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Monetary Return Crowdfunding: Social Roots but Real Losses

Mari-Liis Kukk

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Declaration:
Hereby I declare that this doctoral thesis, my original investigation and achievement, submitted for the doctoral degree at Tallinn University of Technology has not been submitted for doctoral or equivalent academic degree.

Mari-Liis Kukk

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Finantstulu pakkuv ühisrahastus: sotsiaalsed juured, kuid päris kaotused

MARI-LIIS KUKK

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Contents

List of Publications

The list of author's publications, on the basis of which the thesis has been prepared:

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II Kukk, M.-L. 2022. The Debt-Equity Choice in Crowdfunding: A Two-method Approach. Venture Capital. https://doi.org/10.1080/13691066.2022.2128932 (ETIS 1.1).

III Kukk, M.-L. 2022. Predicting business failure after crowdfunding success: Are platforms the unsung heroes? Journal of Business Venturing Insights, vol. 17, e00308. DOI: https://doi.org/10.1016/j.jbvi.2022.e00308. (ETIS 1.1).

Author's Contribution to the Publications

Contribution to the papers in this thesis are:

I The author of the thesis had a leading role in preparing the dataset, systemising the literature and writing the draft article. The author of the thesis co-wrote the final version of the article.

II The author of the thesis is the sole author of the article.

III The author of the thesis is the sole author of the article.

Introduction

Based on Arner et al. (2017), the symbiotic development of finance and technology can be described in three stages. First, in the latter half of the twentieth century, developed countries began switching from analogous solutions to digital solutions for facilitating financial transactions. Secondly, led by developing countries, where physical infrastructure was lacking but uptake of mobile phones or even the Internet was notably high, fully digital financial services began to emerge. Finally, after the 2008 Global Financial Crisis and accompanying increased regulatory scrutiny for traditional players, a noticeable wave of small market entrants using advanced technologies began to catch attention, occupying market share or addressing markets that were previously left unserved by traditional financial service providers. Among these new entrants, collectively named FinTechs, crowdfunding has emerged as one of the first and most prominent business domains so far (Griffiths, 2020).

Nevertheless, in terms of academic research, crowdfunding is still considered a relatively novel area of finance (Lambert, 2022). The most widely acknowledged definition for the phenomenon has been provided by Belleflamme et al. (2014): *"Crowdfunding involves an open call, mostly through the Internet, for the provision of financial resources either in form of donation or in exchange for the future product or some form of reward to support initiatives for specific purposes*". Usefully, this definition already makes it clear that crowdfunding can come in both monetary and non-monetary reward offering forms. Further, it highlights the two distinct models operating in the non-monetary sphere, namely donation- and reward-based models. However, equity- and lending-based models that are now considered to make up the monetary reward offering space were not separately mentioned in the definition, likely indicating less interest in those types of models at that time. This is not surprising, given that historical data (e.g. Collins et al., 2013) on crowdfunding volumes also point that non-monetary models dominated the early emergence of crowdfunding.

Over time, that balance of power has shifted strongly toward monetary reward offering models, and crowdfunding has become a viable option for raising capital for profit-seeking entrepreneurs (Da Rin and Hellmann, 2020), as opposed to the artists and creatives that it initially tended to serve (Lambert, 2022). This increased uptake, as a way of earning for entrepreneurs, investors, and the crowdfunding platforms alike, has also prompted governments to legislate the field to ensure investors are protected and any risks are properly mitigated. Notably, however, regulation of crowdfunding is strictly focused on debt- and equity-based crowdfunding, since non-monetary reward offering models are either covered by existing consumer protection regulations or do not entail significant risks and are also relatively narrowly used for entrepreneurial purposes. Monetary reward offering models on the other hand seem to entail a flurry of issues that, when left unaddressed, could lead to serious investor harm.

Conversely, academic research seems to have remained somewhat stuck on non-monetary models, while research related to debt- and equity-based crowdfunding remains scarce. Offering insight into equity-based crowdfunding research, Schwienbacher (2019) notes that studies for this area have mostly focused on campaign success factors and other dynamics occurring during the active funding period, akin to studies on reward-based models. Much less is known about what surrounds the campaign, i.e. why is crowdfunding used, how is the suitable crowdfunding type chosen, and what happens once the funding is successfully secured. Similarly, Bollaert et al.

(2021) note that, among studies of debt-based crowdfunding models targeted at business financing, the focus has been mostly on whether crowdfunding lending models replace or complement traditional financing methods, and little is known why businesses may choose this type of funding, and how it is used.

Thus, there exists a clear research gap surrounding entrepreneurs' use of monetary crowdfunding as a method of raising capital. The aim of this thesis is to explore the drivers behind the use of monetary crowdfunding compared to non-monetary models, look at the entrepreneur's choice between using either of the two monetary crowdfunding models when raising capital, and factors that may describe their ability to remain as a going concern after successfully raising funds through crowdfunding. With academic research thus far focused firmly on matters arising from the collaborative and socially oriented roots of crowdfunding, this thesis aims to take a broader approach to understanding the use of monetary crowdfunding models, encompassing theories and ideas developed in other financial contexts, and looking for key differences arising from the crowdfunding setting. As noted by Bollaert et al. (2021), missing these links has been a key weakness of crowdfunding research thus far. The thesis is based on three papers (Kukk and Laidroo, 2020; Kukk, 2022a; Kukk, 2022b), which have all been published in peer-reviewed journals focusing on the fields of finance and/or management. The author of this thesis is either the sole author or the first author for all three papers.

The first paper included in the thesis, "*Institutional Drivers of Crowdfunding Volumes*", was published in the *Journal of Risk and Financial Management*, vol. 13, no. 12. The paper forms a foundation that makes it possible for the subsequent two papers to apply the findings of previous crowdfunding research on strictly monetary crowdfunding models. The paper is based on a dataset collected by the Cambridge Centre for Alternative Finance covering crowdfunding volumes in 122 countries for the years 2015–2016. The paper aims to understand the country-level heterogeneity in the spread of crowdfunding as a phenomenon, and utilizes institutional theory to test the crowdfunding volumes in each country against regulatory, cultural and social indicators descriptive of that country's institutional setup. The paper employs a cross-sectional linear regression model to test the statistical significance of the selected indicators. The paper contributes by highlighting the role of institutions in facilitating or delaying the local spread of crowdfunding. The results of the paper indicate that cultural factors, notably in the form of acceptance towards e-services forms a bedrock for crowdfunding uptake. Importantly for the aims of this thesis, the paper specifically tests the institutional indicators both against total crowdfunding volumes and against volumes for each type of crowdfunding models separately. While certain regulatory aspects seem also to cement the legitimacy of certain types of crowdfunding, strong e-service culture remains the most reliable explanatory variable of crowdfunding volumes, suggesting that the acceptance of crowdfunding has similar delivery models for each type of crowdfunding.

Therefore, it should be expected that some of the dynamics observed in the early phases of crowdfunding, where non-monetary models were more prominent, may remain at play in monetary models as well. The second and third papers of the thesis turn to strictly monetary crowdfunding models, and are based on the SEC Crowdfunding Offerings Data Sets. These data include all crowdfunding campaigns launched by US businesses under Regulation Crowdfunding, which was established as the most open way for US businesses to obtain financing from a crowd of investors that need not be sophisticated or institutional investors in order to participate. As elsewhere in the world,

this type of financing for businesses became strictly regulated, with specific requirements set on company disclosures, campaign marketing, and the intermediating platform.

The second paper of the thesis "*The Debt-Equity Choice in Crowdfunding: A Two-method Approach*" was published in *Venture Capital*. The paper explores the pre-campaign dynamics of companies using monetary return offering crowdfunding methods. The paper contributes to literature by offering insight into the use of equity- and debt-based crowdfunding models when funding entrepreneurial growth. Belleflamme et al. (2014) had previously suggested a theoretical model which showed that entrepreneurs ought to prefer reward-based crowdfunding in case of smaller capital requirements, and equity-based crowdfunding in the opposite case. Similarly, Paschen (2017) presented an additional theoretical framework, indicating that entrepreneurs should likely find very early capital from donation-based models, utilize debt-based models to expand, and then finally move to equity-based models. Notably, that framework considered reward-based models as a part of debt crowdfunding, while this interpretation is questioned since the former is unregulated in most countries. Therefore, the paper included in this thesis conducted empirical tests to analyse what type of companies choose debt-crowdfunding, and what type of companies choose equity-crowdfunding. The data included 713 equity and 403 debt campaigns, and used both logistical regression and a random forest classifier to determine company and funding characteristics associated with either choice. The findings suggested that, contrary to earlier literature, equity-crowdfunding models are used by firms with smaller financing needs, while debt-crowdfunding is used by those with larger growth momentums and higher capital requirements. Combined with previous literature, the results of the paper indicate that donation-, reward- and equity-based models are preferably used by earlier stage firms, while debt-based models are preferred by more mature undertakings.

The third paper, "*Predicting business failure after crowdfunding success: Are platforms the unsung heroes?*" was published in *Journal of Business Venturing Insights*, vol. 17. This paper turns its focus on the post-campaign dynamics of companies using monetary crowdfunding models to obtain financing. Specifically, the paper analyses crowdfunding offerings that were successfully completed by companies, some of which later endured business failure. The paper's empirical analysis is based on initial campaigns of 380 companies, where the occurrence of business failure is tested using the Cox proportional hazards model against company-, campaign- and platform-level characteristics that were observable to investors at the time when the campaign was actively soliciting funds. Through this, the paper contributes to understanding the methods behind investor protection in the regulated sphere of monetary crowdfunding. Notably, the findings indicate that while high-detail disclosures to investors about the companies involved are helpful, further significant information about the probability of early business failure is also carried to investors through campaign-level characteristics. Even more importantly, in at least the specific case of Regulation Crowdfunding, the intermediating platforms also matter a great deal, as some platforms seems to be more capable or more willing to perform due diligence to ensure the quality of the campaigns they intermediate.

The remainder of the thesis consists of Section 1, which provides a short overview of extant literature. Section 2 gives a broader overview of the papers included in this thesis, while Section 3 provides final comments and concludes.

1 Literature Overview

The emergence of crowdfunding has been pinpointed to the birth of the platform ArtistShare, which was established in the US in 2001 (Artistshare, n.d.). Crowdfunding has also been linked to developments related to Web 2.0, which emerged at around the same time. This evolution of the Internet was characterized by a new genre of websites that emphasized the value of user-generated content and social interaction between users (Murugesan, 2007). Social media platforms such as Facebook, Twitter, and Youtube emerged, each of which are centrally controlled platforms, where much of the value is created in a decentralized manner by the users themselves, often without any direct monetary rewards being offered for their contribution. Crowdfunding has been described to offer a similar collaborative approach to the financing of endeavours (e.g. Pelizzon et al., 2016).

The term 'crowdfunding' refers to an open call for the provision of financial resources, which is targeted at a wide audience, each of whom is expected to contribute only a fraction of the capital required (Mollick, 2014). Through this definition, the phenomenon has often been described as a distinct form of crowdsourcing (e.g. Belleflamme et al., 2014), or relatedly a form of "social financing" (e.g. Pelizzon et al., 2016). Both comparisons point to the fact that, similarly to either of those phenomena, a central trait of the emergence of crowdfunding has been its strong focus on social values. Specifically, several research papers (e.g. Herzenstein et al., 2011; Agrawal et al., 2015; Gleasure and Feller, 2016) suggest that the decision of crowdfunding investors on whether to support financially a project calling for funds is not merely of economical nature, but also heavily tied to the social aspects involved.

Importantly, the first crowdfunding platforms to emerge did not involve any monetary rewards whatsoever, and were instead set up to support charitable causes (donation-based crowdfunding) or projects that aimed to provide something people would enjoy, with the product or service in development itself, when finished, often provided to investors as compensation for their support (reward-based crowdfunding). In fact, financial aspects have notoriously caused rifts within the collaborative communities engaging with these projects. As an example, when Oculus VR, used the reward-based crowdfunding model to introduce their Rift virtual reality headset to the market, many backers of the project reacted in a hostile manner when the company was subsequently sold to Facebook for 2 billion USD. Even though the company had provided backers with the rewards they had promised, some of the funders felt the project owners had betrayed the community trust by "selling out" (Gleasure and Feller, 2016).

Donation- and reward-based models, commonly known as non-monetary models, dominated the early emergence of crowdfunding. For instance, in 2011 in the UK, total crowdfunding volumes reached 496 million USD, out of which 346 million USD[1], or 70% was attributed to non-monetary crowdfunding models. However, partly as a result of the preceding financial crisis in 2007–2008, debt- and equity-based models offering monetary returns had begun to emerge. Kallio and Vuola (2020) associate this evolution with a level of distrust developing against the so-called traditional financial sector, which itself also became more restrictive in its financing actions as a response to increasingly strict financial regulations being introduced. As such, monetary models of crowdfunding

[1] Author's calculations based on data by Collins et al. (2013) showing total volumes of 309 million GBP and non-financial model volumes of 216 million GBP and using an average exchange rate of 1 USD = 0.6236 GBP for 2011.

provided individuals and entrepreneurs with an alternative way of obtaining finances, while also offering monetary rewards to small investors that were struggling to find returns in a low interest rate environment after the financial crisis.

Fast-forward to 2019, and the UK's total crowdfunding volumes had skyrocketed to 11 billion USD, which represents a compound annual growth rate of 47%. However, only 2.1 billion USD, or 19% of those volumes represented non-monetary crowdfunding models, with types of crowdfunding offering monetary rewards clearly becoming more prominent. Importantly, the same continuous evolution toward monetary crowdfunding model prominence has been witnessed all over the world. In fact, with global total crowdfunding volumes topping 176 billion USD in 2019, non-monetary crowdfunding models made for just 2.5% of that[2].

Furthermore, monetary crowdfunding models have begun to be recognized as regular financial services, with most leading jurisdictions in the world introducing bespoke regulations in order to establish a regulated market for these activities. The US was among the first countries in the world to introduce a bespoke regime to regulate crowdfunding in 2012, however regulation opening the market up to a wider audience did not arrive until 2016 (Torris, 2016). In 2020, the European Parliament adopted a comprehensive EU-wide regulation for monetary crowdfunding (European Parliament, 2020), while several member states such as Italy, France and Germany had adopted their own regulations already between 2012 and 2015 (Torris, 2016). China was also early to act, with bespoke regulation targeting crowdfunding introduced in 2014 (Yasar, 2021).

While monetary crowdfunding models have clearly become more prominent in terms of volumes, and also widely accepted as a legitimate form of financing by regulatory authorities, academic research has largely remained more interested in the initial premise that crowdfunding had to offer, i.e. the funding of socially valuable projects without any monetary benefits necessarily involved. In a systematic review, Alegre and Moleskis (2021) found that out of 139 notable crowdfunding studies published between 2009 and 2017, just 30 focused strictly on either of the two monetary crowdfunding models. Furthermore, as Martinez-Climent et al. (2018) found, a large proportion of literature focusing on monetary return models actually cover P2P lending, where individual lenders contribute small amounts of money to lend to individual borrowers. However, none of the regulations highlighted above target these types of businesses either.

Further, out of the fraction of academic research focused on monetary crowdfunding models that typically fall under novel financial sector regulation, the vast majority has focused on the success factors and dynamics surrounding the crowdfunding campaigns (Yasar, 2021), similarly to what has been the continued focus for academic research regarding non-monetary crowdfunding (Alegre and Moleskis, 2021). Critically, academic research has been reluctant to deal with questions of governance and the long-term firm survival, which ought to become central issues once one realises that monetary crowdfunding has come far away from the "social values first" ethos of non-monetary crowdfunding, and investment losses can be material. For instance, Lambert (2022) notes that for the reward-based model, the mean individual contribution is likely to be less that USD 100, while for equity-based models, they are usually several thousands of dollars. Based on the context of equity crowdfunding, albeit in a way that is easily also extendable to debt-based models, Cumming et al. (2021) note that there are numerous new and

[2] Author's calculations based on data by Ziegler et al. (2021).

highly pronounced governance issues that arise specifically in the monetary crowdfunding setting that will need to be addressed for the sector to stay healthy.

Among such, Ahlers et al. (2015) note that individual investors in crowdfunding are unlikely to embark on extensive due diligence efforts since that would be too costly compared to the size of their investment. Hornuf et al. (2021) note, based on German data, that investors in monetary crowdfunding settings also tend to be highly passive individually and they have little ability to exercise their control rights against the entrepreneur. Alongside, Cumming et al. (2021) highlight the limited willingness and ability of individual microinvestors to coordinate among themselves to set up governance structures that would ensure their rights are protected. They also note that retail investors in the crowdfunding setting are usually considered "unsophisticated" in regulatory terms, meaning they are not very wealthy nor do they have very high incomes. Simply put, investors in crowdfunding do not have a deep understanding of their investments, have little ability to protect their rights nor are they capable of coordinate with others to do so, and cannot really afford to lose significant amounts of their investments. Clearly, investors need help from regulators to not incur significant losses, and academic research could provide help to make those decisions.

Still, there are also several takeaways from extant literature on campaign dynamics and success factors, some of which seem to be relevant for both monetary and non-monetary crowdfunding models, and may therefore also provide helpful insight for dealing with governance and investor protection issues. For example, several papers have noted that there exists a herding behaviour in most crowdfunding settings, where project backers seek to obtain signals about the quality of the project from the choices of earlier contributors (for example Herzenstein et al., 2011; Zhang and Liu, 2012; Kuppuswamy and Bayus, 2018; Smith et al., 2015; Astebro et al., 2020). Several papers (e.g. Belleflamme et al., 2015; Shiller, 2015; Hornuf and Schwienbacher, 2018) highlight that crowdfunding companies are expected to provide investors with considerable amounts of information, which also helps them achieve funding goals, however information asymmetry and uncertainty remain central issues in crowdfunding (Belleflamme et al., 2014).

2 Summaries of the Studies

2.1 Institutional Drivers of Crowdfunding Volumes

Crowdfunding has gained significant attention from leading regulators and international organisations (e.g., World Bank Group and People's Bank of China, 2018; European Commission, 2018) for its potential in addressing challenges of financing that so-called traditional finance has been unable to address. In glimpses, crowdfunding has also proven to be very capable of gaining considerable market share rather quickly. For example, in the UK in 2017, nearly a third of new loans issued to businesses with an annual turnover below £2 million GBP were raised through crowdfunding (Zhang et al., 2018). Such examples seem to confirm that, at least in rather specific settings, there is some sort of added benefit from having crowdfunding available. Yet, data gathered by the Cambridge Centre for Alternative Finance (CCAF) for the years 2015–2016 make it rather clear that such examples of crowdfunding finding early prominence are rare and tend to manifest only in select countries. According to that data, per capita volumes of crowdfunding tend to fluctuate wildly between countries and types of crowdfunding, with countries such as China, the U.S. and the UK recording overall volumes per capita that are more than 15-fold compared to the global average.

Previous academic research does not offer a particularly comprehensive understanding of why crowdfunding volumes tend to be so heterogeneous. Several early papers (e.g. Cumming et al., 2017; Rossi et al., 2018 and Cumming et al., 2019) were held back by a lack of common aggregate statistics on global crowdfunding volumes, forcing research to focus instead on individual platforms or countries. Such studies, of course, do not provide conclusion representative of the wider crowdfunding industry. In contrast, Dushnitsky et al. (2016) do attempt to investigate the global spread of crowdfunding but focus on the number of platforms instead of funding volumes, which are not necessarily correlated. A working paper by Rau (2020) employs empirical tests on crowdfunding volumes against a range of descriptive variables, but focuses on those related to the regulatory environment, and only includes other indicators sporadically as control variables. While Rau (2020) also tests descriptive characteristics for volumes of monetary and non-monetary crowdfunding separately, these models are also limited by the type of variables included.

At the same time, outside the crowdfunding setting, there is a strong body of literature focusing on institutional theory as a framework to explain the spread of digital innovations and particular models of financial intermediation, both categories that crowdfunding can be considered a part of. Based on institutional theory, institutions, which can be divided into regulative, normative and cultural-cognitive rules (Scott, 2014), provide legitimacy to social objects, which ultimately defines their acceptance (Ostrom, 2008). The paper included in this thesis aims to build on a theoretical framework based on institutional theory proposed by Kshetri (2015, 2018), formulating eight hypotheses that are tested using data obtained from CCAF for years 2015–2016. The data covers crowdfunding volumes for 122 countries and can be separated into the four main types of crowdfunding. The determinants of crowdfunding volumes are analysed with the help of cross-sectional regression models.

The results of this paper indicate that a wider range of institutional aspects proposed by theoretical literature do indeed seem to emerge as relevant determinants of crowdfunding volumes. Consistent with findings from previous literature, several variables

describing the regulative pillar of institutions, such as explicit regulation of crowdfunding, seem to be positively correlated with crowdfunding volumes. However, several other regulative and cultural-cognitive institutions also emerge as important determinants, with indicators proxying the level of e-service culture indicating a particularly robust positive correlation. Importantly in the context of this thesis, the proxies for e-service culture remain highly significant for all four types of crowdfunding. This result indicates that populations that are particularly open to using e-services are similarly welcoming of all types of crowdfunding, regardless of whether there are monetary or non-monetary motivations behind using it. Similarly, a strong regulative pillar, even beyond explicit crowdfunding regulation targeting any single type of crowdfunding, seemed to be positively correlated with all types of crowdfunding volumes.

Combined, these results imply that the mechanism of social acceptance behind the spread of crowdfunding does not seem to differ much between different types of crowdfunding. Regardless of whether there are monetary or non-monetary motivations behind a crowdfunding offering, they are accepted by society based on similar pretences. This finding is useful for future research, including as a setting for the subsequent two papers included in this thesis, as it provides additional ground to expect that several findings within crowdfunding settings, which have often been based on socially motivated non-monetary types of crowdfunding, could be expected to remain relevant when dealing with the regulated, financially motivated realm of monetary crowdfunding.

2.2 The Debt-Equity Choice in Crowdfunding: A Two-method Approach

Very little is known about what influences the firms' decision when choosing what type of crowdfunding to use for financing their endeavours (Moritz and Block, 2016; Schwienbacher, 2019). In an early study Belleflamme et al. (2014) suggested that entrepreneurs should prefer reward-based (non-monetary) crowdfunding when initial capital requirements are low, and turn to equity-based (monetary) crowdfunding when the opposite is true. Describing the same choice, Miglo (2021) suggests equity-based crowdfunding is more profitable if entrepreneurs are overly confident. In an attempt to add more types of crowdfunding to the fray, Paschen (2017) provides a theoretical framework indicating that start-ups should begin their growth by seeking donations, then moving to either debt- or reward-based models, and finally end with equity-based crowdfunding. As a clear weakness, this framework considers debt- and reward-based models as equals, which is an unrealistic interpretation, given that the former is based on monetary returns, and is strictly regulated in many countries, while the latter is not.

As such, there seems to be some agreement among academics that non-monetary models ought to be used by earlier stage firms, but little is known about how firms should choose between debt- and equity-based crowdfunding once they move on to monetary crowdfunding models. Such a choice between debt- and equity-based financing has been extensively researched based on more traditional methods of financing, with several prominent theories, such as the trade-off theory and the pecking order theory, emerging. However, literature focusing on capital structure decisions in a small and medium-size enterprise (SME) setting has largely cast aside these traditional theories (López-Gracia and Sogorb-Mira, 2008), highlighting severe issues of information asymmetry and financial constraints these small entrepreneurs face (Berger and Udell, 1998; Jõeveer, 2013). Separately, literature on crowdfunding, albeit not strictly in monetary return offering settings, has highlighted several directions in which the unique setting crowdfunding provides may distort the very same issues SME capital structure literature

highlights as reasons why traditional theories may not apply for small entrepreneurs, very much like those that look to raise capital through crowdfunding. However, crowdfunding literature only provides several indications of these issues plaguing SMEs being altered in the crowdfunding setting, but remains inconclusive on whether the issues are exacerbated, reduced, or balanced out.

Accordingly, the motivation of this paper is to explore the research gap within monetary crowdfunding, where it is unclear what characteristics help the firm choice of opting for either debt- or equity-based crowdfunding. With added uncertainty emerging regarding whether traditional theories of capital structure remain irrelevant for SMEs even in a novel crowdfunding setting, the empirical approach of this paper includes variables for both the trade-off and pecking order theories, but also additional variables collected from previous empirical research on SME capital structure decisions that are not considered a component of a particular theory. The empirical tests are based on 713 equity and 403 debt campaigns registered with the U.S. Securities and Exchange Commission under Regulation Crowdfunding between May 16, 2016 and September 30, 2019. The tests are carried out using logistic regression and, as a complementary method, a random forest classifier to extract further details on the capital structure decisions of these firms.

The results of the paper indicate that, similarly to what has been found in other settings of SME financing decisions, the two traditional theories of capital structure decisions do not seem to be capable of consistently explaining the choice between debt and equity in a crowdfunding setting either. However, the empirical tests carried out in this paper do find several firm characteristics that seem to affect the choice between debt and equity in crowdfunding in a similar fashion to other settings of SME financing. Overall, the results indicate that firms seem to prefer opting for equity crowdfunding in earlier stages of their development when capital requirements are rather low. In this sense, equity crowdfunding seems to act somewhat similarly to seed financing among more traditional sources of start-up capital providers. In contrast, debt crowdfunding seems to be the preferred choice of more mature start-ups, which are going through a strong spurt of revenue growth and are looking to raise larger amounts of capital.

The paper contributes to SME financing literature in two ways. First, traditional theories of capital structure decisions remained incapable of offering an explanation to the choices between debt and equity for the SMEs included in the sample of this paper. It can therefore be inferred that even as crowdfunding exhibits several important traits that differentiate it from more traditional ways of SME financing, it does not seem to alter the issues of information asymmetry and access to financing in ways that help overcome the barriers that SMEs have faced thus far in financing their endeavours when compared to larger firms. Second, the paper offers first insight regarding how firms utilise debt- and equity-based crowdfunding within their evolutionary paths. Previous literature seemed to agree that firms would opt for monetary crowdfunding after debt- and reward-based crowdfunding, however without a clear understanding of the exact order. The paper included in this thesis indicates that within monetary crowdfunding, equity-based capital is likely to be used by earlier stage firms, while debt-based crowdfunding seems to be the choice of more mature start-ups.

2.3 Predicting Business Failure after Crowdfunding Success: Are Platforms the Unsung Heroes?

Monetary return crowdfunding is regulated in several leading jurisdictions, with the U.S. initially being among the frontrunners to propose a regulatory regime for this type of crowdfunding, but then taking several years to implement the changes and allowing other nations to pass (Rose, 2019). When the so-called Regulation Crowdfunding (RegCF) was finally introduced, the Securities and Exchange Commission (SEC) was adamant that it was designed primarily with investor protection in mind (Farris, 2016). However, the regulations were considered unnecessarily restrictive and costly by some, and the SEC's methods for ensuring investor protection were questioned by some, highlighting that they achieve little in the way of reducing information asymmetry (e.g. Shiller, 2015). In contrast to similar regulations in other jurisdictions, RegCF would not allow third parties to be involved with facilitating the campaigns (U.S. Securities and Exchange Commission, 2019), thus ruling out the use of lead investors that have often been used to coordinate investor activity elsewhere. Further, the SEC demanded extensive disclosure for each campaign but also restricted communications to a single channel (U.S. Securities and Exchange Commission, 2016).

The motivation behind the paper included in this thesis was to examine this unique setting of the U.S. RegCF through the lens of investor protection, by looking at the business failure of companies that are backed through crowdfunding by often unsophisticated individual investors but are then unable to continue their operations some time afterwards. Overall, academic research has been able to collect relatively little about what happens after firms are successful in raising capital through crowdfunding (Schwienbacher, 2019). Four papers (Coakley et al., 2018; Signori and Vismara, 2018; Hornuf et al., 2018; Bouaiss et al., 2020) have been identified that have looked at either business success or failure during the post-campaign period. However, all four have focused on equity-based crowdfunding in European settings. Therefore, the unique rules of RegCF, as they were initially introduced, provide an interesting background to understand how certain requirements demanded by the SEC fared in terms of investor protection. Importantly, the SEC decided to amend the rules on March 15, 2021, very much aligning them to what has been seen in other jurisdictions, but without public analysis regarding the initial ruleset.

The paper included in this thesis uses a Cox proportional hazards model to analyse the company-, campaign- and platform-level characteristics that were observable during the active funding period of the crowdfunding campaign, using these to predict firm survival during the period after successfully completing that campaign. The analysis is based on 380 successfully completed campaigns between May 16, 2016 and March 30, 2018, with survival data last collected on February 15, 2021. The data is therefore both left- and right-censored. In headline numbers, 66 companies failed after the campaign, with tracking times falling between 33 and 55 months.

