Essays on Venture Lending as Alternative Source of Funding for Innovative Ventures

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Cheers!

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List of Abbreviations

e.g.	for example
et al.	and others
EUR	Euro
GBP	Great Britain Pound
i.e.	that is
IPO	Initial public offering
IRR	Internal rate of return
Max	Maximum
Mil.	Million
Min	Minimum
N	Number
OLS	Ordinary least square
R&D	Research and Development
SD	Standard deviation
UK	United Kingdom
USD	United States Dollars

A. Introduction

1. Focus and motivation

Young and innovative companies need access to sufficient and adequate funding from external capital providers to develop their business models and to create company value, due to corporate growth, as their internally generated operating cash flow is usually restricted or negative. A main issue that arises, regarding the optimal funding of those companies, is whether the financing in form of equity or debt is more appropriate and beneficial to develop the entrepreneurial company (Berger & Udell, 1998). Due to the high-risk profile and high uncertainties of young and innovative companies that stem from the liability of newness and smallness (Stinchcombe, 1965), their choice of optimal financing instruments is a key concern and strongly dependent on the information asymmetries between start-ups and capital providers (e.g. Denis, 2004). The probability of failure for entrepreneurial and innovative ventures, compared to companies with established business models, is higher and, therefore, restricted in receiving certain types of financing instruments (Carpenter & Petersen, 2002a).

The funding of innovative entrepreneurial often follows a similar pattern. The first funds mostly come from the founder's team, friends, and family, followed by business angels and sources, such as public equity and traditional bank debt financing instruments. In a firm's lifecycle between or during this phase, they have access to venture capital, traditional bank debt, or specialized hybrid or mezzanine financing instruments (Denis, 2004). Companies with established business models are often financed by bank debt, while innovative companies, associated with high fundamental and financial risks, try to convince more venturesome equity investors, such as venture capitalists (Cassar,

2004). The funding of those firms is often limited and may lead to financing gaps and, eventually, to constrained growth and success (Carpenter & Petersen, 2002b).

The conventional wisdom holds that equity, e.g., in form of venture capital, is the most common form of funding for young and high-potential companies (Berger & Udell, 1998), whereas, others show these companies often receive debt in combination with equity financing instruments (Cosh, Cumming, & Hughes, 2009; Cumming, 2005b; Robb & Robinson, 2014).

This dissertation aims at theoretically and empirically exploring venture lending as an alternative and complementary source of funding for innovative ventures. While research efforts, regarding entrepreneurial finance, has grown over the past years, and equity-based financing instruments, such as venture capital or business angels received great attention in academia, venture lending has been largely left out in the past years.

While traditional debt financing for start-ups is largely used in industries that belong to the low-tech sector or are active in established business models (Carpenter & Petersen, 2002a), venture loans are structured for the specific needs of young and innovative venture capital-backed firms. However, the nature of debt financing intuitively does not seem adequate for the characteristics of young and innovative firms. Technology is changing fast, and new ventures that develop, e.g., internet services or software, do not need tangible assets. These firms lack a track record, collateral, stable revenues, or positive cash flows. Consequentially, typical conditions for receiving traditional bank loans are non-existent (Denis, 2004). Contrary to bank equipment loans, which are a line of credit for financing assets secured by these specific assets, venture loans can be used without restrictions, for example, to fund product development, obtain access to the

market, or any other operational need. The main reason for using venture loans is to extend the cash runway and to reach milestones set by the venture capitalists to postpone the next equity round. This indicates clear progress and, therefore, a higher intrinsic valuation of the entrepreneurial firm. Consequentially, the existing venture capitalists are not willing or able to participate in the next equity round, and the entrepreneurs suffer less dilution in this round.

Due to the special requirements, conditions, and different purpose of using, compared to traditional bank loans, venture loans are structured differently in terms of payment schedules and other provisions. For instance, venture loans include higher interest rates, specific fees, and there is an important “equity kicker”, called warrant coverage, compared to traditional bank loans. This equity instrument within the venture loan is a certain amount of warrants, proportional to the size of the venture loan, and provides for equity participation in case of a successful exit for the venture lender. To reduce risk and potential losses in case of default for the venture lender, several risk reduction instruments are applied in those deals (see Chapter B), and the collateral in form of intangible assets play an important role for the venture lender (see Chapter C).

There is a particular relationship triangle between the venture lender, the start-up, and the existing venture capitalists. The presence of a venture capitalist is a mandatory condition for the venture lender to lend money, and the venture lender relies on the due diligence, monitoring, and willingness of the venture capitalist to aim a successful exit of the company (see Chapter D).

Venture lending deals are - contrary to venture capital deals - mostly not published by the media or venture lenders and start-ups. It is difficult to estimate the

actual market size of the venture lending market. Recent market estimates, the United States reaches from one to five billion dollars per year (Ibrahim, 2010). Rassenfosse and Fischer (2016) estimate the market volume at three billion dollars in 2010, which reflects about one venture debt dollar in relation to seven venture capital dollars invested. Similar numbers are found, regarding the total venture lending deals in the United States between 1995 and 2013 among 12,629 venture capital-backed companies, 28.7%, which received at least one venture lending round (Tykvova, 2016). While in the United States venture lending appeared in the 1970s, in Europe, venture lending had its beginnings at the end of the 1990s. In 2007, the estimated market volume in Europe accounted for approximately 6% of the venture capital market (Sage, 2010).

Existing research on venture lending is mostly case-based (Josh Lerner, Hardymon, & Leamon, 2012; Roberts, Sahlmann, & Kind, 2008) or interview-based (Ibrahim, 2010; Rassenfosse & Fischer, 2016). These studies reveal important insights about venture lending, which help to capture the relation between the start-ups, venture lenders, and venture capitalists, and the optimal use of and aim of venture lending. Intangible assets and venture capital involvement seem important factors in venture lending contracting. Empirical studies on venture lending deal with publicly available data sources on venture debt financing, which do not entail information about venture lending contract details (Yael V. Hochberg, Serrano, & Ziedonis, 2014; Tykvova, 2016). The empirical studies point out the importance of patents in debt financing and how these intangible assets support young and innovative companies to obtain debt by collateralizing these intangible assets.

The missing data on venture lending deals is also a reason only a few researchers have paid attention to this field of research. As the above mentioned statistics show, there

is a considerable market for venture lending in the entrepreneurial world, and the existing studies leave open fields for further empirical research, which I try to fill with my dissertation. In three self-contained essays, this dissertation aims at theoretically and empirically analyzing venture lending as an alternative and complementary source of innovative ventures. The access to a hand-collected proprietary and unique dataset from a European venture lending fund enables detailed in-depth analyses and contains detailed information about the venture lending contracts, including interest rates, risk reduction instruments, and information about the start-ups.

2. Research gaps

In particular, two factors are mainly responsible for the lack of academic research on this topic. First, the unavailability of deal-level data is a main issue. Second, venture lending deals were mostly not published in the media, which leads to little attention in the start-up scene and academia. Many questions are still unanswered and leave research gaps, which I identify and elaborate in this dissertation.

