from other forms such as donation-based or reward-based crowdfunding. Donation-based crowdfunding often involves the funding of artistic or philanthropic projects. Under this model, backers donate their funds without receiving a specific compensation. Altruistic motives and feelings of warm glow therefore play a crucial role when backers support projects. This is different under the reward-based model of crowdfunding, in which backers are promised tangible or intangible perks (e.g., a coffee mug, having their name posted in the credits of a movie). In reward-based crowdfunding, backers also finance a product or service, which the venture still must develop and backers intend to consume later on. Under the ECF model, backers expect financial compensation. Until now, the extent of altruistic and financial motives of investors in ECF has been largely under-researched. It seems unlikely, however, that investors expect financial returns from ECF to contribute to their personal savings plan or even a retirement savings portfolio.

To convince the crowd to finance a start-up via an ECF platform, entrepreneurs in some jurisdictions offer equity shares in a limited liability company (LLC). In the UK, common equity shares are offered on portals such as Crowdcube or Seedrs. By contrast, start-ups in Germany do not offer common equity shares, because transferring LLC shares requires the costly service of a notary. German firms engaging in ECF therefore draft financial contracts in the form of profit-participating loans or silent partnerships that mimic the future cash flows of the firm and are only payed out after the investment contract expires or a new investor buys a substantial fraction of the firm. ECF also differs from marketplace lending or loan-based crowdfunding, in which investors finance loans and receive a pre-determined, periodic interest payment in return.

Start-ups that aim to raise capital in an ECF campaign negotiate the valuation of the firm with the portal and decide how much capital they want to raise. The portal provides a boilerplate financial contract, which establishes the financial relationship between the start-up and the crowd. Most portals allocate funds under one of two models: all-or-nothing or keep-it-all (Cumming et al., 2014). Under the all-or-nothing model, which is the predominant model in Germany and the UK, founders set a funding goal and keep nothing unless this goal is reached. In many campaigns, the funding goal is set at 50 thousand EUR. If the funding goal cannot be reached during the funding period, the potential investors receive the capital they

had previously pledged back. This process is different in the US, where reward-based crowdfunding portals such as Indiegogo run a keep-it-all model and start-ups can decide whether to keep the money pledged independent of whether the funding goal was reached or not. Furthermore, most portals in Germany and the UK allocate shares under a first-come, first-served model, in which the start-ups set a funding limit and stop selling shares after the funding limit is reached.

Finally, it should be mentioned that most start-ups raising capital through ECF avoid legal disclosure requirements by using the exemptions from the national prospectus regime. This is achieved by raising overall amounts of less than 2,5 million EUR in Germany and 5 million GBP in the UK (Hornuf and Schwienbacher, 2017b).

4.3 Theory and hypotheses

4.3.1 Theoretical considerations

Little is known about the determinants that affect follow-up funding and firm survival of equity-crowdfunded start-ups. While human capital theory and organizational ecology offer general insights into the determinants of firm survival (Brüderl et al., 1992), the financial contracting and the allocation mechanism of shares in ECF are still new and thus might lead to atypical outcomes. The hypotheses and empirical analysis therefore inevitably remain to some extent original and exploratory. Nevertheless, I test whether the factors affecting follow-up funding and firm survival in BA/VC finance are important in ECF as well. Furthermore, I investigate whether the specific features of an ECF campaign determine the likelihood that start-ups ultimately build enduring businesses or not. Before I outline the hypotheses, it should be noted that whether a start-up can build an enduring business generally depends on two factors. First, start-ups capable of sending effective signals in the spirit of Spence (1973) to potential investors should receive more capital and, as a result, also have a lower probability of firm failure. Second, independent of whether firms can send effective signals, some firms might be inherently more valuable and thus might have a lower probability of failure. However, if investors cannot observe the value of a firm, these firms will in some cases lack the necessary capital and therefore have a higher probability of failure.

4.3.2 Hypotheses

I hypothesize that the management team has an impact on follow-up funding and firm survival. I differentiate the hypothesis about the management team according to its size, age, and gender.

Empirical research on large and publicly traded companies indicates a negative relationship between board size and firm performance (Coles et al., 2008; Guest, 2009; Yermack, 1996). According to Jensen (1993) and Lipton and Lorsch (1992), the main reason larger boards are less efficient is that they face difficulties in solving the agency problem among the board members. Bennedsen et al. (2008) investigate the boards of small and medium-sized companies and find no performance effects when the board size was below six directors. While the board is the highest authority in the management of the firm, start-ups might not even have a board of directors, but a management that consists solely of one or two founders, who supervise a handful of employees. On the one hand, starting a business alone can be difficult and cumbersome because of a lack of competences and capacity constraints. On the other hand, the larger the management team of a start-up becomes, the more likely are disputes among management team members to arise. In line with that reasoning, Chowdhury (2005) shows that entrepreneurial team size is negatively correlated with team effectiveness. Moreover, sometimes only a single extraordinary person is necessary to turn a poorly performing firm around. A well-known example is the return of Steve Jobs to Apple in 1997, which helped the firm quickly gain on performance again. I therefore expect that a larger management team has a negative effect on firm performance and, therefore, follow-up funding and firm survival.

H1a: Management team size decreases the probability of follow-up funding and increases the probability of firm failure.

The average age of the management team can have two opposing effects on follow-up funding and firm survival. On the on hand, age comes with experience. Older managers often have more industry and leadership experience, which allows them to create a more successful company (McGee et al., 1995). In a conjoint experiment with 51 VCs from Munich, Berlin, and Vienna, Franke et al. (2008) show that fund managers evaluate older start-up teams more positively in general; a management team of only young members receives a lower team evaluation by VCs. Thus, experienced management team members might help the firm acquire follow-up funding and survive. On the other hand, younger managers are not stuck in

old patterns of thinking and are close to trending markets. A well-known anecdotal example is Mark Zuckerberg, who founded Facebook at the age of 20 and appealed to the need of many young people to connect with friends online. Consequently, Facebook became the most famous online social network worldwide. Young age may therefore ensure higher growth rates for the future (Stuart and Abetti, 1990). Thus, young managers may raise the chance of receiving follow-up funding from BAs/VCs searching for high-growth start-ups. By contrast, firm survival might be negatively correlated with the greater risk affinity of young managers, which potentially comes with their higher innovativeness.

A management team with a large degree of age heterogeneity might combine the advantages of being young and senior, resulting in better firm performance. Greater diversity may bring both extensive industry experience and knowledge of trending markets. However, different perspectives, caused by age disparities, can also lead to lower team performance stemming from potential disagreement and disunity. Chowdhury (2005) interviewed 174 entrepreneurs in 79 entrepreneurial teams that worked in start-ups that were between two and five years in operation. He finds that a large team age heterogeneity decreases team effectiveness. In a similar vein, Franke et al. (2008) show that teams with a higher age heterogeneity receive a worse evaluation by VCs. I conjecture that such a loss of team effectiveness affects firm performance and firm valuation, leading to lower rates of VC funding and a higher likelihood of failure.

H1b: A higher average age of the management team increases the probability of follow-up funding and decreases the probability of firm failure. Higher age heterogeneity decreases the probability of follow-up funding and increases the probability of firm failure.

Fairlie and Robb (2009) compare the performance of 13,918 female-owned firms with 24,102 male-owned firms in the US from 1992 to 1996. They find that female founders have lower survival rates, profits, and sales and fewer employees. However, in a more recent study, Robb and Watson (2012) find no difference in the performance between 1,041 female-owned and 2,975 male-owned US firms. The difference is mostly driven by their use of firm size–adjusted performance measures, which allows them to consider that female-owned firms tend to be smaller.

The evidence on gender and credit constraints is largely mixed. While Bellucci et al. (2010) show that female entrepreneurs face tighter credit availability, Cavalluzzo and

Cavalluzzo (1998) find the opposite to be true.[40] Furthermore, Alsos et al. (2006) find in their survey that women receive significantly less equity and debt capital, which also negatively affects the growth rates of female-owned firms. I thus hypothesize that female founders in ECF might find it more difficult to obtain follow-up funding, which in turn might affect firm survival because of the lack of capital.

H1c: A higher share of women in the management team decreases the probability of follow-up funding and increases the probability of firm failure.

Patents and trademarks can affect follow-up funding and firm survival because they provide a signal for the innovativeness and brand value of the firm. They also allow the start-up to protect its intellectual property and brand. Overall, the impact of patents and trademarks should be positive for follow-up funding and firm survival. Especially trademarks are important for young firms. De Vries et al. (2017) show that start-ups are more likely to file trademarks than patents when entering the market. BAs/VCs might base their funding decisions on firms' trademarks or ability to obtain a granted patent. For that reason, firms that possess trademarks and patents might receive more funding and thus have a higher chance of firm survival.

In general, firms may overcome information asymmetries between investors and entrepreneur by using patents and trademarks to effectively signal their quality. Hsu and Ziedonis (2013) examine a sample of 370 US semiconductor start-ups and find that patents have a positive effect on firm evaluation by VCs. In the context of biotechnology, Haeussler et al. (2014) show that patent applications are positively related to follow-up VC investments. In addition, patents might reveal that the firm was able to create an innovation and will do so in the future (Farre-Mensa et al., 2017). With respect to trademarks, Block et al. (2014) report that especially in early funding rounds, trademark applications are highly valuable for VCs and lead to higher firm valuations. In their study, the impact on the valuation by trademarks is even higher than that for filed patents. The authors assume that this is due to the higher success rate of applications for trademarks than for patents. Furthermore, Zhou et al. (2016) show that start-ups that applied for both patents and trademarks obtained higher valuations by VCs. Overall, I conjecture that patents and trademarks lead to a higher chance of receiving follow-up investments by BAs/VCs.

[40] See also the meta-studies of Post and Byron (2015) and Terjesen et al. (2009).

Regarding firm survival, I expect that firms that filed or were granted patents might be more innovative and, thus, more successful. In addition, intellectual property protection allows the firm to reap monopoly profits during the duration of the patent. Farre-Mensa et al. (2017) show that start-ups with patents have an 80% higher sales growth five years after they filed the first patent application and higher-quality follow-up innovation. Therefore, their ability to build an enduring business should be greater. A similar rationale might hold for trademarks, which allow firms to make use of a valuable brand and be more successful. Block et al. (2014) explain that trademarks not only have a signal effect on investors but also have a protection value for the firm. Trademarks protect the firm's brand and thus might offer a higher chance of survival. In support of this, Helmers and Rogers (2010) find that trademarks and patents lead to lower probability of firm failure. I therefore expect a positive effect of patents and trademarks on firm survival.

H2: Patents and trademarks increase the probability of follow-up funding and decrease the probability of firm failure.

Campaign characteristics, such as the number of investors and the total amount raised, provide important insights into the quality and ultimate success of the start-up (Ahlers et al., 2015; Hornuf and Schwienbacher, 2018). Investing in a firm and spending a larger amount of money in total suggest that people believe in the firm's quality and prospects. If a 'wisdom of the crowd' exists in crowdfunding, as Mollick and Nanda (2015) suggest, crowd support is a good predictor of follow-up funding and firm survival. Moreover, firms that obtained more funding through an ECF campaign are in a better financial condition than firms that received less money during an ECF campaign. Therefore, I hypothesize that funding success during an ECF campaign results in a higher chance of follow-up funding by BAs/VCs and, thus, a lower chance of firm failure.

Whether a successful reward-based crowdfunding campaign positively affects follow-up funding is not yet established in the literature. Ryu and Kim (2017) show that firms that ran a successful reward-based crowdfunding campaign have a lower chance of receiving follow-up funding by VCs. By contrast, Kaminski et al. (2016) show that reward-based crowdfunding campaigns lead to subsequent VC investments. Colombo and Shafi (2016) provide evidence that firms with external financing before their crowdfunding campaign receive even more follow-up funding when they perform badly and deliver their product late. Drover et al. (2017b) investigate the impact of crowdfunding on the VC screening process. They find that a

successful crowdfunding allows for certification effects and positively influences the decision of a VC to fund the start-up. Therefore, I expect that a large amount of crowd participation predicts the future interest of BAs/VCs.

By running a survey among entrepreneurs who ran a Kickstarter campaign, Stanko and Henard (2017) show that the number of backers in reward-based crowdfunding positively affects the product-market performance of the venture after the campaign. In general, better sales performance should help the firm survive. Furthermore, the larger the investor community, the more people are interested in the success of the firm. Crowd investors who are convinced about the product might also promote the firm via their social and business networks. I therefore expect that a larger amount of interest during the ECF campaign leads to a higher chance of firm survival.

H3: Interest in an ECF campaign increases the probability of follow-up funding and decreases the probability of firm failure.

I conjecture that certain financial indicators predict both the follow-up funding by BAs/VCs and the chance of firm survival. I consider a firm's financial situation according to the number of BAs/VCs that have previously supported it and the ratio of equity to total assets. The number of BAs/VCs positively influences a firm's prospects for various reasons. Drover et al. (2017b) show that the certification effect of prior BA investments allows for VCs positive assessments of the start-up. Furthermore, VCs tend to syndicate with one another (Lerner, 1994). In general, syndicate VCs' performance is better, and their portfolio companies have a higher chance of surviving (Hochberg et al., 2007). VCs' networks allow them to improve the quality of deal flow by sharing information and expertise. Therefore, I hypothesize that a greater number of BAs/VCs might attract further investments by other BAs/VCs. In other words, as firms with a large syndicate of VCs have better performance, I expect that the probability of firm survival is higher if more BAs/VCs are engaged.

Furthermore, I use the ratio of equity to total assets as a variable for the capital structure. A small ratio of equity to total assets might predict firm failure due to the lack of capital and low profit or no profit at all. However, it might not be a predictor of follow-up funding, as potential investors of the start-up focus more on the firm's prospects and less on the current capital structure. Nevertheless, I expect that a low or negative ratio of equity to total assets might lead to a higher chance of prospective firm failure.

H4: BA/VC syndication and sound financials increase the probability of follow-up funding and decrease the probability of firm failure.