The results indicate that, in the RegCF setting, company-level characteristics seem to have little predictive power toward ensuing business failure after successfully completing a campaign, which could be a result of the extensive disclosures demanded by the SEC from each firm launching a campaign. With significant information, including its financial results already made available for potential investors about the firm, it seems plausible that even individual investors investing small amounts are capable of taking the risks involved into account. However, the results do indicate that several campaign- and

platform-level characteristics are correlated with the risk of a business failing earlier, indicating that certain information about the risk of early business failure can also be extracted from how others in the crowd behave, and which platforms intermediate the campaigns. Importantly, the latter result also implies that certain platforms seem either more capable or more willing to filter out companies that may fail quickly in the future. Consequently, especially in the initial RegCF setting, where other large parties capable of due diligence were banned from participating in the campaigns, intermediating platforms proved rather important in protecting investors through their role in choosing the campaigns to intermediate.

3 Final Comments and Conclusion

The thesis at hand set out to explore the use of monetary crowdfunding by entrepreneurs that tend to lead rather small, early-stage ventures. The aims of the thesis were to establish the drivers behind the uptake of monetary crowdfunding as opposed to non-monetary models, study the entrepreneur's choice between using either type of the two monetary crowdfunding models, and predictors that may describe a firm's ability to continue as a going concern after successfully completing a campaign. These aims were motivated by the fact that crowdfunding began as mostly a social phenomenon, whereby non-sophisticated individual investors would provide small amounts for project they wished to support, gaining either nothing but gratitude or a small item in return. However, over time, crowdfunding has evolved primarily into a business, where almost all global funding volumes are created within monetary crowdfunding models, traditional financing entities have taken up a position in the market, and regulators have developed bespoke rules for operating in these markets. In contrast, academic research still seems to be rooted in the early emergence of crowdfunding, where monetary rewards were not considered, or were even frowned upon, and social benefits were centrally important.

All three papers included in this thesis are united in the aim of studying crowdfunding's development from its community roots into a fully-fledged business. Whereby the contribution toward a greater good was considered the primary motivation for participating in non-monetary models, monetary models are characterised by conflicting interests, issues of information asymmetry, and regulatory frameworks established to ensure at least some overlap between the goals of each party.

The first paper broadly investigates the heterogeneity easily observable in crowdfunding volumes between countries. In this sense, the paper contributes to understanding why crowdfunding is used, as it provides determinants that help explain why some countries seem to have high levels of uptake, while others do not. Overall, the results suggest that crowdfunding adoption rates may be at least partially explained by a broad range of institutions representing regulative, cultural and social norms established in the countries. Notably however, some institutional determinants that could be associated more strongly with non-monetary models, such as the propensity to allocate time, money and resources to help others, do not yield expected results of a statistically significant positive correlation, not even when tested separately against the volumes of non-monetary models. Instead, all types of crowdfunding seem to be linked more strongly to a similar set of indicators describing regulative and cultural norms, with the cultural trait of e-service acceptance showing the most robust positive connection. Overall, this suggests that the mechanisms at play in accepting crowdfunding as a legitimate way of financing endeavours may not differ that much between types of crowdfunding. Essentially, crowdfunding is considered the same, even if it has transformed from its non-monetary roots into a business where financial returns are expected in addition to, if not in place of social returns.

The second paper focuses on what happens before the monetary return offering crowdfunding campaign is launched. Broadly, the paper concludes that companies using monetary crowdfunding seem to be faced with similar issues as any other small- and medium-sized enterprise looking for financing. Information asymmetries seem to remain protrusive, and traditional theories describing capital structure decisions, such as trade-off theory and pecking order theory, do not seem to apply. Companies seem to

turn toward equity crowdfunding in cases where the company is still developing, little is known about their activities, and amounts needed are small, akin to seed capital. In contrast, debt crowdfunding seems to be used when companies have better developed businesses, are enjoying higher growth, and are in need of large amounts quickly. The paper thus contributes to understanding how monetary crowdfunding is used.

Finally, the third paper looks at what happens next, after the campaign is successfully completed and the funding is received. The paper takes an investor protection view, basing on the issues of information asymmetries highlighted in the earlier paper, and the related fact that investors are not able to perform their own due diligence, as it becomes too costly for them. Therefore, the paper contributes to understanding how regulatory regimes may be set up to increase investor protection in monetary crowdfunding settings. With access to information a key issue, the findings of the paper highlight that while arming investors with detailed disclosures about the company seeking funds is helpful, it is also important to ensure that investors have full transparency of the evolution of the campaign, and an ability to act when new signals are received. Most importantly, however, there exist central parties in monetary crowdfunding models, such as the intermediating platforms, that can have better possibilities to perform due diligence, and could reduce information asymmetries involved.

Evidently, information asymmetry issues emerge as a key theme throughout all three papers and seem to be fundamental in ensuring monetary crowdfunding fulfils its promise in contributing toward a more efficient financial sector. For instance, the acceptance of crowdfunding as a method of financing, covered in the first paper included in this thesis, is ultimately nothing but an issue of information asymmetry. Based on institutional theory, people are generally expected to be cautious toward novel social objects but can more quickly perceive innovations as legitimate if these correspond to the values embedded in local regulative, social and cultural-cognitive norms. In essence, it is a mechanism to overcome information asymmetry, where society is unable to perceive the particular details of the novel object but can grasp its main values. Similarly, information asymmetry issues seem to arise when firms attempt to use monetary crowdfunding to raise funds, continuing to affect SME capital structure decisions, and should ultimately be the underlying target of any investor protection mechanism.

The findings introduced in this thesis have implications for investors and entrepreneurs that participate in the crowdfunding setting, highlighting several aspects which they may consider helpful for streamlining their experience. For instance, investors may find it useful to consider a broader range of information pertaining to the progression of the campaign and the facilitating platform to better protect themselves from occurring losses. On the other hand, entrepreneurs may find it helpful to know that equity crowdfunding seems to be the preferred choice for other similar ventures if they are in early stages of development, while debt crowdfunding may be preferred by more mature ventures. When it comes to the campaign, entrepreneurs may also want to carefully consider how the terms of the campaign may be perceived by investors, as ambiguity presented in the terms could be interpreted as signs of a risky investment.

The findings ought to also be considered carefully by regulators responsible for building a framework for regulating digital finance. As the first paper included in the thesis highlights, the regulative institutional pillar could be a robust and quick way of facilitating uptake for novel financial innovations such as crowdfunding. This puts the pressure firmly on regulators to develop rules for digital finance solutions that work

toward reducing information asymmetry, which, as also presented in this thesis, seems to be the main culprit behind inefficiencies in the crowdfunding setting. However, without arming regulators with sufficiently robust academic research to base their decisions on, it easily becomes a game of pin the tail on the donkey.

While this thesis provides background that could be useful for developing rules better suited to overcome naturally occurring deficiencies in crowdfunding, there are limitations to this research. Notably, the first paper included in the thesis draws on a period when crowdfunding was still in early stages of development in several jurisdictions. Events occurring after the period under consideration, especially those within the regulative pillar such as the introduction of harmonized EU-wide regulation for crowdfunding in 2020 could affect results if the analysis were to be repeated based on newer data. Further, the latter two papers included in the thesis focus on a single U.S. setting with rather distinct rules. As such, the findings cannot be reliably used equally for all crowdfunding settings globally. Future academic research could improve our understanding of monetary return crowdfunding by carrying out similar analyses in different settings and establishing effective ways of overcoming informational deficiencies in various interactions within this specific area of crowdfunding.

With monetary return offering crowdfunding and the whole digital finance movement encompassing it growing importance, finding answers on how to mitigate the apparent deficiencies are an urgent issue. It should not be discarded that while digital finance phenomena such as crowdfunding often have social roots, when it comes to financial services, which they tend to evolve into, profits trump all. It is therefore important to ensure that all stakeholders involved are well equipped to make informed decisions. In social settings, where crowdfunding was born, a lack of communication may lead to someone getting emotionally hurt. In the business world of monetary crowdfunding, it may lead to more material losses.

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Abstract

Monetary Return Crowdfunding: Social Roots but Real Losses

This thesis explores monetary return crowdfunding, a relatively novel way of raising capital by mostly small entrepreneurial firms. The thesis is motivated by a lack of academic research into this specific area of crowdfunding, which offers monetary payments to investors and has become widely regulated throughout the world, thus becoming very similar to many traditional financial sector business models. Moreover, monetary crowdfunding has emerged from a phenomenon that in its early days held a strong focus on social values and helped socially motivated endeavours raise capital without the expectation of anything significant being offered in return.

While academic research has considered these types of early models to a great extent and has also explored the social interactions occurring during a crowdfunding campaign in monetary return offering models, little is known about how monetary return crowdfunding fits into the context of the financial sector. To this extent, this thesis aims to explore what drives the uptake of monetary crowdfunding, the use of debt- and-equity based crowdfunding by entrepreneurs, and the post-offering lives of the firms that have successfully used monetary return crowdfunding. The thesis includes three papers, Paper I, Paper II and Paper III, which pursue these aims.

The first publication, titled "*Institutional Drivers of Crowdfunding Volumes*" studies the crowdfunding volumes of 122 countries for the years 2015–2016, using institutional theory to draw conclusions on factors that may explain the relatively large country-level heterogeneity of crowdfunding volumes. The paper highlights regulatory aspects and e-service culture as important characteristics explaining why some countries seem to be more accepting of crowdfunding. Importantly, the paper also tests institutional characteristics against the volumes of each type of crowdfunding separately and suggests that the mechanisms driving acceptance appear rather similar between them.

The second publication, titled "*The Debt-Equity Choice in Crowdfunding: A Two-method Approach*" uses logistic regression and a random forest classifier on 713 equity-and 403 debt-based crowdfunding campaigns to explore the characteristics that help explain which firms tend to opt for either type of monetary return crowdfunding. The results suggest that equity crowdfunding is used by firms that are in an earlier phase of their business cycle, and require smaller amounts of capital, while debt crowdfunding is preferred by more mature start-ups that are growing quickly and require larger amounts of capital. The results also suggest that information asymmetry remains a persistent issue for SMEs when raising funds even in the relatively public crowdfunding setting.

The third publication, titled "*Predicting business failure after crowdfunding success: Are platforms the unsung heroes?*" explores the post-campaign lives of 380 firms that were successful in raising funds through crowdfunding. The paper takes an investor protection viewpoint, using the Cox proportional hazards model to study which company-, campaign- and platform-level characteristics help explain firm survival in the post-offering period. The analysis is based on a U.S. setting with unique restrictions, and results indicate that the high level of disclosure expected from firms raising funds in this setting seems to have helped raise investor protection levels, while there remains information embedded in the active phase of the campaign that could also be extracted to provide investors with additional information. Further, the results indicate that the platforms mediating the campaigns are capable of offering significant input into investor

protection but the ability or willingness of individual platforms to do so seems heterogeneous.

The thesis contributes to crowdfunding literature by exploring monetary return crowdfunding from several angles that have thus far seen little academic research. The thesis provides further understanding of the spread of monetary return crowdfunding and the pre-campaign and post-campaign lives of the firms that use this type of crowdfunding. A key theme emerging from this research is information asymmetry, which appears to still plague many of the relationships between stakeholders involved, even as crowdfunding is considered a relatively public way of raising funds when compared to other types of funding typically used in the SME setting, and several mechanisms commonly not available to SMEs have been introduced to facilitate the sharing of information in this setting. To this extent, the thesis suggests that there remains much to be done in understanding what additional methods of lessening information asymmetry could be applied in the monetary crowdfunding setting.

Lühikokkuvõte

Finantstulu pakkuv ühisrahastus: sotsiaalsed juured, kuid päris kaotused

Käesolev doktoritöö vaatleb finantstulu pakkuvat ühisrahastust, mis on võrdlemisi uudne meetod kapitali kaasamiseks ja mida kasutavad peamiselt väikesed äriettevõtted. Doktoritöö on motiveeritud asjaolust, et seda spetsiifilist ühisrahastuse liiki, mis jaguneb omakorda võla- ja omakapitalipõhiseks ühisrahastuseks, on akadeemilises kirjanduses võrdlemisi vähe uuritud. Finantstulu pakkuv ühisrahastus on välja kasvanud fenomenist, mis algusaastatel tugines paljuski sotsiaalsetele väärtustele ja mida vaadeldi esialgu ennekõike mõne projekti toetamisena ühise heaolu nimel paljude väikeseid summasid panustavate inimeste poolt, ootamata seejuures oma panuse eest märkimisväärset tasu. Finantstulu pakkuv ühisrahastus see-eest lubab investoritele projekti panustamise eest rahalist tulu ning on tänaseks üle maailma laialdaselt reguleeritud kui finantssektorisse kuuluv ärimudel.

Akadeemiline kirjandus seevastu on paljuski keskendunud just varastele heategevuslikele või auhinnapõhistele ühisrahastuse mudelitele. Ka finantstulu pakkuva ühisrahastuse analüüsimisel on teadustegevus keskendunud ennekõike sotsiaalsetele suhetele, mis esinevad kampaania korraldamise ajal. Võrdlemisi vähe on seevastu teada selle kohta, kuidas sobitub finantstulu pakkuv ühisrahastus finantssektori konteksti. Käesoleva doktoritöö eesmärk on analüüsida finantstulu pakkuva ühisrahastuse kasutuselevõttu maailmas, seda kasutavate ettevõtjate kampaaniaeelseid valikuid võla- ja omakapitalipõhiste mudelite vahel ning edukalt ühisrahastuse kaudu raha kaasanud ettevõtete edasist tegutsemist kampaaniajärgsel perioodil. Doktoritöö põhineb kolmele artiklile, Kukk ja Laidroo (2020), Kukk (2022a) ja Kukk (2022b), mis nimetatud eesmärke käsitlevad.

Doktoritöö esimene publikatsioon *„Ühisrahastuse mahtude institutsionaalsed tegurid“* analüüsib ühisrahastuse levikut 122 riigis, võttes aluseks aastatel 2015 ja 2016 neis kaardistatud rahastusmahud. Artikkel tugineb institutsionaalsele teooriale, et leida riikidele omaseid tunnuseid, mis võiksid selgitada nendes mahtudes esinevat võrdlemisi suurt heterogeensust. Artikli tulemused viitavad, et ühisrahastuse levikut riikide lõikes selgitavad peamiselt teatud regulatiivsed tunnusjooned ja väga tugevalt ka e-teenuseid aktsepteeriv kultuuriruum. Seejuures analüüsitakse artiklis ühisrahastuse mahtusid ka nelja ühisrahastuse liigi lõikes, kuid tulemused viitavad, et riikide valmidust aktsepteerida ühisrahastust kui legitiimset ühiskondlikku nähtust kirjeldavad suuresti sarnased mehhanismid. See on käesoleva doktoritöö raames oluline järeldus, viidates, et ühiskondliku avatuse mõttes ei tehta olulist vahet finantstulu pakkuvatel ja seda mittepakkuvatel mudelitel, ehkki ühed neist on loodud selgelt ärilistel kaalutlustel ning on allutatud ka finantssektori reeglitele.

Doktoritöö teine publikatsioon “*Võla ja omakapitali valik ühisrahastuses: kahe meetodiga lähenemine*” kasutab logistilise regressiooni ja otsustusmetsa meetodeid, et analüüsida tunnuseid, mis aitavad selgitada 713 omakapitalil ja 403 võlal põhineva ühisrahastuskampaania alusel, millised ettevõtted eelistavad üht või teist tüüpi ühisrahastuskampaaniaid algatada. Tulemused viitavad, et omakapitalipõhine ühisrahastus osutub eelistatuks pigem varajasemas faasis olevatele ettevõtetele, samas kui laenupõhist ühisrahastust eelistavad kasutada juba arenenumad iduettevõtted, kes kogevat kiiret ärimahtude kasvu ja vajavad suuremates summades rahastust. Ühtlasi

viitavad tulemused, et informatsiooni asümmeetria jääb väikestele ettevõtetele sarnaselt varem eksisteerinud alternatiividele kapitali kaasamisel oluliseks tõrkeks ka ühisrahastuses, ehkki seda peetakse võrdlemisi avalikuks kapitali kaasamise meetodiks.

Doktoritöö kolmas publikatsioon kannab pealkirja „*Ennustades ärilist läbikukkumist pärast edukat ühisrahastuse kampaaniat: kas platvormid on tunnustamata kangelased?*" ning analüüsib 380 edukalt finantstulu pakkuva ühisrahastuse kaudu kapitali kaasanud ettevõtte kampaaniajärgset arengut. Täpsemalt analüüsib artikkel Cox'i proportsionaalsete riskide mudeli abil kampaaniaid läbi viinud ettevõtetele, kampaaniatele endile ning neid vahendanud platvormidele omaste tunnuste abil mõjureid, mis võivad aidata juba aktiivse rahastusperioodi ajal tuvastada ettevõtteid, mis ei püsi elujõulisena kaua pärast edukalt raha kaasamist. Sel viisil võetakse artiklis vaatluse alla võimalikud mehhanismid, mis võiksid olla olulised investorkaitse küsimuste lahendamisel. Analüüs põhineb ühisrahastuse kontekstis unikaalsele USA raamistikule ning tulemused viitavad, et seal ettevõtetele peale pandud kohustus avaldada kampaania alguses investoritele suures mahus informatsiooni ettevõtte olukorra kohta on tõenäoliselt aidanud kaasa investorkaitse tugevdamisele. Teisalt nähtub analüüsist, et ka aktiivse kampaania käigus tuletatavate indikaatorite abil oleks investoritel potentsiaalselt võimalik tuvastada teatud ettevõtete suuremat riski äritegevus peatselt lõpetada, ent seda informatsiooni ei rakendata piisaval määral. Samuti viitab analüüs, et kampaaniaid vahendavad platvormid on võimelised olulisel määral investorkaitsesse panustama, ent nende võimekus või tahe seda teha võib olla kõikuv.

Käesolev doktoritöö panustab ühisrahastust puudutavasse akadeemilisse kirjandusse peamiselt seeläbi, et analüüsib mitmeid tahkusid finantstulu pakkuvast ühisrahastusest, mis on seni jäänud suuresti tähelepanuta. Doktoritöö suurendab arusaama finantstulu pakkuva ühisrahastuse levikust maailmas ning seda rakendavate ettevõtete kampaaniaeelsetest ja -järgsetest toimingutest. Doktoritöös kerkib läbivalt esile informatsiooni asümmeetria küsimus, mis näib sügavalt mõjutavat kõikide osapoolte omavahelisi suhteid. Seda hoolimata asjaolust, et võrreldes väikeettevõtetele traditsiooniliselt kasutada olevate kapitali kaasamise võimalustega, peetakse ühisrahastust võrdlemisi avalikuks raha kaasamise meetodiks ning see sisaldab mitmeid täiendavaid viise investoritega suhtlemiseks, mida väikeettevõtetele teiste raha kaasamise viiside puhul tüüpiliselt ei võimaldata. Sellest lähtuvalt viitab käesolev doktoritöö olulisele vajadusele täiendavalt analüüsida informatsiooni asümmeetriat justnimelt finantstulu pakkuva ühisrahastuse kontekstis, et tuvastada parimaid meetodeid asümmeetria vähendamiseks ning seeläbi ühisrahastuse kaudu kapitali kaasamise efektiivsemaks muutmiseks.

Appendix 1

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Institutional Drivers of Crowdfunding Volumes

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Abstract: Crowdfunding improves access to financing, yet cases of crowdfunding's importance, besides traditional financing, are rare and notably localized. In explaining why global crowdfunding volumes are so heterogeneous, previous academic research has focused mainly on the existence of a legal system that is supportive of crowdfunding, but with conflicting results. We argue that a broader range of institutions must be considered to describe the spread of crowdfunding at its current early stage of development, and provide first empirical evidence on the matter. Using a dataset covering crowdfunding volumes of 122 countries over the years 2015–2016, we confirm that the existence of crowdfunding-specific regulations has a positive association with total crowdfunding volumes per capita. We also find that regulation targeted at a specific type of crowdfunding has an economically stronger association with corresponding transaction volumes. In line with our argument, we find that a significantly broader range of less crowdfunding-specific institutions exhibit strong ties to crowdfunding volumes, with strong e-service culture emerging as an especially robust determinant of all types of crowdfunding volumes. Stronger legal rights, greater financial freedom, and higher democracy levels are also associated with greater total crowdfunding volumes, but exhibit varying relevance across different types of crowdfunding.

Keywords: crowdfunding; financing; institutions; regulations; norms; culture

1. Introduction

Crowdfunding is a digital innovation that has been hailed for its potential to address financing challenges (World Bank Group and People's Bank of China 2018; European Commission 2018). In 2016, global crowdfunding volumes more than doubled compared to 2015, reaching more than $290 billion USD. At the same time, crowdfunding volume continues to vary significantly between countries, with China, the U.S., and the UK exhibiting volumes per capita which are more than 15 times higher than the global average[1]. Such heterogeneity in volumes explains why crowdfunding is not yet able to compete with traditional sources of financing in economic terms. It was 0.29% of the global stock of domestic credit at the end of 2016 and 0.43% of the global market value of publicly traded shares at the end of 2015[2]. Still, there are examples of crowdfunding taking up a prominent role in financing. One such example can be found in the UK, where crowdfunding contributed nearly a third of all new loans to businesses with an annual turnover of less than £2 million GBP in 2017 (Zhang et al. 2018). The fact that crowdfunding has become important only in certain markets raises the question, why has the adoption of crowdfunding been so uneven across countries?

[1] Authors' calculation based on the data of the Cambridge Centre for Alternative Finance.
[2] Authors' calculations based on data obtained from the Cambridge Centre for Alternative Finance and CIA World Factbook https://www.cia.gov/library/publications/the-world-factbook/.

With crowdfunding being both a digital innovation and an added layer of financing, previous research related to these fields may help to address this question. Within the field of digital innovations, Hinings et al. (2018) provide a formidable explanation on why institutional theory should be considered a linchpin for studying the development and spread of digital innovations. They argue that existing institutional arrangements are fundamental to laying the path for new ideas to emerge and disseminate, since these new ideas must first gain legitimacy from critical crowds to become socially accepted. According to institutional theory, institutions provide such legitimacy to social objects and act as vehicles for allocating society's resources (Ostrom 2008; Parsons 1953; Suchman 1995). The relevance of institutions in determining which objects become more socially acceptable and, therefore, more prominent, also features extensively in literature related to financing activities. The role of institutional factors (e.g., the market for corporate control, bankruptcy code and the tax code, type of financial system), has been also investigated in literature that focuses on the differences in financing patterns of firms across countries e.g., (Rajan and Zingales 1995; Demirgüç-Kunt and Maksimovic 1999; Moritz et al. 2016). Several papers, such as Demirgüç-Kunt and Levine (2001), Ergungor (2004), Aggarwal and Goodell (2009) find empirical evidence that institutional factors may help explain differences in country-level preferences towards either market-based or bank-based financial intermediation models.

However, we cannot directly link the determinants of crowdfunding volumes to those found in previous literature. First, La Porta et al. (1998) argue that there is no use in distinguishing countries based on firm financing patterns, since market-based and bank-based systems can be complementary ways of financing, and effective institutions, such as a well-functioning legal system, should support both, allowing each to develop independently of the other. Similarly, literature related to crowdfunding highlights this phenomenon as a new and complementary form of financing (Short et al. 2017; Hervé and Schwienbacher 2018), which therefore should follow its own path of development. Second, as argued by Ang and Kumar (2014), the spread of financial innovation is not necessarily tied to any previous developments in a country's financial system, but instead to the underlying institutional framework. They find that countries that are genetically more distant from frontier countries of innovation tend to be less capable of incorporating innovative ideas within their financial systems. As such, there seems to be little reason to limit ourselves to only those determinants that are associated with the spread of previous, unconnected financial developments.

Still, in connection with the previous literature, we argue that institutional theory as a whole also provides a rich framework for understanding the adoption of crowdfunding. First, as in the related literature on digital (financial) innovations and financial intermediation models e.g., (Ang and Kumar 2014; Hinings et al. 2018), we expect institutions to act as vehicles of legitimacy for this novel financial development. Therefore, institutional determinants should have significant power in explaining the heterogeneity in crowdfunding volumes between countries. Second, the role of institutions has been shown to lessen over time as innovations move towards general validation e.g., (Johnson et al. 2006). Thus, the current development stage of crowdfunding provides suitable conditions to test why only some countries have become early adopters of crowdfunding, while others have shown only minute interest. Third, crowdfunding is associated with severe market imperfections, such as information asymmetry (Belleflamme et al. 2014; Kleinert et al. 2020; Miglo 2020) and moral hazard (Strausz 2017; Chemla and Tinn 2020). Institutions may mitigate the risk associated with these imperfections by broadly inserting trust within the system (Bergh et al. 2019). Finally, Scott (2014) emphasizes that while each institutional pillar—regulative, normative and cultural-cognitive—may act towards achieving the same goal, each employ their own mechanisms and may, at times, counteract each other. As such, it is possible for a country to have large crowdfunding volumes even if only one of the three pillars is supportive in providing legitimacy to crowdfunding. Because of this, it is important to consider the role of institutions from all three pillars.

Although Kshetri (2015, 2018) proposes a theoretical framework, based on institutional theory, to explain crowdfunding success, empirical research on crowdfunding has been inhibited by the

highly fragmented nature of the crowdfunding industry and lack of common aggregate statistics. Accordingly, the majority of previous research has focused on data from one specific crowdfunding platform (for a review, see (Gleasure and Feller 2016)). As an example, Cumming et al. (2017) view cleantech crowdfunding across 81 countries, with one of their hypotheses proposing that the prominence of cleantech crowdfunding campaigns is associated with certain cultural characteristics. While they do find that cleantech crowdfunding campaigns more frequently originate from countries with low levels of individualism, their data is limited to only those campaigns hosted on the platform Indiegogo, which is based in the U.S. As a result, more than 80 per cent of the campaigns examined originate from the U.S. and Canada, and all of the campaigns are strictly reward-based, due to the nature of the platform used. Alternatively, Cumming et al. (2019) use data from 93 different platforms and find that a regulative update carried out by Canadian provinces in early 2016 led to a better application of due diligence by platforms, which in turn was positively related to campaigns success and higher crowdfunding volumes. However, all of the platforms under consideration originated from Canada, thus significantly limiting the variation of the wider surrounding institutional framework that may affect crowdfunding volumes. Moving more towards a global approach, Rossi et al. (2018) use a survey to collect campaign data from 185 investment-based platforms spread across nine countries. As their aim is to focus on how certain platform-specific characteristics affect crowdfunding outcomes, they only include some institutional factors as country-level control variables, and do not record any statistically significant association for these variables when tested against money raised. Moreover, even though they consider platforms from multiple countries, they do not specifically aim to capture a representative sample of all crowdfunding volumes in each country. While this type of research helps understand crowdfunding as a phenomenon in specific settings, it does not provide a thorough explanation on how institutional factors affect crowdfunding on a global scale and for different types of crowdfunding.

To the best of our knowledge, there exist only two relevant papers focusing on the country-specific determinants of all types of crowdfunding on a global scale. First, Dushnitsky et al. (2016) investigate the determinants of crowdfunding platform creation. As they focus on the number of platforms, their study does not cover the actual crowdfunding volumes. Moreover, their coverage of institutional aspects is limited to only the regulative pillar, where they consider legal rights and crowdfunding-specific regulations to be important indicators, but find no significant association for the latter. In contrast to this result, the working paper by Rau (2018), which also focuses on how the legal framework of a country affects its crowdfunding volumes, finds that the introduction of explicit crowdfunding regulations does indeed provide a very robust link to crowdfunding volumes. As Rau (2018) considers the legal system to be especially important and does not rely on any firm theoretical foundation for the inclusion of other explanatory variables, he otherwise fails to take a broad range of potentially important institutional indicators into account. Consequently, the models employing crowdfunding volume as a dependent variable only control for, in select specifications, the generalized level of trust within a country as an additional institutional factor beside the introduction of explicit crowdfunding regulations. Compared to Rau (2018), we view the regulative aspects in much more detail, distinguishing between whether the crowdfunding-specific regulation targets only debt-based or equity based types of crowdfunding, and testing how these targeted regulations affect both the total crowdfunding volumes within a country, as well as the volumes of different types of crowdfunding. Furthermore, in contrast to both previous papers, we compare country-level crowdfunding volumes to a broad set of institutional factors, including a total of 12 institutional variables consistent with the theoretical framework of Kshetri (2015, 2018). Hence, our paper provides a comprehensive answer to each of Kshetri's (2015, 2018) institutional theory based propositions, which have thus far been ignored in empirical research. While we use the same underlying data as Rau (2018), we collapse the annual data into average values instead of using a panel setup, since the institutional explanatory variables are unlikely to exhibit significant variation over the two year period observed.