First, previous literature has pointed out that the relationship triangle among start-ups, venture lenders, and venture capitalists is important to create a functioning financing instrument for the involved parties. They indicate that intangible assets help to reduce risk for the venture lender (Ibrahim, 2010; Rassenfosse & Fischer, 2016). However, these studies do not focus on the effect of venture loans on the equity structure of the start-ups. The effect of the extended cash runway due to venture loans is complex, because it has different effects on existing investors, who will invest more equity, or those investors, who will not invest more equity. Chapter 1 provides an in-depth analysis about

the mechanism of venture loans regarding the equity structure. Based on the access to internal deal-data, we explain and analyze the applied risk reduction instruments in those deals.

Second, analyses on the particular design of venture loans are non-existent. Interviews indicate that intangible assets, especially patents, are an important factor in the lending decision, but there is no evidence on the influence of patents on capital costs in those contracts. However, patents have a positive signal effect on equity investors, such as venture capitalists (e.g. Conti, Thursby, & Rothaermel, 2013; Hsu & Ziedonis, 2013; Joshua Lerner, 1994). Are the results on patent signaling on equity investors transferrable to venture lending? Therefore, we analyze the effect of capital costs on venture lending contracts and show how information asymmetries can be reduced. It is worthwhile to include the company's lifecycle in the analysis to emphasize the mechanism about the patent signaling and to incorporate different levels of information asymmetries, as information asymmetries are higher in early stage companies than in later stage companies.

Third, venture capitalist reputation has emerged as a valuable asset of the venture capitalists and as a signal to other business partners. Studies on venture capital reputation mainly focused on the long-run performance effects and how the reputation influences several measures of firm performance, such as exits, the velocity to initial public offerings, and the asset productivity (Lee & Wahal, 2004; Megginson & Weiss, 1991; Nahata, 2008). Although, these studies examine an important impact of the "asset" venture capital reputation, they lack empirical evidence on immediate effects of venture capital reputation on another financial intermediary and financial contracts. Therefore, I empirically analyze the influence of venture capital reputation on the financial contract

design between venture lenders and start-ups and indicate immediate effects of venture capitalist reputation on another financial intermediary.

The three main research questions in this dissertation remain the following:

1. What is the aim and effect of venture loans for the start-up, the venture lender, and the venture capitalist, and which instruments are applied in those deals to substitute missing traditional securities for debt financing instruments?

2. How do patents influence capital costs in venture lending deals, and which role does a company's lifecycle play in this context?

3. What is the effect of venture capitalist reputation on the design of venture lending contracts, regarding capital costs and the timing of the loan issuance?

3. Research objectives and contributions

This thesis supports the understanding of venture lending by analyzing factors that influence the contract design and indicate effects of the financing instrument on the involved parties. This dissertation concentrates on three major contributions to the current entrepreneurial finance literature.

Chapter B "Liquidity Runway and Horizon of Disappointment: Business Model of Venture lending" theoretically examines the venture lending business model, the behavior of the involved parties, and their aims regarding this financing instrument. I underline the results by using a proprietary dataset and reveal the underlying interdependencies between venture lenders, venture capitalists, and the start-ups.

Intellectual property and the venture capitalist involvement is crucial in the venture lending business model. Risk reduction instruments applied by the venture lender are presented, which can mitigate the financing risks and stem from the lack of conventional securities. I contribute to the current literature by revealing the applied risk reduction instruments in venture lending contracts, which we can underline with empirical data from actual venture lending contracts. Additionally, I highlight the importance of the investment behavior of venture capitalists and under which circumstances they will invest further in those deals.

In Chapter C "Patent Activity of Start-ups and the Structuring of Venture Lending Contracts", I analyze the impact of patents on venture lending contracts. Interview-based and choice-based experiments point out that the intangible assets in venture lending contracts could serve as security for the venture lender. I even go beyond this and analyze how the intangible assets can influence capital costs in venture lending contracts. The presence of at least one granted or pending patent negatively influences direct (credit spread) and indirect (warrant coverage) costs of venture lending contracts. The presence of patents conveys information and signals quality to the payoff distribution of the venture loans. I analyze how the development stage of a company also influences the relation between capital costs and patents in these deals. We point out that the company development stage negatively influences the relation between patents and capital costs, i.e., in later stages patents seem to represent a less relevant quality signal than in earlier stages. Patents are especially of high relevance in early stage companies as they can reduce information asymmetries between the venture lender and the start-ups.

Chapter C contributes to the current literature in three fields. First, the literature on venture lending by contributing an empirical analysis about the influence of patents

on capital costs is extended. Second, I contribute and extend the patent signaling literature. Patent signaling is also existent in venture lending and indicates that patents signal quality not only to equity investors, but also to venture lenders. As a consequence, patents can convey positive related information in this context and show they can reduce information asymmetries for venture lenders, which focus on the reduction of downside risks. Patents are more important for companies in earlier stages than in later stages, which highlights the relevance of asymmetric information in venture lending contracts. Third, this analysis extends the literature on entrepreneurial finance by revealing and analyzing a financing instrument, which enables young and innovative companies to receive debt financing under certain conditions.

Chapter D "Venture Capitalist Reputation and the Effect on Venture Lending Contracts" examines interdependencies between financial intermediaries, such as venture capitalists and venture lenders, and how this relation can influence financial contracting. In particular, I investigate whether venture capitalist reputation has an influence on the venture lending contract design. The importance of venture capitalist has been shown by theoretical and choice-based studies, but there has been no empirical evidence on this topic. Foremost, I go one step further and analyze whether venture capitalist reputation influences actual venture lending contracts, regarding capital costs and the timing and show immediate effects of venture capitalist reputation. Venture capitalist reputation negatively influences capital costs in venture lending contracts. This can be explained by reduced information asymmetries and positive signal sent by the reputation to the venture lender. The highest influence on capital costs is shown by the lead venture capitalist's reputation. The timing of the venture loan issuance is affected by the venture capitalist reputation. A higher venture capitalist reputation leads to a shorter duration between the

last venture capital round and the venture loan issuance. Highly reputable venture capitalists have more investment opportunities and might force the venture lenders and start-ups to issue the venture loan earlier, after the last venture capital round, to avoid dilution, whereby low reputable venture capitalists might try to postpone the venture loan to invest more of their own equity.

Chapter D contributes to the current literature in several ways. Besides long-run performance effects, venture capitalist reputation can also finance contracts from venture lenders and affect contract details and, therefore, immediate performance. Consequentially, the affiliation with highly reputable venture capitalists can reduce capital costs on venture lending deals, which counteracts higher costs that are usually imminent in equity rounds of reputable venture capitalists, due to the higher equity share they gain (Hsu, 2004). Second, I extend the current literature on relationship lending and contribute new findings to this field of research. Relationship lending literature focuses mainly on the relation between banks and companies and the direct interaction between these two parties. I suggest a relationship triangle, which indicates the relation between venture lenders and start-ups is also affected by venture capitalists. Third, the literature on signaling theory is extended. Venture capitalist reputation can convey positive signals to another financial intermediary, such as venture lenders. As a consequence, this reputation directly influences financial contracting between venture lenders and start-ups.

In summary, this dissertation extends the current entrepreneurial finance literature by contributing new empirical insights in the fields of venture lending and venture capital. Patents and the venture capitalist reputation are of high relevance in venture lending deals and emphasize the complicated character of this specialized debt financing instrument.