In 2015, the UK ECF market was 10 times larger than the German market (Dorfleitner et al., 2017). The question therefore is: What are the reasons for these differences, and how do they affect follow-up funding and firm failure? Potential explanations for the larger UK market might be tax advantages,[41] the benefit of London as a financial center,[42] and the possibility of real equity investment in the UK compared with the mezzanine financial instruments offered in Germany. The benefits of tax advantages might make investors less cautious and inclined to invest in riskier start-ups, because only a fragment of their investment is actually lost in case of firm failure. The presence of London as a financial center might be an indicator of more financial sophistication among investors. Furthermore, in the case of high information asymmetry, riskier firms tend to offer non-convertible debt rather than common equity and, in this way, provide a signal of their type (Stiglitz and Weiss, 1981). This mechanism is to some extent not a factor in Germany, because equity offers are virtually non-existent. The availability of debt and equity financing could therefore represent an advantage of the UK market, resulting in a better selection process that manifests itself in higher firm survival rates. Finally, because of the large number of firms that obtain ECF in the UK, more firms with lower growth expectations and a higher risk of failure could also receive ECF. Moreover, with respect to follow-up funding, the overall VC market in the UK in 2016 was 4.8 billion USD compared with 1.9 billion USD in Germany.[43] Therefore, I expect that more follow-up funding is naturally available in the UK than in Germany; I am not aware of any general difference between the two countries in start-up performance and firm survival.

H5: The unique market conditions in Germany and the UK have a differential impact on follow-up funding and firm survival in ECF.

[41] The UK provides two tax reliefs for investors. Both the Enterprise Investment Scheme and the Seed Enterprise Investment Scheme offer a tax relief of up to 30% and 50%, respectively.
[42] Vulkan et al. (2016) show that approximately 38% of all pledges come from London.
[43] Source: PitchBook database.

4.4 Data and method

4.4.1 Data

For the period from September 24, 2011, to June 30, 2016, I hand-collected data on 656 firms that ran at least one successful ECF campaign in Germany or the UK. I collected the data directly from the ECF portal websites. For further analysis an additional sample of 60 German firms, which never successfully completed an ECF campaign, is used. The initial data set consists of information about the ECF campaign characteristics. I merged this data set with additional information on firm characteristics from the BvD Orbis and Zephyr databases, Thomson Reuters Eikon, CrunchBase, and the German company register (*Unternehmensregister*).

4.4.2 Dependent variables

The study investigates two events, so I use two dependent variables. The first variable measures the event of receiving follow-up funding by BAs/VCs at time t after the firm's first successful ECF campaign. The primary data source is BvD Orbis and Zephyr, CrunchBase, and Thomson Reuters Eikon. In an initial step, I identified the firms from the sample in the data base Orbis. I then collected information about financing rounds from Zephyr, CrunchBase, and Thomson Reuters Eikon for these firms. I also systematically searched for additional information about follow-up funding on the websites of the firm, VCs, and ECF portals and supplemented the data set accordingly. To exclude rumors and identify only actual equity investment by investors, I scrutinized the shareholder list of the corresponding firm. I consider the date of registering the investor on the shareholder list as the time of the investment.

To identify different shareholder types (BAs/VCs), I used the shareholder list from Orbis. The management team with shares is excluded. I defined investors as VCs if I found a company website with clear information about their investment activity as VCs. In the study, shareholders represent BAs if the shareholder is a private person who invested as a shareholder in at least two other companies. After identifying the initial investments by BAs/VCs, I used investments by outside BAs/VCs as a follow-up funding event for the duration analysis. For example, if a new investment round took place, I consider this a BA/VC funding round if new, outside investors became shareholders of the firm. This allows me to focus on the effect of an ECF campaign on outside investors.

The second variable captures a firm failure event—that is, whether a firm went insolvent, was liquidated, or was dissolved at time t after its first successful ECF campaign. I collected the data from the German company register (*Unternehmensregister*) and Companies House in the UK. I use the first announcement date of the insolvency or liquidation as the failure event. In some cases, insolvency proceedings were not initiated because of a lack of assets, and the firm was liquidated right away.

4.4.3 Independent variables

Firm characteristics

To control for firm characteristics, I consider three variables. First, to control for country-specific factors, I define a dummy variable that equals 1 if the firm is incorporated in the UK and 0 if it is incorporated in Germany. Second, I include a dummy variable that equals 1 if no minimum capital requirements exist for the respective legal form of the start-up seeking ECF and 0 otherwise. In Germany, the legal form is the *Unternehmergesellschaft (haftungsbeschränkt)* and in the UK the Limited (Ltd.). Moreover, four partnership companies were seeking capital through ECF but were excluded from the sample because the numbers were too small to retrieve any meaningful analysis from them. Third, I control for the firms' age at the end of the first successful ECF campaign using the date of incorporation. I collected the information about firm characteristics from Orbis.

Management

To test H1 that the specific characteristics of the management team have an impact on follow-up funding and firm survival, I collected information about the senior management as of January 1, 2017, to investigate the impact of the size of the management team, average age, and share of female management. The senior management includes the CEO, managing partners, and managing directors. The variables consist of the number of senior management team members, the average age of senior management team members, and the share of female senior management team members. To capture age heterogeneity, I calculated the age difference between the oldest and youngest senior management team members. The source of the management team information is Orbis.

Trademarks and patents

Because trademarks and patents signal firm quality, I consider the number of filed patents, number of granted patents, and number of granted trademarks to test H2. The source for trademarks is Orbis and for patents PATSTAT and Orbis. I retrieved the data on January 1, 2017.

Campaign characteristics

To test H3, I derived several variables related to the ECF campaigns. The campaign characteristic variables are time-varying and change with any subsequent successful ECF campaign. These variables are the total amount of capital raised, the total amount of the funding target, the total number of investors, and the business valuation by the portal at the time of the ECF campaign. Furthermore, I consider the ratio of the amount raised to the funding target to test for the effect of overshooting and excessive funding. Moreover, if a firm is not able to set its funding targets correctly and thus cannot properly estimate how much money it can collect through ECF, BAs/VCs might assess the firm and its founders negatively. I collected this data from the ECF portal websites.

Financials

I measure the financial situation of the firms in two ways to test H4. First, I identified the current number of BAs and VCs via the shareholder list from Orbis. The variable is time-varying and changes with any follow-up funding event. Second, on a sub-sample of 287 firms, I derived information about the capital structure and used the ratio of equity to total assets from Orbis.

4.4.4 Method

To examine the effect of various factors that may contribute to higher or lower hazards for the success or failure events of a start-up, I use a Cox semi-parametric proportional hazards model. The advantage of this model is that it does not require the specification of the time dependence distribution of the hazard. Furthermore, the model allows for right-censored data and time-varying explanatory variables. Clustered standard errors by industry allow me to consider industry-specific effects. The observation period starts after the end of the first successful ECF campaign and lasts until failure or right-censoring as of June 30, 2016. In the

duration analysis of follow-up funding, I consider repeated events. This means that the model allows including multiple follow-up funding for one firm.

4.5 Results

4.5.1 Descriptive statistics

Table 4-1 shows descriptive statistics for the 656 firms in the sample. These firms ran 778 successful campaigns (on average 1.2 successful campaigns per firm), 512 of which took place in the UK and 266 in Germany. The average amount raised is 340,271 EUR in Germany and 515,575 EUR in the UK (diff. 175,303 EUR, p=0.001).[44] In the UK, on average 207 investors support an ECF campaign, while in Germany, 323 investors do so (diff. 116 investors, p=0.000). Most firms operate in the information and communication industry (26.22%), followed by the wholesale and retail business (17.68%) and manufacturing (16.16%) industries. On average, every second ECF-financed firm received capital from a VC fund, while four of 10 firms received money from a BA. The average age of the crowdfunded firms at the end of their first successful campaign is 2.8 years. The average manager in the team is 44 years of age, and the team consists of 2.7 people on average. The average age difference between the oldest and youngest team member is nine years. Only some firms possess trademarks or patents. Every 10th firm filed for a patent, and only half as many were granted a patent. More than half the start-ups received a registered trademark.

[44] The EUR/GBP exchange rate as of the date of the ending of the campaign provided by Thomson Reuters Eikon is used for the conversion.

Table 4-1: Summary statistics

Panels provide summary statistics of 656 firms that ran at least one successful ECF campaign between September 24, 2011, and June 30, 2016. Column 'Yes' indicates that a dummy variable takes the value of 1. Panels B and C show sub-samples of firms from Germany and the UK, respectively. Variables reported are defined in Appendix 4, Table A4-1. Amount raised, funding target, and business valuation are in EUR. The EUR/GBP exchange rate as of the date of the ending of the campaign provided by Thomson Reuters Eikon is used for the conversion.

PANEL A: Total sample

	N	Mean	Std.-dev.	Minimum	Median	Maximum	Yes
	Total						
Events							
Firm insolvency or liquidation	656	0.117	0.322	0	0	1	77
Number of VCs	656	0.476	1.349	0	0	16	
Number of BAs	656	0.419	1.245	0	0	12	
Number of successful campaigns	656	1.184	0.528	1	1	6	
Firm characteristics							
Age of the firm at end of first campaign	656	2.793	3.577	0.000	1.768	33.956	
LLC form with no capital requirements	656	0.040	0.195	0	0	1	26
Management							
Number of senior management	598	2.732	1.932	1	2	12	
Share of female senior management	577	0.139	0.273	0.000	0.000	1.000	
Average age of senior management	576	43.584	9.371	22	43	72	
Age difference of senior management	577	9.196	12.034	0.000	3.000	46.000	
Trademarks and patents							
Number of filed patents	656	0.090	0.555	0	0	8	
Number of granted patents	656	0.040	0.343	0	0	6	
Number of granted trademarks	656	0.520	1.462	0	0	19	
Campaign characteristics							
Amount raised	778	455,638	722,296	1,026	200,000	6,336,332	
Funding target	769	2,030,507	48,848,807	1,000	116,836	1,354,829,968	
Ratio of amount raised to funding target	761	1.681	19.473	0.033	0.730	432.900	
Number of investors	733	242.322	311.439	1	145	2702	
Business valuation	600	3,236,979	7,352,256	63,549	1,396,146	85,055,711	
Financials							
Number of subsequent successful campaigns	656	0.184	0.528	0	0	5	
Exit of the crowd	656	0.015	0.123	0	0	1	10
Ratio of equity to total assets	427	39.585	46.940	-95.932	43.584	100.000	
Duration statistics							
Time at risk in days	656	647.637		1	560	1741	

PANEL B: German Sample

	N	Mean	Std.-dev.	Minimum	Median	Maximum	Yes
				Germany			
Events							
Firm insolvency or liquidation	236	0.182	0.387	0	0	1	43
Number of VCs	236	0.581	1.616	0	0	16	
Number of BAs	236	0.814	1.815	0	0	12	
Number of successful campaigns	236	1.131	0.407	1	1	3	
Number of subsequent unsuccessful campaigns	236	0.030	0.193	0	0	2	
Firm characteristics							
Age of the firm at end of first campaign	236	2.823	4.645	0.000	1.481	33.956	
LLC form with no capital requirements	236	0.110	0.314	0	0	1	26
Management							
Number of senior management	222	1.734	1.087	1	1	8	
Share of female senior management	205	0.076	0.242	0.000	0.000	1.000	
Average age of senior management	205	41.387	8.860	22	39	68	
Age difference of senior management	205	2.020	5.230	0.000	0.000	39.000	
Trademarks and patents							
Number of filed patents	236	0.119	0.635	0	0	5	
Number of granted patents	236	0.059	0.457	0	0	6	
Number of granted trademarks	236	0.708	1.841	0	0	19	
Campaign characteristics							
Amount raised	266	340,271	538,619	1,026	159,242	4,818,000	
Funding target	257	117,161	222,608	1,000	50,000	2,000,000	
Ratio of amount raised to funding target	251	0.485	0.302	0.033	0.500	1.471	
Number of investors	223	323.448	343.268	4	198	1982	
Business valuation	197	2,451,861	2,523,079	310,000	1,500,000	17,800,000	
Financials							
Number of subsequent successful campaigns	236	0.13	0.41	0	0	2	
Exit of the crowd	236	0.034	0.181	0	0	1	8
Ratio of equity to total assets	67	30.283	30.073	-11.521	19.896	99.964	
Duration statistics							
Time at risk in days	236	773.852		1	754	1704	

PANEL C: UK Sample

	N	Mean	Std.-dev.	Minimum	Median	Maximum	Yes
				UK			
Events							
Firm insolvency or liquidation	420	0.081	0.273	0	0	1	34
Number of VCs	420	0.417	1.171	0	0	12	
Number of BAs	420	0.198	0.664	0	0	5	
Number of successful campaigns	420	1.214	0.584	1	1	6	
Firm characteristics							
Age of the firm at end of first campaign	420	2.777	2.811	0.000	1.952	18.337	
LLC form with no capital requirements	420	0.000	0.000	0	0	0	0
Management							
Number of senior management	376	3.322	2.076	1	3	12	
Share of female senior management	372	0.174	0.283	0.000	0.000	1.000	
Average age of senior management	371	44.798	9.436	25	45	72	
Age difference of senior management	372	13.151	12.871	0.000	9.000	46.000	
Trademarks and patents							
Number of filed patents	420	0.074	0.505	0	0	8	
Number of granted patents	420	0.029	0.257	0	0	4	
Number of granted trademarks	420	0.414	1.187	0	0	13	
Campaign characteristics							
Amount raised	512	515,575	795,180	3,018	207,208	6,336,332	
Funding target	512	2,990,917	59,862,536	3,031	179,200	1,354,829,968	
Ratio of amount raised to funding target	510	2.270	23.772	0.058	0.823	432.900	
Number of investors	510	206.849	289.744	1	128	2702	
Business valuation	403	3,620,771	8,774,515	63,549	1,250,781	85,055,711	
Financials							
Number of subsequent successful campaigns	420	0.21	0.58	0	0	5	
Exit of the crowd	420	0.005	0.069	0	0	1	2
Ratio of equity to total assets	360	41.316	49.286	-95.932	50.054	100.000	
Duration statistics							
Time at risk in days	420	576.717		29	503	1741	

4.5.2 Duration analysis of follow-up funding

I begin by discussing the descriptive statistics regarding the chance of receiving follow-up funding after an ECF campaign, which are provided by a Nelson–Aalen cumulative hazard graph, categorized by country (see Figure 4-1).[45] In Germany, there is a steady increase in the hazard of receiving funding after the first campaign. The picture is similar in the UK. Overall, in Germany around 38% of all firms received follow-up funding by an outside BA/VC 36 months after the first campaign, whereas only 22% of all UK firms received follow-up funding in the first 36 month after their first campaign. This contrasts with the greater amount of venture capital available in the UK. Comparing the German sub-sample of successful and unsuccessful funded firms, I find that firms are less likely to receive follow-up funding if their ECF campaign failed (see Figure 4-2).