The objective of this paper is to investigate how a wide range of institutional factors that may rely on different operating mechanisms contribute to the adoption of crowdfunding in different countries.

We build on the theoretical framework proposed by Kshetri (2015, 2018) to formulate eight hypotheses. For testing the hypotheses, we use data on crowdfunding volumes gathered by the Cambridge Centre for Alternative Finance (CCAF) for years 2015–2016. The sample covers 122 countries. Determinants of crowdfunding volumes are investigated using cross-sectional regression models.

We confirm that institutions highly targeted at crowdfunding, such as explicit regulation, seem to matter, but also show that a broad range of other regulative and cultural-cognitive institutions are important determinants of crowdfunding volumes. The results concerning the role of normative institutions remain rather inconclusive. We find that countries having crowdfunding-specific regulations, stronger legal rights, greater financial freedom, higher democracy levels, and stronger e-service culture have also tended to experience greater total crowdfunding volumes per capita. The most robust associations across different types of crowdfunding are observed for the presence of crowdfunding-specific regulations, with the economic association becoming stronger when the regulation is explicitly targeted at the corresponding type of crowdfunding, and e-service culture. Some of these institutions, such as crowdfunding-specific regulations, can be developed easily by policymakers. Others, such as e-service culture, are more difficult to influence, but are still important factors to consider. Over time, however, continuous use of crowdfunding in localized settings is likely to increase its acceptance and utilization on a global scale.

This paper contributes to two streams of literature. First, we add to the discussion of the role of institutions in providing legitimacy for the adoption of (digital) financial innovations (Aggarwal and Goodell 2009; Ang and Kumar 2014). Secondly, we provide much needed empirical evidence on the interlinkages between institutional structures in place and crowdfunding volumes hypothesized in Kshetri (2015, 2018). As such, the empirical results of this paper are important for policymakers, as they provide a pathway to developing institutions that could foster the growth of crowdfunding.

The remainder of this paper is organized as follows. Section 2 provides a brief overview of institutional theory and discusses its implications on crowdfunding, following which we develop a set of hypotheses on how differing institutional structures in countries may affect crowdfunding volumes. Section 3 discusses the data and methodology. Section 4 presents the results of the empirical models and discusses the findings. Finally, Section 5 concludes and discusses the contribution and limitations of this paper as well as the implications for policy considerations.

2. Hypothesis Development

A number of leading scholars in the field of new institutional economics e.g., (North 1990; Ostrom 2008; Williamson 1991), have embraced the term "rules of the game" to describe the role of institutions in macroeconomic analysis. North (2008) defines institutions as a set of formal rules and informal norms, along with the manners in which either are enforced. Organizations, as economic agents, use their skills and strategies to act within the set of rules in order to win the game (North 1990). Therefore, the success of organizations depends upon a combination of both the "rules of the game" and the set of attributes of each economic agent. As the institutional framework of the economy dictates the skillset that will lead to the greatest possible pay-off, the types of organizations that come into existence in a given economy ultimately reflect the payoff structure of the society (North 2008).

The ability of the institutional framework to dictate which organizations thrive and which suffer can be traced back to a key concept of institutional theory: the need for legitimacy. Suchman (1995, p. 574) describes legitimacy as "a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions". According to Scott (2014), the "socially constructed system" Suchman is referring to are the institutions. Although institutional factors alone cannot determine the outcomes, institutions act as structures that individuals use to allocate resources (Ostrom 2008).

If the institutional theory were to hold for the development of crowdfunding, these concepts could potentially explain the vast heterogeneity of crowdfunding volumes between countries. When applying

institutional theory on crowdfunding, we can view crowdfunding platforms as organizations with rather homogenous skillsets and targeted levels of performance. Platforms are then subjected to different "rules of the game" in various countries, thus resulting in differing levels of perceived legitimacy. In addition to institutional effects, platforms are also subject to different levels of resources, for instance, the level of traditional financial sector development, availability of funds, and general wealth of the population. The combination of these effects is expected to lead to heterogeneous crowdfunding volumes, even when platforms themselves operate in a similar fashion.

Institutions should also be more relevant for newly formed innovations, such as crowdfunding. According to Johnson et al. (2006) only those innovations that are in accordance with a local society's widely accepted norms, values, and beliefs will find legitimacy and will, thereby, enter use. Once an innovation is locally validated in one society, it will also be more readily adopted elsewhere. Still, its adoption in other locations during the early stages of global diffusion will somewhat depend on how well the innovation conforms to each specific location's widely accepted values. Eventually, the innovation will become widely accepted as part of the global status quo, framing the future actions of all societies. This implies that if crowdfunding were to become a prominent component of the financial system in at least some countries, further expansion into others would become less reliant on the local values and beliefs of those societies. The latter would hinder the ability of institutions to explain the success of crowdfunding.

Thus far, we have mostly used the term "institutions" to describe a set of rules that either inhibit negative or endorse positive behavior, as defined by society's widely accepted values. However, there is no agreement amongst institutional theorists on the types of institutions that matter the most. Scott (2014) divides institutions into three pillars: regulative, cultural-cognitive, and normative. The regulative pillar is based on setting formal or informal rules, monitoring compliance, and sanctioning disobedience. The cultural-cognitive pillar refers to a collective, taken for granted, understanding of how objects should be interpreted within a society, shaped by deep-rooted cultural values. The normative pillar assumes that individuals comply because they feel it would be socially appropriate to do so, not because of the threat of sanctions. Scott (2014) argues that although the underlying elements for each of these pillars form a continuum, they are divergent concepts and need to be analyzed separately. This approach enables us to refrain from ruling out the effects of specific types of institutions prematurely but does mean that we must classify each hypothesis only under one specific pillar.

Kshetri (2015, 2018) relied on Scott's (2014) three-pillar handling of institutions to develop a theoretical framework on how institutional factors may affect to crowdfunding success. We build on his propositions to formulate eight testable hypotheses linking crowdfunding success with various indicators describing institutional structures in place within countries. In order to fully test all of the propositions, we formulate a hypothesis accounting for each of the institutional factors outlined by Kshetri (2015, 2018) in his framework. It is important to note that while formulating our hypotheses, we will use a different dependent variable, crowdfunding volume, instead of fundraising success proposed in Kshetri (2015). Following the logic of Ahmad and Hoffmann (2008), volumes can be considered a suitable measure of crowdfunding performance. When formulating the hypotheses, we expand Kshetri's (2015, 2018) propositions to include a broader view of crowdfunding. We argue that the legitimacy of all types of crowdfunding (debt-based, equity-based, reward-based, donation-based) is affected by all institutions, albeit to a different extent depending on the type of crowdfunding in question. We also substitute some of the institutional variables proposed by Kshetri (2015, 2018) with variables that we expect to provide a more direct linkage to crowdfunding volumes. The following sections cover the hypotheses related to the three pillars, regulative, cultural-cognitive, and normative institutions, in turn.

2.1. Regulative Institutions and Crowdfunding

La Porta et al. (1998) suggest that much of the differences in financial development between countries are a result of the prevailing legal system and how efficiently laws are enforced. Kshetri (2015) considers crowdfunding regulations to be especially important for equity-based crowdfunding. Still,

having formal laws that define the rights and responsibilities of each party is likely to increase the legitimacy of all crowdfunding platforms. Rules and referees should be considered particularly important for situations based on competitive interests, such as markets (Scott 2014). Thus, platforms offering pecuniary rewards should be affected most, as each party is expected to prioritize his/her (financial) interest. Platforms offering non-pecuniary rewards are less likely to be affected by regulations and more likely to be affected by the normative and cultural-cognitive factors. Yet, it is conceivable that the existence of crowdfunding regulations will improve the legitimacy of crowdfunding as a whole, regardless of the type of crowdfunding. Indeed, Miglo and Miglo (2019) note that firms may exhibit an overall preference towards crowdfunding as opposed to traditional bank financing if bankruptcy costs are high. As such, countries with very strict bankruptcy laws may exhibit relatively higher crowdfunding volumes for all types of crowdfunding.

While institutional theory states that regulations legitimize and thus empower social objects, it may still be possible that regulations are put in place as a result of higher crowdfunding volumes. When investigating the timing of crowdfunding regulations' implementation and the development of crowdfunding volumes, we see that both scenarios have been realized in countries where formal rules have been set in place. For example, Belgium, France, Spain, Great Britain, Portugal, and Slovenia have experienced a significant increase in the growth rate of crowdfunding volumes per year following the introduction of regulations compared to the year prior to the introduction of regulations. However, in Austria and Germany, the growth rate of crowdfunding volumes has decreased (but remains positive) following the introduction of regulations.[3] This indicates that the presence of crowdfunding regulations may indeed increase the legitimacy of crowdfunding and may not be just a mere reflection of the increased popularity of this activity. Legitimacy is also increased if the rules are enforced (North 2008). As greater enforcement of crowdfunding regulations is likely if rules are formally written down, we propose that:

Hypothesis 1 (H1). *Crowdfunding volumes are greater in countries with regulatory framework supporting crowdfunding activities.*

Due to the relative novelty of crowdfunding, most countries have not yet established crowdfunding-specific regulations. Moreover, the European Commission is of the opinion that member states should take only proportional action in regulating crowdfunding (European Commission 2018). A review of crowdfunding regulation by the European Crowdfunding European Crowdfunding Network (2017) shows that only 11 out of 32 countries analyzed have regulations in place that specifically target crowdfunding. In light of this, Kshetri (2015) emphasizes the importance of a country's overall regulatory framework in supporting entrepreneurship as a key factor determining the success of equity-based crowdfunding. We argue that crowdfunding is less likely to be influenced by regulations aimed at the general entrepreneurial climate and more likely to be affected by regulations targeted specifically at financial services. Both debt-based and equity-based crowdfunding are likely to be more directly affected by financial services regulations because of their similarities to financial markets. However, spillover effects on the legitimacy of reward- and donation-based crowdfunding could also occur. Therefore, we frame the following hypothesis:

Hypothesis 2 (H2). *Crowdfunding volumes are greater in countries with more favorable regulatory climate for the provision of financial services.*

Crowdfunding is (by nature) a highly democratic process, which may be incompatible with authoritarian regimes (Kshetri 2015). In authoritarian regimes, regulatory systems take on extreme

[3] It is important to note that this analysis does not consider the exact timing of implementing the regulations during the calendar year or how much in advance the public was made aware of such regulations entering force.

values (Scott 2014) and the enforcement of rules is undertaken by non-neutral agents (North 1990). As a result, strong regulations do not always support the legitimacy claims of social objects, because authoritarian regimes may use regulations to further their own interest. The latter may not necessarily combine well with advancements that are democratic by nature. Crowdfunding is highly reliant on the development of information technology which, according to Pitroda (1993), can be considered one of the greatest democratizing tools ever created. As we have seen, some authoritarian regimes (e.g., Russia) have used regulations to control the use of such technology. Kshetri (2015) points out that because crowdfunding calls for the democratic participation of a large group of investors, this is likely to conflict with the measures of top-down control imposed on information and communications technology by authoritarian regimes. We, therefore, propose that:

Hypothesis 3 (H3). *Crowdfunding volumes are greater in more democratic countries.*

2.2. Cultural-Cognitive Institutions and Crowdfunding

Cultural-cognitive institutions cover the potential effects of attitudes that societies "take for granted" (Scott 2014). These should be viewed separately from regulative institutions because they tend to also incorporate perceptions that have been learned from past institutions (Tabellini 2010). Cultural-cognitive institutions are not formed instantaneously and may, therefore, incorporate a rich history of the development of widely accepted perceptions.

Following this logic, we must also consider the implications of cultural beliefs on the use of e-services (services provided through the Internet). The use of e-services requires certain skills and an attitude favoring their use. Cultural factors determine what people deem sensible (Ostrom 2008). Therefore, if the use of e-services is considered sensible because of trust in machines, speed, etc., then it is likely to also be reflected in their active use. As crowdfunding is based on transactions carried out using the Internet, the countries with more favorable e-services culture are also expected to exhibit greater crowdfunding volumes. Therefore, the hypothesis is:

Hypothesis 4 (H4). *Crowdfunding volumes are greater in countries with more favorable e-service culture.*

Crowdfunding may also be influenced by the level of trust within a society because it empowers the claims of legitimacy of crowdfunding platforms (Kshetri 2015). Contributing or investing on crowdfunding platforms usually involves supporting a cause initiated by a stranger, requiring a certain amount of trust in his/her good intentions. Furthermore, crowdfunding is typically characterized by high levels of information asymmetry (Belleflamme et al. 2014; Kleinert et al. 2020; Miglo 2020). Sriram (2005) notes similar issues in his study of the emerging field of microfinance in India, and finds that social trust becomes a highly effective tool to overcome issues arising from imperfect information and enable microfinance to develop. Trust is particularly important in countries with a weak record of enforcing contracts (Wu et al. 2014), effectively becoming a substitute for a strong regulatory environment (Karlan 2005). Accordingly, the trust within a society should be considered especially important in countries without crowdfunding-specific regulations in place. In such countries, lending funds on a crowdfunding platform would leave the lender with little action to take if the borrower defaults (Rau 2018). Therefore, a high degree of thin trust between strangers should support crowdfunding success. We phrase our hypothesis accordingly:

Hypothesis 5 (H5). *Crowdfunding volumes are greater in countries characterized by greater trust between strangers.*

Social stigmatization has been associated with a number of economic consequences, such as low institutional ownership, weak analyst coverage, and discounted equity values for companies that are in conflict with social norms (Novak and Bilinski 2018). Similarly, Kshetri (2018) argues that a high degree of stigmatization of entrepreneurial failure would lead to lower crowdfunding

success. While Landier (2005) points out that all entrepreneurial activities are negatively affected by the stigma of failure, Kshetri (2018) argues that this is even more so for funding campaigns conducted on crowdfunding platforms. The reasoning behind this lies in the sheer number of contributors that crowdfunding campaigns normally mobilize. When an entrepreneur fails in a venture financed by more traditional methods, only a small group of experienced investors will know about it and the feeling of shame will be less pronounced. However, as crowdfunding campaigns are open to the wider public, failure will also become public knowledge and the humiliation will, therefore, be greater. It should also be considered that failure is perceived differently in different cultures. For example, the EY Global Entrepreneurship Barometer 2013 points out that attitudes towards business failure are particularly positive in the U.S. where 43% of respondents viewed failure as an opportunity to learn, while the G20 average was 23%. Moreover, risk-taking by individuals tends to vary, depending on whether the country is more collectivistic or individualistic (for a review, see Illiashenko and Laidroo 2020). Kshetri's (2018) proposition regarding this matter is framed through the normative indicator of stigmatization in society, while we believe it is more realistic to measure the cultural-cognitive trait of fear of entrepreneurial failure, which is why we have phrased our hypothesis accordingly:

Hypothesis 6 (H6). *Crowdfunding volumes are greater in countries characterized by lower fear of entrepreneurial failure.*

2.3. Normative Institutions and Crowdfunding

Following Scott (2014), normative institutions must incorporate the norms and values of the society that are put in place by social obligation. This means that participants on a crowdfunding platform ask themselves whether participating in a campaign would be considered socially appropriate. A key ingredient in normative institutions affecting crowdfunding is the degree of philanthropic involvement present in society (Kshetri 2015). As philanthropy describes involvement in projects that are brought into life in order to forward some mutual values (Ostrander 2007), it is a straightforward example of what Scott (2014) describes as normative institutions. Kshetri (2015) argues that philanthropic involvement is especially important for donation-based crowdfunding but may also affect reward-based crowdfunding. However, because of the uncertainty of returns in crowdfunding in general, we do not cast aside the possibility that the degree of philanthropic involvement in society could also have some positive influence on the volumes of debt-based and equity-based platforms. We, therefore, propose:

Hypothesis 7 (H7). *Crowdfunding volumes are greater in countries characterized by greater levels of philanthropic involvement.*

Kshetri (2015) also emphasizes the power of trade associations for providing legitimacy. Trade associations are normative institutions in that they are unable to sanction noncompliant non-members for actions deemed unacceptable, but rather enforce a social obligation to become a member and abide by the common set of rules. There are some signs of the emergence of country-based crowdfunding-specific associations. For example, in the UK, twelve leading crowdfunding platforms established a self-regulatory body that required all members to operate to a defined minimum standard (Crowdcube 2013). However, the online presence of platforms seems to have led to the emergence of mainly continent-wide associations such as the European Crowdfunding Network and the African Crowdfunding Association. The existence of such associations makes it difficult to assess their impact on country-specific crowdfunding volumes. Instead, we focus on the financial services cluster as a whole. If the cluster is well-developed, there are likely to be specific and strong cluster organizations that also provide legitimacy to crowdfunding. We, therefore, phrase our final hypothesis as:

Hypothesis 8 (H8). *Crowdfunding volumes are greater in countries with more developed financial services cluster.*

3. Data and Methodology

We obtained data on crowdfunding volumes from CCAF. This data is gathered through surveys, wherein platforms self-report their annual volumes and answer numerous questions regarding their businesses. To date, it is the best data source for country-level crowdfunding volumes because alternative sources (e.g., Massolution, TAB Dashboard) have been shown to significantly underestimate crowdfunding volumes, especially outside of the U.S. It is important to note that CCAF may also somewhat underestimate the volumes, as some platforms fail to respond to the survey. CCAF does specify that the data covers nearly 90% of volumes in Europe and about two-thirds of volumes in the Asia-Pacific region.

Crowdfunding in CCAF's survey is distributed into 19 different categories, which we reclassify into the following five types: debt-based, equity-based, reward-based, donation-based, and other crowdfunding. Debt-based crowdfunding covers all platforms that include the term "lending" or "debt" in CCAF's classification, as well as invoice trading, which is also considered a type of debt financing. Equity-based crowdfunding encompasses all platforms, wherein the definition provided by CCAF refers to the use of equity or revenue/profit sharing models. We also consider mini-bonds as equity-based transactions, because of their short duration and unsecured nature. Reward-based crowdfunding includes only the platforms labeled reward-based by CCAF, while donation-based crowdfunding includes platforms labeled donation-based. Other crowdfunding covers the data from platforms that were not distributed into the previously mentioned types, such as community shares and pension-led funding.

The dataset initially includes crowdfunding data for 160 countries across the world during 2015–2016. In estimations, the number of countries decreases to 122 and below due to missing data for some of the control variables. This means that compared to the original CCAF dataset we lose data for at least 38 countries accounting for 0.065% of total global crowdfunding volume, with Middle Eastern and African countries accounting for nearly half of the number of countries lost. In robustness tests, we also use the data for 2013 and 2014 which for most countries has been backfilled during the 2015 survey and covers only 121 countries.

There exists a significant variation in crowdfunding volumes across countries of different sizes. Therefore, the use of raw volumes can provide misleading indications. In order to control for the size of the country, we use a relative measure of crowdfunding volumes (*cf_total*) calculated as country-specific total crowdfunding volume in USD over the entire estimation period divided by the average population of a country over the same period. The population is preferred as the scale variable due to its lower volatility compared to GDP. A similar approach has been used in several recent studies focusing on crowdfunding and FinTech credit e.g., (Claessens et al. 2018; Rau 2018). This ratio exhibits significantly greater values for five countries—China, the U.S., Great Britain, Estonia, and New Zealand. In Table A5 in Appendix A under robustness test 2, we provide some results for regression models excluding these extreme observations. As the results were not significantly affected, we decided to keep these somewhat extreme observations and there through also maintain the sample size. Instead, in regression models, we use a log transform of *cf_total* to cope with its extreme values and the skewness of its distribution. In addition to the indicator for total crowdfunding volume, we employ similar country-specific volume measures for the specific types of crowdfunding defined above.

Institutional variables are selected based on the empirical proxies which could be obtained for the maximum number of countries. In case several alternatives were identified, preference was given to those variables which could be more directly linked to crowdfunding activity. We were also forced to make some compromises when determining the measurement unit of variables. For example, as the trust between strangers has been measured using different scoring systems in two different surveys covering somewhat different sets of countries, the number of observations could be maintained only through the use of a dummy variable. Table 1 presents the variables used for each of the pillars with their description and descriptive statistics. The first letter of each institutional indicator refers to either regulative (*r*), cultural-cognitive (*c*), or normative (*n*) pillar, as explained in Section 2.

Table 1. Descriptive statistics for 2015–2016.

Variable	Description	Data Source	Hyp.	Sign	Obs.	Mean	Std.dev.	Min	Max
Crowdfunding Volumes									
cf_total	total crowdfunding volume to population (USD)	Authors, based on CCAF		N/A	122	9.99	36.02	0.00	245.84
cf_totalgdp	total crowdfunding volume to GDP (%)	Authors, based on CCAF		N/A	122	35.9	378.14	0.00	4176.5
cf_debt	debt-based crowdfunding volume to population (USD)	Authors, based on CCAF		N/A	122	8.67	33.91	0.00	242.53
cf_equity	equity-based crowdfunding volume to population (USD)	Authors, based on CCAF		N/A	122	0.84	3.03	0.00	23.72
cf_reward	reward-based crowdfunding volume population (USD)	Authors, based on CCAF		N/A	122	0.33	0.67	0.00	3.58
cf_donat	donation-based crowdfunding volume population (USD)	Authors, based on CCAF		N/A	122	0.16	0.70	0.00	5.43
Regulative Variables									
rleg	legal rights index, 0–12 (best)	World Bank Doing Business	H1	+	107	5.55	2.76	1.00	12.00
rlawd	1 if the country has specific crowdlending regulation, or 0	European Crowdfunding European Crowdfunding Network (2017) and Internet	H1	+	122	0.10	0.28	0.00	1.00
rinvp	strength of investor protection index, 0–10 (best)	World Bank Doing Business	H1	+	108	5.70	1.12	3.15	8.25
rlawe	1 if the country has specific equity crowdfunding regulation, or 0	European Crowdfunding European Crowdfunding Network (2017) and Internet	H1	+	122	0.12	0.32	0.00	1.00
rfifr	financial freedom, 0–100 (best)	Heritage Foundation	H2	+	113	55.49	16.64	10.00	90.00
rfree	Freedom House aggregate score up to 100 (best)	Freedom House	H3	+	122	66.59	25.30	10.00	100.00
Cultural-Cognitive Variables									
cacc	% of people above 15 years of age who used a mobile phone or the Internet to access an account in the past year	World Bank Financial Inclusion Index database	H4	+	108	8.67	9.01	0.08	33.98
cpay	% of people above 15 years of age who used the Internet to pay bills or to buy something online in the past year	World Bank Financial Inclusion Index database	H4	+	108	20.79	23.39	0.43	78.98
ctrust	1 if the indicator for the trust between strangers was above the median of surveyed countries, or 0	Authors, based on World Values Survey and European Values Study	H5	+	77	0.48	0.50	0.00	1.00
cfear	fear of failure rate (%)	Global Entrepreneurship Monitor	H6	-	69	35.93	8.52	15.91	53.41
Normative Variables									
ngiv	world giving total score up to 100 (best)	Charities Aid Foundation	H7	+	117	34.56	11.35	11.50	73.00
nclust	1 if the country has a top10 financial center in a world, or 0	Authors, based on Z/Yen Group	H8	+	122	0.07	0.26	0.00	1.00
Non-Institutional Control Variables									
mgdpp	log transform of GDP per capita	Authors, based on World Bank	N/A	?	122	9.40	1.13	6.58	11.69
mremit	personal remittances received (% of GDP)	World Bank Financial Development database	N/A	?	122	4.07	5.76	0.01	31.36
mtop5	top 5 bank asset concentration	World Bank Financial Development database	N/A	+	122	77.51	15.39	28.27	100.00
mfdi	financial development index, 0–10 (best)	International Monetary Fund	N/A	?	118	0.39	0.23	0.05	0.94

Notes: Hyp. refers to the hypothesis that the institutional variable corresponds to. Obs. refers to the number of observations available for the corresponding variable. Mean is the arithmetic mean of the variable. Std.dev. is the standard deviation of the variable. Min is the minimum value of the variable. Max is the maximum value of the variable. Sign refers to the expected association between crowdfunding and explanatory variable.

We also control for several non-institutional country-specific indicators covering economic development, the size of the non-traditional financial sector and characteristics of the traditional financial sector. Economic development is proxied with a log transform of GDP per capita (*mgdpp*). The size of the non-traditional financial sector is proxied by the personal remittances received as a % of GDP (*mremit*) because remittances have been shown to act as substitutes for the traditional financial sector in countries with less developed financial systems (Giuliano and Ruiz-Arranz 2009). Characteristics of the traditional financial sector are proxied by the top 5 bank concentration ratio (*mtop5*) and the financial development index (*mfdi*).

All of the regression estimations in this paper will be based on a cross-sectional dataset due to the following reasons. First, reliable estimates for crowdfunding volumes are present only for two years (2015–2016). Therefore, a panel design would add little value in light of many of the explanatory variables having very low variation across such a short time period. Second, even if institutional variables change over time, their impact may be more clearly visible several years after the change. A potential caveat of the cross-sectional design is the omitted variable bias and the low number of observations. We try to address these concerns by considering different model specifications and reducing the number of control variables.[4] The estimations remain vulnerable to endogeneity concerns. In order to respond to the endogeneity concerns, we did estimate some equations with explanatory variables taken from 2014 (see Tables A4 and A5 in Appendix A); however, it did not significantly change the results reported hereafter. As the explanatory variables do not also vary significantly over time, we decided to use the average of 2015–2016 in baseline estimations. We also have to consider multicollinearity. This was done by checking variance inflating factors (VIFs) and pair-wise correlations. The mean of VIFs for all estimations are presented at the bottom, of each table containing the results. The pair-wise correlations of explanatory variables are presented in Table A1 in Appendix A. As country-based controls *mgdpp* and *mfdi* are strongly correlated, the baseline combination will include only the former indicator.

We estimate each cross-sectional regression model using simple ordinary least squares with robust standard errors. All explanatory variables in these models represent an average over 2015–2016. In those robustness tests where we use crowdfunding volume data covering the period of 2013–2016, the explanatory variables are calculated as averages over 2013–2016. In order to see the explanatory power of different types of institutional variables and to maintain the maximum number of observations per model, the first set of regression models is estimated so that each hypothesis is tested in a separate model:

$$CF_i = f(Inst_i,\ mgdpp_i, mremit_i, mtop5_i) \tag{1}$$

The dependent variable (CF_i) refers to the log transform of the crowdfunding volume per capita (*cf_total*) in country *i*. The institutional variable sets (*Inst*) include one institutional variable at a time with the exception of H1 which includes two regulatory variables at once. Country-specific non-institutional variables will be the same in every model.

In order to control for the simultaneous impact of several institutional variables, the following set of regression models will include all institutional variables with the exception of trust and entrepreneurial failure (H5 and H6). The latter variables are excluded due to their significantly lower number of observations. The models take the form:

$$CF_i = f(rleg_i,\ rlawd_i, rfifr_i, rfree_i, cacc_i, ngiv_i, nclust_i, mgdpp_i, mremit_i, mtop5_i) \tag{2}$$

$$CF_i = f(rinvp_i,\ rlawe_i, rfifr_i, rfree_i, cpay_i, ngiv_i, nclust_i, mgdpp_i, mremit_i, mtop5_i) \tag{3}$$

[4] As an alternative strategy for reducing the number of explanatory variables, one could consider the use of principal components. We have tested this by creating pillar-based principal components for the regulative and normative pillar. Only the first principal components of the regulative pillar obtained a statistically significant positive coefficient. However, due to the interpretation difficulties of the principal components, we decided not to use these in this paper.

$$CF_i = f(rleg_i, rlawd_i, rfifr_i, rfree_i, cacc_i, ngiv_i, nclust_i, mremit_i, mtop5_i, mfdi_i) \quad (4)$$

Equations (2) and (3) differ in terms of the first two variables used to capture regulatory framework (H1) and variables *cacc* and *cpay* used to capture e-service culture (H4). In Equation (4), compared to Equation (2), the GDP per capita (*mgdpp*) indicator is replaced with the financial development index (*mfdi*). As the simultaneous consideration of hypotheses increases the number of control variables, the estimations are followed by a backward elimination procedure until the model includes only those explanatory variables which are statistically significant at $p < 10\%$ level. All three equations will be estimated with total crowdfunding volumes and Equation (2) for all types of crowdfunding excluding equity-based crowdfunding. Equation (3) will be employed to estimate the determinants of equity-based crowdfunding.