4. Further remarks

In the following I list the three studies included in this dissertation and their original sources of publication to depict the current status. In addition, I list the academic conferences where I have presented and discussed these studies.

Study 1: M. Hesse, E. Lutz, E. Talmor (2016): Liquidity Runway and Horizon of Disappointment: Business Model of Venture Lending, In: Journal of Alternative Investments, Fall 2016, Vol. 19, No.2, pp. 28-37.

Study 2: M. Hesse, E. Lutz (2016): Patent Activity of Start-ups and the Structuring of Venture Lending Contracts. In: Journal of Modern Accounting and Auditing, Vol. 12, No. 8, pp. 410-428.

Conferences:

- ENTFIN Conference 2016, Lyon, France 08.07.2016
- Fachkonferenz Economics of Entrepreneurship and Innovation, Trier, Germany, 02.06.2015
- 19. Interdisziplinäre Jahreskonferenz G-Forum, Kassel, Germany, 08.10.2015

Study 3: M. Hesse, E. Lutz, E. Talmor: Venture Capitalist Reputation and the Effect on Venture Lending Contracts. Unpublished Working Paper Status.

Conferences:

- 76th Annual Meeting, Academy of Management Conference 2016, 09.08.2016, Anaheim, USA
- Global Conference on Business and Finance, San Jose, Costa Rica, 28.05.2016 (Best in Session Award Winner)

B. Study 1: Liquidity Runway and Horizon of Disappointment: Business Model of Venture Lending

1. Introduction

For innovative entrepreneurial firms, gaining access to financial resources is a key challenge. In the arena of alternative investments, venture lending has emerged as an effective vehicle to finance such high-potential start-ups with debt to complement and boost equity.[1] Yet the use of debt in such a high-risk environment is not intuitive and even paradoxical. After all, there is seemingly no logic in financing a nascent business with negative cash flows, no collateral, and no recourse, thereby taking equity risk for a debt return. In this article, we explain the business model of venture lending funds and their approach to financing young entrepreneurial firms.

Innovative start-ups develop products and services that usually require a high upfront investment in research and development. Even after core research activities are completed, the firms need to invest resources to bring their product to market and, depending on the type of innovation, may even need to create new markets. They are thus faced with particularly high additional costs for production, marketing, and brand positioning. Due to the high risk of failure embedded in the liability of smallness (Brüderl, Preisendörfer, & Ziegler, 1992) and newness (Stinchcombe, 1965; Westhead & Storey, 1997; Wiklund, Baker, & Shepherd, 2010), the financing of innovative start-ups is mainly driven by equity. While the majority of small firms with an established business model are at least partly financed by traditional bank loans (Berger & Udell, 1998),

[1] Consistent with practice, the terms *venture lending*, *venture debt*, and *venture loan* are used synonymously.

entrepreneurial firms centered around an innovation do not have a meaningful access to debt due to their high-risk profile, in contrast to established firms, with tangible assets and positive cash for new ventures (Cosh et al., 2009). This situation makes it unlikely for them to receive bank loans without holding reliable or traditional securities (Denis, 2004; Winton & Yerramilli, 2008). The situation is somewhat mitigated in the North American market where studies show that about one out of four entrepreneurial firms are at least partly debt financed (Cumming, 2005b; Cumming & binti Johan, 2008). External equity from business angels or venture capitalists is an alternative financing source for young firms. Despite a well-established venture capital market around the globe, access to venture capital is limited, the cost of funds high, and, for the majority of entrepreneurial firms, still unlikely or attractive to be sufficiently funded by venture capitalists (Achleitner, Braun, & Kohn, 2011; Davis, 2003; Fraser, 2005).

In this paper, we focus on venture lending as financial stimulus for young and innovative firms. The roots of venture lending go back to the late 1980s, first as an extension of equipment leasing.[2] Over the years, the industry has followed the swings of the high-tech sector, with major contractions following the dot com burst (e.g., the disastrous collapse of Comdisco) as well as the more recent global financial crisis. Overall market data on venture lending are not readily available; however, an estimate for total investments in venture debt in the life sciences sector in the United States alone was about 800 million USD in 2011, representing 10% of the equity market (Booth, 2012). Total market estimates reached 5 billion USD for the United States (Ibrahim, 2010) and around 300 million GBP for Europe (Sage, 2010). Although venture lending continues to

[2] Meier-Mitchell pioneered venture lending backed by intangibles, which was then propagated by Equitec Financial Group, Western Technology Investment, and Silicon Valley Bank.

establish itself as a viable form of financing for innovative new ventures, it has received hardly any attention in academic research, most probably because of lack of systematic granular data. Using such a database, this article aims to present the concept and pragmatic aspects of venture lending and its economic underpinnings.

In contrast to traditional bank loans, venture loans are explicitly structured for young and innovative venture capital-backed firms. Whereas bank equipment loans are a line of credit for financing assets secured by these specific assets, venture loans can be used without restrictions, for example, to fund product development, obtain access to the market, or any other operational need. Due to fast changes in technology, new ventures do not necessarily need tangible assets to develop products and services. Consequently, for young innovative firms, who lack a track record, hard collateral, stable revenues, or positive cash flows, typical conditions for receiving traditional bank loans are non-existent (Denis, 2004).

Venture loans are structured differently from traditional bank loans in terms of payment charges as well as other provisions. Interest rates are higher, payment schedules differ, and there is an important “equity kicker” in the form of warrant coverage, that is, a certain amount of warrants proportional to the size of the loan provides for equity participation in case of a successful future exit. Venture loans are also quite different from short-term instruments such as convertible or bridge financing instruments, which are used to convert debt into equity in a subsequent equity round. Contrary to convertible debt, a venture loan must always be paid back, including interest, and is not meant to convert into equity, which can be expressed by the phrase “no loan to own.”

As mentioned above, venture lending, despite its hybrid properties, has received only limited attention in academic research. A key roadblock for researchers is the unavailability of data on venture lending. Venture lending deals are not publicly disclosed and data are not systematically collected. Consequentially, the literature either deals with theoretical models (De Bettignies & Brander, 2007) or is descriptive and interview based (Ibrahim, 2010). Fischer and de Rassenfosse (2012) study the determinants of lending decisions using a survey and experimental design. In contrast, the current study uses proprietary access to a complete record of transaction data from a venture lending fund that issued venture loans in Western and Northern Europe, Israel, and the United States. In total, more than 120 venture loans to about 100 firms were granted over eight years in the beginning of the 2000s. The investment focus of the fund was on highly innovative firms, all backed by venture capital funds. Our analysis of the structure of venture lending deals is based on these deal-level data.

2. Venture lending business model

Venture loans are individually structured financing instruments targeted towards the specific needs of high-growth start-ups and returned through an equally amortized payment of the loan principal plus interest. Further income components are fees charged by the venture lender. The most common one is an arrangement fee, which amounts up to 1.5% of the original loan amount. In addition, early repayment is charged (prepayment penalty), which provides a form of upside return in case the borrower wishes to pay back the full loan amount ahead of the arranged schedule, which is almost always due to an outright merger or acquisition.

In addition, the lender can exercise warrants on equity in case of a liquidation event, which, in our sample, is, on average, 1.8% of the borrower's equity stake at a given price at the time of the loan issuance (with a median of 1.4%). The income sources of venture lenders are shown in Figure B. – 1.