[45] In contrast with the Kaplan–Meier estimates, the advantage of using the Nelson–Aalen cumulative hazard function is that repeated events, such as several BA/VC investments in one firm, can be considered.

Figure 4-1: Nelson–Aalen cumulative hazard estimates (GER and UK)
Figure illustrates the Nelson–Aalen cumulative hazard estimates comparing the German and UK sample. The graph shows the time until the first follow-up funding by a VC investor or BA for successful campaigns.

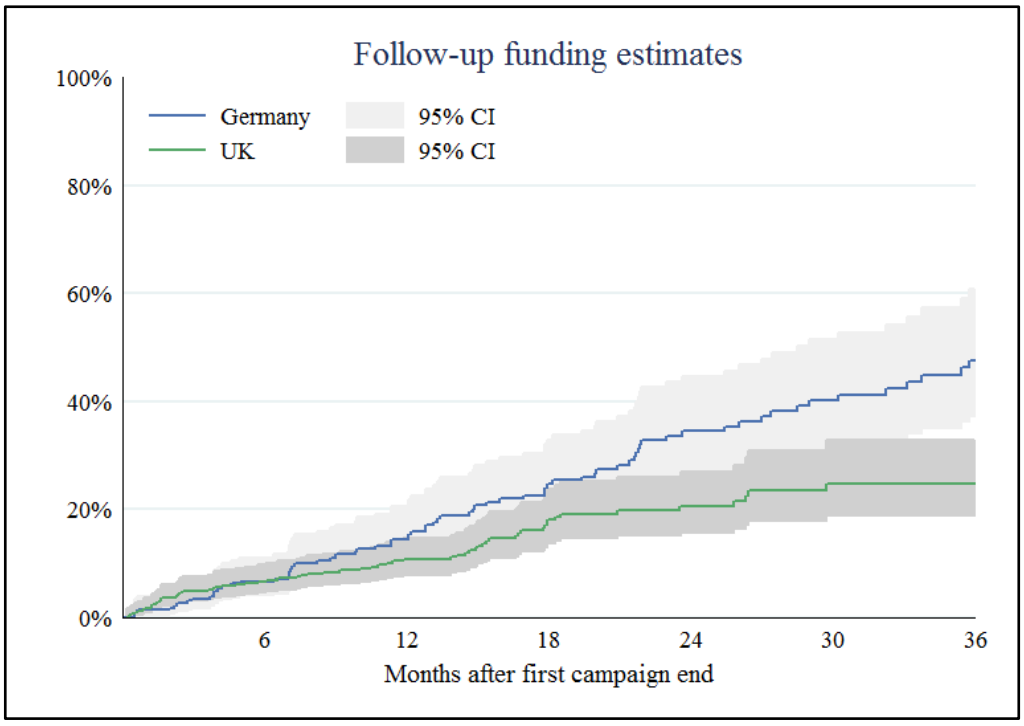
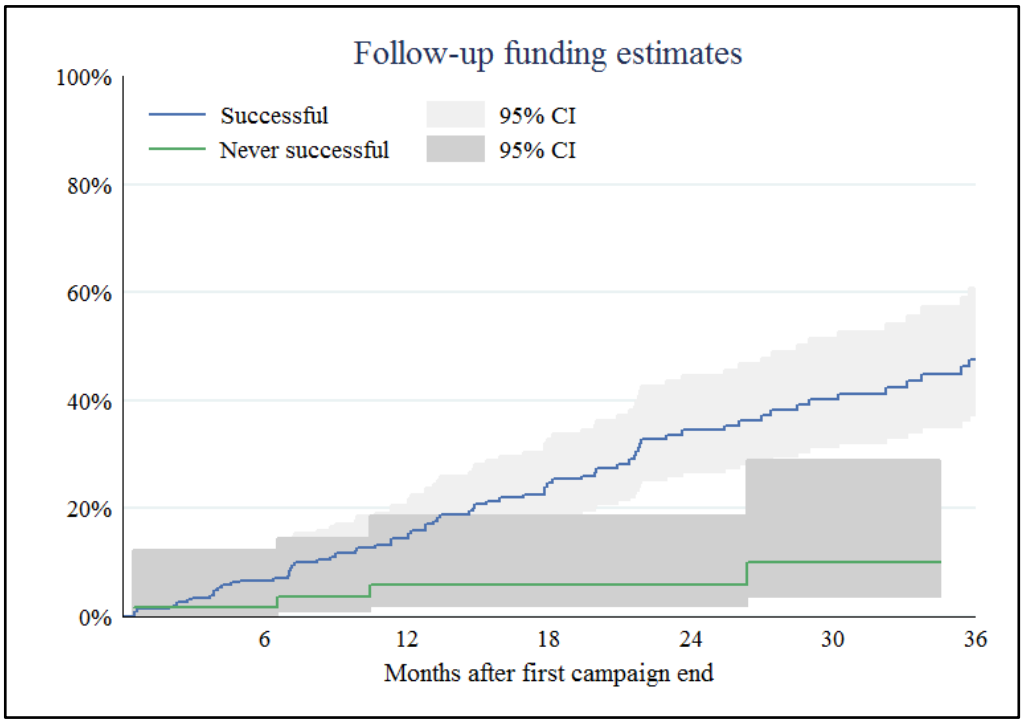


Figure 4-2: Nelson–Aalen cumulative hazard estimates (GER)
Figure illustrates the Nelson–Aalen cumulative hazard estimates for the German sample. Figure shows the comparison between firms with at least one successful ECF campaign and firms that never ran a successful ECF campaign. The graph shows the time until the first follow-up funding by a VC investor or BA.



I now turn to the Cox proportional hazard regressions to evaluate contributing factors to follow-up funding. I categorize the explanatory variables in segments: firm characteristics (baseline), management, trademarks and patents, campaign characteristics, and financials. Table 4-2 presents the results. In regressions (1) to (5), Panel A, I first consider each segment separately. In the baseline regression with firm characteristics only, the chances of follow-up funding are significantly lower for firms incorporated in the UK and older firms, a finding in line with the Nelson–Aalen estimates. The management variables are only partially in accordance with H1. Age heterogeneity and female participation do not influence follow-up funding. While team size leads to a higher chance of follow-up funding, an older management team has a lower chance. Thus, BAs/VCs appreciate younger managers who have hands-on knowledge about trending markets more than industry and leadership experience.

H2 is partially supported. The trademark and patent variables are significant for trademarks but not for filed or granted patents. Protecting the firm's brand at this stage is apparently more important for BAs/VCs than determining whether the start-up is developing a higher-quality innovation. The regression results for the campaign characteristic variables show that subsequent successful ECF campaigns, crowd investor exits, and the total amount of the funding target are significant predictors of follow-up funding. Thus, campaign success of follow-up ECF campaigns can explain further investments by BAs/VCs. The total amount of capital raised or the total number of investors is not a predictor of follow-up funding though. Furthermore, firms raising more capital during an ECF campaign than initially estimated ('overshooting') is perceived as a negative signal by BAs/VCs. Moreover, a good predictor of follow-up funding after the ECF campaign is the number of VCs that engaged in the firm before the ECF campaign took place. This result is in line with H4.

In regression (6), Panel B of Table 4-2, I consider all explanatory variables together. The results are similar to those in regressions (1) to (5). In regression (7), I use a sub-sample of firms with detailed financial information and add the ratio of equity to total assets as an additional variable to the regression. However, I do not find evidence that the capital structure is an important factor for BAs/VCs to make funding available.

Furthermore, I test H5 about the differential impact of the variables of interest for the UK and Germany. Regression (12), Panel C of Table 4-2, shows the results. I use interaction dummies with almost every variable that had sufficient variation. I find that granted patents and subsequent successful campaigns are relatively less important for follow-up funding in

the UK than in Germany. The significant effect of crowd exit might be due to the fact that only two exits took place in the UK so far.[46] Furthermore, I find a relatively stronger syndication effect for BAs in the UK; the overall number of BAs leads to a higher chance of follow-up funding.

Firms that received ECF from more popular portals might also have better chances of receiving follow-up funding. In regressions (15) and (16), Panel D of Table 4-2, I approach this explanation using a sub-sample that consists of firms that received funding from the two largest UK portals (Crowdcube and Seedrs) and the three largest German portals (Companisto, Innovestment, and Seedmatch). I consequently dropped 240 firms from the sample that were funded on 33 minor German ECF portals. The results are similar to the large sample that included start-ups funded on smaller portals.

To test H3, regressions (17) and (18) consider a sub-sample of German firms with successful and unsuccessful ECF campaigns. Regression (17) includes a dummy for firms that never ran a successful ECF campaign, while regression (18) includes a variable that counts the number of unsuccessful campaigns after the first successful campaign. Both variables are highly significant and lower the chance of follow-up funding.

For robustness checks, I apply accelerated failure time (AFT) models with an exponential distribution and a Weibull distribution. An advantage of AFT is that the coefficients of this model can be intuitively interpreted in terms of which variable accelerates or decelerates the occurrence of the event of failure or follow-up funding.[47] The results appear in regressions (8) to (11), Panel B of Table 4-2, and regressions (13) and (14), Panel C. Using this slightly different estimator hardly affects the results.

[46] As of January 1, 2017, E-Car Club and Camden Town Brewery cashed out their crowd investors.

[47] Please note that coefficients in AFT models are interpreted the other way round compared to Cox semi-parametric proportional hazards model. Thus, one unit increase leads to an increase in the survival time.

Table 4-2: Follow-up funding regression results

The table provides Cox semi-parametric proportional hazard regression results on follow-up funding. Coefficients instead of hazard rates are reported. Standard errors are clustered by firm and appear in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level.

PANEL A

	(1)	(2)	(3)	(4)	(5)
	Cox				
Firm characteristics					
UK firm	-0.520**	-1.085***	-0.466**	-0.366	-0.352
	(0.218)	(0.200)	(0.225)	(0.266)	(0.263)
LLC form with no capital requirements	-0.137	-0.423***	-0.129	-0.035	-0.031
	(0.123)	(0.123)	(0.129)	(0.172)	(0.099)
Age of the firm at end of first campaign	-0.106***	-0.111***	-0.119***	-0.156***	-0.125***
	(0.037)	(0.035)	(0.033)	(0.059)	(0.041)
Management					
Number of senior management		0.345***			
		(0.047)			
Share of female senior management		-0.063			
		(0.389)			
Average age of senior management		-0.052***			
		(0.008)			
Age difference of senior management		-0.005			
		(0.011)			
Trademarks and patents					
Number of filed patents			0.068		
			(0.149)		
Number of granted patents			-0.233		
			(0.341)		
Number of granted trademarks			0.108**		
			(0.050)		
Financials					
Number of subsequent successful campaigns				0.541***	
				(0.128)	
Exit of the crowd				1.337***	
				(0.212)	
Campaign characteristics					
Total amount of money raised				0.008	
				(0.015)	
Total amount of funding target				0.033**	
				(0.013)	
Total number of investors				0.003	
				(0.027)	
Business valuation				-0.003	
				(0.018)	
Ratio of amount raised to funding target				-1.368**	
				(0.534)	
VC and BA					
Number of VCs					0.193***
					(0.046)
Number of BAs					0.111*
					(0.057)
Days at risk	425294	363533	425294	350050	425294
No. of events	142	134	142	125	142
No. of firms	656	577	656	497	656
Pseudo-R-square	0.011	0.051	0.013	0.052	0.035
Log-likelihood	-837.623	-736.056	-835.806	-680.521	-817.024
Chi-square	19.359	448.869	25.461	4544.325	55.890