Several robustness tests will also be carried out. First, Equations (2)–(4) (together with backward eliminations) will be run including also variables for trust (*ctrust*) and fear of entrepreneurial failure (*cfear*). This reduces the number of observations, but enables to see the results of the simultaneous consideration of all institutional variables. Second, Equation (2) (together with backward eliminations) will be estimated for the time period 2013–2016 for total crowdfunding volumes and its types (with the exception of Equation (3) estimated for equity-based crowdfunding). This reduces the number of countries and increases the vulnerability of the estimations to the potential misstatements. However, it does enable to capture the robustness of reported associations over a longer time period. Third, in order to address the endogeneity concerns, we estimate the Equations (1) and (2) using explanatory variables from 2014. Fourth, to address the concerns over the potential impact of outliers, we estimate Equation (2) excluding the observations of the five countries with the greatest volume per capita.

4. Results and Discussion

4.1. Crowdfunding Volumes across Regions and Countries

As can be seen from Table 2, the total crowdfunding volume during 2015–2016 for the 122 countries amounted to $428 billion USD; 97.2% of this amount stemmed from debt-based crowdfunding, 1.5% from equity-based crowdfunding, followed by reward- and donation-based crowdfunding. The lowest country-specific volumes characterize the Middle East and Africa (MEA). The greatest means of country-specific volumes can be observed in the Asia Pacific region (APAC), followed by the Americas and Europe. On a per capita basis, the mean of country-specific volumes in Europe outperforms the mean volumes in the Americas in all cases, except for donation-based crowdfunding. However, when looking at medians, European countries exhibit the greatest volumes both in total terms and on a per capita basis. Large standard deviations refer to the uneven distribution of crowdfunding volumes across countries.

Table 2. Crowdfunding volumes during 2015–2016 across regions and types of crowdfunding.

Type	Region	Total Volume (USD bn)	No. of Countries	Country-Based Volume (USD mln)			Country-Based Volume to Population (USD)		
				Mean	Std.dev.	Median	Mean	Std.dev.	Median
All	APAC	341.0	19	17,940.0	77,500.0	4.8	21.50	59.87	0.14
	Americas	72.1	30	2404.0	12,900.0	4.7	9.57	40.12	0.35
	Europe	15.1	41	368.9	1820.0	7.1	12.64	31.58	1.33
	MEA	0.2	32	6.2	11.8	1.9	0.17	0.22	0.10
	Total	428.0	122	3511.0	31,200.0	4.4	9.99	36.02	0.25
Debt-based	APAC	336.0	19	17,680.0	76,500.0	1.0	20.28	58.24	0.08
	Americas	67.6	30	2252.0	12,200.0	2.8	7.86	37.70	0.24
	Europe	12.7	41	309.3	1600.0	4.7	10.61	28.17	0.87
	MEA	0.1	32	1.7	4.7	0.0	0.03	0.09	0.00
	Total	416.0	122	3412.0	30,700.0	0.1	8.67	33.91	0.00
Equity-based	APAC	1.7	19	91.4	361.0	0.3	0.50	1.35	0.00
	Americas	2.7	30	90.4	445.0	0.0	1.13	4.49	0.00
	Europe	1.8	41	43.2	184.0	0.0	1.34	3.40	0.00

Table 2. *Cont.*

Type	Region	Total Volume (USD bn)	No. of Countries	Country-Based Volume (USD mln)			Country-Based Volume to Population (USD)		
				Mean	Std.dev.	Median	Mean	Std.dev.	Median
Equity-based	MEA	0.1	32	3.8	6.6	1.0	0.11	0.16	0.05
	Total	6.3	122	52.0	281.0	0.0	0.84	3.03	0.00
Reward-based	APAC	2.8	19	148.8	620.0	0.3	0.37	0.71	0.01
	Americas	1.3	30	42.5	210.0	0.1	0.30	0.83	0.02
	Europe	0.5	41	12.4	28.4	1.5	0.58	0.71	0.24
	MEA	0.0	32	0.2	0.3	0.1	0.01	0.02	0.00
	Total	4.6	122	37.8	266.0	0.3	0.33	0.67	0.02
Donation-based	APAC	0.3	19	17.3	58.5	0.0	0.35	1.25	0.00
	Americas	0.6	30	18.7	72.6	0.0	0.28	0.96	0.00
	Europe	0.1	41	3.4	12.7	0.0	0.09	0.23	0.00
	MEA	0.0	32	0.5	1.2	0.1	0.02	0.03	0.00
	Total	1.0	122	8.6	43.5	0.0	0.16	0.70	0.00

Notes: APAC refers to the Asia Pacific, MEA refers to the Middle East and Africa. Data source: authors, based on data obtained from the CCAF.

In order to shed more light on crowdfunding volumes on a per-country basis, Figure 1 presents these on two-dimensional plots. The horizontal axis for each subfigure represents the total per capita volumes for each country over 2015–2016 and the vertical axis for each subfigure refers to either the total debt-, equity-, reward-, or donation-based crowdfunding volumes for each country during 2015–2016 per capita. As such, a country's position on the horizontal axis remains the same for all subfigures, while its position on the vertical axis changes based on which type of crowdfunding is examined in the respective subfigure, enabling to quickly comprehend which types of crowdfunding are more prevalent in which countries.

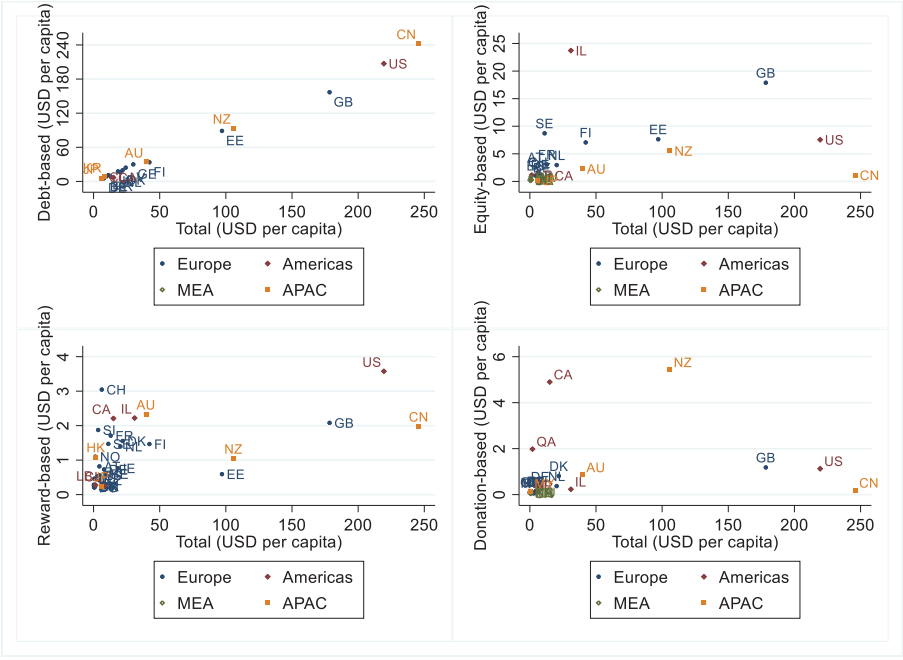

Figure 1. Total crowdfunding volumes during 2015–2016 per capita by types of crowdfunding across countries. Notes: APAC refers to the Asia Pacific, MEA refers to the Middle East and Africa. Countries are represented by two-letter codes. Data source: authors, based on data obtained from CCAF.

In terms of total crowdfunding volumes, China, the U.S., and Great Britain are ahead of all others with volumes over 2015–2016 exceeding $150 USD per capita. They are followed rather closely by New Zealand, Estonia, Finland, and Australia. The same countries are in the lead in terms of debt-based crowdfunding. In equity-based crowdfunding, the situation is a bit different—Israel in the lead with $23.7 USD per capita, followed by Great Britain, Sweden, Estonia, Finland, and the U.S. In the context of reward-based crowdfunding, the U.S. is in the lead with $3.6 USD per capita followed by Switzerland, Australia, Israel, and Canada. Country-specific indicators for donation-based crowdfunding exhibit rather different patterns with New Zealand in the lead with $5.4 USD per capita, followed by Canada, Qatar, Great Britain, and the U.S. This indicates that although the U.S. reaches the top five list of volumes in most types of crowdfunding, there exist rather significant differences in the ordering of countries based on volumes. Given the low country-specific volumes for most types of crowdfunding, the following analysis and discussion will concentrate more on the total crowdfunding volumes.

4.2. Determinants of Total Crowdfunding Volumes

4.2.1. Results of Testing Each Institutional Variable Set Separately

Table 3 presents the estimates of Equation (1) for each set of regulative determinants of crowdfunding. The results show that, in line with expectations, all selected regulative variables exhibit a statistically significant positive association with crowdfunding volumes with the exception of the variable focusing on investor protection (*rinvp*). As the latter variable is less crowdfunding specific, it can be considered of lower importance compared to indicators focusing on crowdfunding regulations. This indicates that if we do not simultaneously control for other institutional characteristics, H1, H2, and H3 are supported. The presence of crowdlending or equity crowdfunding regulations is associated with an increase in crowdfunding volumes per capita by 17 to 18 times. A one standard deviation change in the legal rights index is associated with a 154% increase in total crowdfunding volumes per capita. One standard deviation changes in financial freedom (*rfifr*) and democracy (*rfree*) scores are associated with a 264% and 214% increase in crowdfunding volumes per capita, respectively. These are very significant changes in economic terms.

Table 3. Regulative determinants of total crowdfunding volumes during 2015–2016 per capita.

Model	M11a		M11b		M12		M13	
Constant	−10.750	***	−8.765	***	−8.294	***	−9.803	***
	(2.093)		(2.386)		(1.987)		(2.315)	
rleg	0.339	***						
	(0.082)							
rlawd	2.854	***						
	(0.571)							
rinvp			0.113					
			(0.227)					
rlawe			2.913	***				
			(0.641)					
rfifr					0.078	***		
					(0.018)			
rfree							0.045	***
							(0.013)	
mgdpp	0.691	***	0.614	***	0.307		0.643	**
	(0.174)		(0.224)		(0.230)		(0.255)	
mremit	−0.098	**	−0.065		−0.077	*	−0.064	*
	(0.044)		(0.039)		(0.039)		(0.037)	
mtop5	0.019		0.016		0.005		−0.004	
	(0.015)		(0.016)		(0.016)		(0.015)	
No. of obs.	107		108		113		122	
Adj. R2	0.39		0.31		0.34		0.35	
F-stat.	29.2	***	19.1	***	17.6	***	19.7	***
Mean VIF	1.2		1.3		1.4		1.3	

Notes: Dependent variable log transform of country-specific total crowdfunding volume during 2015–2016 per capita (*cf_total*). For variable descriptions see Table 1. The second number marking the columns after "M1" refers to the number of the hypothesis that the specification is testing. Robust standard errors in parentheses. No. of obs. refers to the number of observations included in the corresponding model. Adj. R2 refers to the adjusted coefficient of determination of the corresponding model. Statistical significance: *** $p < 0.01$, ** $p < 0.5$, * $p < 0.1$.

Table 4 presents the estimates of Equation (1) for each cultural–cognitive and normative determinant of crowdfunding. All cultural–cognitive determinants of crowdfunding (models M14a to M16), with the exception of the fear of entrepreneurial failure (*cfear*), exhibit a statistically significant positive association with crowdfunding volumes. The insignificance of the latter result (H6) may be partly due to the lower availability of data, which leads to only 69 observations. Still, these results do show that e-service culture and trust play an important role in crowdfunding activity (strong support for H4 and H5). The coefficients of these variables are also economically significant. A 1 percentage point increase in the number of people using a mobile or the Internet to access an account (*cacc*) is associated with a 16% increase in crowdfunding volumes per capita. A 1 percentage point increase in the number of people using the Internet to pay bills or buy something online (*cpay*) is associated with an 11% increase in crowdfunding volumes per capita. In countries where trust is above the median of other countries, crowdfunding volumes per capita are 3.3 times greater.

Table 4. Cultural-cognitive and normative determinants of total crowdfunding volumes during 2015–2016 per capita.

Model	M14a		M14b		M15		M16		M17		M18	
Constant	−7.134	***	2.119		−12.300	***	−17.010	***	−13.310	***	−11.660	***
	(2.406)		(2.918)		(4.584)		(4.331)		(2.572)		(2.416)	
cacc	0.154	***										
	(0.0)											
cpay			0.100	***								
			(0.013)									
ctrust					1.205	**						
					(0.558)							
cfear							−0.036					
							(0.047)					
ngiv									0.017			
									(0.024)			
nclust											2.467	***
											(0.814)	
mgdpp	0.428	**	−0.533	*	0.973	**	1.642	***	1.148	***	0.972	***
	(0.205)		(0.282)		(0.417)		(0.457)		(0.197)		(0.216)	
mremit	−0.005		−0.040		−0.070		−0.006		−0.061		−0.051	
	(0.043)		(0.042)		(0.056)		(0.077)		(0.037)		(0.035)	
mtop5	0.010		0.001		0.024		0.023		0.013		0.016	
	(0.015)		(0.015)		(0.024)		(0.024)		(0.017)		(0.015)	
No. of obs.	108		108		77		69		117		122	
Adj. R2	0.35		0.49		0.24		0.18		0.26		0.28	
F-stat.	21.2	***	35.3	***	7.7	***	5.4	***	12.0	***	17.1	***
Mean VIF	1.4		1.8		1.5		1.4		1.1		1.2	

Notes: dependent variable log transform of country-specific total crowdfunding volume during 2015–2016 per capita (*cf_total*). For variable descriptions see Table 1. The second number marking the columns after "M1" refers to the number of the hypothesis that the specification is testing. Robust standard errors in parentheses. Statistical significance: *** $p < 0.01$, ** $p < 0.5$, * $p < 0.1$.

Normative determinants of crowdfunding (models M17 and M18) provide more mixed results. In line with H8, the coefficient for the cluster indicator (*nclust*) exhibits a positive coefficient. Countries that have a top10 financial center exhibit 11 times greater crowdfunding volumes per capita compared to countries that do not have such centers. At the same time, the coefficient of the world giving score (*ngiv*) remains statistically insignificant.

The results presented in Tables 3 and 4 also show that from the non-institutional variables, GDP per capita (*mgdpp*) exhibits the most stable significant and positive association with total crowdfunding volumes. As exceptions, this indicator does remain insignificant in specification M11b and exhibits a negative sign in M14b. Dushnitsky et al. (2016) also reported a positive association between GDP per capita and the number of crowdfunding platforms. Although Rau (2018) observed more mixed results for this variable, in most specifications a positive association with crowdfunding volumes emerged. Remittances exhibit an expected negative association with crowdfunding volumes only in

three specifications. Bank concentration remains statistically insignificant in all specifications. This is surprising, as Rau (2018) reported a positive association between crowdfunding volumes and top 5 bank concentration ratio.

4.2.2. Results of Testing Institutional Variables from All Three Pillars Simultaneously

Table 5 presents the results of Equations (2)–(4) including institutional variables from all three pillars simultaneously. We see that the positive association between crowdfunding volumes and regulatory framework (H1) remains robust across different specifications. Although the coefficient for investor protection (*rinvp*) remains statistically insignificant, legal rights (*rleg*), and the existence of crowdfunding regulations (*rlawd*, *rlawe*) exhibit a positive association with crowdfunding volumes. The magnitude of the association between crowdfunding volumes and regulative indicators does decrease after controlling for other institutional variables. However, the associations continue to remain economically significant. A unit increase in the strength of legal rights is associated with a 20% to 30% increase in crowdfunding volumes per capita. The presence of crowdlending regulations is associated with a 5- to 8-fold and the existence of equity crowdfunding regulations with a 3-fold increase in crowdfunding volumes per capita.

Table 5. Institutional determinants of total crowdfunding volumes during 2015–2016 per capita.

Model	**M2a**		**M2b**		**M3a**		**M3b**		**M4a**		**M4b**	
Constant	−2.284		−3.985	***	5.946	*	5.528	**	−5.307	***	−4.763	***
	(2.605)		(1.441)		(3.021)		(2.777)		(1.878)		(1.302)	
rleg	0.180	**	0.198	**					0.254	**	0.262	***
	(0.087)		(0.082)						(0.097)		(0.082)	
rlawd	2.125	***	2.133	***					1.811	***	1.687	***
	(0.525)		(0.490)						(0.564)		(0.515)	
rinvp					0.047							
					(0.230)							
rlawe					1.160	**	1.305	***				
					(0.465)		(0.465)					
rfifr	0.021				0.036	**	0.044	**	0.010			
	(0.018)				(0.016)		(0.019)		(0.021)			
rfree	0.028	**	0.030	**	0.014				0.023	*	0.027	**
	(0.014)		(0.012)		(0.014)				(0.013)		(0.013)	
cacc	0.115	***	0.129	***					0.087	**	0.101	***
	(0.0)		(0.0)						(0.0)		(0.0)	
cpay					0.081	***	0.086	***				
					(0.016)		(0.015)					
ngiv	−0.046	*	−0.043	*	−0.056	***	−0.055	***	−0.045	*	−0.044	*
	(0.025)		(0.026)		(0.020)		(0.019)		(0.026)		(0.026)	
nclust	1.167	*	1.125	*	0.627				0.598			
	(0.641)		(0.588)		(0.540)				(0.709)			
mgdpp	−0.276				−1.002	***	−0.902	***				
	(0.290)				(0.330)		(0.283)					
mremit	−0.056				−0.078	**	−0.075	**	−0.032			
	(0.042)				(0.039)		(0.036)		(0.044)			
mtop5	0.006				−0.001				0.010			
	(0.013)				(0.014)				(0.013)			
mfdi									2.036		2.708	**
									(1.850)		(1.300)	
No. of obs.	100		100		101		101		98		98	
Adj. R2	0.52		0.52		0.56		0.57		0.53		0.54	
F-stat.	22.4	***	33.9	***	29.6	***	41.7	***	20.6	***	27.5	***
Mean VIF	1.7		1.4		2.0		2.0		1.9		1.6	

Notes: dependent variable log transform of total country-specific crowdfunding volume during 2015–2016 per capita (*cf_total*). Specifications marked with "a" contain all institutional variables used to test H1, H2, H3, H4, H7, and H8. Specifications marked with "b" present the results of backward elimination of specification "a". For variable descriptions see Table 1. Robust standard errors in parentheses. Statistical significance: *** $p < 0.01$, ** $p < 0.5$, * $p < 0.1$.

The results remain less robust with respect to other regulative institutions (H2 and H3). Still, in several specifications, we do observe that a more favorable regulatory climate for financial services, reflected in greater financial freedom (*rfifr*) and greater democracy level (*rfree*), is associated with greater crowdfunding volumes. A one standard deviation increase in financial freedom is associated with an 82% to 109% and a one standard deviation increase in the democracy level with a 77% to 114% increase in crowdfunding volumes per capita.

As in Table 4, support for the relevance of the cultural-cognitive factor e-service culture (H4) remains strong. A positive association exists irrespective to the used proxy (*cacc* or *cpay*). A 1 percentage point increase in the number of people using a mobile or the Internet to access an account (*cacc*) is associated with a 2.3% to 3.1% increase in crowdfunding volumes per capita. A 1 percentage point increase in the number of people using the Internet to pay bills or buy something online (*cpay*) is associated with a 9% increase in crowdfunding volumes per capita. These are economically significant changes (although lower than those reported in Table 3).

The normative institutions provide some results that we did not observe in previous simpler specifications. The world giving score (*ngiv*) exhibits a negative association with crowdfunding volume in all six specifications. This result is contrary to H7. In terms of the financial services cluster, we observe that countries with a top10 financial center have three times greater crowdfunding volumes per capita. Still, the support for H8 is not very robust to different combinations of explanatory variables.

The simultaneous inclusion of institutional variables in Table 5 reduces the significance of non-institutional variables compared to Tables 3 and 4. Economic development, reflected in GDP per capita, remains insignificant in the baseline M2 models and becomes statistically significant and negative in M3 specification. The latter result seems to be partly driven by a rather strong correlation between GDP per capita (*mgdpp*) and the number of people using the internet to pay bills or buy something online (*cpay*). If we would remove *cpay* from model M3, the coefficient of *mgdpp* becomes statistically insignificant and a significant positive coefficient emerges for democracy (*rfree*) and the cluster indicator (*nclust*). If *mgdpp* is replaced with a proxy for financial development (*mfdi*), its positive association with crowdfunding emerges after backward elimination (see model M4). The support for a negative association with remittances appears in one specification out of the three.

4.2.3. Robustness of Results Concerning Total Crowdfunding Volumes

In order to test the robustness of results presented in Section 4.2.2, we run a separate set of models including all institutional variables at once (see Table A2 in Appendix A). This leads to a significant decrease in the number of observations and to a slight decrease in the explanatory power of the models. As a consequence, the support for H2, H3, H7, and H8 disappears. Despite these changes, the support for H1 and H4 remains. This shows that regulations more directly affecting crowdfunding, as well as the e-service culture, are important crowdfunding determinants. The coefficients of the added variables for H5 and H6, trust between strangers (*ctrust*) and fear of failure (*cfear*), both emerge as statistically significant. In line with expectations, countries with above-median trust levels have almost three times greater crowdfunding volume per capita. A 1 percentage point increase in the fear of entrepreneurial failure rate is associated with a 7.7% decrease in crowdfunding volumes per capita.

As an additional robustness test, we run models M2a and M2b also using crowdfunding data from 2013–2016 (see Appendix A Table A3 columns M2a and M2b for total crowdfunding). Similarly to results reported in Table 5, the support for H1 and H4 remains. Support for H3, H7, and H8 disappears. However, an expected positive association is reported for financial freedom (H3) after backward elimination. Considering that in this estimation the number of observations drops from 100 to 86 and the pre-2015 crowdfunding data is prone to greater biases, the loss of significance of some of the previously reported associations in Table 5 is not too surprising.

The robustness test focusing on endogeneity concerns (see Table A4 in Appendix A) shows that all the significant associations reported in Tables 3 and 4 remain. Furthermore, two of the institutional variables which were insignificant earlier (investor protection and giving score) now also exhibit

the expected significant positive association with total crowdfunding volume. When most of the institutional variables are added into the specification together (see Appendix A Table A5 columns for robustness test 1), we do observe that the coefficients for the legal rights, giving score, and cluster lose their statistical significance compared to Table 5. However, the remaining institutional variables maintain their significant associations after the elimination of insignificant control variables.

Additional robustness tests are presented in Table A5 in Appendix A as test 2 and 3. When the total crowdfunding volume is scaled by the GDP (see robustness test 2), the results remain rather similar to those reported in Table 5. The positive association with crowdfunding regulations and e-service culture remains and the non-institutional variables exhibit greater significance. It can be argued that countries with very high crowdfunding volumes may somehow influence the reported results. However, the exclusion of the five countries with the greatest per capita crowdfunding volumes (see robustness test 3) does not lead to significant changes in the reported results. Compared to Table 5, the only change concerning institutional variables is the significant positive coefficient reported for financial freedom, which previously was insignificant in the same specification.

4.2.4. Discussion of Total Crowdfunding Volumes' Determinants

Our results show that in the context of total crowdfunding volumes the strongest support exists for H1 and H4, reflected in legal rights, crowdfunding specific regulation and e-service culture. It is not surprising that among the indicators for the regulative pillar, H1 has the strongest support. Specifically, the existence of crowdfunding-specific regulations should have a more pronounced association with total crowdfunding volumes, in comparison to more general laws and the ruling regime, because of their direct and explicit nature. The positive association with legal rights seems consistent with Miglo and Miglo (2019), who suggest that crowdfunding may be preferred in countries with relatively higher bankruptcy costs, which are captured through this variable. Previous studies have similarly shown that legal rights tend to be positively associated with the number of debt-based crowdfunding platforms (Dushnitsky et al. 2016) and crowdlending regulations with crowdfunding volumes (Rau 2018). An important conclusion from this result would be that implementing regulations that are specific to crowdfunding could enable to boost crowdfunding activity. However, it is important to note that, due to data restrictions, we are unable to explicitly test for causality, which does leave the possibility that regulations are implemented as a response to greater crowdfunding volumes. Still, crowdfunding-specific regulations are a rare example of institutions that could be changed within a short timeframe. Other institutional variables do not tend to change so rapidly. An example of such an institution can be found in H4, which focuses on the extent of trust in internet transactions. Similarly to crowdfunding-specific regulations, this can also be considered a rather direct indicator of the attractiveness of crowdfunding activity in a country compared with other institutional variables like thin trust between strangers or fear of entrepreneurial failure. However, it remains more difficult to change, because of the reliance on perceptions that have evolved over long periods of time. Still, the promotion of e-services by the government could be a way to gradually increase the public interest in crowdfunding.

Depending on the specification and number of observations, slightly weaker support exists for the relevance of regulative institutions reflected in financial freedom (H2) and the level of democracy (H3). This shows that the overall strength of different regulative institutions is an important crowdfunding determinant and the creation of a regulatory climate that is more suitable for the provision of different financial services, as well as higher levels of democracy, could contribute to more active crowdfunding.

Cultural cognitive institutions reflected in trust (H5) and fear of entrepreneurial failure (H6), provide less robust results. The lower significance of these variables can be explained by the fact that the data for their proxies was not available for many of the covered countries. Still, the existing results do show that crowdfunding volume tends to be greater in countries with greater trust between strangers, which is consistent with the expectation that thin trust acts as an alleviative to issues related

to imperfect information. Furthermore, the increased visibility of crowdfunding campaigns may deter entrepreneurs if the culture holds a particularly negative view on failure.

The most intriguing results emerge for the normative institutions. There is a weak positive association with the presence of a strong financial services cluster (H8). As we used a very simple proxy for that variable (presence of top10 financial services center), future studies could try more elaborate metrics with closer linkages to crowdfunding. However, the results concerning philanthropy (H7) remained opposite to expectations—greater allocation of time, money and resources allocated for the benefit of others is associated with lower crowdfunding volumes per capita. It does seem to support the view that the dominance of debt- and equity-based crowdfunding in total crowdfunding volumes could cancel out the potentially philanthropic motive driving reward- and donation-based crowdfunding. The latter hypothesis may be better suited for models using donation-based crowdfunding as a dependent variable. As the determinants of crowdfunding volumes may vary across different types of crowdfunding, we investigate this aspect in the following Section 4.3.

It is rather surprising that non-institutional variables provided significantly less robust results in the estimations compared to institutional ones. It does seem that the simultaneous consideration of different institutional variables from all three pillars tended to increase multicollinearity issues and there through reduced the ability to detect the association between these variables and crowdfunding volumes.

4.3. Determinants of Crowdfunding Volumes by Types of Crowdfunding

Table 6 presents the results of Equation (2) for debt-, reward-, and donation-based crowdfunding and Equation (3) for equity-based crowdfunding. In terms of regulative indicators, none of the indicators appear statistically significant in donation-based crowdfunding. This is not too surprising as donations are driven by the free will of individuals rather than regulations. In other types of crowdfunding, regulative indicators remain rather important. The support for H1 remains the strongest, however, more in the context of crowdfunding-specific related regulations (*rlawd*, *rlawe*). For these indicators, it is also worth noting that, economically, the association between regulation targeted at debt and at equity is significantly stronger towards the corresponding types of crowdfunding than they were for either indicator in Table 5, when compared with total crowdfunding volumes. This seems to indicate that not only is the general existence of crowdfunding-related regulation important, the association also is more prominent when the regulation is targeted at specific types of crowdfunding. Financial freedom (*rfifr*) appears statistically significant only in debt-based crowdfunding and after backward elimination exercise. The overall democracy level maintains its statistical significance only in reward-based crowdfunding. Interestingly, this indicator takes a negative, albeit statistically insignificant coefficient when tested against equity-based crowdfunding volumes. If we consider the democracy level of a country to be generally indicative of overall transparency in the society, this result would be consistent with the theoretical model proposed by Belleflamme et al. (2014), which suggests that information asymmetry has a negative effect on reward-based crowdfunding, but a positive effect on equity-based crowdfunding. However, aside from this, the support for H2 and H3 seems to remain more vulnerable to the type of crowdfunding.

From the remaining institutional indicators, the support for the relevance of cultural-cognitive factors reflected in e-service culture (H4) remains very robust across all types of crowdfunding. Results remain less explicit with respect to normative institutions. Philanthropy (H7) remains insignificant irrespective of the type of crowdfunding and support for the relevance of financial services cluster (H8) emerges only in reward-based crowdfunding.

When comparing our results to those of Dushnitsky et al. (2016), we observe some differences. They find a negative association between legal rights and the number of donation-based or equity-based platforms (insignificant in our models). However, unlike in this paper, Dushnitsky et al. (2016) find no significant association between crowdfunding regulations and numbers of any type of crowdfunding platforms. This may be partly due to the use of the annual count of new crowdfunding platforms (not crowdfunding volume) as a dependent variable. The only result of Dushnitsky et al. (2016) that

matches ours is the positive association reported for the number of debt-based crowdfunding platforms and legal rights.