Figure B. – 1: Income sources in venture lending deals

	Scenarios		
Income components	Net > 0X	Net0X	Liquidation
Principal	fully	fully	partly
Interest	fully	fully	partly
Fees	fully	fully	partly
Warrant	dependent on exit value		
Collateral			dependent on liquidation value

To illustrate, we consider three possible exit scenarios: First, Scenario Net > 0X, where the borrower's business develops successfully and is able to pay back the full loan amount, including interests and fees. Due to increased valuation, the warrant gain will additionally increase the lender's revenues. In the second scenario, Scenario Net0X, the

borrower also develops successfully and is able to repay the loan, including interest and fees, but the warrants expire with no economic value, mostly because the value of the firm ultimately fails to reach a liquidity event at a pricing above that set as the warrant exercise price. In the third scenario, liquidation, the borrower fails and falls into insolvency prior to full payment of the loan. In that scenario, the lender obtains principal and interest until the borrower is no longer able to pay. Most often, such a scenario is preceded by harsh negotiation in which the lender may reluctantly agree to restructure the loan, particularly to stretch the period of loan maturity. In the event of default, through holding a senior lien, the lender is able to partially recoup the unpaid share of the principal through selling off tangible or intangible assets and others, such as the tax shield from accrued losses. In general, a venture loan is considered and approved based on the borrower's ability to pay it back rather than on the basis of predicting the value from a potential upside. The upside of warrants is hugely uncertain and, although it could provide a meaningful upside, it is in no way a substitute for uncontrolled downside risk. The latter is achieved in three ways: First, as with any other lending activity, a thorough credit analysis is required to ensure that all risks are calculated; second, through the design of the loan payments; and, third, through ongoing monitoring, keeping the finger tightly on the firm's pulse through formal periodic reports and less formal conversations.

2.1 Income sources for venture lenders

In our sample, we observe an average credit spread of 814 basis points above the three-year swap rate at the time of loan issuance, for an average interest rate of 12.1%. The charged interest rate is mainly dependent on the borrower's risk profile. Typical internal rates of return (IRRs) in Net0X scenarios range from 8% to 16%. Instead of

warrants, exit incentives are sometimes arranged that already have an impact on the composition of income in a Net0X scenario, leading to an increased IRR of up to 21%. Exit incentives consist of either an option to buy a previously agreed amount of the firm's stocks or just a fixed amount of money in the event of an exit. In our sample, warrants were arranged in nearly 90% of the deals and exit incentives were arranged in the remainder. IRRs for Net > 0X scenarios start at 13.5% and can reach up to more than 50% if very successful exits are assumed. A recent study based on 311 debt investments in private firms across 25 countries by Cumming and Fleming (2013) show that the annual return from 2001 to 2010 was on average 14.4%. This study analyzed different types of debt investments and indicates the potential average debt returns for debt providers in general. From our sample, we show that in successful scenarios returns of venture loans can be significantly larger than this average. .

For our sample of primarily European loans, the warrant coverage ranges between 5% and 20% of the original loan amount and is, on average, 14%. The warrants are issued at an exercise price equal to the last equity round and carry down price protection in case the subsequent qualified round occurs at a lower price (i.e., a so-called down round). For example, suppose a loan of 1 million EUR, 15% warrant coverage, and a strike price equal to the last round's share price of 0.75 EUR. In such a case, the firm will issue at the grant of the loan 200,000 warrants at the above price to the venture lender, with a long warrant maturity (e.g., 10 years). Despite the obvious economic attractiveness of such warrants, they play no fundamental role in the lending decision. A managing partner from a venture lending fund summarized to us in an interview the state of mind in that regard: "Warrants are nice to have but it's not our core business." First and foremost, venture lending is a banking business that is focused on managing the downside

risks and not on a major upside potential. Warrant coverage is seen as a valuable additional income component that is aimed to compensate for the risk lenders accept. The warrant coverage allows the venture lender to participate in the success. It covers the upside return potential whereas in case of a failure the venture lender would take the complete loss of his capital (Cumming, 2006). Even so the potential return through warrant coverage should never influence the credit decision. Venture loans are priced primarily as debt and should only be evaluated at origination as such.

2.2 Risk reduction in venture lending contracts

As mentioned above, venture loans are usually structured as amortizing loans according to which the borrower has to pay a fixed amount (interest plus a portion of the principal). The terms of loan typically range between 30 months and 36 months, with monthly payments. Occasionally a grace period of interest only is extended for the first six months. The monthly payments feature is a critical component of the loan structure, since it aligns the economic interests of the different parties. This feature is discussed later.

Another important mechanism to reduce the lender's capital at risk is to split the original loan amount into tranches. Our data show that one-third (32.8%) of the issued loans were split into at least two and up to four tranches. Usually, those tranches are dependent on preset milestones that the borrower has to achieve to obtain the next piece of the venture loan. The milestones can be technological (e.g., successfully passing clinical tests) or based on revenues. Making tranches of the loan contingent on passing pre-agreed upon milestones links the extended size of the loan to the progress and

worthiness of the business, thereby acting as the most direct mechanism to mitigate credit risk.

To reduce potential losses in case of default, venture loans are written as the most senior debt and require the securing of intellectual property and tangible assets through a first-priority lien. The value of fixed tangibles in highly innovative businesses such as software, Internet, or biotechnology businesses is minimal. Consequently, lenders secure their loans by ensuring the right to exploit the start-up's intellectual property in case of loan default in bankruptcy. Intellectual property in young high-growth firms often consists of patents, software, and specialized technologies. The intellectual property's value is often determined by the industry and the specific market circumstances of each firm. In start-ups, it also depends heavily on its creator and the experts in these technologies. Thus, software and unpatented technologies without employees who are very familiar with these technologies are difficult to monetize in case of default. In such instances, this clause acts mainly as partial deterrence to the original owners or developers rather than a source of cash recovery to the lender.

Clearly, intellectual property in the form of patents serves better as collateral in venture lending deals. Patents are easier to liquidate due to valuation aspects in accordance with the projected cash flows from those patents. However, most of the issues that are relevant to unpatented knowhow also apply to patented knowhow. Being a financial institution, the venture lender must find a buyer for the patented goods in case of default, which is rarely practicable. In addition, operating from outside of the industry, the lender is unable to identify incidents of patent infringement, intentional or otherwise. Altogether, it is doubtful whether a venture lender is able to liquidate those intangible assets in a bankruptcy, unless the defaulted firm is sold en bloc. Nevertheless, a blanket

lien on all assets, including intellectual property, offers an incentive for the entrepreneurs to fulfill the loan agreement and ultimately repay the loan.

To increase the likelihood of a full loan repayment, venture lenders subordinate their loans from other lenders or investors in the firm. Subordination agreements prevent other lenders from initiating insolvency proceedings against the borrower while the venture loan is outstanding. In our sample, financial covenants were not included in the venture lending deals, with only one exception. Associated with the subordination, the venture lender typically arranges the restriction of indebtedness clause. This clause restricts the borrower from undertaking new debt or limits the total indebtedness to a certain amount (typically modestly above the level of the venture loan). Even if a new loan is junior to the venture loan, a situation of further leverage may trigger a default, thereby jeopardizing the soundness of the venture loan. Restrictions on borrowing also enable a tight grip in case of overseas expansion and similar growth activities that may jeopardize the venture loan.