PANEL B

	(6)	(7)	(8)	(9)	(10)	(11)
	Cox		AFT (Exponential)		AFT (Weibull)	
Firm characteristics						
UK firm	-0.773***	-0.567	0.505	0.791*	0.829**	0.631
	(0.278)	(0.757)	(0.314)	(0.442)	(0.344)	(0.990)
LLC form with no capital requirements	-0.221*	0.257	0.883***	0.529*	0.279*	-0.227
	(0.126)	(0.691)	(0.231)	(0.314)	(0.159)	(0.976)
Age of the firm at end of first campaign	-0.163***	-0.276***	0.160**	0.352***	0.195***	0.361***
	(0.058)	(0.078)	(0.079)	(0.095)	(0.075)	(0.128)
Management						
Number of senior management	0.229***	0.275***	-0.167*	-0.263***	-0.303***	-0.403***
	(0.043)	(0.048)	(0.089)	(0.096)	(0.060)	(0.089)
Share of female senior management	0.117	-0.401	-0.177	0.520	-0.153	0.558
	(0.387)	(0.474)	(0.378)	(0.542)	(0.465)	(0.652)
Average age of senior management	-0.032***	-0.022	0.156***	0.131***	0.041***	0.036
	(0.010)	(0.018)	(0.011)	(0.019)	(0.011)	(0.025)
Age difference of senior management	0.004	-0.003	-0.049***	-0.031***	-0.004	0.006
	(0.008)	(0.008)	(0.009)	(0.009)	(0.010)	(0.012)
Trademarks and patents						
Number of filed patents	-0.118	-0.102	0.105	0.134	0.145	0.183
	(0.180)	(0.161)	(0.197)	(0.187)	(0.229)	(0.220)
Number of granted patents	-0.829	-39.383***	0.999**	13.565***	1.032	18.078***
	(0.522)	(0.933)	(0.448)	(1.186)	(0.695)	(3.179)
Number of granted trademarks	0.058	0.121	-0.014	0.013	-0.072	-0.137
	(0.064)	(0.081)	(0.063)	(0.073)	(0.077)	(0.131)
Financials (1)						
Number of subsequent successful campaigns	0.335**	0.191	-0.102	0.090	-0.333	-0.125
	(0.163)	(0.183)	(0.171)	(0.211)	(0.216)	(0.219)
Exit of the crowd	0.157	0.384	0.394	0.697	0.167	0.467
	(0.207)	(0.491)	(0.322)	(0.600)	(0.288)	(0.901)
Campaign characteristics						
Total amount of money raised	0.025	-0.042	-0.039*	-0.001	-0.022	0.044
	(0.017)	(0.054)	(0.020)	(0.055)	(0.020)	(0.080)
Total amount of funding target	-0.006	0.069	-0.001	-0.053	-0.006	-0.087
	(0.019)	(0.053)	(0.021)	(0.057)	(0.021)	(0.079)
Total number of investors	-0.031	-0.048	0.152***	0.170	0.037	0.073
	(0.031)	(0.085)	(0.041)	(0.108)	(0.039)	(0.113)
Business valuation	-0.005	0.002	-0.014	-0.019	0.007	-0.006
	(0.021)	(0.010)	(0.025)	(0.012)	(0.028)	(0.015)
Ratio of amount raised to funding target	-1.142*	-1.363	3.212***	3.060***	1.649*	2.190*
	(0.669)	(0.888)	(0.872)	(0.987)	(0.906)	(1.313)
VC and BA						
Number of VCs	0.193***	0.180	-0.136	-0.017	-0.205**	-0.166
	(0.075)	(0.114)	(0.086)	(0.138)	(0.103)	(0.217)
Number of BAs	0.049	0.340**	0.025	-0.157	-0.055	-0.316
	(0.046)	(0.144)	(0.033)	(0.138)	(0.060)	(0.258)
Financials (2)						
Ratio of equity to total assets		-0.001		0.007***		0.001
		(0.003)		(0.002)		(0.004)
Constant					5.745***	5.633***
					(0.466)	(1.533)
Days at risk	298608	191186	298608	191186	298608	191186
No. of events	119	65	119	65	119	65
No. of firms	434	287	434	287	434	287
Pseudo-R-square	0.077	0.108	-	-	-	-
Log-likelihood	-611.102	-302.414	-370.801	-217.951	-332.457	-194.523
Chi-square	570008.284	208706.350	-	-	8102.096	10578.825

PANEL C

	(12)		(13)		(14)	
	Cox		AFT (Exponential)		AFT (Weibull)	
		Interaction w/ UK firm		Interaction w/ UK firm		Interaction w/ UK firm
Firm characteristics						
UK firm	-2.138**		6.484***		2.574*	
	(1.006)		(0.645)		(1.350)	
LLC form with no capital requirements	-0.225		0.650***		0.277	
	(0.213)		(0.244)		(0.231)	
Age of the firm at end of first campaign	-0.122	-0.118	0.130	0.103	0.136	0.159
	(0.090)	(0.134)	(0.138)	(0.171)	(0.111)	(0.171)
Management						
Number of senior management	0.003	0.360*	0.251	-0.626**	-0.037	-0.415**
	(0.155)	(0.184)	(0.233)	(0.249)	(0.189)	(0.198)
Share of female senior management	0.975*	-1.936	-1.100**	2.076	-1.220*	2.476*
	(0.530)	(1.241)	(0.450)	(1.288)	(0.622)	(1.476)
Average age of senior management	-0.062***	0.047*	0.149***	-0.131***	0.077***	-0.057*
	(0.015)	(0.025)	(0.024)	(0.038)	(0.019)	(0.034)
Age difference of senior management	0.071	-0.093	-0.126*	0.149**	-0.090	0.118*
	(0.057)	(0.057)	(0.069)	(0.068)	(0.065)	(0.065)
Trademarks and patents						
Number of filed patents	0.034	-0.570	-0.125	0.686	-0.028	0.701
	(0.381)	(0.581)	(0.387)	(0.591)	(0.459)	(0.708)
Number of granted patents	-0.602	-30.008***	0.876	10.809***	0.795	13.840***
	(0.493)	(1.015)	(0.610)	(0.926)	(0.639)	(1.086)
Number of granted trademarks	0.029	0.371	-0.001	-0.438	-0.029	-0.473
	(0.099)	(0.295)	(0.108)	(0.297)	(0.133)	(0.362)
Financials						
Number of subsequent successful campaigns	0.792***	-0.708***	-0.510**	0.566	-0.770***	0.729**
	(0.155)	(0.207)	(0.205)	(0.406)	(0.189)	(0.350)
Exit of the crowd	0.963***	-34.955***	-0.566***	15.833***	-0.843***	19.769***
	(0.135)	(0.843)	(0.179)	(0.947)	(0.164)	(2.262)
Campaign characteristics						
Total amount of money raised	0.100*	-0.178**	-0.139	0.223*	-0.111	0.211**
	(0.055)	(0.072)	(0.109)	(0.118)	(0.071)	(0.090)
Total amount of funding target	0.198	-0.105	-0.242	0.144	-0.297	0.178
	(0.206)	(0.222)	(0.223)	(0.236)	(0.229)	(0.253)
Total number of investors	-0.054	0.025	0.162*	-0.143	0.069	-0.036
	(0.056)	(0.117)	(0.096)	(0.149)	(0.067)	(0.138)
Business valuation	-0.126	0.134	0.187	-0.197	0.155	-0.166
	(0.140)	(0.136)	(0.240)	(0.234)	(0.182)	(0.175)
Ratio of amount raised to funding target	-1.224**	-0.580	3.108***	-1.064	1.878***	0.486
	(0.598)	(1.599)	(0.949)	(1.700)	(0.668)	(1.937)
VC and BA						
Number of VCs	0.084	0.135	-0.037	-0.140	-0.059	-0.190
	(0.058)	(0.106)	(0.038)	(0.152)	(0.073)	(0.179)
Number of BAs	-0.017	0.306**	0.044	-0.289**	0.025	-0.383*
	(0.044)	(0.136)	(0.072)	(0.145)	(0.054)	(0.199)
Constant					4.142***	
					(0.615)	
Days at risk	298608		298608		298608	
No. of events	119		119		119	
No. of firms	434		434		434	
Pseudo-R-square	0.099		-		-	
Log-likelihood	-596.625		-328.555		-318.912	
Chi-square	203922.704		-		92019.374	

PANEL D

	(15)	(16)		(17)	(18)
	Large portals			*Germany*	
	Cox	Cox		Cox	
			Interaction w/ UK firm		
Firm characteristics					
UK firm	-0.936***	-2.436**			
	(0.289)	(1.023)			
LLC form with no capital requirements	-0.230**	-0.221		-0.219	-0.205
	(0.106)	(0.162)		(0.208)	(0.224)
Age of the firm at end of first campaign	-0.145**	-0.087	-0.153	-0.120	-0.115
	(0.060)	(0.087)	(0.131)	(0.091)	(0.097)
Management					
Number of senior management	0.231***	-0.008	0.370**	0.016	-0.009
	(0.042)	(0.156)	(0.180)	(0.166)	(0.180)
Share of female senior management	0.053	0.846*	-1.808	0.947*	0.949*
	(0.373)	(0.473)	(1.213)	(0.545)	(0.546)
Average age of senior management	-0.034***	-0.069***	0.054*	-0.062***	-0.059***
	(0.010)	(0.020)	(0.031)	(0.016)	(0.016)
Age difference of senior management	0.004	0.056	-0.079	0.073	0.072
	(0.008)	(0.059)	(0.059)	(0.059)	(0.061)
Trademarks and patents					
Number of filed patents	-0.136	0.032	-0.567	0.023	0.012
	(0.176)	(0.382)	(0.580)	(0.388)	(0.387)
Number of granted patents	-0.849	-0.619	-35.940***	-0.613	-0.609
	(0.519)	(0.501)	(1.027)	(0.473)	(0.478)
Number of granted trademarks	0.047	0.017	0.382	0.029	0.039
	(0.062)	(0.099)	(0.298)	(0.106)	(0.109)
Financials					
Number of subsequent successful campaigns	0.326**	0.660***	-0.575**	0.651***	0.714***
	(0.166)	(0.214)	(0.282)	(0.123)	(0.147)
Exit of the crowd	0.171	0.948***	-40.858***	0.829***	0.844***
	(0.192)	(0.148)	(0.841)	(0.132)	(0.138)
Campaign characteristics					
Total amount of money raised	0.031*	0.109*	-0.187**	0.091	0.092
	(0.017)	(0.060)	(0.076)	(0.058)	(0.066)
Total amount of funding target	-0.012	0.395	-0.302	0.249	0.191
	(0.018)	(0.387)	(0.407)	(0.197)	(0.215)
Total number of investors	-0.043	-0.065	0.035	-0.048	-0.047
	(0.033)	(0.056)	(0.118)	(0.056)	(0.055)
Business valuation	-0.003	-0.148	0.155	-0.122	-0.116
	(0.020)	(0.135)	(0.131)	(0.140)	(0.160)
Ratio of amount raised to funding target	-0.985	-1.081**	-0.723	-1.292**	-1.239**
	(0.695)	(0.495)	(1.550)	(0.540)	(0.530)
VC and BA					
Number of VCs	0.180**	0.074	0.145	0.068	0.074
	(0.076)	(0.064)	(0.108)	(0.064)	(0.064)
Number of BAs	0.042	-0.024	0.314**	-0.016	-0.032
	(0.044)	(0.044)	(0.138)	(0.041)	(0.039)
Unsuccessful campaigns					
Firm never ran successful campaign				-37.368***	
				(0.805)	
Number of subsequent unsuccessful campaigns					-31.431***
					(1.524)
Days at risk	287003	287003		120807	120807
No. of events	119	119		69	69
No. of firms	416	416		147	147
Pseudo-R-square	0.078	0.100		0.076	0.074
Log-likelihood	-606.179	-591.568		-288.415	-289.032
Chi-square	652584.506	201603.305		79442.391	58190.813

4.5.3 Survival analysis

Figure 4-3 and Figure 4-4 depict the Kaplan–Meier curves of the survival rates of ECF funded firms. The chance of failure is somewhat higher for German firms than for UK firms. After 36 months, 20% of UK firms and 24% of German firms failed. Using the German sub-sample of successful and unsuccessful campaigns, I find that firms that never ran a successful campaign are more likely to fail. However, only 67% of the firms that ran an unsuccessful ECF campaign are still operating 36 months after the ECF campaign.

Figure 4-3: Kaplan–Meier survival estimates (GER and UK)
Figure illustrates the Kaplan–Meier survival estimates comparing the failure of German and UK firms after a successful ECF campaign.

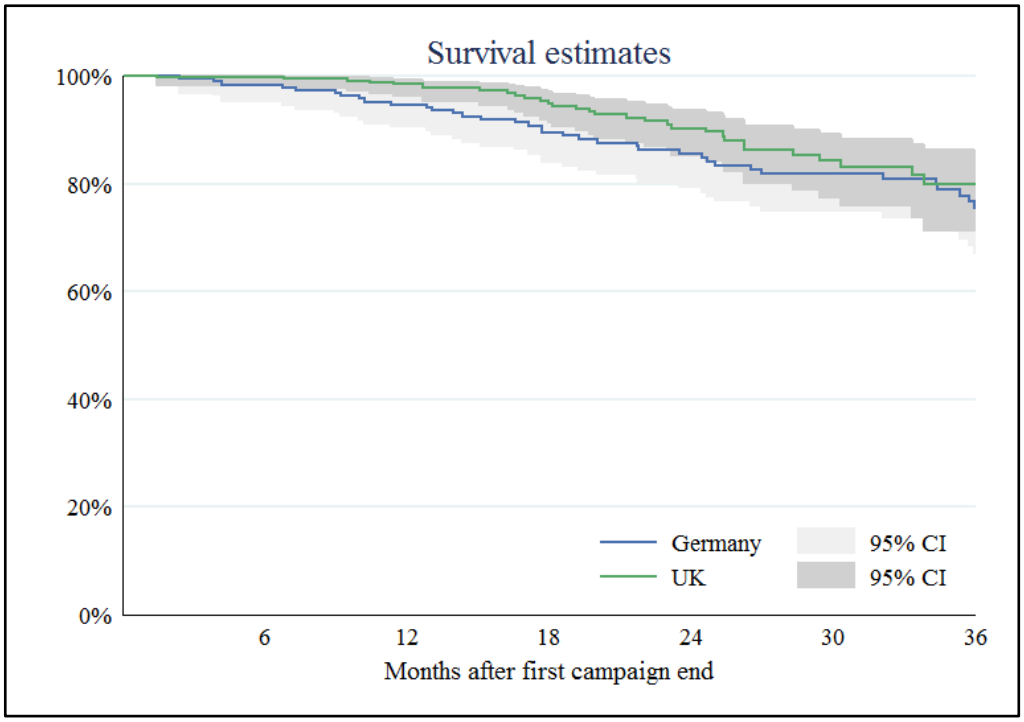
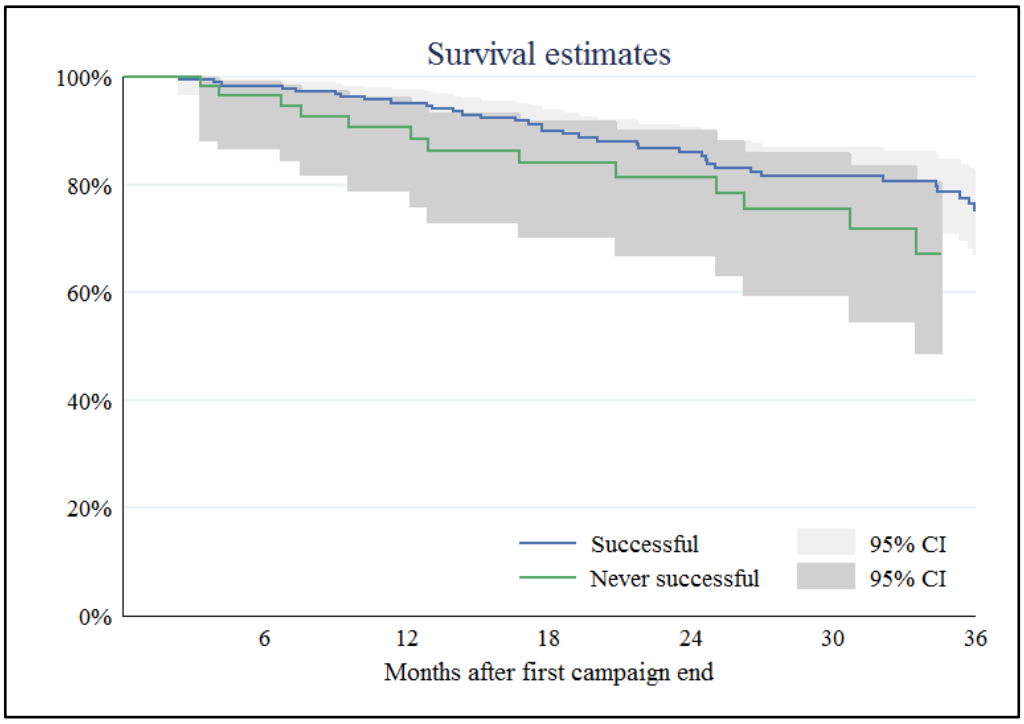


Figure 4-4: Kaplan–Meier survival estimates (GER)
Figure illustrates the Kaplan–Meier survival estimates for the German firms. The figure compares firms with at least one successful ECF campaign and firms that never ran a successful ECF campaign.