Table 6. Institutional determinants of total crowdfunding volumes during 2015–2016 per capita by types of crowdfunding.

Type of Crowdfunding	Debt-Based				Equity-Based				Reward-Based				Donation-Based			
Model	**M2a**		**M2b**		**M3a**		**M3b**		**M2a**		**M2b**		**M2a**		**M2b**	
Constant	−6.094		−8.618	***	12.390	***	12.300	***	−11.310	***	−11.250	***	−4.129		−5.671	***
	(3.824)		(1.546)		(3.727)		(3.258)		(1.985)		(1.464)		(2.625)		(0.371)	
rleg	0.234		0.245	*					0.056				0.043			
	(0.149)		(0.132)						(0.049)				(0.080)			
rlawd	3.341	***	3.660	***					1.473	***	1.379	***	0.716			
	(0.889)		(0.713)						(0.370)		(0.322)		(0.790)			
rinvp					−0.036											
					(0.296)											
rlawe					2.060	*	1.961	*								
					(1.043)		(1.030)									
rfifr	0.051		0.063	**	0.018				−0.004				0.005			
	(0.032)		(0.028)		(0.021)				(0.014)				(0.018)			
rfree	0.016				−0.009				0.027	**	0.028	**	0.016			
	(0.018)				(0.014)				(0.010)		(0.012)		(0.011)			
cacc	0.1	**	0.1	**					0.077	***	0.1	***	0.089	**	0.1	***
	(0.1)		(0.0)						(0.0)		(0.0)		(0.0)		(0.0)	
cpay					0.099	***	0.100	***								
					(0.023)		(0.020)									
ngiv	−0.048				−0.003				−0.025				0.023			
	(0.034)				(0.021)				(0.017)				(0.023)			
nclust	0.932				0.083				1.036	*	0.837	*	0.023			
	(1.191)				(1.078)				(0.530)		(0.473)		(1.123)			
mgdpp	−0.065				−1.718	***	−1.700	***	0.616	***	0.585	***	−0.288			
	(0.392)				(0.410)		(0.344)		(0.219)		(0.219)		(0.275)			
mremit	−0.114	*	−0.107	*	−0.112	**	−0.112	**	0.010				−0.085	**	−0.071	**
	(0.068)		(0.063)		(0.048)		(0.048)		(0.039)				(0.034)		(0.033)	
mtop5	−0.011				−0.027	*	−0.027	*	0.006				−0.014			
	(0.023)				(0.016)		(0.016)		(0.010)				(0.013)			
No. of obs.	100		100		101		101		100		100		100		100	
Adj. R2	0.42		0.43		0.37		0.40		0.66		0.66		0.26		0.27	
F-stat.	19.2	***	32.4	***	13.3	***	22.0	***	39.4	***	74.2	***	5.6	***	15.4	***
Mean VIF	1.7		1.4		2.0		1.8		1.7		1.6		1.7		1.2	

Notes: dependent variable log transform of country-specific total crowdfunding volume during 2015–2016 per capita by type of crowdfunding. Specifications marked with "a" contain all institutional variables used to test H1, H2, H3, H4, H7, and H8. Specifications marked with "b" present the results of backward elimination of specification "a". For variable descriptions see Table 1. Robust standard errors in parentheses. Statistical significance: *** $p < 0.01$, ** $p < 0.5$, * $p < 0.1$.

From the non-institutional control variables, the robust significant association remains only for remittances for all types of crowdfunding with the exception of reward-based crowdfunding. Similarly to results presented in Table 5, in equity-based crowdfunding using the number of people using the Internet to pay bills or buy something online (*cpay*) variable, the GDP per capita has a negative coefficient. At the same time, a positive association is reported for reward-based crowdfunding. This contradiction is driven by the strong correlation between *cpay* and *mgdpp*. Bank concentration ratio appears significant only in models focusing on equity-based crowdfunding. As the coefficient is negative, it indicates that equity crowdfunding is greater in countries with lower bank concentration.

In order to test the robustness of the abovementioned results, the models presented in Table 6 were re-run with crowdfunding indicators covering a period of 2013–2016 (see Table A3 in Appendix A). The extension of the period reduces the number of observations and explanatory power of models for all types of crowdfunding with the exception of reward-based crowdfunding. The support for H1 (crowdfunding regulations) and H4 (e-service culture) remains very robust. Slightly stronger support for a positive association with financial freedom (H2) is observed in the context of debt-based crowdfunding. However, the support for the relevance of democracy (H3), in the context of reward-based crowdfunding, disappears. Results concerning philanthropy (H7) remain inconclusive and support for H8 (presence of top10 financial center) is observed only for reward-based crowdfunding (as in Table 6). The significance

of other control variables decreases, especially for remittances (*mremit*). Contradicting signs for GDP per capita across different types of crowdfunding remain.

The above-mentioned results show that donation-based crowdfunding remains the least affected by different institutions, exhibiting a significant positive association only with e-service culture (H4). This is rather surprising given that Kshetri (2015) proposed it to have strong linkages also with democracy (H3) and philanthropy (H7). The lack of significance of philanthropy in this paper can be partly explained by the use of an indicator capturing not just money, but also time and other resources for the benefit of others.

The initial propositions of Kshetri (2015, 2018) indicated the lack of relevance of some of the hypotheses for some types of crowdfunding which we observe as significant in our models. These include the positive association with the regulatory framework (H1) observed for reward-based and debt-based crowdfunding and positive association with financial freedom (H2) observed for debt-based crowdfunding. We do see that the relevance of institutional factors across different types of crowdfunding does vary, as also hypothesized by Kshetri (2015, 2018). This does indicate that it would be desirable to investigate the determinants of crowdfunding volumes more thoroughly by types of crowdfunding in future studies. The latter requires improved availability of data on volumes of different types of crowdfunding across countries. It should be borne in mind that the dataset used in this paper had many countries with no data for some specific types of crowdfunding. We assumed in such cases that it would be 0 if the country had some data available on some other types of crowdfunding. This simplification may be too naïve of an expectation and may also reduce the possibilities to detect some significant associations between the variables.

5. Conclusions

Overall, the results of our paper show that many of the institutional aspects proposed in the theoretical literature as relevant crowdfunding determinants do indeed survive the empirical tests. Institutions seem to be important vehicles in the spreading acceptance of crowdfunding, as they provide legitimacy to this novel way of financing and mitigate woes such as imperfect information, moral hazard, and diverging incentives. Regulative and cultural cognitive institutions are especially important determinants of crowdfunding volumes, while normative institutions provide rather inconclusive results. The results of this paper should be considered especially important for policymakers, as governments have numerous levers to influence a country's institutional structures. For instance, if policymakers are interested in promoting crowdfunding to improve access to financing, implementing, and enforcing clear crowdfunding-specific regulations could help legitimize crowdfunding in the eyes of both investors and those seeking funds. Shaping cultural beliefs with initiatives promoting the use of e-services as a reliable way of transacting could also contribute to the increase of crowdfunding volumes. In addition to policymakers, managers of crowdfunding platforms could campaign for stronger industry regulations and promote their platforms as a credible way of obtaining financing or investing money for the wider public, in an attempt to increase the legitimacy of their businesses and, with that, the volume of transactions mediated through their platforms.

It is noteworthy that institutional variables provide a more significant and robust association with crowdfunding volumes compared to country-specific non-institutional variables. This implies that even if crowdfunding could be an economically rational choice for projects looking for financing in some countries, we may still see only minuscule crowdfunding volumes in such countries if local institutions are unwelcoming towards crowdfunding. These results also provide significant insight for future research by indicating a need to incorporate institutional variables as controls in future models focusing on crowdfunding volumes. However, there are some important caveats to consider when interpreting these results. First and foremost, we were not able to explicitly test for causality due to data restrictions, which leaves a possibility that some variables (i.e., crowdfunding-specific regulations) may exhibit correlation with crowdfunding volumes because they themselves are responding to the change in crowdfunding volumes. Another factor to keep in mind is that the role of institutions may

become less pronounced over time, as crowdfunding becomes more widely accepted as a widely approved method of raising funds.

In conclusion, this paper provides a much-needed understanding of at least one set of factors that help to explain the adoption rate of crowdfunding globally. It, therefore, breaks away from the academic literature on crowdfunding that has so far mostly focused on single platforms or regions and gives a more generalized view of this phenomenon. The paper also contributes to a growing area of empirical research that highlights how institutions interact with digital innovations and what role they have in determining whether these innovations are legitimate and, therefore, accepted for wider use. Keeping in mind the fast growth of crowdfunding and the more proactive stance some countries have taken in regulating this phenomenon in recent years, it would be interesting to repeat this study in the future to examine how the effects of institutions evolve over time.

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Appendix A

Table A1. Pairwise Correlations between Explanatory Variables.

	rleg	*rlawd*	*rinvp*	*rlawe*	*rfifr*	*rfree*	*cacc*	*cpay*
rleg	1.00							
rlawd	−0.07	1.00						
rinvp	0.26	0.21	1.00					
rlawe	0.09	0.83	0.32	1.00				
rfifr	0.28	0.27	0.45	0.36	1.00			
rfree	0.18	0.38	0.43	0.42	0.63	1.00		
cacc	0.21	0.26	0.40	0.43	0.55	0.43	1.00	
cpay	0.16	0.45	0.44	0.56	0.65	0.63	0.81	1.00
ctrust	0.00	0.19	−0.05	0.22	0.25	0.21	0.44	0.46
ngiv	0.12	0.11	0.22	0.32	0.32	0.24	0.50	0.42
nclust	0.17	0.07	0.23	0.29	0.41	0.27	0.45	0.46
cfear	−0.10	0.24	0.19	0.25	0.12	0.03	0.17	0.32
mgdpp	−0.01	0.34	0.49	0.38	0.60	0.51	0.55	0.74
mremit	0.11	−0.20	−0.23	−0.23	−0.25	−0.20	−0.42	−0.39
mtop5	−0.05	0.02	0.06	0.06	0.21	0.21	0.22	0.24
mfdi	0.05	0.42	0.55	0.53	0.61	0.51	0.67	0.76
	ctrust	***ngiv***	***nclust***	***cfear***	***mgdpp***	***mremit***	***mtop5***	***mfdi***
ctrust	1.00							
ngiv	0.37	1.00						
nclust	0.18	0.32	1.00					
cfear	−0.06	−0.01	0.05	1.00				
mgdpp	0.28	0.26	0.35	0.42	1.00			
mremit	−0.11	−0.19	−0.18	−0.30	−0.39	1.00		
mtop5	0.07	0.07	−0.11	−0.08	0.06	−0.16	1.00	
mfdi	0.21	0.38	0.57	0.44	0.79	−0.39	0.02	1.00

Table A2. All Institutional Determinants of Total Crowdfunding Volumes during 2015–2016 per Capita.

Model	M2a		M2b		M3a		M3b		M4a		M4b	
Constant	−2.886		0.297		14.970		1.756		−0.696		0.297	
	(6.944)		(1.335)		(12.200)		(1.324)		(2.967)		(1.335)	
rleg	0.230	**	0.216	**					0.272	**	0.216	**
	(0.110)		(0.094)						(0.118)		(0.094)	
rlawd	2.166	***	2.329	***					1.755	**	2.329	***
	(0.672)		(0.642)						(0.784)		(0.642)	
rinvp					0.139							
					(0.398)							
rlawe					1.555	**	1.095	*				
					(0.648)		(0.574)					
rfifr	0.012				0.021				0.001			
	(0.025)				(0.028)				(0.029)			
rfree	0.001				−0.021				0.007			
	(0.021)				(0.024)				(0.018)			
cacc	0.1	**	0.123	***					0.098	**	0.123	***
	(0.1)		(0.0)						(0.0)		(0.0)	
cpay					0.097	***	0.064	***				
					(0.034)		(0.012)					
ctrust	1.086	*			0.658				1.112	*		
	(0.538)				(0.625)				(0.601)			
cfear	−0.080	**	−0.081	**	−0.107	***	−0.098	**	−0.090	**	−0.081	**
	(0.033)		(0.040)		(0.034)		(0.039)		(0.037)		(0.040)	
ngiv	−0.070				−0.068				−0.081			
	(0.047)				(0.042)				(0.051)			
nclust	0.236				0.445				−0.354			
	(0.792)				(0.751)				(0.939)			
mgdpp	0.343				−1.276							
	(0.692)				(0.939)							
mremit	−0.008				−0.062				0.038			
	(0.136)				(0.151)				(0.135)			
mtop5	0.010				0.007				0.010			
	(0.020)				(0.022)				(0.020)			
mfdi									4.126			
									(3.516)			
No. of obs.	51		51		52		52		51		51	
Adj. R2	0.42		0.45		0.47		0.48		0.45		0.45	
F-stat.	9.7	***	19.4	***	11.5	***	18.2	***	10.9	***	19.4	***
Mean VIF	2.1		1.1		2.4		1.2		2.3		1.1	

Notes: dependent variable log transform of country-specific total crowdfunding volume during 2015–2016 per capita (*cf_total*). Specifications marked with "a" contain all institutional variables used to test all hypotheses H1 to H8. Specifications marked with "b" present the results of backward elimination of specification "a". For variable descriptions see Table 1. Robust standard errors in parentheses. Statistical significance: *** $p < 0.01$, ** $p < 0.5$, * $p < 0.1$.

Table A3. Institutional Determinants of Crowdfunding Volumes during 2013–2016 per Capita by Types of Crowdfunding.

Type	**Total Crowdfunding**				**Debt-Based**				**Equity-Based**				**Reward-Based**				**Donation-Based**			
Model	**M2a**		**M2b**		**M2a**		**M2b**		**M3a**		**M3b**		**M2a**		**M2b**		**M2a**		**M2b**	
Constant	−6.369	**	−5.445	***	−12.890	***	−14.640	***	13.430	***	9.203	***	−12.750	***	−13.390	***	−2.194		−5.345	***
	(2.596)		(1.122)		(4.432)		(2.386)		(4.816)		(3.012)		(1.867)		(1.348)		(3.380)		(0.285)	
rleg	0.251	**	0.212	**	0.226								0.080				0.070			
	(0.113)		(0.100)		(0.196)								(0.061)				(0.121)			
rlawd	2.861	***	2.923	***	3.655	***	3.397	***					2.012	***	2.041	***	1.287			
	(0.582)		(0.534)		(1.071)		(1.018)						(0.429)		(0.465)		(1.086)			
rinvp									0.050											
									(0.303)											
rlawe									2.552	**	2.539	**								
									(1.254)		(1.178)									
rfifr	0.036		0.050	**	0.078	*	0.086	**	0.016				0.012				0.014			
	(0.022)		(0.021)		(0.040)		(0.039)		(0.024)				(0.013)				(0.023)			
rfree	0.008				0.001				−0.008				0.015				0.000			
	(0.019)				(0.026)				(0.019)				(0.012)				(0.015)			
cacc	0.096	**	0.103	***	0.088		0.101	*					0.068	**	0.077	***	0.101	**	0.122	***
	(0.040)		(0.030)		(0.064)		(0.051)						(0.028)		(0.017)		(0.047)		(0.032)	
cpay									0.108	***	0.101	***								
									(0.024)		(0.021)									
ngiv	−0.028				−0.030				−0.025				−0.015				0.000			
	(0.024)				(0.032)				(0.020)				(0.016)				(0.024)			
nclust	0.941				1.000				0.334				1.076	*	1.067	**	0.173			
	(0.716)				(1.048)				(1.172)				(0.557)		(0.522)		(1.351)			
mgdpp	0.047				0.626		0.687	*	−1.793	***	−1.569	***	0.659	***	0.891	***	−0.261			
	(0.312)				(0.437)		(0.377)		(0.483)		(0.348)		(0.220)		(0.126)		(0.332)			
mremit	0.001				−0.041				−0.064				0.032				−0.081	*		
	(0.060)				(0.081)				(0.095)				(0.032)				(0.045)			
mtop5	0.018				−0.013				−0.023				0.017		0.018	*	−0.020			
	(0.015)				(0.025)				(0.019)				(0.010)		(0.010)		(0.015)			
No. of obs.	86		86		86		86		85		85		86		86		86		86	
Adj. R2	0.54		0.54		0.46		0.48		0.34		0.37		0.73		0.72		0.20		0.23	
F-stat.	27.2	***	47.0	***	25.1	***	54.5	***	12.8	***	33.0	***	56.2	***	90.1	***	4.3	***	14.9	***
Mean VIF	1.9		1.5		1.9		1.8		2.1		2.2		1.9		1.4		1.9		1.0	

Notes: dependent variable log transform of country-specific total crowdfunding volume during 2013–2016 per capita by type of crowdfunding. Specifications marked with "a" contain all institutional variables used to test H1 to H8. Specifications marked with "b" present the results of backward elimination of specification "a". For variable descriptions see Table 1. Robust standard errors in parentheses. Statistical significance: *** $p < 0.01$, ** $p < 0.5$, * $p < 0.1$.

Table A4. Robustness of Regulative, Cultural-Cognitive, and Normative Determinants of Total Crowdfunding Volumes during 2015–2016 per Capita.

Model	M11a		M11b		M12		M13		M14a		M14b		M15		M16		M17		M18	
Constant	−14.780	***	−11.900	***	−8.746	***	−8.869	***	−7.952	***	1.995		−12.690	***	−18.330	***	−15.140	***	−11.040	***
	(2.342)		(2.627)		(2.042)		(2.287)		(2.509)		(3.189)		(4.435)		(4.331)		(2.575)		(2.480)	
rleg	0.451	***																		
	(0.105)																			
rlawd	2.834	***																		
	(0.664)																			
rinvp			0.283	*																
			(0.165)																	
rlawe			2.809	***																
			(0.680)																	
rfifr					0.082	***														
					(0.017)															
rfree							0.050	***												
							(0.014)													
cacc									0.158	***										
									(0.026)											
cpay											0.103	***								
											(0.014)									
ctrust													1.120	**						
													(0.557)							
cfear															0.025					
															(0.043)					
ngiv																	0.031	*		
																	(0.018)			
nclust																			2.501	***
																			(0.815)	
mgdpp	0.914	***	0.779	***	0.280		0.395		0.443	**	−0.575	*	1.043	**	1.487	***	1.156	***	0.812	***
	(0.179)		(0.212)		(0.232)		(0.255)		(0.220)		(0.303)		(0.415)		(0.473)		(0.212)		(0.212)	
mremit	−0.057		−0.033		−0.069	*	−0.071	*	0.019		−0.022		−0.055		−0.058		−0.055		−0.061	*
	(0.047)		(0.042)		(0.036)		(0.039)		(0.044)		(0.043)		(0.055)		(0.106)		(0.040)		(0.036)	
mtop5	0.032	**	0.025	*	0.011		0.012		0.017		0.006		0.021		0.036		0.032	**	0.030	**
	(0.014)		(0.014)		(0.014)		(0.014)		(0.015)		(0.014)		(0.020)		(0.023)		(0.015)		(0.014)	
No. of obs.	107		107		112		117		107		108		77		62		106		117	
Adj. R2	0.35		0.27		0.35		0.34		0.34		0.48		0.23		0.28		0.26		0.25	
F-stat.	21.0	***	20.6	***	18.3	***	17.7	***	20.6	***	34.8	***	6.7	***	8.2	***	13.6	***	14.6	***
Mean VIF	1.1		1.2		1.4		1.3		1.4		1.8		1.4		1.2		1.1		1.2	

Notes: dependent variable log transform of country−specific total crowdfunding volume during 2015–2016 per capita (*cf_total*). All explanatory variables are taken from year 2014. For variable descriptions see Table 1. Robust standard errors in parentheses. Statistical significance: *** $p < 0.01$, ** $p < 0.5$, * $p < 0.1$.

Table A5. Robustness of Institutional Determinants of Total Crowdfunding Volumes during 2015–2016 per Capita.

Robustness Test	1				2				3			
Dependent Variable	*ln(cf_total)*				*ln(cf_total_gdp)*				*ln(cf_total)*			
Model	M2a		M2b		M2a		M2b		M2a		M2b	
Constant	−6.551	**	−5.813	***	17.460	***	−4.500	***	−3.192		−5.812	***
	(3.043)		(1.152)		(3.166)		(0.791)		(2.324)		(0.779)	
rleg	0.177				0.141		0.227	*	0.152	*	0.197	**
	(0.117)				(0.116)		(0.131)		(0.090)		(0.085)	
rlawd	2.114	***	1.851	***	2.831	***	2.108	***	1.968	***	2.088	***
	(0.380)		(0.334)		(0.753)		(0.755)		(0.559)		(0.500)	
rfifr	0.031		0.036	*	0.012				0.030	*		
	(0.021)		(0.020)		(0.023)				(0.018)			
rfree	0.026		0.027	*	0.014				0.036	***	0.039	***
	(0.017)		(0.014)		(0.018)				(0.011)		(0.009)	
cacc	0.115	**	0.117	***	0.148	***	0.060	*	0.073	***	0.077	***
	(0.047)		(0.035)		(0.050)		(0.032)		(0.026)		(0.025)	
ngiv	−0.030				−0.056	*			−0.027	*		
	(0.024)				(0.030)				(0.016)			
nclust	0.965				1.598				1.199	*	1.145	*
	(0.749)				(0.996)				(0.661)		(0.591)	
mgdpp	−0.054				−1.942	***			−0.382			
	(0.350)				(0.351)				(0.259)			
mremit	0.000				−0.148	***			−0.044			
	(0.043)				(0.052)				(0.042)			
mtop5	0.020				−0.040	**			0.012			
	(0.012)				(0.019)				(0.012)			
No. of obs.	95		95		100		100		95		95	
Adj. R2	0.48		0.48		0.34		0.11		0.52		0.50	
F-stat.	30.0	***	67.1	***	10.4	***	8.3	***	20.5	***	31.7	***
VIF	1.8		1.7		1.7		1.5		1.7		1.3	

Notes: all explanatory variables in robustness test 1 are from year 2014 and the dependent variables is the log transform of country-specific total crowdfunding volume during 2015–2016 per capita (*cf_total*). Robustness test 2 copies the models presented in Table 5 using the dependent variable log transform of total crowdfunding volume during 2015–2016 to mean annual GDP (*cf_totalgdp*), including also the five countries with extreme crowdfunding volumes. In robustness test 3 all explanatory variables are averages over 2015–2016 and the five extreme observations of the dependent variables (volume per capita above $50 USD over 2015–2016) have been eliminated. The dependent variable in test 3 is the log transform of country-specific total crowdfunding volume during 2015–2016 per capita (*cf_total*). For variable descriptions see Table 1. Robust standard errors in parentheses. Statistical significance: *** $p < 0.01$, ** $p < 0.5$, * $p < 0.1$.

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Appendix 2

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The debt-equity choice in crowdfunding: a two-method approach

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ABSTRACT

Securities-based crowdfunding has evolved into an important source of financing for small and medium-sized enterprises (SME), but little is known about how crowdfunding campaigns fit into the capital structure decisions of SMEs. Combining insights from SME capital structure and crowdfunding literatures results in high ambiguity, as crowdfunding seems to change SME financing dynamics, but in an uncertain direction. We construct variables based on previous work on SME capital structure literature to empirically test which characteristics help explain the choice to seek either equity or debt funding among firms using crowdfunding. We use 713 equity and 403 debt campaign announcements registered with the U.S. Securities and Exchange Commission under Regulation Crowdfunding. Our empirical procedure includes both the traditionally used logistic regression method as well as a random forest classifier. We find that less-established firms with smaller funding needs are more likely to issue equity, whereas firms with strong growth momentum and larger funding needs prefer debt.

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1. Introduction

Crowdfunding has become a viable source of financing for SMEs, with 1351 campaigns seeking up to $775.9 million of funding announced in the U.S. over the first two and a half years since the implementation of Regulation Crowdfunding in 2016 (U.S. Securities and Exchange Commission 2019a). With this regulation, small U.S. firms were allowed to conduct securities-based crowdfunding campaigns, including both debt and equity, without needing to fulfill the registration requirements set out in the Securities Act of 1933. Effectively, Regulation Crowdfunding has therefore given SMEs improved access to financing that resembles the kind of access that is commonly enjoyed by larger, well-established firms, without some of the prerequisites and costs normally involved with going public (Fenwick, McCahery, and Vermeulen 2017).

The development of this novel type of financing poses some rather interesting questions about SME financing decisions. We know from earlier research that classical capital structure theories have been largely cast aside by empirical analyzes of SME financing decisions, as pointed out by López-Gracia and Sogorb-Mira (2008). The reasoning behind

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this is that SMEs commonly face severe issues of information asymmetry and financial constraints that do not plague large firms, based on which most theories are constructed (Berger and Udell 1998; Jõeveer 2013).

We also know from previous research that crowdfunding seems to address some of these issues in SME financing by changing the dynamics of the information asymmetry and financial constraints firms face. For instance, information asymmetries should be reduced because of better communication channels for investors (Shiller 2015), additional disclosure requirements (Belleflamme, Omrani, and Peitz 2015), and higher firm presence on the internet (Raab et al. 2017). However, information asymmetries could also be increased because crowdfunding involves a large number of small investors unable to properly monitor their investments (Ahlers et al. 2015). The problem is, therefore, that even as we know that crowdfunding alters such dynamics, we cannot be entirely certain of the direction of these changes. As such, it remains unclear how these attributes of crowdfunding affect SME financing decisions on balance.

There has also been very little research focusing on what happens before crowdfunding campaigns are launched. Specifically, there is a lack of understanding of what influences firm choice between the different types of crowdfunding available (Moritz and Block 2016; Schwienbacher 2019). The motivation of this paper is to reduce the gap of knowledge in this matter by empirically examining firm choice between debt and equity crowdfunding. In other words, we aim to find the firm-level characteristics that could help explain why some firms, having already decided on crowdfunding, prefer to seek it in equity form, while others prefer debt. Although there are other types of financing alternatives for SMEs, the focus of this paper is solely on the decision between using either equity or debt within crowdfunding.

To draw our main variables of interest, we rely on two of the most discussed variants of classical capital structure theory, the trade-off theory and the pecking order theory. Even as empirical literature on SME financing decisions has largely ignored these theories, López-Gracia and Sogorb-Mira (2008) and Serrasqueiro and Caetano (2015) have found rare evidence that both may still explain SME capital structure dynamics. Furthermore, the basics behind why some argue that these theories do not apply to SMEs seem to be affected by introducing crowdfunding to the equation, albeit in an uncertain direction. We also control for several other variables that have been highlighted by previous empirical work to potentially drive SME decisions between debt and equity financing. Ultimately, our aim is to produce initial understanding of what characteristics drive firm choice between debt and equity in a crowdfunding setting.

We use a sample of 713 straight equity and 403 straight debt offerings filed with the U.S. Securities and Exchange Commission (SEC) over the period 16 May 2016–30 September 2019 under Regulation Crowdfunding. Our results do not indicate that firm behavior can be consistently explained by either classical capital structure theory, while we observe several findings that are consistent with SME empirical literature. Firms seem more likely to seek equity crowdfunding when they are looking for only small amounts evocative of seed capital. At the same time, firms further down their evolutionary path exhibiting strong revenue growth and larger capital needs are more likely to seek debt crowdfunding.

We claim two main contributions from our paper. First, we elaborate on previous SME financing literature, adding a new dimension by examining the debt-equity choice of

firms using crowdfunding. Second, we gather further insight on the debt-equity choice of firms by using a random forest classifier as a complementary method on top of the more commonly used logistic regression method. The random forest method has not been previously used to analyze the capital structure decisions of firms. However, it has been shown to perform better than the logistic regression for complex datasets where data cannot be clearly linearly separated (Kirasich, Smith, and Sadler 2018), and is likely to provide additional perspective due to its non-parametric nature. We find that the random forest provides superior accuracy for analyzing the small, young, and rapidly changing firms in our sample.

We proceed by first discussing the extant literature that could potentially help explain the capital structure decisions of firms using crowdfunding. We base our discussion on the trade-off and pecking order theories, adding insight from SME capital structure and crowdfunding literature that could affect if and how these theories explain the behavior of firms seeking crowdfunding. We outline the data, variables, and the estimation procedure in Section 3. We then move on to the first phase of our estimation procedure, which aims to calculate a target leverage ratio for all the firms in our sample in Section 4. In the subsequent two sections, we use two complementary methods to analyze the firms' debt-equity choice. Finally, Section 7 discusses and concludes.