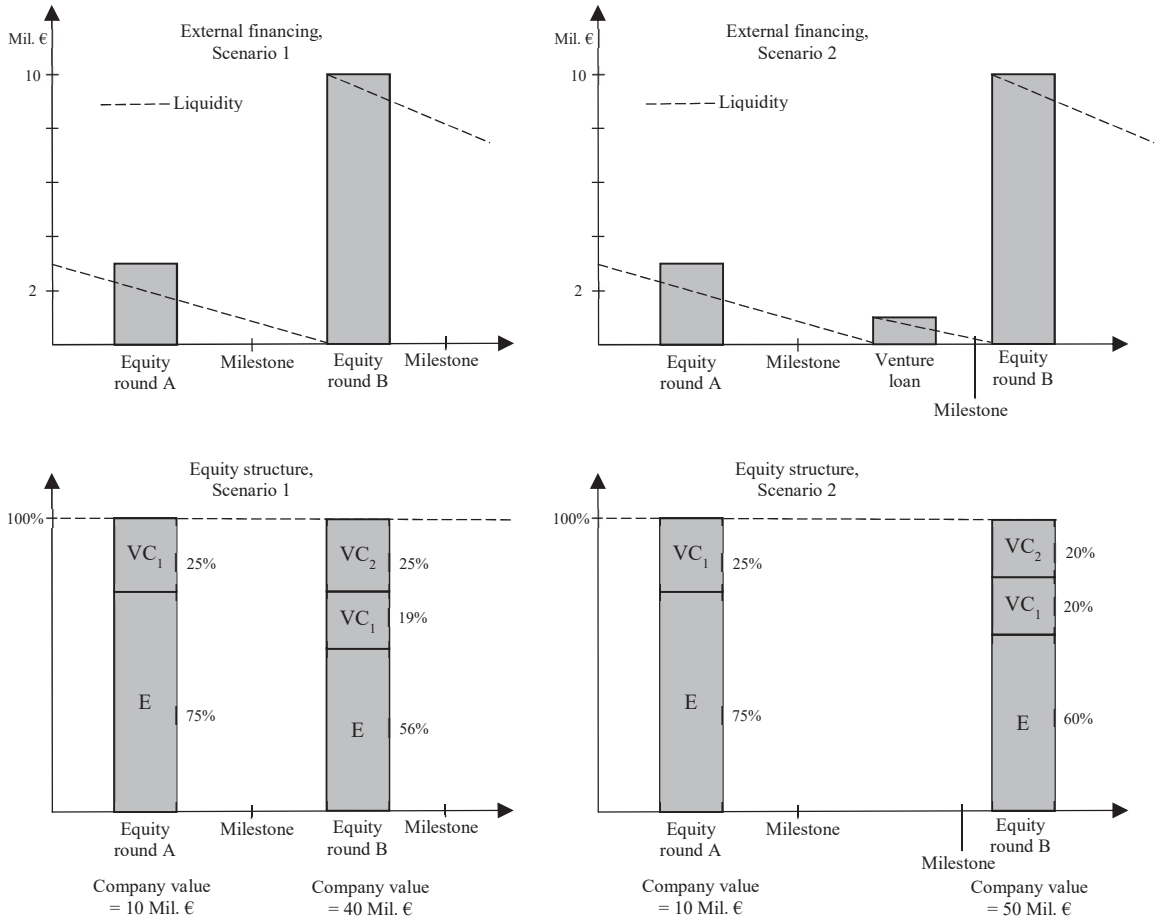
3. Perspectives in the venture lending business model

3.1 Venture firm perspective: Extending the cash runway

Venture loans are used to provide further cash to accelerate growth or achieve other milestones set by the board and management of the firm. Accelerating growth means, for instance, launching products, entering markets, investments in employees, or research and development. These activities above burn a certain amount of budgetary cash. In taking out the venture loan, the venture firm is able to extend its cash runway to

achieve its growth targets. Figure B. – 2 shows the effects of venture loans on the further funding requirements, extended cash runway, and equity structure of the venture.

Figure B. – 2: Effects of a venture loan



E: Entrepreneur; VC_1: VC round A, assumed not to participate in round B;

As shown in Figure B. – 2, for a given monthly cash burn, the liquidity runway (dashed lines, top graphs) and equity structure in the first scenario is based solely on equity investors. In the second scenario, a venture loan extends the liquidity runway, enabling the firm to postpone the next equity round to a later date, which gives it more time to reach milestones that indicate clear progress and therefore a higher intrinsic valuation. This scenario corresponds to the hockey stick metaphor, whereby it is possible to postpone the next equity round until a higher valuation can be obtained (see bottom

right graph). For both the entrepreneur's perspective and existing investors not willing or able to prorate participation in the next round, this translates into lower dilution in the next equity round. Although warrants are granted, the venture loan transaction is far less dilutive to the start-up firm compared to external equity in a valuation prior to attaining meaningful milestones and thus the desirable hockey stick phenomenon.

We discussed the role of venture loans to buy time and build more value in the business ahead of the next round of funding. However, this is only true if the next round is meant to include new investors. If the entire next round investment comes from existing investors, then taking out a venture loan is counterproductive, since it would have to be returned plus interest and other debt service costs before playing a role in reducing dilution. Of course, increasing the runway to achieve exit plays the same positive role as postponing the next round of funding with external equity participation.

In addition, there are cash flow consequences to taking out the venture loan. Due to the risk profile of young and innovative firms, venture loans are often the first debt financing instrument in such firms and may have inherent effects on those start-ups. Besides extending the cash runway, venture loans inflict a fixed periodic payment of interest and amortized principal during the term of the loan. This may have multiple and conflicting influences. On one hand, a significant debt service could hinder growth and lead to dampened performance; however, on the other hand, it might also lead to more disciplined cash management and, consequently, higher efficiency. A large scale empirical study on start-ups in Belgium indicates that entrepreneurial firms that are more indebted are more profitable and realize higher growth rates (Franck, Huyghebaert, & D'Espallier, 2010).

Another aspect of debt is the impact on operational efficiency provided by the financial resources. The academic literature largely advocates that an increase in financial slack can have counteracting effects on operational performance. While a moderate slack level positively influences performance, an increasing level of slack has a negative effect, thereby leading to an inverse U-shaped relationship (George, 2005; Tan & Peng, 2003). Regarding venture loans, we suspect that the impact of extending the runway dominates and, if anything, allows for more efficiency than in a situation in which resources are extremely tight and hence performance is compromised under harsh budgetary constraints and inefficient choices.

3.2 The relationship triangle between venture capitalists, start-ups, and venture lenders

Theoretical and interview-based studies suggest that venture capitalists play an important role in the venture lending business model. In our sample, we find that at least one venture capitalist and, on average, three venture capitalists were invested in a start-up that received a venture loan. Most venture lenders insist on having at least one and preferably two venture capital firms on the board of the start-up they plan to back. Altogether, the entrepreneurial firms in our sample received, on average (median), 19 million EUR (15.25 million EUR) in venture capital before they received a venture loan.