I now turn to the Cox proportional hazard regressions to evaluate the contributing factors to firm failures. Again, I categorize the explanatory variables in segments: firm characteristics (baseline), management, trademarks and patents, campaign characteristics, and financials. Table 4-3 presents the results. In regressions (1) to (5), Panel A, I first consider each segment separately. Beginning with the baseline regression, the results show that a firm's location and age do not affect firm survival. The management variables, testing H1, are also not significant and have no effect on firm survival. Given the mixed evidence in the literature, this is what I might partly expect for the management team age and gender variables. In contrast with the expectations, team size and age heterogeneity also do not exert a significant effect. Moreover, the trademark and patent variables, which test H2, show no significant impact on firm survival. However, when firms run a successful follow-up ECF campaign or can buy the crowd out, they are more likely to survive. The campaign characteristic variables thus partially support H3. The number of VCs significantly lowers the risk of firm failure, which is also in line with H3.

In regression (6), Panel B of Table 4-3, I consider all variables together. The results are mostly in line with regressions (1) to (5). However, the impact of VC investments vanishes.

As in the analysis on follow-up funding, regression (7) considers the sub-sample of firms for which data on capital structure were available. The ratio of equity to total assets had no explanatory power on firm survival. At this stage of firm development, other factors are apparently more important.

Regression (12), Panel C of Table 4-3, investigates H5 regarding the differential impact of the explanatory variables on firm failure. I use interaction dummies with every variable that has sufficient variation. The regression results show that older UK firms suffer from a higher risk of failure. However, UK firms with a high share of female managers are more likely to survive. This finding might be due to innate differences of female managers or differences in the access to capital. Furthermore, a higher business valuation comes with a higher risk of firm failure in the UK.

In regressions (15) and (16), I use the sub-sample of firms that received funding through one of the large ECF portals. Again, the results are similar to the complete sample.

To test H3, I consider the sub-sample of German firms with both successful and unsuccessful campaigns in regressions (17) and (18). H3 cannot be rejected, given that both variables measuring campaign success are significant and lower the risk of firm failure.

For robustness checks, regressions (8) to (11), Panel B of Table 4-3, and regressions (13) and (14), Panel C, show AFT models with an exponential distribution and a Weibull distribution. Again, the models display similar results for the most part.

Table 4-3: Firm survival regression results

The table provides Cox semi-parametric proportional hazard regression results on firm survival. Coefficients instead of hazard rates are reported. Standard errors are clustered by firm and appear in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level.

PANEL A

	(1)	(2)	(3)	(4)	(5)
	Cox				
Firm characteristics					
UK firm	-0.368	-2.112***	-0.453	-0.210	-0.371
	(0.284)	(0.622)	(0.281)	(0.281)	(0.267)
LLC form with no capital requirements	-0.268	-0.428	-0.260	-0.514	-0.266
	(0.393)	(0.482)	(0.370)	(0.497)	(0.393)
Age of the firm at end of first campaign	-0.056	-0.032	-0.050	-0.142***	-0.059
	(0.038)	(0.049)	(0.038)	(0.053)	(0.036)
Management					
Number of senior management		-0.012			
		(0.088)			
Share of female senior management		0.241			
		(0.731)			
Average age of senior management		0.015			
		(0.027)			
Age difference of senior management		-0.011			
		(0.015)			
Trademarks and patents					
Number of filed patents			-0.051		
			(0.217)		
Number of granted patents			0.128		
			(0.268)		
Number of granted trademarks			-0.352		
			(0.265)		
Financials					
Number of subsequent successful campaigns				-0.835***	
				(0.296)	
Exit of the crowd				-37.411***	
				(0.513)	
Campaign characteristics					
Total amount of money raised				-0.003	
				(0.033)	
Total amount of funding target				0.004	
				(0.014)	
Total number of investors				-0.064	
				(0.073)	
Business valuation				0.012	
				(0.012)	
Ratio of amount raised to funding target				-0.188	
				(0.595)	
VC and BA					
Number of VCs					-0.199**
					(0.085)
Number of BAs					0.030
					(0.100)
Days at risk	424850	363089	424850	350050	424850
No. of failures	77	37	77	67	77
No. of firms	656	577	656	497	656
Pseudo-R-square	0.005	0.074	0.011	0.024	0.007
Log-likelihood	-426.250	-190.714	-423.504	-348.872	-425.225
Chi-square	2.991	127.807	60.714	16104.134	27.015

PANEL B

	(6)	(7)	(8)	(9)	(10)	(11)
	Cox		AFT (Exponential)		AFT (Weibull)	
Firm characteristics						
UK firm	-2.244***	-2.330**	1.669**	1.770	1.480***	1.561***
	(0.623)	(0.942)	(0.654)	(1.419)	(0.512)	(0.462)
LLC form with no capital requirements	-0.791*	-0.387	1.345**	1.094	0.557	0.198
	(0.436)	(0.616)	(0.548)	(0.946)	(0.389)	(0.454)
Age of the firm at end of first campaign	-0.027	0.109	0.108	0.003	0.011	-0.081
	(0.128)	(0.129)	(0.219)	(0.226)	(0.086)	(0.084)
Management						
Number of senior management	0.016	-0.069	0.517*	0.620	-0.019	0.047
	(0.204)	(0.222)	(0.314)	(0.591)	(0.141)	(0.150)
Share of female senior management	-0.014	-2.731*	-0.104	2.090	-0.032	1.724
	(0.663)	(1.480)	(0.814)	(1.396)	(0.446)	(1.126)
Average age of senior management	-0.005	0.020	0.126***	0.109	0.004	-0.012
	(0.038)	(0.062)	(0.036)	(0.078)	(0.026)	(0.046)
Age difference of senior management	0.001	0.007	-0.066***	-0.034	-0.000	-0.004
	(0.017)	(0.035)	(0.019)	(0.071)	(0.011)	(0.025)
Trademarks and patents						
Number of filed patents	-0.166	-0.504	-0.043	0.011	0.117	0.295
	(0.412)	(0.344)	(0.604)	(0.482)	(0.264)	(0.222)
Number of granted patents	0.493	0.949*	-0.488	-1.190***	-0.342	-0.726
	(0.398)	(0.561)	(0.567)	(0.308)	(0.224)	(0.465)
Number of granted trademarks	-0.218	-0.287	0.201	0.510**	0.148	0.222
	(0.176)	(0.235)	(0.148)	(0.237)	(0.156)	(0.175)
Financials (1)						
Number of subsequent successful campaigns	-1.932***	-34.598***	1.407	13.989***	1.393**	10.273***
	(0.622)	(0.575)	(1.009)	(1.467)	(0.686)	(2.605)
Exit of the crowd	-33.323***	-36.477***	14.331***	17.017***	9.133***	11.031***
	(1.047)	(1.842)	(0.984)	(2.616)	(1.921)	(4.268)
Campaign characteristics						
Total amount of money raised	-0.037	0.056	0.018	-0.158	0.029	-0.035
	(0.038)	(0.123)	(0.135)	(0.297)	(0.027)	(0.086)
Total amount of funding target	0.096	-0.017	-0.118	0.045	-0.070	0.008
	(0.073)	(0.165)	(0.132)	(0.242)	(0.064)	(0.113)
Total number of investors	-0.033	-0.093	0.373***	0.377	0.022	0.055
	(0.050)	(0.112)	(0.101)	(0.260)	(0.035)	(0.080)
Business valuation	0.029	0.028	-0.058***	-0.057***	-0.022*	-0.022
	(0.020)	(0.023)	(0.021)	(0.021)	(0.012)	(0.015)
Ratio of amount raised to funding target	-0.341	-0.525	3.549**	3.499	0.317	0.448
	(0.650)	(2.602)	(1.469)	(3.789)	(0.528)	(1.773)
VC and BA						
Number of VCs	0.039	0.059	-0.113	0.101	-0.008	-0.001
	(0.197)	(0.201)	(0.172)	(0.184)	(0.127)	(0.129)
Number of BAs	0.166	-0.211	-0.094	0.040	-0.127	0.162
	(0.144)	(0.912)	(0.133)	(1.252)	(0.127)	(0.659)
Financials (2)						
Ratio of equity to total assets		0.013		0.002		-0.009
		(0.008)		(0.005)		(0.007)
Constant					7.412***	8.406***
					(0.639)	(1.494)
Days at risk	298608	191186	298608	191186	298608	191186
No. of failures	31	9	31	9	31	9
No. of firms	434	287	434	287	434	287
Pseudo-R-square	0.112	0.198	-	-	-	-
Log-likelihood	-147.373	-36.380	-125.061	-44.064	-102.976	-34.502
Chi-square	1079082.546	1858738.891	-	-	81496.971	143404.304

PANEL C

	(12)		(13)		(14)	
	Cox		AFT (Exponential)		AFT (Weibull)	
		Interaction w/ UK firm		Interaction w/ UK firm		Interaction w/ UK firm
Firm characteristics						
UK firm	-2.262		9.519***		0.751	
	(1.697)		(2.668)		(1.915)	
LLC form with no capital requirements	-0.896		1.549**		0.677	
	(0.564)		(0.620)		(0.543)	
Age of the firm at end of first campaign	-0.374*	0.572***	0.663**	-0.880***	0.242	-0.377***
	(0.215)	(0.100)	(0.269)	(0.217)	(0.180)	(0.142)
Management						
Number of senior management	-0.035	0.010	0.811	-1.262**	-0.036	-0.306
	(0.377)	(0.279)	(0.562)	(0.534)	(0.306)	(0.302)
Share of female senior management	0.513	-3.235***	-0.995*	2.497***	-0.429**	1.418***
	(0.314)	(0.934)	(0.559)	(0.657)	(0.182)	(0.494)
Average age of senior management	-0.013	-0.001	0.108***	-0.059	0.010	0.030
	(0.026)	(0.109)	(0.024)	(0.121)	(0.018)	(0.095)
Age difference of senior management	0.058	-0.061	-0.106	0.137	-0.023	0.045
	(0.094)	(0.147)	(0.077)	(0.125)	(0.076)	(0.120)
Trademarks and patents						
Number of filed patents	-0.269		-0.864	16.635***	-0.257	10.372***
	(0.520)		(1.316)	(2.715)	(0.486)	(2.845)
Number of granted patents	0.677		-0.438	16.045***	-0.314	10.275***
	(0.588)		(1.186)	(1.573)	(0.586)	(1.759)
Number of granted trademarks	-0.453**	0.497*	0.472	-0.557	0.338	-0.419
	(0.208)	(0.284)	(0.307)	(0.497)	(0.233)	(0.398)
Financials						
Number of subsequent successful campaigns	-1.813**		0.645	12.207***	1.150	7.495***
	(0.922)		(1.300)	(1.957)	(0.787)	(1.141)
Exit of the crowd			20.177***	-17.452***	13.766***	-11.922***
			(1.403)	(2.630)	(2.328)	(2.965)
Campaign characteristics						
Total amount of money raised	-0.408	0.473*	0.368	-0.627	0.282	-0.441*
	(0.314)	(0.277)	(0.544)	(0.527)	(0.232)	(0.257)
Total amount of funding target	0.121	-0.142	0.507	0.078	-0.051	0.443
	(0.931)	(0.907)	(1.843)	(1.844)	(0.774)	(1.011)
Total number of investors	0.070	-0.221	0.340*	0.098	-0.032	0.322
	(0.178)	(0.142)	(0.189)	(0.263)	(0.116)	(0.199)
Business valuation	0.477**	-0.442**	-0.511*	0.132	-0.314*	0.044
	(0.193)	(0.198)	(0.294)	(0.409)	(0.175)	(0.279)
Ratio of amount raised to funding target	-0.070	-0.240	3.204**	-3.143	0.207	0.185
	(0.669)	(2.540)	(1.282)	(2.589)	(0.416)	(2.102)
VC and BA						
Number of VCs	-0.136		-0.251	16.582***	-0.020	10.868***
	(0.140)		(0.185)	(4.024)	(0.121)	(4.024)
Number of BAs	0.247		-0.254	23.047***	-0.208	16.005***
	(0.165)		(0.204)	(5.439)	(0.162)	(5.052)
Constant					7.258***	
					(0.628)	
Days at risk	298608		298608		298608	
No. of failures	31		31		31	
No. of firms	434		434		434	
Pseudo-R-square	0.143		-		-	
Log-likelihood	-142.186		-103.666		-90.063	
Chi-square	1001152.680		-		27011.420	