2. Literature overview

The two strands of capital structure theory that have garnered the most attention in previous research are the trade-off theory and the pecking order theory. The trade-off theory argues that there are various costs and benefits involved with using either debt or equity capital, resulting in an optimal leverage ratio that the firm should strive toward (Shyam-Sunder and Myers 1999). Criticism of the theory in a SME setting is based on the understanding that SMEs face rather different problems when obtaining financing than large firms (Berger and Udell 1998). Examples of such differences include a lack of benefits from the tax shield for small firms (Ang 1991), access to public capital markets being tied to economies of scale (Berger and Udell 1998), and the cost of debt decreasing with firm age (Ramalho and da Silva 2009). These issues may render moving toward some target leverage ratio unrealistic for SMEs.

The pecking order theory, in contrast, deals specifically with information asymmetry, which is a prominent issue for SME financing decisions. Specifically, it states that firm funding decisions are explained by the information costs of each type of funding (López-Gracia and Sogorb-Mira 2008) Firms prefer internal funds as the first option and switch to debt when internal funds are exhausted. External equity is considered only as the last resort when leverage ratios climb too high and obtaining debt funding becomes unfeasible (Shyam-Sunder and Myers 1999). However, Frank and Goyal (2003) note that the theory performs underwhelmingly in the SME setting, while it seems to work significantly better for larger firms. Relatedly, Sapienza, Korsgaard, and Forbes (2003) posit that the pecking order behavior observed in some settings may not be a result of information asymmetries, but rather because entrepreneurs prefer types of funding that enable them to keep control of the firm.

Crowdfunding has been found to exhibit certain characteristics that may alter the dynamics surrounding the application of traditional theory within a SME financing

context. There is widespread expectation from international organizations and regulators that crowdfunding increases SME access to all types of funding (e.g., European Commission 2018). Early research into the uptake of crowdfunding mostly seems to confirm this view (Eldridge, Nisar, and Torchia 2019). However, research also shows that factors such as social media backing (Hossain and Oparaocha 2017), personal networks (Mollick 2014), and quality of promotional materials (Koch and Siering 2015) contribute to crowdfunding campaign success. Thus, access to financing may be limited for some firms that lack these social traits, even if they are economically sound investments.

Results for information asymmetry issues are similarly controversial. Firms using this type of financing are expected to disseminate a considerable amount of information to investors (Belleflamme, Omrani, and Peitz 2015), intermediaries are expected to create channels of communication between the many small investors and firm management (Shiller 2015), and successful campaigns have a significant internet presence (Raab et al. 2017). On the other hand, crowdfunding campaigns involve a very large number of investors that typically provide a small amount of funds (Belleflamme, Lambert, and Schwienbacher 2014). This leads to a possible increase in information asymmetry as it becomes proportionally too costly for each individual investor to conduct detailed due diligence (Ahlers et al. 2015).

Finally, when using crowdfunding, concerns over control dilution should be less important for equity issues, as the share of ownership is divided between a large group of investors who are less coordinated than venture capitalists or angel investors (Walthoff-Borm, Schwienbacher, and Vanacker 2018). Accordingly, in crowdfunding, the advantage of using debt to limit control dilution should be smaller than it is for more traditional sources of SME financing. However, the use of syndicates, which, on the one hand, reduces information asymmetries, provides an immediate counterweight to this benefit by offering a coordinating mechanism for investors that would re-ignite SME worries of control dilution (Agrawal, Catalini, and Goldfarb 2016).

Within this controversial but rapidly developing crowdfunding literature, little attention has been given to how firms use different types of crowdfunding to fund their operations (Moritz and Block 2016). In a pioneering study, Belleflamme, Lambert, and Schwienbacher (2014) develop a theoretical model which shows that entrepreneurs preferred reward-based crowdfunding (pre-ordering) when initial capital requirements were small, and equity (profit-sharing) crowdfunding when capital requirements were large. Miglo (2020) also focuses on the choice between reward-based and equity crowdfunding but adds the aspect of entrepreneurial overconfidence to the model and predicts that overconfidence leads to equity crowdfunding being more profitable out of the two choices. Adding more types of crowdfunding, Paschen (2017) presents a theoretical framework to aid startups in choosing the best type of crowdfunding for each phase of their expansion, indicating that their evolutionary path should begin with donation crowdfunding, then move to debt crowdfunding and finally end with equity crowdfunding. However, her framework views reward and debt crowdfunding as a single pillar. This interpretation is questionable, as in many countries, such as the U.S., the first remains largely unregulated while the latter is subject to strict regulations.

In empirical tests, Walthoff-Borm, Schwienbacher, and Vanacker (2018) find that firms using equity crowdfunding in the UK act in line with pecking order theory and are characterized by low profitability, excessive debt and a high amount of intangible assets,

when compared to similar firms that do not use crowdfunding. However, the paper does not compare the use of debt and equity crowdfunding interchangeably. As such, previous empirical literature attempts to answer the question why some firms prefer to use crowdfunding as opposed to alternative ways of obtaining similar type of funding.

In our paper, we ask why some firms, having decided to use crowdfunding, seek equity financing and why others seek debt financing. Given the opposing views offered by crowdfunding literature on key issues of SME financing such as access to public capital, information asymmetry, and control dilution, we find it untimely to discard traditional theories of capital structure without first conducting relevant empirical tests. It could easily be that, on balance, crowdfunding inverts the underlying concerns that have limited the usefulness of traditional capital structure theories in SME settings in such a way that small firms start behaving more like their larger counterparts, for which the theories have been shown to be of use. It could also easily be that, on balance, crowdfunding does not do much at all to alter those dynamics, and that SMEs using crowdfunding will continue to behave similarly to any other SMEs that are tasked with making decisions of their capital structure. Therefore, our variables of interest include both indicators closely related to the trade-off theory and the pecking order theory, as well as those that have been found to affect financing decisions in empirical literature on SMEs.

3. Empirical approach

3.1. Data

The data used in this study is obtained from the SEC Crowdfunding Offerings Data Sets (U.S. Securities and Exchange Commission 2019b). These data sets include information on all security-based crowdfunding offerings that have taken place on online intermediaries in the U.S. registered with the SEC under Regulation Crowdfunding[1]. Focusing on Regulation Crowdfunding campaigns provides us with a strict framework for our analysis, while limiting variance that is left unmeasured by our model specifications.

First, Regulation Crowdfunding only applies to U.S. small firms using crowdfunding platforms that have registered with the SEC, thus minimizing the effect of county-level factors such as differences in the legislative frameworks (Hornuf and Schwienbacher 2017). Second, Regulation Crowdfunding applies equally to all types of crowdfunding within its scope. Therefore, both debt and equity offerings are subjected to the same rules, such as disclosure requirements, limitations to the size of the offering and restrictions to the amount each individual investor may provide (U.S. Securities and Exchange Commission 2019a). Finally, Regulation Crowdfunding allows for a large choice of intermediaries for firms, with 50 different platforms listed as intermediaries for the campaigns included in our sample.

As the aim of this study is to focus solely on the determinants of choosing between financing a firm's operations with either crowdfunded debt or equity, we look at only the initial campaign announcements filed with the SEC, regardless of whether the campaigns were successful or not. This enables us to provide a unique understanding of capital structure decision-making focusing mainly on the demand side of such decisions. Previous empirical studies of capital structure decisions tend to rely on financial

statements to capture whether the firm issued equity or debt, thus leaving the analysis prone to survivorship bias and introducing supply-side filtering to the decision-making process. Similar concerns are raised by Cumming and Johan (2017) and Walthoff-Borm, Schwienbacher, and Vanacker (2018). Our data provides a unique opportunity to include both successful and unsuccessful attempts of raising capital, enabling us to circumvent these concerns.

Still, a potential source of bias remains in the form of the pre-investment selection process of campaigns that are allowed online by crowdfunding platforms. As Zhang et al. (2019) point out, crowdfunding platforms themselves may be selective of which campaigns proceed to the investment stage, as they do not wish to launch online projects that are likely to be unsuccessful in reaching their funding goals. Löher (2017) uses a qualitative approach to find evidence of such selection processes in the German equity crowdfunding market, while Kleinert et al. (2021) also provide quantitative evidence of the restrictiveness of the pre-investment selection process based on a sample of equity crowdfunding campaigns in 22 countries, including the United States.

However, such bias is unlikely to affect the decision on which type of crowdfunding to seek directly. Cumming, Johan and Zhang (2019) note that there are likely differences in the levels of selectiveness of platforms. Based on the same SEC data sets as this paper, Kukk (2022) also finds evidence indicating that some Regulation Crowdfunding platforms are either more capable or more willing to choose which campaigns they intermediate. Finally, the data used in this paper indicate that most Regulation Crowdfunding platforms intermediate both debt and equity campaigns[2]. Therefore, it seems reasonable to assume that even if companies do encounter a restrictive selection process by platforms, they may choose a less-selective platform, but there seems to be little reason to expect that they would need to change the decision of which type of crowdfunding to seek.

The SEC data sets start from the second quarter of 2016 and are updated on a quarterly basis. The final period included in this study is the third quarter of 2019. Altogether, the SEC Crowdfunding Offerings Data Sets list 1957 campaign announcements over the sample period. This extracted list of campaign announcements also includes campaigns that are based on instruments such as preferred shares and convertible notes, as well as novel instruments such as simple agreements for future equity and cryptocurrency tokens. As such instruments are considered hybrids between straight debt and straight equity and could be issued in place of either (Lewis, Rogalski, and Seward 1999), we remove these from the sample[3]. After cleaning the data, the final sample consists of 1116 crowdfunding offerings, of which 713 are based on straight equity and 403 are based on straight debt instruments.

3.2. Variables

In addition to Regulation Crowdfunding data, we use two additional sources of data to add information about the campaigns. We collect all funding rounds listed on the Crunchbase database as of 4 November 2019, with an announcement date between 1 April 2013 and 30 September 2019, and then use the company names and websites from our sample of campaigns to find whether these companies had any funding rounds listed in the Crunchbase dataset (Crunchbase (Funding Rounds) 2019). We combine the datasets using text similarity indices and verify each match manually. For each campaign,

we extract the type of the latest funding round on record. We only include funding rounds that were completed no more than three years before the campaign announcement date[4].

We also use the Federal Deposit Insurance Corporation data (Federal Deposit Insurance Corporation (Bank Data and Statistics) 2019) to find the 15 U.S. cities with the highest deposit amounts in bank branches and Pitchbook data (Florida 2018) detailing the 11 U.S. cities where annual venture capital investment exceeds $1 billion. For each city, we assign a zip code corresponding to the city center and use the Microsoft Bing Maps API to calculate the driving distance in miles between those points and the respective company's headquarters. For each company, we collect the driving distances to the closest banking city and the closest venture capital city. The complete sample characteristics of the quantitative and dichotomous variables included in our empirical tests are shown in Appendices A and B, respectively. The characteristics are divided into two groups based on whether they were related to an equity or debt crowdfunding campaign.

It follows from the sample characteristics that the firms undertaking crowdfunding campaigns in this sample are, on average, small, young and fast-growing enterprises. The average age of firm over the total sample is just shy of three years, with firms issuing debt slightly younger on average, although the difference is not statistically significant. Some other noteworthy differences between the two groups include the normalized leverage ratio and the revenue growth rate, which are both higher for firms issuing debt. Moreover, a higher proportion of debt-issuing firms have negative profitability and negative equity. All these characteristics seem consistent with the findings of La Rocca, La Rocca, and Cariola (2011), who also found that younger firms with better growth opportunities, but lower profitability, are expected to have higher leverage.

On the other hand, a higher proportion of firms issuing equity have no assets at all, nor do they have revenues. Equity-issuing firms also seem to be geographically further away from both larger banking districts and venture capital hubs. Looking at the statistics for campaign data, debt-issuing campaigns seem to have larger minimum offering amounts but also have shorter campaign deadlines and have agreed to pay a slightly larger percentage of proceeds as fees to the intermediary. Overall, there seems to be some indication that debt-crowdfunding is used by younger firms with faster revenue growth and more ambitious financing targets. The characteristics that could potentially explain which firms prefer to seek equity crowdfunding and which companies prefer to seek debt crowdfunding are explored further in the next sections by using more sophisticated analytical tools.

3.3. Estimation procedures

To accommodate a test for the trade-off theory, we follow Hovakimian, Opler, and Titman (2001) and conduct our estimations in two phases. The underlying assumption for this approach is that even though firms in our sample have likely each deviated from their targeted leverage ratio, there exists a set of variables that can be extracted to calculate a likely target ratio for each firm. Accordingly, our first estimation aims to calculate a target leverage ratio for each firm in the sample using a simple OLS regression. The difference of this ratio and the actual leverage ratio is used in our second estimation to

examine whether firms issue debt or equity in order to move toward their targeted leverage ratio, in accordance with what is expected in the trade-off theory.

This second estimation also includes variables drawn from the pecking order theory and previous SME capital structure literature, using the logistic regression method to predict whether the firm announced a debt or equity crowdfunding campaign. Separately, we use a random forest classifier to establish the pathways of how firms choose between debt and equity financing. Using this additional method on top of the logistic regression enables us to both validate the results of the logistic regression, as well as explore the matter from a different angle, owing to the non-parametric nature of the random forest classifier. The equations for the first two classical econometric methods take the form:

$$DA\_norm_i = X_i\alpha + \varepsilon_i \tag{1}$$

$$INST_i = Z_i\beta + u_i \tag{2}$$

Where X_i – the vector of independent variables to estimate a target leverage ratio,

Z_i – the vector of independent variables to estimate the choice between debt and equity,

α, β – the parameter values for the respective variables in estimations,

ε_i, u_i – the error terms in estimations.

The dependent variable for Equation (1) (DA_norm) is defined as the sum of short-term debt and long-term debt divided by the total assets of the firm, all for the most recent fiscal year prior to announcing the campaign. It is important to note that the firms in our total sample include mostly very young firms that are often loss-making. Accordingly, 370 firms report zero assets in their most recent financial statements, while 317 report negative values for equity, which lead to debt/assets ratios above one. To account for this, we take two steps. First, the leverage ratio is estimated using only firms that have assets and, with that, a capital structure in place. Second, as leverage under normal circumstances should be between zero and one, the leverage ratio is limited from above to one. This approach is consistent with Hovakimian, Opler, and Titman (2001).

The dependent variable for Equation (2) (INST) is a binary variable taking the value one if the firm sought crowdfunded debt and zero otherwise. In model specifications aimed at testing the trade-off theory, the vector of independent variables Z includes the variable DA_n_diff, calculated as the predicted value of DA_norm from the first equation, minus the actual value of DA_norm. If firms do indeed behave according to the trade-off theory, this variable is expected to obtain a positive sign in our estimations. Hovakimian, Opler, and Titman (2001) use a similar approach to test whether firms converge toward a target leverage ratio.

In specifications aimed at testing the pecking order theory, the vector Z includes a dummy variable for firms that have stated no assets for their most recent fiscal year before the campaign and a second dummy variable for very high levels of debt. If firms behave according to the pecking order theory, these variables are expected to obtain negative signs in our estimations. The variables are similar in nature to those used by Walthoff-Borm, Schwienbacher, and Vanacker (2018). All specifications of the model also include several control variables that could determine the preference of a firm to issue

either debt or equity, as indicated in previous empirical literature on capital structure decisions.

Our final empirical test uses a supervised learning method for solving classification problems called random forest (Breiman 2001). As with the logistic regression method, our aim is to predict the outcome of the variable (INST), which, as we know from earlier, includes more observations of equity campaigns than debt campaigns. Such imbalance in the data may cause problems, as the classifier focuses on improving the overall predictive accuracy, thus potentially overly focusing on the more common outcome (Diez-Pastor et al. 2015). To achieve a more equal accuracy rate in classifying observations of both debt and equity, we use the Synthetic Minority Oversampling Technique (SMOTE) (Chawla et al. 2002) to generate 403 new observations of debt campaigns based on the features of existing campaigns. These new observations are only used for training the model, while the model evaluation is based on the original dataset.

When using any Machine Learning algorithm, the aim should be to produce a flexible model that fits the data well, but not so well that it loses the power to correctly predict out-of-sample observations (Athey and Imbens 2019). We use two methods to control for the generalization ability of the model. First, we split the sample and use 70% of data to train the model, while the remaining 30% will be used as an out-of-sample test of the model's predictive capability. Second and in parallel, we use 10-fold cross-validation to measure the performance stability of the model.

To evaluate model performance, we calculate the accuracy Equation (3) and the area under the Receiving Operating Characteristic (ROC) Equation (4) curve (AUC), which is calculated from a plot of ROC at various cut-off thresholds. Accuracy is a straightforward measure of the percentage of observations that are correctly labelled by the classifier, but it is a relatively inefficient measure for highly imbalanced datasets, in which accurate predictions of majority classes lead to high levels of accuracy regardless of the prediction accuracy of minority classes. The AUC measure, on the other hand, takes into account the trade-off between true positives and false positives, thereby providing a more consistent measure for imbalanced datasets (García, Mollineda, and Sánchez 2009). The equations for calculating both measures are:

$$Accuracy = \frac{\text{True Debt} + \text{True Equity}}{\text{Number of Observations}} \tag{3}$$

$$ROC = \frac{\text{True Equity}}{\text{True Equity} + \text{False Debt}} \Big/ \frac{\text{False Equity}}{\text{False Equity} + \text{True Debt}} \tag{4}$$

4. Determining target leverage

In this section, we use Equation (1) to estimate a target normalized leverage ratio for each firm in our sample. The most parsimonious specification is shown in Table 1. The regression model for determining target leverage includes different intercepts by company type (dCORP for corporation, dLLC for limited liability company, and dPBC for public benefit company), the dummy values for which were jointly significant using the F-test ($p < 0.05$).

Table 1. OLS regression for normalized leverage (Da_norm).

Variable	Coefficient
dCORP	0.323*
	(0.175)
dLLC	0.252
	(0.175)
dPBC	0.632**
	(0.246)
COGS_norm	0.133**
	(0.057)
dROANEG	0.206***
	(0.035)
dNOREVFIN	−0.113***
	(0.042)
LNWORK	0.042**
	(0.020)
Intercept	0.052
	(0.179)
Observations	746
F (7,738)	15.22
R^2	0.126
Adjusted R^2	0.118

Standard errors in parentheses. * for significance at 10%; ** for significance at 5%; *** for significance at 1%.

We also allow different intercepts for the companies that have negative profitability (dROANEG)[5] and those that list assets in their financial statements, but do not have revenue (dNOREVFIN).

The negative sign for dNOREVFIN is as expected, as firms that do not have revenues (and therefore have no income) are unable to pay the periodical interest payments associated with debt. The positive association between leverage and firm size, measured here as a natural logarithm of the number of workers (LWORK) is in unison with the findings of both the SME study of La Rocca, La Rocca, and Cariola (2011) and the study by Hovakimian, Opler, and Titman (2001), which used a sample of large firms. Finally, COGS_norm and dROANEG exhibit a positive association with leverage, indicating that firms with lower profitability tend to have higher levels of debt. This finding is not consistent with the large-firm tests of Hovakimian, Opler, and Titman (2001), but is consistent with the findings of La Rocca, La Rocca, and Cariola (2011) for SMEs.

Before moving to the second phase of our estimations, we use these findings to calculate a target leverage ratio for each firm in our sample, adding an additional variable (DA_n_diff) for our future estimations. As explained earlier, DA_n_diff is simply the difference between the predicted value of DA_norm from our OLS regression and the actual value of DA_norm obtained from the data. For firms that do not have assets, DA_n_diff is assumed to be zero, so that these firms would not influence the results for this variable in our estimations for debt-equity choice but still allow us to use the full sample to test the variables that are not related to trade-off theory. In some specifications, these firms are removed from sample entirely in order to test for the robustness of the results.

Table 2. Logistic regression for debt-equity choice (INST).

	Model 1 Log-odds	Model 2 Log-odds	Model 3 Log-odds	Model 4 Log-odds	Model 5 Log-odds	Model 6 Log-odds	Model 7 Log-odds
Trade-off							
DA_n_diff	−0.422**	−0.388*	−0.300				
	(0.201)	(0.199)	(0.278)				
Pecking order							
dNA				−0.207	−0.231		
				(0.174)	(0.176)		
d100				0.272		0.262	0.195
				(0.169)		(0.168)	(0.197)
d90					0.194		
					(0.167)		
Controls							
GROWTH	0.462***	0.265	0.402*	0.312*	0.313*	0.219	0.369*
	(0.169)	(0.183)	(0.210)	(0.175)	(0.176)	(0.182)	(0.207)
LNBDIST	−0.347***	−0.345***	−0.435***	−0.351***	−0.349***	−0.346***	−0.434***
	(0.052)	(0.064)	(0.079)	(0.052)	(0.052)	(0.063)	(0.079)
LNVCDIST	0.145***	0.108*	0.129*	0.146***	0.144***	0.111*	0.129*
	(0.052)	(0.063)	(0.077)	(0.052)	(0.052)	(0.063)	(0.077)
LNOFFER	0.647***	0.623***	0.512***	0.651***	0.651***	0.625***	0.512***
	(0.060)	(0.075)	(0.089)	(0.060)	(0.060)	(0.075)	(0.089)
dNOFIN	0.781***	0.780***	0.770**	0.841***	0.830***	0.806***	0.800**
	(0.269)	(0.295)	(0.322)	(0.271)	(0.270)	(0.296)	(0.323)
dEARLY	1.325***	1.371***	1.371***	1.319***	1.317***	1.381***	1.378***
	(0.337)	(0.365)	(0.397)	(0.338)	(0.338)	(0.365)	(0.397)
Constant	−7.402***	−6.876***	−5.511***	−7.462***	−7.428***	−7.025***	−5.580***
	(0.686)	(0.842)	(0.990)	(0.694)	(0.694)	(0.849)	(0.997)
Model diagnostics							
Observations	1116	746	543	1116	1116	746	543
Chi-squared	214.4***	136.8***	98.6***	216.6***	215.3***	135.5***	98.4***
Log-likelihood	−622.7	−428.7	−316.5	−621.6	−622.3	−429.4	−316.57
Accuracy	71.3%	69.7%	69.6%	70.3%	70.6%	69.1%	69.4%

Dependent variable INST = 1 for debt campaigns. Standard errors in parentheses. * for significance at 10%; ** for significance at 5%; *** for significance at 1%.

5. Logistic estimation of debt-equity choice

Table 2 shows the results of all seven specifications of our logistic regression models. Models 1–3 are constructed to test the trade-off theory, while models 4–7 test the pecking order theory. Models 2 and 6 limit the observations to only those firms that had reported assets for their most recent financial year. We include this robustness test to account for the possibility that such firms may behave differently when choosing their initial choice of funding than those that already have a capital structure in place. Models 3 and 7 exclude firms which reported no debt for their most recent fiscal year before the campaign. In doing so, we account for the possibility that some early-stage firms may be systematically reluctant to use debt financing. Finally, for testing the robustness of the results for the pecking order theory, in model 5 we substitute the variable d100, which indicates firms with debt levels over 100%, with the variable d90, using debt levels above 90%. The overall labelling accuracy rate was consistently between 69.1% and 71.3% for the different specifications using a 0.5 cut-off threshold.

In contrast to our expectations from the trade-off theory, DA_n_diff obtains a negative sign in all three specifications. The coefficient is significant for the first two models, while for model 3, the coefficient is still negative but no longer significant, possibly due to the

lower number of observations in this test. These results seem to indicate that for SMEs that have decided to use crowdfunding to finance their operations, moving toward a target leverage ratio seems to be far away from the top of their list of priorities. Moreover, the negative sign for all specifications indicates that firms seem to be rather set on using instruments that they have prominently utilized thus far.

If we look at the original data, 18.8% of equity-issuing firms were unlevered prior to the campaign, while the same could be said about 17.1% of all debt-issuing firms. At the other end of the spectrum, 26.3% of firms issuing equity had leverage ratios of 1 or above, while a total of 33.7% of firms issuing debt were already fully levered prior to the campaign. In total, 47.2% of the firms in our sample had leverage ratios that were either zero or above one. In these circumstances, it is highly surprising that firms did not seem to seek either equity or debt financing to move away from such extreme leverage ratios and converge toward a ratio that is more in the middle[6].

Unsurprisingly, considering the results of the trade-off theory specifications, we are unable to confirm that the pecking order theory can explain the choice between equity and debt crowdfunding for the firms in our sample. While the sign for dNA, which indicates firms that do not have assets, and therefore collateral, is negative as expected, it is statistically insignificant for both model 4 and model 5. The signs for the variables d100 and d90, which indicate highly indebted firms at two different cut-off points, are also statistically insignificant. Furthermore, they are also positive, indicating that firms with high levels of debt are more likely to seek even more debt, deemed unfeasible by the pecking order theory.

In contrast, the control variables provide a much more unison result. The minimum offering amount of the campaign (LNOFFER), and in most specifications also revenue growth (GROWTH), are both associated with a strong preference to issue debt when these variables obtain high values. In other words, firms that are growing at a faster pace and that need larger amounts of financing are more likely to initiate debt crowdfunding campaigns. This result is consistent with La Rocca, La Rocca, and Cariola (2011), who found that SMEs with above-industry growth rates are more inclined to use debt financing. It is, however, inconsistent with the findings of Hovakimian, Opler, and Titman (2001) who showed that large firms with higher perceived growth opportunities tend to issue equity rather than debt. The dummy variables dNOFIN, which indicates there is no information found regarding previous external financing, and dEARLY, which indicates that the firm has previously received external early-stage capital (pre-seed or seed financing), both contribute positively towards the probability of the company announcing a debt crowdfunding campaign.

A more unexpected result appears when we look at the signs for LNBDIST and LNVCDIST, which are the natural logarithms of driving distance in miles from firm headquarters to a top 15 banking city and a top 11 venture capital city, respectively. The negative sign for LNBDIST indicates that firms that were closer to top banking cities were more likely to announce a debt crowdfunding campaign, while the positive sign for LNVCDIST indicates that firms closer to top venture capital cities were more likely to initiate equity crowdfunding campaigns. This seems to indicate that, in general, crowdfunding does not act as an alleviator for firms that are further away from specific sources of capital and thus may wish to use crowdfunding as a more accessible method of obtaining that type of capital. Instead, firms seem to anticipate that they have better

chances of receiving the type of funding that is more prevalent in their geographic proximity. This seems consistent with previous crowdfunding research (e.g., Kim and Kim 2017; Dejean 2019) suggesting that crowdfunding investors prefer spatially closer projects. In part, this could be due to persisting information asymmetry issues, which can be somewhat mitigated when investors are physically closer to the companies looking for funding.

While we did not find evidence of firms behaving according to either trade-off theory or pecking order theory, the results paint an interesting picture of the funding cycle of firms that use crowdfunding to finance their operations. Firms that are looking to obtain smaller amounts of capital and have low revenue growth (possibly no revenues at all, as this was accounted for in calculating the target leverage ratio) are more likely to look towards initiating an equity crowdfunding campaign. In contrast, firms that have already received some early-stage funding, are experiencing high revenue growth and need larger amounts of capital, seem to be more inclined to initiate a debt crowdfunding campaign.

It follows from this that firms using crowdfunding to finance their operations seem to issue equity when they are looking for seed-financing to propel their as of yet unsubstantiated business ideas into actual working businesses, while firms issue debt when they need to finance operations that are already functioning, growing at a fast pace, and need higher amounts of funding. This is in stark contrast to the optimal funding strategy envisioned by Paschen (2017). We explore these findings further by using a supervised learning algorithm to map out the decision-making processes of the firms in our sample in choosing between debt and equity crowdfunding.

6. Random forest estimation of debt-equity choice

We begin this section by testing various combinations of model parameters for our random forest classifier to ensure that our choice of parameters has no negative effect on the generalization ability of the classifier. Table 3 reports a shortened version of the sensitivity table of our model evaluation metrics for the generalization ability tests against various values of model parameters. For cross-validation, these measures are recorded as the mean results of the different folds along with the standard deviation of the reported metrics between the folds. It is important to note that the cross-validation test has been applied to the dataset after using SMOTE, which could lead to overoptimistic evaluations of model performance (Santos et al. 2018). Accordingly, our primary focus is on achieving the best possible metrics for the out-of-sample test, which uses the 30% data split that was not used for training the classifier and has been randomly drawn from the initial sample without using SMOTE.

We find that the highest AUC for the out-of-sample test is achieved with 14 trees, where the maximum depth of each tree is set at 13, the number of random splits per node at 63, and the minimum number of samples per leaf node at 8. Increasing the maximum depth to 14 or 15 would not decrease AUC, but we prefer the smaller depth to limit potential overfitting. Albeit accuracy is higher for some specifications, this is sensitive to using the default cut-off threshold 0.5, as well as affected by the imbalance of the data. Therefore, for our final model that uses the full dataset with SMOTE for training, we apply parameters that provided the best AUC for the out-of-sample test with the smallest depth.

Table 3. Sensitivity table of control tests for random forests classifier.