Venture loans are relative small and allocated over many portfolio firms. Furthermore, the modest upside of loans versus equity and the nature of venture lenders to operate as a bank dictate that they completely depend on venture capitalists for the guidance and stewardship of investee firms. Such a role is critical, since young and

innovative start-ups that are eligible for venture loans are often in a pre-revenue stage or burn more cash than they earn. In the majority of cases (87.5% in our sample), they have negative operating cash flows.

The role of venture capital in providing value-added services is well documented and achieved through both mentoring and corporate governance: preferences, control, and veto rights, which enable them to influence the board and financing and strategic decisions. Venture capitalists provide monitoring and value-added services to accelerate the growth and development of their portfolio firms (Kaplan & Strömberg, 2003). Megginson and Weiss (1991) show that venture capital has a positive certification effect on the pricing of initial public offerings. In addition, the aim of venture capitalists is to bring their portfolio firms to a successful exit to benefit from valuation increases (Cumming, 2008; Cumming & Johan, 2008). This implies an additional potential source of repayment of the venture loan of which the venture lender would profit. Furthermore, firms backed by highly reputable venture capitalists perform better than firms backed by venture capitalists of lower reputation (Nahata, 2008). For these reasons, venture capital backing constitutes valuable risk reduction functions for the lender.

Relying on venture capital services to portfolio firms is a prerequisite for venture loans when screening investment candidates. In a sense, the venture lenders “free-ride” on these services as part of their business model. However, lenders formally demand a prior venture capital investment for other reasons as well. First, it is essential that equity round valuation, which forms the basis for the warrant strike price, is based on an arm’s length transaction and set by experienced professional investors. Second, in conducting due diligence for the loan and in further dealing with the firm, it is also essential that the counterparties be institutional investors, which are there for the long haul and hence their

credibility and reputation play a role in their conduct. This is most helpful in the stage of due diligence, since it can be assumed that the books are correct and the likelihood of fraud is materially smaller. The same also applies later on, when dealing with the firm on an ongoing basis following the loan investment. In the absence of institutional investors, lenders may later find themselves in a situation in which conduct is murky or unprofessional. In particular, should the firm fall on hard times, either reaching default or requiring loan renegotiation, it is then vital that a professional code of conduct be maintained, which cannot be guaranteed if only private individuals are the investors. Therefore, the presence of a venture capitalist on the investment board mitigates a large chunk of counterparty risk.

Developing trust and credibility during difficult times give rise to a repeated game mentality and therefore to a bilateral need to build long-term relationships and joint engagements in multiple transactions. Consequently, building networks with venture capital firms and frequently dialoguing with venture partners strengthen the business relationships between the parties, mitigating risks and providing further deal flow. Altogether, building a reliable network with multiple lenders or venture capitalists reduces moral hazard and facilitates smoother loan renegotiations if the worse happens.

Turning now to explore the motivation of the other party, there are also strong reasons for venture capitalists to seek venture loans for their portfolio firms. First, the inherent high risk of early-stage investment prompts venture capital firms to adopt a diversification strategy, avoiding investing in a narrow number of firms. This approach is also economically sound, since it enables the venture capitalists to spread their skills and experience over a meaningful number of firms. Consequently, syndication is very common in venture capital investments. Venture loans act to substitute some of the need

to syndicate the equity and, in fact, provide better economics, given the far less dilutive form of financing. Second, since investment in start-ups is staged, venture capitalists are required to reserve sufficient capital ("dry powder") for future rounds of investment in their portfolio firms. Venture loans also act to alleviate some of this pressure for future reserves.

Signaling theory, particularly (Leland & Pyle, 1977), produces a strong rational in favor of venture lending. The more hopeful a venture capitalist is about the portfolio firm, the more the venture capitalist would prefer venture debt over an external equity round without pro rata participation, which provides a strong signal to the lender on a concurrent assessment of the business and its future prospects. Ceteris paribus, venture capitalists would prefer seeking venture loans for their more favorable portfolio firms and equity provided by external investors to their other firms.

3.3 Horizon of disappointment and the design of venture loans

We mentioned above that investment in young and innovative firms is done in stages, to reduce the magnitude of capital at risk, and that this gives rise to uncommitted capital reserves kept aside by the venture capitalists for the future support of their portfolio firms. This practice has a first-order effect in the economic logic of venture loans, because, for the majority of start-ups, further equity rounds or the prospect of an exit are the most likely possibilities to repay venture loans. Since there are typically no or insufficient positive operating cash flows in the short or mid-term, the continuing need for external financing to expand the business becomes the prime life buoy of the lender should the loan enter hazardous territory (ends up on the so-called watch list).

As mentioned earlier, a mandatory condition for granting a venture loan is that the firm be backed by strong hands. In assessing the venture lending decision, analyzing the financial capabilities of the current investors and their enthusiasm to further back the firm is equally important for the business due diligence of the firm itself. Since the venture loan is paid in installments over a period of three years or so, the underlying premise is that, even if the firm falls on hard times, there is enough value in the firm such that current investors would not be willing to default on their service debt payment, which would erase their entire past investment, surrendering the firm to the venture lender. To minimize the chance of default, the lending transaction is arranged such that the loan is small in relation to past investments and the latest round valuation. Second, the loan is tranched, which again reduces the size of the loan principal. Third, institutional investors, particularly venture capitalists, need to state that they reserved funds for follow up on investment in the firm (although that statement is not contractual). Fourth, the firm needs to show that it has enough cash even prior to undertaking the loan (ideally not less than nine months of runway prior to obtaining the loan). Hence, a default is only possible during the second or third year of loan maturity. Since the loan is structured to be amortized, the likelihood of loan default in the third year should also be modest, since the remaining balance of the loan at that point is typically small, roughly one-third still outstanding. For an average size loan of 1.5 million EUR, the outstanding loan balance after two years is slightly above 0.5 million EUR. It is hoped that the value of the firm or its assets are significantly higher than that, especially for firms where the investment so far was in the tens of millions and there were enough positive indications during the loan due diligence.

The latest point highlights the key principle in the economics of venture loans, whereby the risk of the loan is not necessarily determined by the riskiness of the underlying business, or even its ultimate fate, but linked to the perceived value during the life of the loan. This point generates the somewhat paradoxical causality that early-stage firms are safer to the lender than mature firms. For example, consider the drug discovery sector. Although ultimately very risky, this sector is capital intensive and has a high level of intellectual property through years of research and development at universities or otherwise, funded by national grants or private sector investors. In such an environment, the venture capital firm is quite unlikely to default in the early years of the business. This phenomenon is referred to as a long horizon of disappointment, which provides the lender a good cushion of risk mitigation. In contrast, an e-commerce firm whose intellectual property is shallow may be a very risky business, even if it is mature and generating cash. Should the fortune of such a firm change, equity investors' horizon of disappointment may be very short, which could trigger a default rather than their throwing good money after bad. Using adages, strong hands correspond to the first situation, whereas weak hands correspond to the latter. Of course, there are other reasons for strong/weak hands. For instance, all else being equal, venture capital firms are more reluctant to commit more capital to portfolio firms that perform poorly and are the last remaining unrealized firm in the current fund. This would qualify as weak hands.