PANEL D

	(15)	(16)		(17)	(18)
	Large Portals			*Germany*	
	Cox	Cox		Cox	
			Interaction w/ UK firm		
Firm characteristics					
UK firm	-2.229***	-1.443			
	(0.707)	(2.059)			
LLC form with no capital requirements	-0.950**	-1.241*		-0.973	-0.898
	(0.473)	(0.695)		(0.644)	(0.585)
Age of the firm at end of first campaign	-0.027	-0.467*	0.664***	-0.358	-0.486*
	(0.131)	(0.271)	(0.138)	(0.229)	(0.260)
Management					
Number of senior management	-0.044	-0.197	0.164	0.043	-0.030
	(0.231)	(0.632)	(0.551)	(0.470)	(0.483)
Share of female senior management	0.101	0.678**	-3.375***	0.648*	0.603*
	(0.665)	(0.266)	(1.048)	(0.368)	(0.315)
Average age of senior management	0.001	-0.002	-0.012	-0.014	-0.018
	(0.038)	(0.031)	(0.110)	(0.031)	(0.028)
Age difference of senior management	0.011	0.100	-0.103	0.037	0.039
	(0.020)	(0.129)	(0.183)	(0.103)	(0.104)
Trademarks and patents					
Number of filed patents	-0.129	-0.238		0.420	0.467
	(0.423)	(0.512)		(0.776)	(0.462)
Number of granted patents	0.567	0.631		0.449	0.415
	(0.388)	(0.702)		(1.067)	(0.741)
Number of granted trademarks	-0.237	-0.375	0.417	-0.518*	-0.383*
	(0.196)	(0.273)	(0.349)	(0.273)	(0.223)
Financials					
Number of subsequent successful campaigns	-1.868***	-2.031**		-0.501	-1.322
	(0.677)	(0.919)		(1.231)	(1.030)
Exit of the crowd				-37.158***	-40.127***
				(1.466)	(1.241)
Campaign characteristics					
Total amount of money raised	-0.035	-0.330	0.390*	-0.381	-0.535**
	(0.030)	(0.265)	(0.228)	(0.281)	(0.259)
Total amount of funding target	0.094	0.595	-0.607	-0.621	-0.264
	(0.067)	(0.907)	(0.902)	(1.448)	(1.246)
Total number of investors	-0.007	0.128	-0.280**	-0.001	0.086
	(0.043)	(0.152)	(0.115)	(0.181)	(0.170)
Business valuation	0.026	0.354*	-0.319*	0.511**	0.706***
	(0.018)	(0.183)	(0.191)	(0.202)	(0.184)
Ratio of amount raised to funding target	-0.107	0.248	-0.598	-0.334	0.163
	(0.802)	(0.723)	(2.552)	(0.798)	(0.647)
VC and BA					
Number of VCs	-0.049	-0.115		0.063	0.076
	(0.158)	(0.155)		(0.207)	(0.193)
Number of BAs	0.210	0.276		0.289	0.227
	(0.159)	(0.214)		(0.198)	(0.195)
Unsuccessful campaigns					
Firm never ran successful campaign				-37.499***	
				(1.256)	
Number of subsequent unsuccessful campaigns					-44.081***
					(2.306)
Days at risk	287003	287003		120807	120807
No. of failures	26	26		26	26
No. of firms	416	416		147	147
Pseudo-R-square	0.108	0.146		0.089	0.104
Log-likelihood	-122.904	-117.621		-104.557	-103.204
Chi-square	246147.131	101421.567		11715.517	17638.920

4.6 Discussion and conclusion

A primary contribution of this study is to provide first evidence of the determinants of follow-up funding and firm failure of start-ups that have received financing through an ECF campaign. Using hand-collected data from 38 ECF portals and 656 firms that ran at least one successful ECF campaign in Germany or the UK, I provide evidence that German firms stand a higher chance of obtaining follow-up funding through BAs/VCs and have a relatively lower likelihood of failure than their British counterparts. Moreover, I find that firm age, the average age of the management team, and excessive funding during the ECF campaign have a negative effect on firms' likelihood to obtain post-campaign financing. By contrast, the number of senior managers, registered trademarks, subsequent successful ECF campaigns, crowd exits, and the amount of the funding target all have a positive impact. Subsequent successful ECF campaigns, crowd exits, and the number of VCs are significant predictors reducing firm failure.

Furthermore, I find that some of these factors have a differential impact on follow-up funding and firm failure for start-ups located in Germany and the UK. While older firms have a higher likelihood of failure in the UK than in Germany, female senior managers and the number of ECF investors increase the likelihood of firm failure in Germany. These findings suggest various avenues of research for human capital theory, organizational ecology, and the comparative corporate governance literature. Further analysis of the management team might investigate whether female managers are discriminated against when applying for capital or simply pursue different goals when running a company in Germany and the UK. Furthermore, the number of ECF investors might have a differential impact in Germany and the UK due to differences in the financial instruments used or the governance features of the platforms. As ECF portals in Germany broker mezzanine financial instruments that mimic the returns of equity shares, but come with little or no control rights for investors, the management of the start-up might have a larger leeway when making decisions.

Further research is necessary to discern the welfare implications of ECF. While in this study I compared the determinants of follow-up funding and firm failure in two countries, future research might compare crowdfunded firms with firms that have received other sources of financing. Doing so might enable researchers to determine the relative advantage of an ECF campaign on building an enduring business. While BAs/VCs have traditionally supported their portfolio firms with advice and their networks, ECF could also provide a

fuzzy signal of early demand and the number of motivated backers willing to support the venture. Furthermore, little is known about the screening process of ECF platforms and their role in selecting valuable start-ups. How they determine start-ups' chances of building an enduring business could also be subject to further empirical investigations.

5 Summary, implications, and outlook

5.1 Summary of findings

Today, start-ups often obtain financing through the Internet. Under the ECF model, non-sophisticated investors make many small contributions to a company and ultimately expect financial compensation. ECF used to be considered a niche phenomenon, though now it is an ordinary source of start-up financing in many countries. Yet little is known about how to regulate this new phenomenon properly and whether funded start-ups can ultimately build enduring businesses. The research goal of this dissertation was to shed light on the characteristics of ECF. More specifically, I asked whether ECF can add benefits to the economy. In Chapter 2, I examined whether geographic barriers can be overcome with ECF. In Chapter 3, I delivered information on the interdependencies of firms' capital structure and ECF. Finally, in Chapter 4, I take a double-sided approach and assess the chances of firm survival and follow-up funding by VCs and BAs after an ECF campaign.

In Chapter 2, I used a hand-collected data set of 20,460 investment decisions on two distinct German portals to analyze whether investors in ECF direct their investments and portfolios to local firms. The results suggest that investors exhibit a local bias, even when controlling for family and friends. In addition to the regular crowd, the sample includes angel-like investors who invest a considerable amount of money and exhibit a larger local bias. By contrast, well-diversified investors are less likely to suffer from this behavioral anomaly. The data further shows that portal design is important for specifically attracting investors who are more prone to having a local bias. Overall, I find that investors who direct their investments to local firms more often pick start-ups that run into insolvency or are dissolved. However, here again portal design plays a crucial role. Angel-like investors, who disclosed that they invest more locally, are more successful in picking firms that survive. Finally, firms engaging in ECF overcome funding barriers by attracting investors at all distances.

In Chapter 3, I assess the relationship between capital structure and ECF. For decades, research has examined firms' capital structures. The emergence of new funding types makes it necessary to adjust existing theories and acknowledge new empirical findings. The study provides first evidence of the relationship between capital structure and ECF. It improves the understanding of the determinants of ECF campaigns and analyzes the outcomes of crowdfunded firms. With a hand-collected data set of 198 UK crowdfunded firms, enhanced

with a propensity score matched control sample of 198 UK non-crowdfunded firms, the analysis discloses that capital structure is not a determinant of running an ECF campaign. Therefore, the results evidence that crowdfunded firms do not differ from non-crowdfunded in terms of capital structure. Furthermore, a difference-in-differences model reveals that after an ECF campaign, equity is only weakly significantly rising in the short run, compared with the control sample. Moreover, there is no significant, positive effect on debt.

In Chapter 4, I empirically analyze firm success with a hand-collected data set from 38 different ECF portals and 656 firms that ran at least one successful ECF campaign in Germany or the UK. The evidence shows that German firms that obtain capital from the crowd stand a higher chance of obtaining follow-up funding through BAs or VCs than firms that have engaged in ECF in the UK. However, start-ups that ran a successful ECF campaign in Germany have a relatively lower likelihood of surviving. In a second step, I also investigate possible determinants of follow-up funding and firm failure. I find that firm age, the average age of the management team, and excessive funding during the ECF campaign all have a negative effect on a firms' likelihood to obtain post-campaign financing. By contrast, the number of senior managers, registered trademarks, subsequent successful ECF campaigns, crowd exits, and the amount of the funding target have a positive impact. Subsequent successful ECF campaigns, crowd exits, and the number of venture capital investors are significant predictors reducing firm failure. Finally, I find that some of these factors have a differential impact in Germany and the UK. While older firms have a higher likelihood of failure in the UK than in Germany, female senior managers and the number of ECF investors increase the likelihood of firm failure in Germany.

Overall, the dissertation provides various insights into investor behavior, determinants of firms for engaging in ECF, and the outcomes of firms after ECF. The results come from an extensive data set on ECF in Germany and the UK, which should allow for a certain degree of generalizability. Moreover, the employed methodical approaches should ensure reliable findings. The limitations of the dissertation are stated in Section 5.3 and are linked to further research avenues.

5.2 Implications for theory and practice

The findings contribute to the evolving entrepreneurial finance literature (Block et al., 2017a; Cumming and Johan, 2017). In addition to the already large literature on crowdlending

and reward-based crowdfunding, my dissertation adds evidence to the growing literature on ECF (Ahlers et al., 2015; Bapna, 2017; Block et al., 2017b; Hornuf and Neuenkirch, 2017; Hornuf and Schwienbacher, 2017a, 2017b, 2018; Vismara, 2016).

In regard to the impact of geographic distance, Chapter 2 reveals the distinctions of ECF besides reward-based crowdfunding (Agrawal et al., 2015) and crowdlending (Lin and Viswanathan, 2015). In contrast with ECF, Agrawal et al. (2015) finds that in reward-based crowdfunding, the tendency to invest locally is driven only by family and friends. However in crowdlending, Lin and Viswanathan (2015) show that this market is still struggling with an investment bias toward the same geographic areas of investors. My study adds to the findings of the recent study by Guenther et al. (2017) by using the local bias as a more complex approach to tackle distance. The concept of local bias allows me to consider alternative investment opportunities at the time of the actual investment, which enables me to control for a limited number of ECF investment opportunities from the perspective of each individual crowd investor. Furthermore, the study gives evidence on the impact of portal design.

Chapter 3 adds first evidence of the interdependencies of capital structure and ECF. In general, capital structure is largely studied. However, a focus of empirical studies on SMEs and start-ups is rare (Cassar, 2004). The study sheds light on how to allocate ECF beyond the traditional sources of financing for start-ups. Furthermore, it adds information on whether capital structure determines the motivation of entrepreneurs to fund their venture through ECF (Belleflamme et al., 2013; Gerber et al., 2012). Additional first insights are provided by the measuring of the impact of the equity injection by ECF.

Finally in Chapter 4, first extensive evidence is given of the impact of ECF on firm survival and follow-up funding. Moreover, the comparison of two countries allows for additional insights compared to other studies (Colombo and Shafi, 2016; Signori and Vismara, 2016). By gathering information from different sources, this study uses a comprehensive and unique data set for firm characteristics and follow-up funding. For example, the analysis of founding team composition on the long-term effect on firm survival and follow-up funding provides new insights. Moreover, the extensive examination of each firm's shareholder list provides novel evidence.

The dissertation provides several practical implications for crowd investors, entrepreneurs, ECF portal operators, policy makers, VCs, and BAs. All three studies provide implications for crowd investors. First, crowd investors should always be aware of the risk of

investing in familiar start-ups located close to the investor's residence, as they can run into the threat of investing in less viable firms when their investment decisions are driven by subjective assessments and do not consider objective risks. Nevertheless, a local investment can be beneficial if the investors exhibit a certain kind of professionalism that allows them to evaluate the firm properly. In this case, local knowledge might even help the investors reduce the information asymmetries and eventually pick the more successful start-ups. Furthermore, Chapter 3 shows that crowdfunded firms do not significantly differ from other firms in terms of capital structure. This might give some counterargument to the notion that ECF only offers investments in lemons (Akerlof, 1970; Ibrahim, 2015). Therefore, potential investors might lower their reservation toward ECF. Finally, Chapter 4 discloses the degree of survivability of crowdfunded firms, thus showing investors the threat of a total loss of their crowd investment. Furthermore, the study gives insights into the chances of follow-up funding, which eventually helps the firms to be successful due to sufficient funds and ultimately ensures a successful investment for the crowd. The study adds information about the chances for the ultimate success of crowd investors' investment caused by a crowd exit. An exit, in which crowd investors are bought out, allows for excess returns. In addition, the results provide information on which firm characteristics determine firm survival and follow-up funding. The findings allow investors to better evaluate ECF campaigns and the firms. For example, they show how important the founding team composition is. A high average age of the founders is negatively associated with follow-up funding. Another example is that a high number of VCs invested in the firm and follow-up ECF rounds provides a higher chance of survival and, therefore, a greater chance of investment success.

Implications for founders and start-ups are manifold. First, the study proves in Chapter 2 that ECF enables firms to overcome the geographic barrier and that firms are also able to attract distant investors. The disadvantage of firms locating in rural areas or outside an entrepreneurial hot spot, such as Berlin or London, is reduced. ECF even helps firms to receive investments from abroad. It should be emphasized that investments from so many individuals and from such long distances would not be possible without the intermediary of an online ECF platform. However, the findings of Chapter 3 disclose that firms considering running an ECF campaign should not only rely solely on equity inflow, as it might not provide such a high increase of capital. In addition, firms should not expect that ECF will result in follow-up debt funding. That is, the findings disclose that ECF might not help firms to access further debt funding after the ECF campaign. Finally, Chapter 4 reveals many

success and failure factors. As already outlined in the implications for crowd investors, who are interested in identifying potential successful founding teams, certain firm characteristics might lead to success or failure. Founding teams should be interested in knowing how to build a successful team. The findings reveal, for example, that younger firms, younger management teams, and trademarks have a positive impact on the receipt of follow-up funding by VCs and BAs. Firms should also try to get several VCs on board and try to run a second ECF campaign, which seems to help firms to survive.