					Out-of-Sample		Cross-validation			
					Mean		Mean		St. Dev	
	Trees	Depth	Splits	Leaf	ACC	AUC	ACC	AUC	ACC	AUC
Test 1	12	13	63	8	0.848	0.923	0.855	0.933	0.032	0.011
Test 2	13	13	63	8	0.845	0.924	0.856	0.933	0.030	0.011
Test 3	15	13	63	8	0.836	0.924	0.854	0.932	0.028	0.011
Test 4	16	13	63	8	0.833	0.923	0.856	0.932	0.024	0.011
Test 5	14	11	63	8	0.842	0.922	0.858	0.934	0.032	0.015
Test 6	14	12	63	8	0.839	0.924	0.862	0.934	0.028	0.015
Test 7	14	14	63	8	0.839	0.926	0.859	0.934	0.025	0.012
Test 8	14	15	63	8	0.839	0.926	0.861	0.933	0.025	0.012
Test 9	14	13	61	8	0.833	0.921	0.852	0.934	0.026	0.019
Test 10	14	13	62	8	0.842	0.922	0.862	0.936	0.023	0.013
Test 11	14	13	64	8	0.821	0.910	0.861	0.933	0.015	0.018
Test 12	14	13	65	8	0.830	0.907	0.855	0.933	0.032	0.011
Test 13	14	13	63	6	0.851	0.919	0.858	0.934	0.029	0.013
Test 14	14	13	63	7	0.845	0.913	0.86	0.935	0.026	0.013
Test 15	14	13	63	9	0.827	0.911	0.856	0.931	0.029	0.011
Test 16	14	13	63	10	0.821	0.913	0.854	0.929	0.032	0.015
Final model	14	13	63	8	0.842	0.926	0.856	0.932	0.028	0.012

The overall accuracy of the full model is 90.5% at the default cut-off threshold and AUC stands at 97.8%. These metrics are a significant improvement to those of the various logistic regression specifications, which had an overall accuracy between 69.1% and 71.3%. To understand which firm characteristics proved to be the most important features for the random forest in assigning labels, Table 4 provides the Permutation Feature Importance (PFI) scores, which in our specification have been set to measure the extent to which the accuracy of the model declines if values for that specific feature were to be randomly shuffled.

The PFI scores indicate that both the offering amount (OFFER) and, as an added result compared to the logistic regression, the maximum offering amount (MOFFER)

Table 4. Feature importance scores.

Feature	Score
OFFER	0.263
TYPE	0.065
MOFFER	0.059
BDIST	0.025
SIZE	0.021
VCDIST	0.020
COGS_norm	0.018
WORK	0.017
AGEY	0.013
FUND	0.013
DA_act	0.008
dNOREVFIN	0.007
DA_n_diff	0.006
NTAX	0.004
GROWTH	0.004
dNA	0.003
ROA	0.002

are important predictors for the random forest. The company type (TYPE) as well as the two distance indicators (BDIST and VCDIST), the two indicators of firm size (SIZE and WORK), and the profitability measure COGS_norm also come up at the top of the list. Features such as the offering amount and the distance indicators were also directly included as control variables in the logistic regression in Section 5 and obtained statistically significant coefficients in those estimations, while the other top features were included in calculating the target leverage ratio in Section 4.

What is more, the variables related to the trade-off theory (DA_n_diff) and the pecking order theory (dNA and DA_act[7]) have little to no effect on the predictive power of the random forest. Randomly reshuffling any of those variables would decrease the accuracy of the random forest by less than 0.8%. Accordingly, even if some firms in our sample do behave according to theory, they are crowded out by most others that do not seem to choose between equity or debt crowdfunding in order to move toward a target leverage ratio or because high levels of debt and low levels of collateral have made seeking more debt unfeasible.

We are able to view how the most important features influence the prediction of the random forest by looking at how individual trees came to the decision on whether to label the campaign as a debt or equity offering. The relevancy of OFFER is immediately clear, with 9 out of 14 trees opting to use that feature as their first decision criteria, and with most using the $10 000 threshold as the cut-off point. A total of 441 equity campaigns and only 38 debt campaigns have minimum offering amounts that are below this threshold, indicating a very strong split in the data. The five remaining trees used the type of company (TYPE) as their first decision node, most of the time opting to differentiate between those firms that were listed as Limited Liability Companies and those that were not. Out of the latter, 523 were firms issuing equity, while 175 were firms issuing debt. This does not seem to provide as strong of a split as using OFFER, however most trees did use that feature soon after to split the data further.

Another early node of interest for some trees is VCDIST, where out of firms that are more than 317.5 miles away from a venture capital hub, 115 are equity-issuing firms and 30 debt-issuing. While in the logistic regression this indicator yielded somewhat surprising results, this split of data by the random forest does seem to indicate that for some firms that are very far away from cities where venture capital can be found more easily, equity crowdfunding may indeed act as a substitute for that type of funding. This result does not invalidate the sign of VCDIST in the logistic regression but enables us to capture a breaking point in the data where the effect of this variable inverts. This is possible because the random forest classifier is a non-parametric method. The existence of such a breaking point also logically extends the discussion on the distance metrics in Section 5, as it seems reasonable to assume that the preference for spatially close projects fades as the distances become greater and information asymmetry increases. The finding also helps understand why the statistical significance of VCDIST was not as robust in the logistic regression as it was, for instance, for BDIST.

Overall, the results of the random forest method confirm our findings from the logistic regression estimations in Section 5. Furthermore, by providing a ranking of feature importance, the random forest method gives us additional insight as to which variables have the greatest effect on the decision to seek either equity or

debt crowdfunding. We find that the minimum amount of funding the firm is looking to obtain is the single most important factor in choosing between equity and debt crowdfunding. Firms that are looking for higher amounts of funding are much more likely to seek debt crowdfunding. In contrast, we did not find any support for firms using equity or debt crowdfunding to move toward a target leverage ratio, as proposed by the trade-off theory, nor do they seem to only seek equity crowdfunding when obtaining more debt should become unfeasible, as proposed by the pecking order theory.

7. Discussion and conclusion

This study contributes to the SME capital structure decisions literature by adding a new dimension of discussion in the form of securities-based crowdfunding. This novel type of financing has gained regulatory approval in the U.S. in 2016 and has become a viable way for small and medium-sized enterprises to obtain funding. However, relatively little is known about how firms use crowdfunding to finance their operations. The aim of this paper was to further the understanding of this novel type of financing and find which characteristics explain the choice between equity and debt crowdfunding. We found the empirical evidence to be inconsistent with the theoretical framework proposed by Paschen (2017), the trade-off theory, and the pecking order theory. We did, however, observe many of the patterns that have been found to explain the debt-equity choice of firms in previous empirical SME capital structure literature, which implies that SME capital structure decisions are likely to be based on where they currently stand in their business growth cycle (Berger and Udell 1998), instead of a universal preference of one type of capital over the other or a targeted move toward some specific leverage ratio.

Firms that decide to gather funds through crowdfunding seem to prefer to offer equity when their business operations are still in an early developmental stage. The likelihood of offering equity was found to be higher if the firm had relatively little revenue growth or no revenues at all and was looking for relatively small amounts of funding. These results seem to indicate that equity crowdfunding is, in essence, acting as a replacement for seed financing for businesses that are still looking to turn ideas into actual business operations. In fact, firms that had already received seed financing from other sources were much more inclined to offer debt instead of equity, further confirming this interpretation.

Companies offering debt using crowdfunding campaigns, however, exhibited rather different characteristics. These companies seemed to have more developed businesses, higher revenue growth and were looking to receive significantly higher amounts of funding. Accordingly, companies seem to prefer debt crowdfunding when they already have established operations but are in need of significant funding to finance their growth. It is also interesting to note that even as the offering amounts for debt crowdfunding were considerably larger, the campaign deadlines were actually, on average, around 12% shorter than for equity offerings, and the firms paid about a percentage point higher fees to intermediating platforms, further indicating a more urgent need to obtain financing.

7.1. Implications for theory and practice

The results of this paper are expected to provide a new viewpoint to the debate on crowdfunding's role in financing SMEs. Although crowdfunding is hailed as a significant development in increasing SME access to financing, while removing some of the information asymmetries that have plagued this type of capital structure decision-making previously, the results of paper do not confirm this. Instead, SMEs using crowdfunding seem to choose between debt and equity financing in a manner that is rather similar to those SMEs that have to obtain financing from private markets. This seems to indicate that similarly to those SMEs, firms using crowdfunding still experience some significant barriers when making their capital structure decisions.

As such, future theory-building efforts should focus more of what these barriers are and why do firms using crowdfunding still act in ways that seem irrational from the perspective of most popular capital structure theories. An intriguing result of this study was that firms using crowdfunding that had extreme leverage ratios (either close to zero or one) were more likely to still choose the type of financing that would keep them at such extreme ratios. This choice is left unexplained by extant theory on capital structure decisions. Hence, there should be significant interest in investigating this issue further.

From a practical view, the results of this paper indicate that crowdfunding still needs to mature considerably if it is to fulfill expectations of providing SMEs with a more flexible and powerful form of financing. Stakeholders operating in crowdfunding should cooperate to alleviate barriers such as information asymmetry that may still hamper crowdfunding campaigns and lead to suboptimal decision-making. This may also be considered a focus area for policymakers if crowdfunding is to be used as a measure for increasing SME access to financing.

7.2. Limitations

When interpreting the results of this paper, it must be considered that this study focuses on only U.S. firms that are offering debt or equity under Regulation Crowdfunding. This provides three limitations that pave way for future research. First, aside from straight debt and straight equity campaigns, Regulation Crowdfunding data also includes campaigns based on other types of contracts such as simple agreements for future equity, preferred shares, and convertible debt. Including such contracts to the analysis may provide additional insight. Second, in addition to Regulation Crowdfunding offerings, there are other exemptions that firms in the U.S. may use to offer securities as part of a crowdfunding campaign. While offerings under these exemptions are not directly comparable because of differing requirements, it may be interesting to examine whether firms using exemptions other than Regulation Crowdfunding behave differently from what was observed in this study. Finally, to better understand the financing dynamics of SMEs utilizing crowdfunding, the study could be repeated in other settings than the U.S., where country-specific characteristics and the regulative environment may impact the results.

Alternatively, if enough firms start using crowdfunding campaigns in a more recurrent manner, it would be interesting to repeat the present study using longer time-series data. Analyzing the capital structure decisions of firms using crowdfunding over a longer period of time may provide a more systematic understanding of the reasoning behind these decisions.

Notes

1. Regulation Crowdfunding is a set of rules developed to implement Title III of The Jumpstart Our Business Startups Act. It allows businesses to be exempt from the registration requirements of the Securities Act of 1933, provided the campaign meets certain criteria regarding the intermediary platform, information disclosure and the maximum amounts raised by each campaign and from each individual investor. Campaigns that do not meet these criteria may be launched under Regulation D but are subjected to different requirements and can only raise money from accredited investors (Freedman and Nutting 2015). Such campaigns are not included in our sample.
2. Of all campaigns included in our sample, less than a quarter were launched on platforms that had intermediated solely either debt or equity campaigns.
3. This is also consistent with the specifications of the main multivariate analysis in Hovakimian, Opler, and Titman (2001).
4. Our initial tests with firms that had initiated a crowdfunding campaign in the third quarter of 2019 indicated that no firms had completed their latest funding round more than three years before the campaign announcement date. We applied the same threshold to all firms equally to account for having a longer period of funding data available for firms that launched a crowdfunding campaign more recently.
5. We considered using ROA directly, but the coefficient estimate for this variable was statistically insignificant.
6. Substituting the target ratio calculated in Section 4 with simply a target leverage ratio of 0.5 for all firms does not significantly alter the results, with the variable DA_n_diff still obtaining a negative sign, although the coefficient is statistically insignificant.
7. For the random forest, we can include the leverage ratio without needing to construct a dummy value for high levels of debt or limiting the ratio to 1 from above, as the random forest method is non-parametric.

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Appendices

Appendix A. Quantitative variables by offering type

		Debt campaigns			Equity campaigns		
Variable	Description	N	Mean	SD	N	Mean	SD
OFFER	Campaign target offering amount (thousand USD)	403	80.38	99.36	713	57.54	131.11
MOFFER	Campaign maximum offering amount (thousand USD)	403	525.93	408.67	713	534.24	438.10
CLEN	Campaign length (days)	403	88.73	52.40	713	101.05	56.75
FEE	Percentage of proceeds paid to intermediary	403	0.07	0.02	713	0.06	0.01
AGEY	Firm age when issuing campaign (years)	403	2.47	3.83	713	2.80	4.29
WORK	Firm number of workers when issuing campaign	403	4.21	6.45	713	5.88	12.01
SIZE	Firm assets most recent fiscal year (thousand USD)	403	170.17	471.34	713	406.29	2504.67
ROA	Firm net income for two latest fiscal years divided by total assets for most recent fiscal year	287	−65.84	1039.11	460	−67.10	1156.82
GROWTH	Revenue most recent fiscal year divided by average revenue over two latest fiscal years	403	0.21	0.40	713	0.14	0.42
COGS	Cost of goods sold divided by revenue for most recent fiscal year	403	0.69	8.35	713	1.66	25.53
COGS_norm	COGS limited to 1 from above	403	0.20	0.32	713	0.18	0.31
NTAX	Net tax paid two latest fiscal years (thousand USD)	403	0.89	7.03	713	1.49	19.51
DA_act	Total debt divided by total assest most recent fiscal year	287	5.87	37.71	460	113.68	2292.61
DA_norm	DA_act limited to 1 from above	287	0.59	0.45	460	0.54	0.45
DA_n_diff	Difference from target leverage ratio estimated by author	403	−0.03	0.35	713	0.02	0.34
BDIST	Distance from nearest TOP15 banking city (miles)	403	95.03	160.30	713	176.04	236.40
VCDIST	Distance from nearest TOP11 venture capital city (miles)	403	124.75	162.88	713	160.70	228.96

Appendix B. Dichotomous variables by offering type

Variable	Description	Debt campaigns	Equity campaigns
INST	Type of campaign	403	713
dNOREVFIN	Company has no revenue, but has financials	112	239
dROANEG	ROA is negative	212	332
dNA	Total assets for most recent financial year are 0	116	254
d100	DA_act is above 100%	132	185
d90	DA_act is above 90%	141	206
dLLC	Registered as limited liability company	228	190
dCORP	Registered as corporation	162	517
dPBC	Registered as public-benefit corporation	2	4
dNOFIN	No information for latest funding round	335	576
dEARLY	Latest funding was pre-seed, seed or angel	46	54
dECF	Latest funding was equity crowdfunding	0	43
dRCF	Latest funding was reward-based crowdfunding	2	9
dDEBT	Latest funding was debt	12	17
dLATE	Latest funding was private equity or corporate round	0	1
dVENTURE	Latest funding was venture capital	4	10
d2016	Campaign issued in 2016	35	81
d2017	Campaign issued in 2017	117	203
d2018	Campaign issued in 2018	124	296
d2019	Campaign issued in 2019	127	133

Appendix 3

Publication III

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Predicting business failure after crowdfunding success: Are platforms the unsung heroes?

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ABSTRACT

Initial rules introduced in 2016 for U.S. Regulation Crowdfunding were considered overbearingly strict by industry insiders, but were argued by regulators to have a pronounced mandate of protecting against investment losses. Five years later the rules were relaxed without much ado. This paper is the first to explore how the uniquely restrictive initial ruleset fared, focusing on business failure as a straightforward measure of investment losses. We empirically test company-, campaign- and platform-level characteristics observable during a campaign against ensuing business failure. We hand-collect a sample of 380 companies that successfully raised crowdfunding between May 16, 2016 and March 30, 2018, and record their operating status as of February 15, 2021. Overall, 17.4% had failed. Our results suggest that filtering by investors may be important, but the role of platforms in protecting investors warrants considerable attention.

1. Introduction

The U.S. was among the first wave of countries to introduce a bespoke national regime to regulate securities crowdfunding (Torris 2016). The initiative was set out through the Jumpstart Our Business Startups Act (the JOBS act) in 2012, and hailed a "potential game changer" (Kalil and Rand 2016). For eight decades previously, the law had demanded that all securities offered to the public must be registered under the strict rules of the Securities Act of 1933. Small private companies were noticeably impeded by these outdated rules, as raising early-stage capital from private markets is notoriously difficult (Jones and Jayawarna 2010). Those rules also stopped small retail investors from distributing their savings into early stage ventures, which may provide superior long-term investment returns.

Still, the path to democratizing the financing of small early stage ventures proved particularly difficult for the U.S. It took four years for Congress to create the JOBS act (Zeidel 2016) and another four years for the Securities and Exchange Commission (SEC) to implement its Title III. Title III came to be known as Regulation Crowdfunding (RegCF) and was created to provide the simplest and most cost-efficient way for early stage ventures to solicit funds from the public. However, RegCF was identified as among the strictest of its kind in the world (Torris 2016), placing tight restrictions on amounts involved for both companies and investors (Isaacson 2016; Hans 2018), and leading to high compliance costs (Barnett 2016). According to the SEC, the restrictions were necessary to ensure investors remained protected (Farris 2016). Shiller (2015) opined that the rules introduced by RegCF were "worthless" for that aim, and that the focus should have been on limiting discrepancies in information instead. Barnett (2016) posited that the strict rules would lead the most viable startups to seek other forms of financing instead, leaving RegCF investors with lower quality firms to choose from. Jeff Lynn, co-founder of Seedrs, pointed out that RegCF rules limited the platforms' options of structuring the deals so that investors would be protected (Alois 2016).

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What is more, the time it took for the SEC to implement rules for RegCF enabled many other countries to overtake the regulatory lead, and implement systems that were considered far more effective in alleviating the difficulties of financing early stage ventures (e.g. Rose 2019). Five years into RegCF, and thirteen years after starting work on the JOBS act, on March 15, 2021, the SEC amended the rules for RegCF, very much aligning them with what had been expected by the industry since day one (Alois 2021). However, there exists surprisingly little public research on how the initial ruleset fared in terms of investor protection. A single report produced by the SEC only notes that no material cases of outright fraud were observed during the first few years of the rules, and that they were unable to examine investor losses further due to a lack of data on successful offerings and the fate of the companies involved (U.S. Securities and Exchange Commission, 2019).

The main aim of this paper is to study the business failure[1] of companies that are initially successful in obtaining financing through RegCF, often backed by non-sophisticated investors, but then fail to continue as a going concern somewhere down the line. The paper is motivated by a lack of analysis of how well the SEC's initial RegCF rules fared in ensuring investor protection. While there is limited analysis of what happens to companies after successful crowdfunding (Schwienbacher 2019), we have identified four papers (Coakley et al., 2018; Signori and Vismara 2018; Hornuf et al., 2018; Bouaiss et al., 2020) that investigate business success or failure after crowdfunding campaigns. However, those papers only do so in European equity crowdfunding settings, where the rules in place provide a much different background.

In particular, the RegCF setting stands out from its European counterparts for the high levels of disclosure required for each campaign, as well as for the limitations imposed on communication between parties. Under the initial RegCF ruleset, companies behind the campaigns were allowed to communicate with potential investors only through channels that were set up by the intermediating platform (U.S. Securities and Exchange Commission, 2016). The use of special purpose vehicles, which in many other settings have been introduced to incorporate lead investors that have aligned interests with smaller crowdfunding investors, was also prohibited (U.S. Securities and Exchange Commission, 2019). As such, the RegCF setting put significant duties on the shoulders of the intermediating platforms, while also holding them accountable for performing those duties through a licensing procedure (Hamilton et al., 2017).

We analyse the business failure of firms that successfully raised funds between May 16, 2016 and March 30, 2018, where the event of business failure provides us with a straightforward indicator of investment losses. Without a central business registry to rely on, we hand-collect events of business failure and vast amounts of other data for the companies we are interested in using online news snippets and social media among other sources. In headline numbers, our data indicate that 66 of the 380 companies in our sample went out of business in the timeframe between closing their offering and February 15, 2021, which was the last date of collecting survival data for our analysis. This gives our sample a failure rate of 17.4%, with a tracking time of 33–55 months before censoring.

We consider our results concerning the role of the intermediating platform to be an important contribution to the discussion on crowdfunding. So far, there has been intense debate on how regulations should lessen information asymmetries and protect investors, but less so on parties involved in the crowdfunding ecosystem that may be better equipped to go beyond the face value of prospective investment opportunities, and uncover the true risks involved behind endeavours. As such, we hope this paper leads to renewed academic interest into the role that intermediating platforms hold in crowdfunding. That being said, we cannot rule out that the importance of platforms on investor protection was especially magnified in our special case of the RegCF setting before the 2021 rule change, as the early rules strictly limited other types of third-party involvement and placed nearly all of the due diligence burden on the platforms.

2. Data and methodology

Our sample of RegCF campaigns is based on public data obtained from the Crowdfunding Offerings Data Sets, which are published quarterly on the website of the SEC based on forms submitted by the companies or platforms behind the campaigns. The data sets provide multiple challenges considering our aims. First, while the data provide a clear event of a RegCF campaign being launched, there is no certain method to extract which campaigns are successful in raising funds or what amounts were raised. Companies are expected to inform the SEC of this through filing a Form C–U, but this is often left undone. Therefore, where a relevant C–U filing does not exist, we hand-collect data from the websites of various platforms, campaign analytics platforms (e.g. Kingscrowd) or news snippets. To the best of our knowledge, four other papers (Geiger and Oranburg 2018; Johan and Zhang 2020; Mamonov and Malaga 2020; Smirnova et al., 2020) have obtained similar information separately from us. For our purposes, we only include the first successful crowdfunding campaign for each company. Altogether, we find 380 successful RegCF campaigns between May 16, 2016 and March 30, 2018 to include in our sample, with 22 different intermediating platforms used across observations.

Second, SEC holds no information about how the companies raising funds fare afterwards. While some indication can be extracted from the annual reports filed by the companies as Form C-AR's, this again does not conclusively tell us whether a company remains a going concern. Because of the SEC's rules, not all companies that run a successful crowdfunding campaign must continue to publish annual reports, and not all have to publish the same number of reports before they are allowed to terminate reporting. Furthermore, a company may decide against filing a C-AR even if it is required to do so, if the company accepts that it will not be allowed to launch a second campaign as a result (U.S. Securities and Exchange Commission, 2016).

Because of these inconsistencies, we have hand-collected these data from websites of the companies themselves, social media or

[1] We treat companies as having experienced failure if they have publicly announced that they have ceased operations or no proof on business operations is publicly available.

news snippets. The final follow-up date for all companies was February 15, 2021, at which time we recorded 66 companies that had gone out of business.[2] This gives us a failure rate of 17.4% in our sample. For survival analysis, we also obtained the month and year of the business failure. Our minimal tracking time was 33 months and maximum tracking time was 55 months before censoring. The average failure time was 19.1 months after completion of the campaign, while the earliest was 2.4 months and the latest was 39.9 months after completion of the campaign.

While the Crowdfunding Offerings Data Sets provides rather thorough information of the company's finances and specifics of the campaign, as well as certain data of the relevant intermediating platforms, there is very little information available regarding the human capital available to these companies. As these data may provide valuable insight, especially in a startup setting, we also hand-collected data regarding the founders and executives involved with the companies behind successful campaigns. As well as extracting gender information based on names and pictures online, for each founder listed as the main founder, we used social media (LinkedIn, Facebook) to gather further information about their education and previous careers. These data included their schools and education levels, their fields of education and whether they had previously worked in a related field, experienced management or experienced ownership.

Because we are mainly interested in understanding how business failure becomes a reality after the completion of a crowdfunding campaign under the RegCF exemption, we look at whether there exist predictors observable at the time of the campaign that seem to increase or decrease the likelihood of business failure further down the line. This approach may provide valuable information for non-sophisticated investors in understanding when their capital may be more at risk, as well as for regulators in understanding in what way regulations could improve investor protection in terms of loss of capital. This is all the more important since the SEC introduced new rules for RegCF from March 15, 2021, even as there is little understanding of how the previous rules worked in terms of investor protection.

For the empirical analysis, we use the Cox proportional hazards model to study company survival. This model enables us to measure for each company the duration from the completion of an initial successful crowdfunding campaign until the event of failure. We account for the fact that we have both left and right censoring, as firms continue to enter our study and become at risk during the initial tracking of campaigns between May 16, 2016 and March 30, 2018, while we also do not continue to track for business failure after February 15, 2021. Using this method, we do not have to specify the time dependence distribution of the hazard occurring. For all models, we use industry fixed effects, for which data of industries is hand-collected and categorized based on the industry group level of the Global Industry Classification Standard (GICS) developed by MSCI and Standard & Poor's. We use robust standard errors for all estimations.

3. Results and discussion

3.1. Descriptive statistics

We begin our analysis with simple summary statistics presented in Table 1 for the variables collected for the 380 companies, their initial successful RegCF campaigns, and intermediating platforms.

A full correlation table for the variables is included in the supplementary material of this paper. For some variables regarding the background of the company founder, the number of observations available is lower than the full sample, as these founders did not have a public profile accessible online or the information provided was incomplete. Accordingly, these are treated as missing data in our survival analysis, which decreases the number of observations to 348 in some models, while the number of failures then falls to 56.

It is perhaps noteworthy that the failure rate for these observations removed is 31.3%, considerably higher than the failure rate of 16.1% for companies for which all of the information regarding their founders was publicly obtainable online. The overall failure rate for all observations is 17.4%. The difference observable between the two groups could indicate that the provision of transparent information about both the company and its founders may be an important pillar for investor protection. As we are unable to determine whether public profiles for these founders were available at the time of launching the campaign and only deleted after business failure occurred, we do not explore this observation further. As any failure among companies using crowdfunding is inherently a very public matter (Kshetri 2018), it could be that founders removed public information in order to avoid the social stigmatization associated with business failure.

An overview of the industries of the companies in our sample and instruments issued through the campaigns is collated in Fig. 1, where the numbers in brackets indicate the occurrence of business failures recorded per industry. There appears to be a rather uniform distribution of the campaigns between seven large industry categories, while markedly less campaigns fall under the remaining 17 categories of the GICS.[3] With regard to business failure, the distribution again seems relatively uniform when also considering the number of observations per group. Still, companies operating in the healthcare industry seems to fare somewhat better than the rest, as the failure rate among these companies is just 8.6%. At the other end of the spectrum, companies operating in the diversified financials industry seem to be rather a more risky choice, as exactly a third of the 18 companies in that industry group have experienced business failure.

Some interesting differences emerge when looking at the type of instrument used to carry out the campaign. A considerably smaller share of firms in the consumer services industry, and, to a slightly lesser extent, the food, beverage & tobacco industry seem to use

[2] While our follow-up period also includes the first year of the COVID-19 pandemic, only 11 failures occurred after COVID-19 was declared a national emergency in the U.S. Of the companies to survive after that date, 3.4% eventually failed.

[3] 14 categories were grouped together under the category „Other", as they included too few observations to include them separately in our analysis.

Table 1
Summary statistics.