Finally, we refer to the feature in the design of venture loans by which amortized payments are made at short intervals, typically monthly. The rationale emerges from the same frame of mind as the previous discussion. For equal monthly payments over three years, each payment amounts to a fraction of the percentage of the original principal of the loan, say, a fix monthly payment of 70,000 EUR. Every month, the equity investors

face the choice of whether to pay that rather modest sum and continue owning the business or to default, thereby surrendering the business to the lenders. This is the well-known correspondence of equity investment to a call option, whereby every debt service payment results from a decision to keep the equity option alive until the next scheduled payment (Merton, 1974). Insights from option pricing theory tell us that the lower the monthly payment, the lower the chance of default, because the value of the option alive is always compared to the payment amount. Hence, if we were to naively structure the loan on a semiannual amortization schedule, that would multiply the probability of default by a factor of six.

4. Conclusions and directions for future research

We emphasized several contractual agreed instruments that are used to mitigate the downside risk in venture lending, a key aspect of which is the presence and collateralizing possibility of intellectual property. Among non-contractual features, a salient consideration is venture capital backing, which can substitute for positive cash flows and tangible assets. From the entrepreneur's and equity investors' perspective, venture debt extends the start-up's liquidity runway and enables the postponement of an external round of financing until further business progress can be reached and milestones are achieved to validate the business model and hence boost the firm valuation. This scenario would result in less dilution for the current shareholders, which should be traded off against the interest and other costs associated with the venture loan. Interest and principal must be paid on a relatively fast schedule and the entrepreneur must have a clear future financing strategy and liquidity management to handle the debt burden. Furthermore, venture loans are collateralized by intellectual property. If the firm were not

able to repay the venture loan, it would lose its intellectual property, which is often the firm's only valuable asset.

We expect the symbiotic relationship between lenders and venture capitalists as well as network aspects to be important. Venture capital involvement, particularly in the case of long horizons of disappointment for the venture capitalists, rather serves as a quality signal for the venture lender.

Due to the scarcity of transaction data, several opportunities for future research in venture lending are still unexploited. As we have shown several instruments in venture lending deals, it would be useful to empirically examine the impact of venture lending and its instruments in particular on the firm's development or exit strategies. Furthermore, loan characteristics such as interest rates, warrants, and risk-reducing instruments likely depend on specific firm characteristics such as intellectual property, industry, and financing history. To examine venture capitalists' influence on loan characteristics, examination of the impact of the venture capitalist's reputation and relationship to lenders on loan cost drivers is paramount to capture its importance for the venture lending business model.

We provide an analytical contribution to the goals and interests of the involved parties in venture lending and their interactions. Empirical studies are necessary to verify these effects and would help to close the aforementioned research gaps.

C. Study 2: Patent Activity of Start-ups and the Structuring of Venture Lending Contracts

1. Introduction

Venture lenders provide individually structured debt financing for young and innovative companies as interim financing to grow the company's operations and to reach either another venture capital financing round under improved terms or an outright exit (Ibrahim, 2010). The unique business model of venture lenders seems to contradict entrepreneurial finance theory. High levels of uncertainty reflected in the liability of smallness and newness (Brüderl et al., 1992) lead to the expectation that debt-based financing forms are seldom suitable for innovative start-ups due to the underlying business and financial risks (Block, De Vries, Schumann, & Sandner, 2014; Colombo & Grilli, 2007; Westhead & Storey, 1997). Our aim is to understand how venture lenders are able to overcome these obstacles and to structure their financing instruments according to the inherent risks. Previous theoretical and interview-based studies have indicated that the intellectual property in young and innovative companies is a crucial factor in the venture lending decision (Fischer & de Rassenfosse, 2012; Ibrahim, 2010). We extend this literature by empirically examining whether the presence of patents offers a quality signal to venture lenders and leads to an adaptation of the capital costs embedded in venture lending contracts.

Through patents, the start-up is protected against the use of its innovative technology, method, or procedure by other firms leading to an advantage over current or potential future competitors. In addition, patents convey firm characteristics such as technological and specific knowledge, as well as innovativeness and creativity, to third

parties, which reduces their information asymmetries (e.g. Hsu & Ziedonis, 2013; Long, 2002). For equity investors, the current literature shows that intellectual property in the form of patents can serve as a signal for the quality of young and innovative companies. Entrepreneurial firms with patent activity are more likely to close venture capital financing rounds (Audretsch, Bönte, & Mahagaonkar, 2012; Cao & Hsu, 2011; Engel & Keilbach, 2007; Haeussler, Harhoff, & Mueller, 2014), and filing patents leads to higher valuations by venture capitalists (Bloom & Van Reenen, 2002; Hsu & Ziedonis, 2013; Joshua Lerner, 1994). However, due to fundamental differences in the business model of venture capitalists and venture lenders, these results cannot readily be applied to venture lending.

Venture capitalists are focused on identifying start-ups that offer high future returns through a successful exit (e.g. Cumming, 2005a, 2007; Sahlmann, 1990). In contrast, venture lenders rely on steady income streams through the receipt of interest payments and principal repayment (Ibrahim, 2010). When selecting start-ups, venture lenders, therefore, have to focus on limiting the downside risk with the upside only modestly important. While patents were shown to be a signal for the upside potential, it is questionable whether patents also convey information on the downside risk. At least in the short term, the costs associated with patents put pressure on the start-up's liquidity, and positive cash flows from patents might fall outside the venture lender's time horizon. In addition, in venture lending, the entrepreneur and involved venture capitalist(s) are joint equity holders stacked against the venture lender as the debt provider. The venture lender holds a derivative security against the value of the asset and is likely to see their claims at least partly as an option on the claim of the venture capitalist. Quality signals for the start-up might hence be less important for the venture lenders as they are relying

on piggybacking off the venture capitalists. In our view, therefore, it is relevant to further describe the role of patents for the lending decision and to identify consequences of patent activity on the particular terms of a venture loan.

With our access to internal data reports of a venture lending fund with high granularity at the deal level, we are able to investigate actual lending deal structures, which open new insights into the underlying decision processes of the lender and the consequences for the borrower. We systematically analyze whether and how the presence of granted and pending patents impacts the lending deal structures. In other words, do granted or pending patents impact (i) the credit spread and/or (ii) the warrant coverage of a venture loan? Furthermore, we examine how company development stage influences the relation between capital costs and the presence of granted or pending patents.

Our analysis uses a proprietary dataset including 119 venture loans that were issued between 2002 and 2009 in Europe, the US, and Israel by a European venture lending fund. To our knowledge, this is the only comprehensive dataset that exists for venture lending and provides the first opportunity to gather empirical evidence on this innovative form of start-up financing. The results show that the presence of patents has a significant and economically relevant impact on capital costs—including both direct and indirect costs—in venture lending contracts. Furthermore, we show that the relation between the presence of patents and direct capital costs is particularly strong in ventures at an early development stage.

The study extends the current literature in three different fields of academic research regarding the financing of entrepreneurial firms. First, we extend the literature on venture lending by contributing the first empirical analysis of factors that influence

capital costs in venture lending contracts. Second, we contribute to the patent signaling theory by revealing that patents provide a signal of quality not only to equity investors but also to the payoff distribution parameters that are applicable principally to debt providers such as venture lenders. Thus, patents are able to convey information that is also relevant to the downside risk to venture lenders. Furthermore, we show that patents are particularly relevant when companies are in their earlier development stages. Third, we extend the literature on entrepreneurial finance that suggests that young and highly innovative entrepreneurial firms often have limited access to debt financing due to the unavailability of tangible securities and high information asymmetries and, thus, are mostly equity financed (Cosh et al., 2009; Denis, 2004; Hellmann & Puri, 2002; Kaplan & Strömberg, 2004). Our data suggest that venture lending—under certain conditions—can be an appropriate financing instrument for young and innovative ventures.