Implications for ECF portal operators are provided by several findings of the dissertation. The advantage of attracting distant investors is revealed in Chapter 2 as one of the biggest advantages of an ECF online platform. Operators can promote that they are able to help start-ups get financed even when they are from a remote location. Because ECF platforms most probably maximize their profits by raising the overall deal flow, as they are expected to be repeat players (Rochet and Tirole, 2003), it can be assumed that operators are interested in attracting as many investors and founders as possible. To build a sustainable business, the findings of Chapter 4 should help enhance and improve the portals' start-up screening and selection processes, which might allow them to identify high-quality start-ups. As already mentioned, certain firm characteristics lead to a higher or lower chance of firm survival and follow-up funding by VCs and BAs. The latter should help ECF portal operators to attract more start-ups because the operators can confirm a long-term positive effect of a successful ECF campaign. However, Chapter 3 discloses that ECF is not that beneficial for start-ups in terms of capital inflow. As such, operators should focus on increasing the overall funding amount to strengthen the appeal of ECF for new ventures.

Implications for policy makers are linked to investors', start-ups', and ECF portal operators' implications. On the one hand, policy makers want to protect unsophisticated investors from investing in high-risk investments, and on the other hand, governments want to empower new ventures to receive sufficient funding and eventually generate additional economic growth. Chapter 2 provides the information that ECF helps to encourage funding for firms not located in start-up hub cities. However, the study also reveals that investors need to be protected against irrational behavior. Investors need to be informed about the risks of investments in new ventures. The failure rate of local investments by small-sum investors confirms this. Policy makers should incorporate in their regulation enough and appropriate disclosure requirements for ECF campaigns. On a positive note, crowdfunded firms are not worse or better off in terms of capital structure than other firms. Therefore, it seems that the

selection process by the ECF portals and eventually by investors works. This might indicate that policy makers do not need to intervene in that case. Finally, Chapter 4 informs regulators about survival rates and allows them to compare them with non-crowdfunded firms. This might be a basis for decisions on whether ECF should be promoted or not. In addition, some firm characteristics that allow for a better chance of survival or follow-up funding are identified, and these can be specifically supported by the government.

Finally, this dissertation reveals some implications for BAs and VCs. First, for traditional investors in start-ups it must be proven whether ECF is a complementary or threatening new source of financing. What is shown in Chapter 2 is that local angel-like investors, who are investing higher amounts, are more successful than others. This might indicate that BAs make use of a standardized investments process with standardized contracts, which in turn lowers the efforts for deal negotiation. However, a typical guidance of founders by investors is not specifically intended and incorporated by the ECF portal operator. Chapter 3 gives some indication that the selection of start-ups by ECF portals and investors might work since crowdfunded firms do not differ in terms of capital structure. This in turn means for VCs and BAs that they might partly rely on the selection of start-ups in ECF. This might help them to identify promising new-ventures. For VCs, Chapter 4 reveals that gathering of several VCs for an investment in one start-up i.e., VC syndication, is beneficial for start-up survival. Consequently, the time will tell whether BAs and VCs are able to make use of ECF to complement it and eventually strengthen their investment success i.e., investment returns.

5.3 Directions of further research

The findings of this dissertation reveal promising avenues for further empirical research. On the basis of the limitations of the studies in the dissertation, some indication is given on the extension potentials for further studies.

First, the results of Chapter 2 are limited to one country, Germany. An extension to further countries would deliver international evidence on the impact of geographic proximity in ECF. However, countries like the UK suffer from large centralization of their start-up industry to London (Vulkan et al., 2016). In that case, a detailed study of investor to firm distance might only end up in investigating the distance from the investor to London. Nevertheless, it might be interesting to disclose the impact of entrepreneurship centralization

on areas beyond the center i.e., rural areas. In addition, because new markets for ECF, such as the US, just started recently, it is of interest to study new emerging markets and their own distinctions. Furthermore, my study consists of two portals and a time frame of almost three years. An addition of more portals and longer time periods might make it possible to consider the fact that ECF is a new emerging trend with different stages of interest.

Second, limitations of the findings in Chapter 3 are mostly based on the sample size. An extension of the sample might allow for more reliable results. Especially an extension with non-disclosed financials from additional crowdfunded firms would enrich the data set. This would also allow for further investigation of the debt structure (short- and long-term debt). In addition, in this study I observe two periods after an ECF campaign, though it would also be fruitful to examine the long-term effect of an equity injection after an ECF campaign. There may be for example long-term effects (e.g., on bank loans) that are not observable in the current data set. Furthermore, there are several measures for capital constraints (Farre-Mensa and Ljungqvist, 2016; Hadlock and Pierce, 2010; Hoberg and Maksimovic, 2014). It might be of interest to check additional financial data for the degree of financial constraints of start-ups before the ECF campaign.

Third, the results in Chapter 4 are limited in terms of the available time frame. Especially the long-term effects (i.e., more than three years) for the most crowdfunded firms are undisclosed or not available. Time will tell how survivable crowdfunded firms are. Moreover, additional detailed information on the founding team, such as education and past professional experience, would allow for further insights for human capital theory or organizational ecology literature. For example, further analyses of the management team might investigate whether female managers are discriminated against when applying for capital or whether they simply pursue different goals when running a company. In addition, the information provided by the business plans during the ECF campaign of the start-ups could help evaluate the quality of the start-ups' products or services. This might help control for the overall quality of the start-ups. Furthermore, ECF investors in Germany and the UK might vary in their impact due to differences in the financial instruments used or the governance features of the platforms. As ECF portals in Germany broker mezzanine financial instruments that mimic the returns of equity shares, but come with little or no control rights for investors, the management of the start-up might have greater leeway when making decisions. This might add insights to the comparative corporate governance literature.

Overall, additional studies need to be conducted to understand the characteristics of ECF. However, one of the results of my study is that the country's regulation matters. Therefore, there is a need to evaluate many findings depending on the distinctions of ECF regulations in each country. Especially the emerging market of ECF in the US will allow for further insights and will show which regulation works better than the other. Furthermore, ECF allows studying theories of the extensive behavioral finance literature (Subrahmanyam, 2008; Tversky and Kahneman, 1973) in the context of ECF. Such studies would reveal potential irrational behavior of crowd investors. Finally, longitudinal studies could test whether ECF can both fill the existing and severe funding gap of start-ups and also identify start-ups with long-lasting and successful business models.

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Appendix

Appendix 1: List of variables (local bias)

Table A1-1: List of variables (local bias)

Variable	Description	Source
Local bias		
Lb_investment	The local bias calculated for the individual investment decision.	Calculation by the authors
Lb_investorbase	The local bias calculated from the perspective of the firm.	Calculation by the authors
Lb_portfolio	The local bias calculated for the investor portfolio.	Calculation by the authors
Portal and campaign characteristics		
Campaign_days	Number of days the firm accepted investments on the respective portal in #/10.	Companisto and Innovestment
Campaign_Innovestment	Dummy variable equal to 1 if the campaign was run on Innovestment and 0 otherwise.	Companisto and Innovestment
Campaign_fundingratio	The ratio of the total funding amount reached to the funding goal. In the case of individual investments, the current ratio at the time of investment is taken.	Companisto, Innovestment, and calculation by the authors
Campaign_success	Dummy variable equal to 1 if the issuer reached or exceeded the funding goal by the end of the funding period and 0 otherwise.	Companisto and Innovestment
Firm characteristics		
Firm_Berlin	Dummy variable equal to 1 if the firm's headquarters is based in Berlin and 0 otherwise.	Commercial register
Firm_Hamburg	Dummy variable equal to 1 if the firm's headquarters is based in Hamburg and 0 otherwise.	Commercial register
Firm_Munich	Dummy variable equal to 1 if the firm's headquarters is based in Munich and 0 otherwise.	Commercial register
Firm_valuation	Is the pre-money valuation of the firm in EUR/1,000,000.	Companisto and Innovestment
Industry_trading	Dummy variable equal to 1 if the industry of the firm equals *trading* according to NACE Rev. 2 and 0 otherwise.	Classification by the authors
Industry_entertainment	Dummy variable equal to 1 if the industry of the firm equals *art, entertainment*, or *recreation* according to NACE Rev. 2 and 0 otherwise.	Classification by the authors
Industry_finance	Dummy variable equal to 1 if the industry of the firm equals *financial and insurance activities* according to NACE Rev. 2 and 0 otherwise.	Classification by the authors
Industry_IT	Dummy variable equal to 1 if the industry of the firm equals *information technology* according to NACE Rev. 2 and 0 otherwise.	Classification by the authors
Industry_manufacturing	Dummy variable equal to 1 if the industry of the firm equals *manufacturing* according to NACE Rev. 2 and 0 otherwise.	Classification by the authors
Industry_otherservice	Dummy variable equal to 1 if the industry of the firm equals *other services* according to NACE Rev. 2 and 0 otherwise.	Classification by the authors
Industry_techservice	Dummy variable equal to 1 if the industry of the firm equals *technical services* according to NACE Rev. 2 and 0 otherwise.	Classification by the authors

Table A1-1: To be continued on next page

Variable	Description	Source
Investor characteristics		
Exper_commodity	Dummy variable equal to 1 if the investor indicated having investment experience in commodities and 0 otherwise.	Innovestment
Exper_deposits	Dummy variable equal to 1 if the investor indicated having investment experience in deposits and/or overnight loans and 0 otherwise.	Innovestment
Exper_fixedincome	Dummy variable equal to 1 if the investor indicated having investment experience in fixed income products and 0 otherwise.	Innovestment
Exper_fundscertif	Dummy variable equal to 1 if the investor indicated having investment experience in funds and/or certificates and 0 otherwise.	Innovestment
Exper_othercorporate	Dummy variable equal to 1 if the investor indicated having experience with other asset classes that enable investment in a firm and 0 otherwise.	Innovestment
Exper_realestate	Dummy variable equal to 1 if the investor indicated having investment experience in real estate and 0 otherwise.	Innovestment
Exper_stocks	Dummy variable equal to 1 if the investor indicated having investment experience in corporate stocks and 0 otherwise.	Innovestment
Investor_averageinvestment	Average investment of the investor in EUR/1,000.	Companisto, Innovestment, and calculation by the authors
Investor_bigcity	Dummy variable equal to 1 if the investor reported living in city with more than one million inhabitants and 0 otherwise.	Companisto, Innovestment, and classification by the authors
Investor_#investments	Number of investments made by the investor from the start of his crowd-investing activities.	Companisto, Innovestment, and calculation by the authors
Investor_familyfriends	Dummy variable equal to 1 if the investor holds true the three criteria according to Agrawal et al. (2015) and 0 otherwise.	Classification by the authors
Investor_female	Dummy variable equal to 1 if the stated name of the investor indicates a female investor and 0 otherwise.	Companisto and classification by the authors
Investor_typo	Dummy variable equal to 1 if the investor misspelled his or her location of origin and 0 otherwise.	Companisto and classification by the authors
Investor_portfolioamount	The sum of the successful portfolio investments an investor has undertaken since its first investment in the portal in EUR/1,000.	Companisto, Innovestment, and calculation by the authors
Region_GDPperP	Is the gross domestic product per person in the county the investor reportedly lives or the firm is located in measured in EUR/1,000.	Statistical offices of the federal and state governments

Table A1-1: To be continued on next page

Variable	Description	Source
Investment characteristics		
Investment_#earlier	Number of investments earlier in the day at the same campaign in #/10.	Calculation by the authors
Investment_#earlier5k	Number of investments, with investment amount of 5,000 EUR or larger, earlier in the day at the same campaign in #/10.	Calculation by the authors
Investment_5k	Dummy variable equal to 1 if the investment amount was 5,000 EUR or larger and 0 otherwise.	Companisto, Innovestment, and classification by the authors
Investment_amount	Is the amount of an individual investment in EUR/1000.	Companisto and Innovestment
Investment_early	Dummy variable equal to 1 if the investment took place in the first three days of the campaign.	Calculation by the authors
Investment_evening	Dummy variable equal to 1 if the investor took place between 5:00 P.M. and 21:59 P.M. and 0 otherwise.	Innovestment and classification by the authors
Investment_night	Dummy variable equal to 1 if the investor took place between 10:00 P.M. and 6:59 A.M. and 0 otherwise.	Innovestment and classification by the authors
Investment_weekend	Dummy variable equal to 1 if the investment took place on a Saturday or Sunday (Central European Time) and 0 otherwise.	Companisto, Innovestment, and classification by the authors

Appendix 2: Robustness test (local bias)

Table A2-1: Local bias for investor sample providing their exact location

The table shows the local bias for individual investments (Panel A), investor portfolios (Panel B), and firm investor base (Panel C) in percentages. I exclude investors who did not provide their exact location. The table categorizes the local bias according to portals and the location of the investor. Furthermore, local biases are calculated by excluding family and friend investors. In line with Agrawal et al. (2015), I define investors as family and friends if (1) they invest in the focal start-up before investing in any other start-up, (2) their investment in the focal start-up is their largest investment, and (3) the investor invests in no more than three other start-ups. I report a one-sample, two-tailed t-test for the null hypotheses that local biases are zero. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level. Variables reported are defined in Appendix 1, Table A1-1.