	N	Mean	S.D.	Min	Max
Survival Data					
Business failure (1 = Y)	380	0.17	0.38	0	1
Time of entry (months after study start)	380	13.76	5.61	0	22.16
Time of exit (months after study start)	380	51.22	9.35	15.11	55.08
Company characteristics					
Age at time of campaign (months)	380	34.90	47.94	0	539
Number of employees	380	6.37	10.54	0	100
Assets for most recent fiscal year (USD)	380	345 223	767 363	0	5 461 545
Previous RegD offering (1 = Y)	380	0.18	0.39	0	1
Positive sales (1 = Y)	380	0.52	0.50	0	1
Zero assets (1 = Y)	380	0.23	0.42	0	1
Positive profit (1 = Y)	380	0.09	0.29	0	1
Human capital characteristics					
Number of founders	380	1.76	1.03	0	7
Management size	380	1.88	1.32	1	11
% of women among management	380	0.17	0.32	0	1
Only male founders (1 = Y)	380	0.79	0.41	0	1
Only female founders (1 = Y)	380	0.13	0.34	0	1
Number of LinkedIn connections	380	423.74	157.98	0	500
Main founder studied in top 100 university (1 = Y)	380	0.32	0.47	0	1
Main founder has bachelor's degree (1 = Y)	341	0.54	0.50	0	1
Main founder has master's degree (1 = Y)	341	0.32	0.47	0	1
Main founder has doctoral degree (1 = Y)	341	0.06	0.23	0	1
Main founder has non-university education (1 = Y)	341	0.09	0.29	0	1
Main founder has industry education (1 = Y)	349	0.43	0.50	0	1
Main founder has management experience (1 = Y)	362	0.74	0.44	0	1
Main founder has ownership experience (1 = Y)	360	0.58	0.49	0	1
Main founder has industry experience (1 = Y)	361	0.77	0.42	0	1
Campaign characteristics					
Minimum target amount (USD)	380	67 588	82 753	9990	500 000
Maximum target amount (USD)	380	597 093	411 863	25 000	1 070 000
Minimum target amount lower (1 = Y)	380	0.05	0.22	0	1
Maximum target amended higher (1 = Y)	380	0.12	0.33	0	1
Spread between minimum and maximum (%)	380	0.19	0.27	0	1.06
Campaign length (days)	380	96.78	53.99	3	425
Deadline postponed (1 = Y)	380	0.31	0.46	0	1
Amount raised (USD)	380	248 997	290 753	10 000	1 074 025
Percentage raised of initial minimum	380	6.73	12.78	0.20	107.01
Percentage raised of initial maximum	380	0.68	1.29	0.01	10.70
Straight equity offering (1 = Y)	380	0.36	0.48	0	1
SAFE or token offering (1 = Y)	380	0.29	0.45	0	1
Platform characteristics					
Age at time of campaign	380	4.88	2.28	0	10
Number of founders	380	2.38	0.82	1	4
Fee commanded by platform for campaign (%)	380	0.06	0.02	0	0.10
Platform asked for higher than average fee (1 = Y)	380	0.38	0.49	0	1
Platform took financial interest in company (1 = Y)	380	0.34	0.48	0	1
Platform trailing number of successful campaigns	380	19.47	20.01	0	91
Platform trailing number of initiated campaigns	380	50.82	47.97	0	208
Platform trailing average success rate (%)	380	0.56	0.32	0	1
Platform trailing market share (%)	380	0.15	0.13	0	0.65

straight equity offerings, which in our setting is the sole type of campaign under which voting rights are disseminated to the funders. At the same time, more than half of campaigns by companies in the media & entertainment, consumer durables and diversified financials industries offer straight equity to backers. All of the latter also exhibit higher than average failure rates, but this is also true for the consumer services industry, which had the lowest proportion of straight equity offerings in the sample. Still, selling equities (voting shares) to backers may be correlated with a higher likelihood of business failure, a finding also documented by Signori and Vismara (2018).

Of course, these relationships observed may also be subject to differences in the time it takes for failure to occur, as we are only able to observe a limited timeframe, i.e. we are right (and left) censoring. To explore the time to failure further, Fig. 2 plots the Kaplan-Meier survival estimate for all observations. The Kaplan-Meier survival graph indicates that, overall, the pace of failure seems to be rather consistent, with firms starting to fail as early as two months after successfully completing the campaign. Still, there seems to be somewhat of an acceleration occurring up until around the 18-month mark, where the rate of failure seems to slow down. Interestingly enough, none of the companies that made it past the 40-month mark in our sample went on to experience business failure, as the last such occurrence came 39.9 months after the campaign. Altogether, 160 companies were under our observation for longer without experiencing business failure.

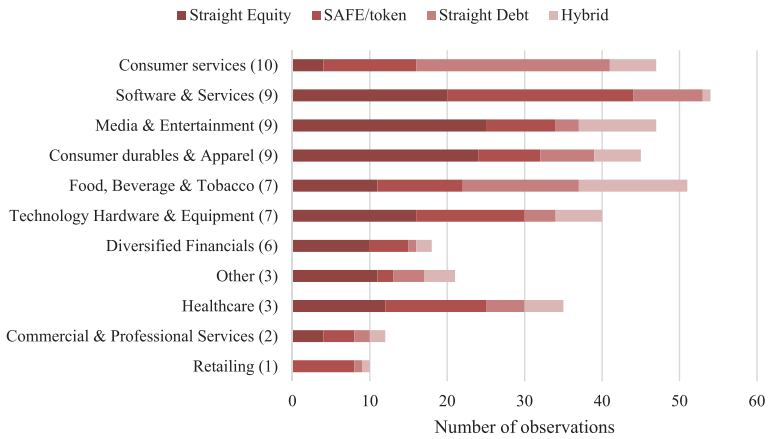

Fig. 1. Campaigns by industry of company and type of instrument.

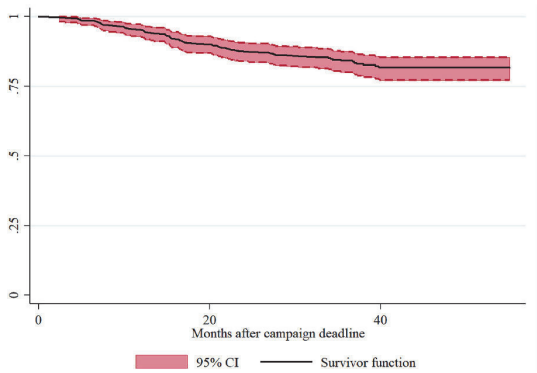

Fig. 2. Kaplan-Meier survival estimates for companies after successful initial RegCF campaign, with 95% confidence intervals.

To view whether any noticeable differences emerge when using separate Kaplan-Meier estimates by crowdfunding campaign type, these estimates are plotted on Fig. 3.

Similarly to our earlier observations based on Fig. 1, the Kaplan-Meier survival estimates also seem to imply that straight equity offerings are tied to a greater (and quicker) likelihood of business failure. Similarly to the overall estimates, the rate of failure for straight equity offerings accelerate throughout the first year and then smooth out somewhere near the 18-month mark, however both

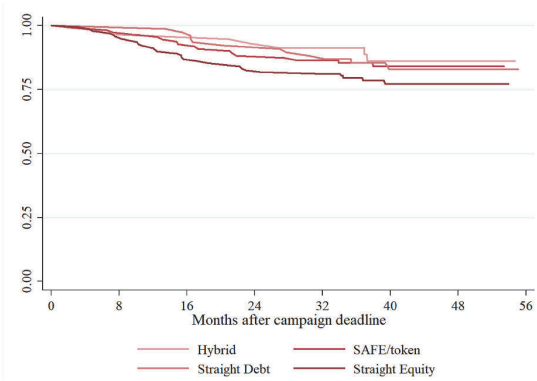

Fig. 3. Kaplan-Meier survival estimates for companies after successful initial RegCF campaign by crowdfunding type.

the initial acceleration and the plateauing are much more pronounced. Interestingly, the line for SAFE/token offerings is noticeably smoother and the group ends up with a higher survival rate than straight debt offerings. Our sample includes just a few token offerings, with 97% of the offerings in this group classified as SAFE's. The latter have been highlighted as particularly risky assets for investors of RegCF, even by the SEC itself (U.S. Securities and Exchange Commission, 2017). As such, the relatively lowly failure rate here could be considered a surprising result, although it must be cautioned that business failure is not the only risk of losing capital that investors face.

3.2. Regression for survival analysis

We now turn to the Cox proportional hazards regression to provide further analysis of the time-to-event relationship between company failure and several variables describing company, campaign, and platform characteristics that were observable during when the RegCF campaign took place. The results of the regressions using the Cox proportional hazards model are presented in Table 2.

Model 1 focuses on the company- and campaign-level characteristics, including a set of variables describing human capital traits of the companies under observation. Some of the variables included in Model 1 are similar in nature to variables used in previous studies researching company failure in European equity crowdfunding settings. Nevertheless, most of these characteristics, especially those categorized as company and human capital characteristics, are not statistically significant in Model 1. Some statistically significant characteristics do appear under the campaign-level variables. Among these, an earlier business failure is associated with companies who ran campaigns with longer deadlines, lowered the minimum required amount of capital during the campaign, and indicated a willingness to accept very low minimum amounts in tandem with large maximum amounts.

More generally, those characteristics seem to describe companies that were not very optimistic about their chances of reaching their desired funding goals quickly, had difficulties reaching those goals during the campaign or were rather unsure what amounts they should target to begin with. In this sense, those findings appear to be in line with the findings of Signori and Vismara (2018), who found that companies that quickly reached their target amounts were likely to fail later. Alternatively, the result of the campaign itself may also have had negative implications for the companies. In particular, companies that saw the need to lower the minimum required amounts during the campaign were likely to do so in order to ensure that the campaign could be successfully completed. However, such a choice would be a double-edged sword, as the company would then likely raise less capital than initially considered necessary, thus putting pressure on the company's finances and increasing the likelihood of premature failure.

Overall, the results from Model 1 indicate that characteristics observable during the campaign may be a valuable indicator of

Table 2
Determinants of company failure.

	Model 1	Model 2
Company characteristics		
Age at time of campaign	−0.004 (0.005)	0.001 (0.004)
Number of employees	−0.028 (0.020)	−0.047** (0.023)
Previous RegD offering	0.127 (0.431)	0.204 (0.374)
Positive profit	0.298 (0.445)	0.068 (0.480)
Human capital characteristics		
Management size	−0.018 (0.095)	−0.033 (0.091)
% of women among management	−0.829 (0.730)	−0.642 (0.690)
Only male founders	−0.279 (0.580)	0.078 (0.545)
Only female founders	0.857 (0.748)	0.965 (0.839)
Main founder studied in top 100 university	−0.607 (0.383)	−0.408 (0.313)
Main founder has industry education	−0.472 (0.376)	−0.359 (0.347)
Main founder has management experience	0.626 (0.394)	0.248 (0.369)
Campaign characteristics		
Campaign length	0.009** (0.004)	0.004* (0.002)
Deadline postponed	0.155 (0.361)	−0.124 (0.306)
Minimum target amended lower	2.071*** (0.774)	1.177** (0.554)
Maximum target amended higher	−0.454 (0.631)	−0.740 (0.544)
Straight equity offering	−0.600 (0.663)	−0.436 (0.412)
SAFE or token offering	0.801 (0.771)	−0.036 (0.425)
Spread between minimum and maximum	0.016*** (0.005)	0.015*** (0.005)
Platform characteristics		
Platform asked for higher than average fee		0.519 (0.435)
Platform took financial interest in company		−1.800*** (0.604)
Platform trailing average success rate		0.343 (0.611)
Platform trailing market share		−3.966** (1.822)
Stratified by industry	Yes	Yes
Stratified by platform	Yes	No
Observations	348	348
Number of failures	56	56
Months at risk	13,916	13,916
Log pseudolikelihood	−85.443	−171.777
Wald chi-squared	33.14	61.83
Wald chi-squared p-value	0.016	0.000

Notes: Coefficients reported instead of hazard rates. Robust standard errors in parentheses. * for significance at 10%; ** for significance at 5%; *** for significance at 1%.

business continuity or failure further down the evolutionary path of companies using crowdfunding. If a company seems to signal hesitancy before or during the campaign through its decisions, or if the campaign does not progress as expected, investors may want to consider their options. To this end, it seems important to allow investors to cancel their commitments up until very close to campaign deadlines to enable them to monitor the evolution of the campaigns and receive additional information that may help better gauge the risks involved. For the campaigns included in our sample, investors were allowed to cancel their commitments until 48 h before the campaign deadline. Notably, as a response to COVID-19, the SEC introduced temporary rule changes that allowed investors to cancel their commitments only until 48 h from making the commitment (U.S. Securities and Exchange Commission, 2020), although this modification remained only temporary and was later not included in the new long-term rules effective from March 15, 2021.

As an important deviation from previous studies, it must be noted that Model 1 stratifies the observations based on not only their respective industries, which is commonplace in studies of business failure, but also by the specific platform the companies used to run their campaigns. Indeed, without this, the descriptive powers of the model prove to be much lower. Testing of various specifications also reveals that if the platform-level stratification is omitted from the model, the results become much less robust and, occasionally, certain specifications of the model become insignificant altogether. This seems to indicate that a lot of variation in post-campaign business failure can be described by the role of the platforms.

The information readily available for investors of RegCF campaigns may not be enough to entirely overcome information asymmetries, as crowdfunding investors typically do not perform due diligence, since it is too costly for each individual investor to do so (Ahlers et al., 2015). As such, one critique of RegCF has been that it does not allow lead investors to perform such duties on the behalf of a larger group of investors, an approach that has been underscored by Agrawal et al. (2016) as a potential long-term solution for increasing efficiency in crowdfunding. Indeed, Coakley et al. (2018) find that lead investors may play an important role in crowdfunding campaigns, and their presence can be associated with positive company performance further down the line. However, in the RegCF setting, one party can still embark on significant due diligence activities, and is very much motivated to do so in order to keep their licences and avoid litigation. These are, of course, the intermediating platforms of the campaigns.

In order to explore this further, Model 2 adjusts the specification of Model 1 by removing the platform-level stratification, and replacing it with characteristics that describe the platform intermediating the campaign. These characteristics are recorded continuously during the observation period and are not directly tied to any particular platform, but could be indicative of the quality of their due diligence in the spirit of Cumming et al. (2019). While Model 2 does still lose some descriptive power compared to Model 1, it remains statistically significant, and further tests indicate that it is also robust to changes in specifications.

Table 3
Robustness of results.

	Model 3	Model 4	Model 5
Company characteristics			
Age at time of campaign	0.001 (0.005)	0.001 (0.005)	−0.001 (0.004)
Number of employees	−0.051** (0.024)	−0.052** (0.025)	−0.036* (0.018)
Previous RegD offering	0.246 (0.393)	0.268 (0.415)	0.076 (0.391)
Positive profit	0.166 (0.481)	0.138 (0.517)	0.088 (0.394)
Human capital characteristics			
Management size	−0.021 (0.093)	−0.020 (0.100)	−0.027 (0.083)
% of women among management	−0.573 (0.692)	−0.663 (0.735)	−0.213 (0.477)
Only male founders	0.200 (0.537)	0.193 (0.565)	
Only female founders	1.069 (0.844)	1.080 (0.892)	
Main founder studied in top 100 university	−0.465 (0.327)	−0.492 (0.333)	
Main founder has industry education	−0.388 (0.364)	−0.409 (0.379)	
Main founder has management experience	0.344 (0.375)	0.318 (0.399)	
Campaign characteristics			
Campaign length	0.004* (0.002)	0.005* (0.002)	0.004* (0.002)
Deadline postponed	−0.216 (0.322)	−0.219 (0.338)	−0.072 (0.282)
Minimum target amended lower	1.073** (0.521)	1.223** (0.617)	1.001* (0.541)
Maximum target amended higher	−0.687 (0.561)	−0.702 (0.569)	−0.700 (0.506)
Straight equity offering	−0.422 (0.431)	−0.467 (0.457)	−0.019 (0.411)
SAFE or token offering	0.094 (0.438)	0.073 (0.456)	0.351 (0.406)
Spread between minimum and maximum	0.017*** (0.005)	0.018*** (0.006)	0.008* (0.004)
Platform characteristics			
Platform asked for higher than average fee	0.525 (0.442)	0.585 (0.457)	0.467 (0.346)
Platform took financial interest in company	−1.897*** (0.635)	−2.007*** (0.680)	−1.492*** (0.501)
Platform trailing average success rate	0.320 (0.591)	0.451 (0.653)	0.387 (0.518)
Platform trailing market share	−4.175** (1.902)	−4.549** (1.991)	−3.99*** (1.511)
Stratified by industry	Yes	Yes	Yes
Stratified by platform	No	No	No
Observations	348	348	380
Number of failures	56	56	66
Months at risk	13,916	13,916	14,236
Log pseudolikelihood	−179.393	−173.701	−215.350
Wald chi-squared	76.79	94.64	44.24
Wald chi-squared p-value	0.000	0.000	0.000

Notes: Coefficients reported instead of hazard rates. Robust standard errors in parentheses. * for significance at 10%; ** for significance at 5%; *** for significance at 1%.

In terms of statistically significant characteristics, two platform-level variables emerge. First, Model 2 indicates that if a platform demands to receive a financial interest (e.g. shares of equity) in the company as part of the compensation for intermediating the campaign, it becomes less likely that business will fail early. In essence, this provides a very straightforward comparison to the role a lead investor would take in other crowdfunding settings. Since the platform itself becomes set to gain financially from that particular business becoming successful, they are likely to either take a more comprehensive approach to due diligence for that specific campaign, or only demand financial interest from companies if their analysis finds that the company is more likely to succeed. In either case, platforms taking up a financial interest in the company seems to be a positive signal that investors may wish to follow.

In addition, it seems that the market share of the platform intermediating the campaign may be similarly important. That variable is measured as the number of RegCF campaigns that the platform had introduced to the public up to the launch date of the campaign, divided by the same number for all platforms put together. As such, it represents the relative size of the platform, as a higher share of RegCF campaigns intermediated is likely to be in correlation with the resources attracted by the platform. According to Cumming et al. (2019), larger platforms are likely to put more effort into due diligence, from which we can derive that larger platforms should also logically intermediate businesses that are more likely to succeed and less likely to fail. Indeed, Model 2 seems to indicate that this is a reasonable assumption. The negative sign indicates that the larger the platform that the company used to raise crowdfunding, the less likely it is that the company would endure early business failure.

Aside from the platform-specific characteristics, one other interesting dynamic appears in Model 2. Among company characteristics, the number of employees, which represents the size of the company itself, becomes statistically significant. In various specifications, this indicator seems to appear and disappear dependent on whether the model uses stratification by platform or not. This seems to indicate that the size of the company itself may be a relevant indicator for business failure, with the hazard ratio being lower at any given time for larger companies. However, it also seems to indicate that some platforms already consider this and prefer to intermediate larger companies, which is why the indicator loses significance when we allow the baseline hazard ratio to fluctuate between platforms.

In order to test the robustness of the above-mentioned results, we construct several additional models, which are derived from Model 2. First, Models 3 and 4 are re-estimated using the same variables as Model 2, but using the exponential and Weibull models, respectively, instead of the Cox proportional hazards model. The results provided in Table 3 indicate that changing the estimation model does not significantly affect the results, as they remain robust to these alterations.

Then, we redesign the specification for Model 2 by removing some of the statistically insignificant variables describing human capital traits, for which we have also recorded missing values, so that we are able to re-estimate Model 2 using all of our 380 observations. While this does result in some of the campaign-level characteristics, namely the length of the campaign and the spread between the minimum and maximum amounts losing some statistical power, all characteristics remain significant. Importantly, the key results of this paper concerning the relevance of the intermediating platforms do not lose any significance, with platform market share becoming significant even at the 1% level in Model 5. Furthermore, Table A1 in the appendix provides four additional robustness tests, where each platform-level characteristic was introduced into the basic specification of Model 2 one-by-one. Both the indicator of financial interest in the campaign and that of platform market share also remained statistically significant in those tests, whilst the other two platform-level indicators did not become statistically significant. As such, the robustness tests reaffirm that in absence of lead investors, in the U.S. setting, the role of platform due diligence is something crowdfunding investors should not overlook.

4. Conclusion

The aim of this paper was to further understanding of what company, campaign and platform traits investors should be focusing on to avoid investment losses, and what regulators could address in order to protect investors. The foundation of this paper's contribution to crowdfunding literature lay in the fact that, compared to similar research focusing on European equity crowdfunding, this paper focused on the unique RegCF setting in the U.S. during its first era of implementation, before its ruleset was changed in 2021. That initial ruleset was heavily criticized for a lack of focus on information asymmetry issues, with the SEC opting to protect investors from losses by setting restrictive investment limits and demanding extensive disclosure, rather than facilitating communication between the parties involved. Previous research has highlighted that crowdfunding investors themselves normally do not perform sufficient due diligence, thus limiting their ability to protect themselves from investment losses, as any investment decisions are likely to be taken based on insufficient information. As a result, the paper was able to provide a unique viewpoint of what some of RegCF's strict rules and limits offered in terms of investor protection, in contrast to the more relaxed but communicative regulative settings explored by previous research.

Overall, our results seemed to indicate that the headline failure rate was rather similar to that found in various studies of business failure in European crowdfunding settings. However, notable differences emerged when looking at the specific characteristics that were statistically significant in predicting hazard rates of failure over time. In this sense, one notable finding of this paper was the lack of statistically significant variables among company-level characteristics. While these variables were mostly constructed in the spirit of previous similar research in other settings, the significance of these variables could not be replicated in the RegCF setting. This was not altogether surprising, as one key feature of the RegCF setting has been the high level of company disclosures required from any business launching a RegCF campaign.

If investors are empowered with significant company-level information for each campaign, such as that provided under RegCF, they might well filter out the riskier projects during the campaigns, so that those that are more likely to fail quickly do not often even successfully reach their funding targets. In this sense, the results of this paper seem to indicate that the strict disclosure requirements imposed by RegCF have indeed enhanced investor protection compared to other settings. While individual crowdfunding investors

may be unlikely to perform much due diligence themselves, the act intuitively becomes more likely if investors do not have to embark on extensive data gathering from third party sources, and are instead provided with the necessary details immediately without added costs. Furthermore, it could be possible that investors themselves feel more responsible without any lead investors explicitly mandated to perform due diligence on their behalf. However, this paper does not clearly answer why company-level characteristics seem insignificant predictors of the hazard rate of post-campaign failure, and further research is necessary to establish those connections.

In terms of statistically significant results, we were able to establish some campaign-level filtering where the companies themselves seemed to signal some ambiguity through their offerings, or where the crowd seemed to be aware of which of these companies may be facing a difficult future in terms of business continuity. It could be inferred from the campaign-level characteristics that some of the crowd were not very enthusiastic about the prospects of certain companies, and therefore those campaigns were only capable of raising capital after much difficulty. As such, it seems that the relative difficulty of achieving campaign targets may be predictive of a higher risk of early business failure. This finding is similar to what has also been established in some papers focusing on European crowdfunding settings. Alternatively, some campaign-level characteristics such as the decision to lower the minimum required amount during the campaign could themselves increase the likelihood of early business failure. Doing so indicates that the company needed to lower the target amount to close the campaign successfully. However, opting to do so would likely mean that the company was capable of raising less than initially hoped for, which would make it more difficult to successfully implement the previously envisioned business plan.

As an important contribution to crowdfunding research, this paper highlighted the importance of the intermediating platform in the unique RegCF setting. Even as the SEC had not introduced in its initial ruleset measures explicitly meant for reducing information asymmetries, such as lead investors, the platforms intermediating the crowdfunding campaigns seem to have taken up an important role in performing due diligence and filtering out campaigns that may lead to investment losses. Indeed, stratifying the observations based on the platforms intermediating the campaigns led to very noticeable improvements in the quality of the models, indicating that there are large differences in the baseline hazard rates of the companies each platform intermediated. As such, some platforms seemed to be either more willing or more capable of establishing which projects were more likely to continue operating in the long-term.

Substituting the platform-level stratification with specific traits focusing on the role of the platforms, we were able to establish that both willingness and capability seemed to matter. Regarding the former, it seems that when platforms opt to take financial interest in the companies they mediate, they also take on a similar role to that of lead investors in other crowdfunding settings. They themselves then become financially dependent on the long-term success of their client, and are therefore likely motivated to perform more in-depth due diligence. Accordingly, crowdfunding investors may benefit from considering the platform's interest as a signal of quality of the campaign. In terms of capability, the results showed that companies using the services of platforms that had historically intermediated a larger proportion of campaigns were less likely to fail early. This result is in line with earlier, albeit very limited research focusing on crowdfunding platforms, that has so far indicated that larger platforms are likely to perform better due diligence.

Overall, the results of this paper imply that while investors in the RegCF setting during the period under observation were relatively capable of using the mandatory disclosures provided to them to perform due diligence and limit losses, additional focus could be directed at characteristics observable regarding the campaign itself and the platform intermediating that campaign. An analysis of some of the metrics highlighted in this paper could help avoid investment decisions in companies that are at increased risk of failing early. In addition, regulators may consider how certain rules may aid or inhibit investor protection in various crowdfunding settings. For instance, the statistically significant campaign-level characteristics highlighted in this paper suggest that it may be important to allow investors to monitor the evolution of the campaign for an extended period of time, and cancel their commitments even very close to the deadline, as the development of the campaign itself may provide important information about the company's prospects. Importantly, the results of this paper also seem to indicate that there is a high disparity in the level of due diligence performed by the platforms for each campaign, and regulators may want to consider how certain rules could increase the motivation and capability of all platforms to ensure the quality of the campaigns they intermediate.

These results also suggest numerous avenues for future research. First, it is important to highlight that the results of this paper are based on the initial RegCF ruleset, which has since been updated. Accordingly, it would be interesting to see if and how the new rules affect the overall failure rate, and any predictors of business failure in this study. Furthermore, as crowdfunding investors are rather less capable of performing due diligence, some of those duties must be delegated to third parties, be those lead investors or the platforms intermediating the campaigns. In this sense, future research could focus on the benefits and drawbacks of both models, and establish whether either party is better equipped to perform due diligence for the benefit of the investors. Lastly, this paper found two statistically significant platform-level characteristics describing the willingness and capability, respectively, associated with the level of due diligence performed by the platform. However, research into the role of platforms in supporting the aim of investor protection remains limited, and further studies employing different methods could provide valuable insight into this matter.

As is often the case with survival analyses, the results of this paper are limited by the relatively short timeframe we were able to follow-up on the observations included in this study. Company failure and resulting investment losses may occur at any given time, and some of the companies in our sample may have experienced failure after the date at which we last recorded their business status. Furthermore, the event of failure used in this study was recorded based on public information, and it cannot be ruled out that some companies had experienced failure without it being publicly known. While the survival analysis method employed in this paper somewhat mitigated these effects by focusing on the time to failure instead of only the event of failure itself, it could still be that some characteristics deemed insignificant could become relevant over time, as more information is gathered.

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Credit author statement

Mari-Liis Kukk: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing, Visualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Mari-Liis Kukk reports a relationship with Estonian Financial Supervision and Resolution Authority that includes: employment.

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Appendix

Table A1
Additional robustness tests.

	Model 6	Model 7	Model 8	Model 9
Company characteristics				
Age at time of campaign	0.000 (0.005)	0.000 (0.005)	0.000 (0.005)	0.001 (0.004)
Number of employees	−0.046* (0.024)	−0.045* (0.024)	−0.045* (0.024)	−0.045* (0.024)
Previous RegD offering	0.009 (0.402)	0.141 (0.383)	0.029 (0.398)	0.026 (0.396)
Positive profit	0.072 (0.516)	0.076 (0.518)	0.068 (0.520)	0.086 (0.483)
Human capital characteristics				
Management size	−0.065 (0.100)	−0.040 (0.092)	−0.066 (0.099)	−0.057 (0.101)
% of women among management	−0.688 (0.755)	−0.716 (0.721)	−0.675 (0.753)	−0.657 (0.748)
Only male founders	0.024 (0.560)	0.029 (0.564)	0.035 (0.559)	0.019 (0.551)
Only female founders	0.693 (0.876)	0.900 (0.855)	0.684 (0.878)	0.655 (0.871)
Main founder studied in top 100 university	−0.392 (0.325)	−0.445 (0.322)	−0.377 (0.331)	−0.372 (0.319)
Main founder has industry education	−0.381 (0.334)	−0.329 (0.326)	−0.394 (0.327)	−0.406 (0.326)
Main founder has management experience	0.268 (0.348)	0.225 (0.357)	0.282 (0.361)	0.287 (0.346)
Campaign characteristics				
Campaign length	0.003 (0.002)	0.001 (0.003)	0.004 (0.002)	0.005** (0.002)
Deadline postponed	−0.014 (0.313)	−0.141 (0.310)	−0.014 (0.308)	0.007 (0.302)
Minimum target amended lower	1.172** (0.533)	1.271** (0.506)	1.230** (0.609)	1.020* (0.528)
Maximum target amended higher	−0.803 (0.571)	−0.834 (0.577)	−0.792 (0.577)	−0.718 (0.571)
Straight equity offering	0.092 (0.398)	−0.358 (0.397)	0.098 (0.376)	0.062 (0.385)
SAFE or token offering	−0.171 (0.401)	−0.112 (0.394)	−0.168 (0.390)	−0.101 (0.387)
Spread between minimum and maximum	0.014*** (0.005)	0.013*** (0.005)	0.014*** (0.005)	0.014*** (0.005)
Platform characteristics				
Platform asked for higher than average fee	0.061 (0.374)			
Platform took financial interest in company		−1.085** (0.472)		
Platform trailing average success rate			0.174 (0.566)	
Platform trailing market share				−2.09* (1.227)
Stratified by industry	Yes	Yes	Yes	Yes
Stratified by platform	No	No	No	No
Observations	348	348	348	348
Number of failures	56	56	56	56
Months at risk	13,916	13,916	13,916	13,916
Log pseudolikelihood	−179.632	−176.509	−179.586	−178.285
Wald chi-squared	41.57	43.32	41.12	49.46
Wald chi-squared p-value	0.002	0.001	0.002	0.000

Notes: Coefficients reported instead of hazard rates. Robust standard errors in parentheses. * for significance at 10%; ** for significance at 5%; *** for significance at 1%.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jbvi.2022.e00308.

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