PANEL A: Local bias individual investments

	N	Mean	Std.-dev	Minimum	25th	Median	75th	Maximum
By portal								
Companisto	12,351	1.3**	62.9	-464.8	-7.0	0.1	14.0	99.7
German investors	11,723	1.4**	64.5	-464.8	-7.2	0.1	17.6	99.7
Foreign investors	628	-0.6	15.1	-40.1	-1.7	0.0	1.6	80.9
Innovestment	1,623	10.6***	45.3	-283.8	-8.8	1.0	33.9	99.8
German investors	1,467	11.6***	47.0	-283.8	-8.8	1.1	39.1	99.8
Foreign investors	156	1.0	22.0	-59.9	-8.4	-0.2	11.6	67.2
By country								
German investors	13,190	2.5***	62.8	-464.8	-7.5	0.2	20.6	99.8
Foreign investors	784	-0.2	16.7	-59.9	-2.8	-0.1	4.3	80.9
Without family and friends								
All portals	10,234	0.7	65.0	-464.8	-8.3	0.1	17.6	99.7
Companisto	8,980	-0.4	67.6	-464.8	-8.3	0.1	15.4	99.7
Innovestment	1,254	8.2***	42.1	-149.3	-8.3	0.7	28.0	99.7
Total	13,974	2.4***	61.2	-464.8	-7.2	0.1	17.6	99.8

PANEL B: Local bias investor portfolio

	N	Mean	Std.-dev	Minimum	25th	Median	75th	Maximum
By portal								
Companisto	4,561	13.3***	46.8	-497.4	-7.6	-1.6	28.5	99.7
German investors	4,259	14.3***	48.0	-497.4	-7.6	-1.6	34.7	99.7
Foreign investors	302	-1.1	15.7	-37.7	-7.8	-2.7	5.2	68.5
Innovestment	432	18.1***	48.9	-113.6	-24.4	11.1	50.5	99.9
German investors	389	19.5***	50.6	-113.6	-25.3	15.6	62.3	99.9
Foreign investors	43	4.8	25.8	-32.4	-14.3	0.3	29.8	78.8
By country								
German investors	4,648	14.7***	48.3	-497.4	-7.8	-1.3	38.5	99.9
Foreign investors	345	-0.4	17.4	-37.7	-8.0	-2.2	6.0	78.8
Without family and friends								
All portals	2,105	9.4***	45.1	-497.4	-7.7	-1.1	21.8	99.8
Companisto	1,881	8.8***	45.3	-497.4	-7.4	-1.4	19.6	99.7
Innovestment	224	14.6***	43.2	-87.3	-21.6	7.7	38.8	99.8
Total	4,993	13.7***	47.0	-497.4	-7.8	-1.3	32.4	99.9

PANEL C: Local bias firm investor base

	N	Mean	Std.-dev	Minimum	25th	Median	75th	Maximum
By portal								
Companisto	30	-4.4	0.5	-2.2	-0.1	-0.1	0.1	0.9
Innovestment	44	-24.8	1.2	-5.0	-0.1	0.1	0.3	1.0
Total	74	-16.5	1.0	-5.0	-0.1	0.0	0.2	1.0

Table A2-2: Regression results for investor sample providing their exact location

The table shows results of the baseline regression. I exclude investors who did not provide their exact location. The dependent variable is the individual investment local bias as defined in Section 2.4.2. The first column in the baseline regression shows ordinary least squares regression results for the sample of 20,460 investments. The second column shows results for the sample in which I have winsorized the data at the bottom 10%. The baseline category for the industry dummies is manufacturing, which is not included in the regressions. All regressions include dummy variables to control for firm fixed effects at the campaign level. In each subsequent regression in Panel A, B, and C, the baseline is included. P-values are in parentheses; standard errors are clustered by investor. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level. Variables reported are defined in Appendix 1, Table A1-1.

Baseline regression

			(win -0.1)	
Campaign_Innovestment	0.050	(0.603)	0.027	(0.770)
Campaign_fundingratio	-0.007*	(0.066)	-0.002	(0.185)
Campaign_success	0.486***	(0.004)	0.480***	(0.004)
Campaign_days	0.006	(0.750)	-0.003	(0.847)
Firm_valuation	0.088***	(0.000)	0.084***	(0.000)
Firm_Berlin	-0.383**	(0.026)	-0.391**	(0.022)
Firm_Hamburg	-0.672***	(0.000)	-0.523***	(0.002)
Firm_Munich	-0.286	(0.114)	-0.296*	(0.098)
Industry_trading	0.794***	(0.000)	0.737***	(0.000)
Industry_IT	0.635***	(0.000)	0.585***	(0.000)
Industry_finance	0.258**	(0.010)	0.249***	(0.008)
Industry_techservice	0.692***	(0.000)	0.600***	(0.000)
Industry_otherservice	0.965***	(0.000)	0.904***	(0.000)
Industry_entertainment	0.505**	(0.011)	0.494***	(0.009)
Constant	-0.752***	(0.000)	-0.651***	(0.000)
Firm fixed effects	Yes		Yes	
No. of observations	13974		13974	
Adjusted-R-square	0.166		0.217	

PANEL A: Family, friends, and angels

	(1)	(2)	(3)	(4)
Investor_familyfriends	0.094***			0.093***
	(0.000)			(0.000)
Investment_early		-0.013		-0.008
		(0.240)		(0.450)
Investment_5k		0.066**		0.022
		(0.030)		(0.516)
Investment_early*5k			0.133***	0.117**
			(0.003)	(0.024)
Firm fixed effects	Yes	Yes	Yes	Yes
No. of observations	13974	13974	13974	13974
Adjusted-R-square	0.170	0.166	0.166	0.170

PANEL B: Investor characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Investor_#investments	-0.028***						-0.003
	(0.000)						(0.529)
Investor_portfolioamount		-0.004***					-0.003***
		(0.000)					(0.004)
Investor_averageinvestment			0.004				0.010
			(0.377)				(0.181)
Investment_amount				0.002			0.002
				(0.635)			(0.794)
Region_GDPperP					0.001***		0.002***
					(0.000)		(0.000)
Investor_bigcity						-0.120***	-0.127***
						(0.000)	(0.000)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	13974	13974	13767	13974	12375	13974	12205
Adjusted-R-square	0.170	0.169	0.167	0.166	0.163	0.174	0.177

PANEL B: Investor characteristics (continued)

	(7)	(8)	(9)
	Innovestment	Companisto	
Exper_deposits	0.062		
	(0.320)		
Exper_stocks	-0.095		
	(0.177)		
Exper_fundscertif	-0.016		
	(0.828)		
Exper_fixedincome	-0.026		
	(0.623)		
Exper_commodity	-0.045		
	(0.333)		
Exper_realestate	0.075*		
	(0.095)		
Exper_othercorporate	0.029		
	(0.380)		
Investor_typo		0.045	
		(0.409)	
Investor_female			-0.012
			(0.491)
Firm fixed effects	Yes	Yes	Yes
No. of observations	1623	12351	12179
Adjusted-R-square	0.207	0.162	0.162

PANEL C: Herding and timing

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
						Innovestment		
Investment_#earlier	-0.004			-0.005*				
	(0.105)			(0.078)				
Investment_#earlier5k		-0.030			-0.035			
		(0.598)			(0.544)			
Investment_weekend			-0.017	-0.025*	-0.018			
			(0.219)	(0.072)	(0.195)			
Investment_evening						-0.020		-0.021
						(0.366)		(0.356)
Investment_night							-0.001	-0.009
							(0.966)	(0.798)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	13974	13974	13974	13974	13974	1623	1623	1623
Adjusted-R-square	0.166	0.166	0.166	0.166	0.166	0.202	0.202	0.202

Table A2-3: Local bias excluding investors with popular names

The table shows the local bias for investor portfolios. I exclude investors with the 20 most popular German names. The table categorizes the local bias according to portals and the location of the investor. Furthermore, local biases are calculated by excluding family and friend investors. In line with Agrawal et al. (2015), I define investors as family and friends if (1) they invest in the focal start-up before investing in any other start-up, (2) their investment in the focal start-up is their largest investment, and (3) the investor invests in no more than three other start-ups. I report a one-sample, two-tailed t-test for the null hypotheses that local biases are zero. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level. Variables reported are defined in Appendix 1, Table A1-1.

Local bias investor portfolio

Local bias investor portfolio	N	Mean	Std.-dev.	Minimum	25th	Median	75th	Maximum
By portal								
Companisto	5,338	10.0***	43.3	-497.4	-8.6	-2.4	20.0	99.7
German investors	4,826	11.2***	45.0	-497.4	-8.5	-2.3	23.6	99.7
Foreign investors	512	-1.4*	16.5	-38.3	-10.1	-2.9	4.3	68.5
Innovestment	432	18.1***	48.9	-113.6	-24.4	11.1	50.5	99.9
German investors	389	19.5***	50.6	-113.6	-25.3	15.6	62.3	99.9
Foreign investors	43	4.8	25.8	-32.4	-14.3	0.3	29.8	78.8
By country								
German investors	5,215	11.8***	45.5	-497.4	-9	-2	27	100
Foreign investors	555	-0.9	17.4	-38.3	-10	-3	5	79
Without family and friends								
All portals	3,010	6.2***	39.2	-497.4	-8.7	-1.9	13.8	99.8
Companisto	2,786	5.5***	38.8	-497.4	-8.3	-2.2	12.0	99.7
Innovestment	224	14.6***	43.2	-87.3	-21.6	7.7	38.8	99.8
Total	5,770	10.6***	43.7	-497.4	-8.9	-2.0	22.7	99.9

Appendix 3: Survey (capital structure)

Dear Sir or Madam,

My name is Matthias Schmitt (www.ip.mpg.de/en/persons/matthias-schmitt), Research Fellow at the **Max Planck Institute for Innovation and Competition**[1]. In an extensive **research study**, I am currently analysing the influence of **successful equity crowdfunding campaigns on subsequent financial decisions**. Therefore, I am conducting a **short survey** about crowdfunded firms in the UK. By answering the questions, ***[FIRM NAME]*** will support the research on start-ups engaging in equity crowdfunding. The study will help to **evaluate the opportunities and threats coming along with an equity crowdfunding campaign**. Any shared data will be kept securely, treated as confidential and used only for the purposes of this research. The published results of this study will never identify any company or individual, nor any individual responses made.

As participants you will receive the results of this research study with interesting insights on the dynamics of equity crowdfunding. I would kindly ask you to answer the following **3 short questions**.

Q1. What was your company's share of long-term debt to total assets in the year of your equity crowdfunding campaign and the year after?
Long-term debt is defined as loans and financial obligations which are to come due in a period greater than 12-month.

[YEAR ECF]	*[YEAR After ECF]*
[ ] %	[ ] %

Q2. Did equity crowdfunding help you to obtain long-term debt in the year 2017 after your equity crowdfunding campaign?
Please insert an X into the brackets [ ] of the specific answer which is most applicable.
[ ] Yes, very much
[ ] Yes, much
[ ] Yes, little
[ ] No

Q3. Did equity crowdfunding help you to obtain short-term bank loans in the year 2017 after your equity crowdfunding campaign?
Short-term bank loans are defined as loans which are to come due within a 12-month period or within the current fiscal year.
Please insert an X into the brackets [ ] of the specific answer which is most applicable.
[ ] Yes, very much
[ ] Yes, much
[ ] Yes, little
[ ] No

Thank you very much for your support. I would appreciate receiving your answers by **replying to this email until Friday, 8 September 2017**. If you have any questions about the questionnaire, please contact me at Matthias.Schmitt@ip.mpg.de.

Sincerely,

Matthias Schmitt

[1] Max Planck Institute for Innovation and Competition is a Munich-based research institute that focuses on fundamental economic and empirical research with regard to innovation and entrepreneurship. Our research is publicly financed, and we do not pursue any company-sponsored research projects.

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Appendix 4: List of variables (follow-up funding and firm survival)

Table A4-1: List of variables (follow-up funding and firm survival)

Variable	Description	Source
Events		
Firm insolvency or liquidation	Dummy variable equal to 1 if the firm went into insolvency or was liquidated and 0 otherwise.	Unternehmensregister (GER), Companies House (UK)
Number of VCs	Number of individual VCs of the firm.	BvD Orbis, BvD Zephyr, Thomson Reuters Eikon, CrunchBase, press releases
Number of BAs	Number of individual BAs of the firm.	BvD Orbis, BvD Zephyr, Thomson Reuters Eikon, CrunchBase, press releases
Number of successful campaigns	Number of successful ECF campaigns of the firm.	ECF portal
Number of subsequent unsuccessful campaigns	Number of unsuccessful ECF campaigns of the firm.	ECF portal (only GER)
Firm characteristics		
UK firm	Dummy variable equal to 1 if the firm ran ECF campaign in the UK and 0 otherwise.	ECF portal
Age of the firm at end of first campaign	Age of the firm at the end of first ECF campaign.	Foundation: BvD Orbis Age: Calculation by the authors
Legal form with no capital requirements	Dummy variable equal to 1 if the firm's legal form does not have capital requirements and 0 otherwise.	Unternehmensregister (GER), Companies House (UK)
Management		
Number of senior management	The number of senior management of the firm.	BvD Orbis
Share of female senior management	The share of female senior management of the firm.	Gender: BvD Orbis Share: Calculation by the authors
Average age of senior management	The average age of senior management of the firm.	Age: BvD Orbis Share: Calculation by the authors
Age difference of senior management	Age difference between the oldest and the youngest senior management of the firm.	Age: BvD Orbis Share: Calculation by the authors
Trademarks and patents		
Number of filled patents	The number of filled patents by the firm.	BvD Orbis, PATSTAT
Number of granted patents	The number of granted patents owned by the firm.	BvD Orbis, PATSTAT
Number of trademarks	The number of trademarks owned by the firm.	BvD Orbis
Financials		
Number of subsequent successful campaigns	The number of subsequent successful campaigns after the first successful campaign of the firm.	ECF portal
Exit of the crowd	Dummy variable equal to 1 if the crowd exited the firm and 0 otherwise.	Press release, ECF portal
Total amount of money raised	The total amount of money raised by ECF.	ECF portal
Total amount of funding target	The total amount of funding target.	ECF portal
Total number of investors	The total number of ECF investors of the firm.	ECF portal
Business valuation	The pre-money valuation of the firm.	ECF portal
Ratio of funding to funding target	The ratio of funding to funding target.	Calculation by the authors
Ratio of equity to total assets	The ratio of firm's balance sheet equity to total assets.	BvD Orbis