We proceed as follows: The next section introduces the venture lending business model, presents the theoretical background on the determinants of capital costs, and develops hypotheses on the relation between patents and capital costs. Section 3 presents the empirical strategy, as well as descriptive statistics and the dependent and independent variables, used in our regression models. In Section 4, we present the empirical results. We conclude in Section 5.

2. Theoretical background and hypotheses development

2.1 Patents and capital costs in entrepreneurial finance

Venture loans are individually structured debt-financing instruments for young innovative firms that provide interim financing for operational growth and to extend the

cash runway between venture capital funding rounds (Ibrahim, 2010; Rhodes-Kropf & Leamon, 2010). However, debt financing is strongly dependent on tangible assets or positive cash flows as securities, which the companies have to provide in order to get debt capital (Berger & Udell, 1990; Cumming & Fleming, 2013). Young and highly innovative firms often do not have tangible assets or positive cash flows to provide as security (Achleitner et al., 2011; Berger & Udell, 1998; Cosh et al., 2009). However, venture loans enable those companies to obtain debt capital from lenders by relying on alternative forms of securitization. The lack of track records and the unavailability of tangible securities require these alternative instruments or assets such as intellectual property or a strong investor-backing to secure the repayment of the loan. Another characterizing instrument in venture lending deals is the warrant coverage, which presents an option for the venture lender on the borrower's equity stake and is an additional income source for the lender compared to traditional bank loans (Roberts et al., 2008).

Although venture lending appeared in the 1980s in the United States and today has an established market position in countries including the US, Israel, and the UK (Roberts et al., 2008), it has received little attention in academic research. Previous research on venture lending has focused on general explanations and analyses regarding the lending decision and underlying assumptions. Based on hand-collected interview data, Ibrahim (2010) described the structure and contract design of venture loans in general. He points out that venture capital backing may substitute for positive cash flows and tangible assets, and that patents support the collateral position of the lender. De Bettignies and Brander (2007) dealt with the choice of entrepreneurial firms between bank finance and venture capital. They theoretically examined the consequences of this choice on the entrepreneurial firm regarding control rights, ownership rights, managerial contributions,

and the cost of capital. Their study emphasizes that entrepreneurs have the choice between debt and equity, and that the entrepreneurs consider aspects like dilution and control rights to balance out which terms of different financing instruments are favorable for them.

Fischer and de Rassenfosse (2012) conducted a choice experiment with 55 senior venture lenders on determinants that influence the lending decision of venture debt firms. Their key result was that venture capital backing can substitute for the start-up's cash flow, but this effect is only observable for early-stage start-ups. Additionally, they state that the presence of patents facilitates the lending decision by serving as collateral for the venture lender. Offering intellectual property in the form of patents as collateral is likely to increase the likelihood of repayment of venture loans. Additionally, a higher activity in the secondary market for patents stimulates the collateral-based debt financing, which emphasizes that patents can serve as collateral and could hence be an important factor in the decision-making process for debt providers for innovative companies (Yael V. Hochberg et al., 2014).

Due to the lack of deal-level data, the current literature on venture lending is either interview-based and theoretical or based on choice-experiments. Quantitative empirical studies regarding the determinants of venture lending contracts are still missing in this strand of research. In our study, we build on the existing literature and focus on the relevance of patents on venture lending contracts and how the presence of patents affects the costs of venture loans. While the existing theoretical studies show that patents are likely to be relevant in the lending decisions of venture loans, we are able to quantify this effect due to a proprietary dataset. In particular, we analyze how patents impact the cost structure of venture loans.

The most discussed and well-known aspect regarding patents is that patenting protects intellectual property against the use of a specific technology, method, procedure, or new substance by competitors (e.g. Haeussler et al., 2014; Hsu & Ziedonis, 2013; Long, 2002; Mann, 2005; Teece, 1986). Thus, the value of patents stems from the exclusive right to use these technologies and to hinder competitors from market entry and imitation.

In the software industry, more patents are granted, the higher market entry barriers are. This emphasizes that patents help to protect start-ups against competitors and to save market niches, entirely new markets, or submarkets (Cockburn & MacGarvie, 2011). Thus, companies who own strong patents in their field have an advantage over their current and potential future competitors.

In addition, patents can have more functions than just being valuable regarding product markets and exclusivity rights as they are able to convey certain information to third parties. Holding patents conveys positive related information because patents imply firm characteristics, such as technological and specific knowledge, newness, and creativity. In pre-revenue start-ups, patents are one of the few vehicles by which value can be transformed from intangible to tangible property. Due to the conveyance of information to third parties, information asymmetries can be reduced and consequently patents can have a positive influence on the firm's performance (Long, 2002). Moreover, the creation and invention of new technologies, procedures, or treatments need financial as well as human resources. Costs are particularly high in cases where companies want to ensure patent protection for their invention in a number of countries (Sandner & Block, 2011). Furthermore, patents have to be filed at a patent office where they will be reviewed

and, in the best case, finally granted. Thus, due to the patenting process and the patent reports of the patent offices, patents are observable and verifiable by outsiders.

Regarding equity providers, an empirical study by Conti et al. (2013) on 226 high-tech start-ups has shown that patents signal quality to venture capitalists and business angels. Moreover, the study revealed that patents are more highly valued by venture capitalists than capital by private informal sources such as family or friends. Additionally, the authors found that patents have a higher impact on the financing of business angels than on money from family and friends. Overall, the authors concluded that patents provide a signal of quality to early-stage equity providers.

Based on 370 venture-backed semiconductor start-ups, Hsu and Ziedonis (2013) showed that patent activity has a positive effect on obtaining venture capital from a highly reputable venture capitalist, on capital costs within several venture capital financing rounds, and on share prices for start-ups that are going public. Their results indicate that successful patenting is more influential for entrepreneurial firms that lack potential quality signals and are in earlier stages of financing. This result is in line with prior studies that reveal that entrepreneurial firms that are filing patents are more likely to receive venture capital (Audretsch et al., 2012; Cao & Hsu, 2011; Engel & Keilbach, 2007; Haeussler et al., 2014). Consequently, patenting leads to higher valuations of the start-ups when they are assessed by venture capitalists (Bloom & Van Reenen, 2002; Hsu & Ziedonis, 2013; Joshua Lerner, 1994). For venture capitalists, patents are considered as an essential factor in their investment decision because they can be sold in the case of a write-off of the portfolio company (B. H. Hall & Harhoff, 2012; Kamiyama, Sheehan, & Martinez, 2006).

Haeussler et al. (2014) went one step further and showed that not only patent applications and granted patents signal quality to outside equity investors but that the filing of patents and the underlying patenting process is also positively related to venture capital funding. Hence, the patenting process itself uncovers relevant information to third parties. Information is revealed due to search reports, citations, and commercial information about the patents during the filing process. Patenting processes affect the likelihood of venture capital funding and provide more information to investors, thereby supporting them in updating evaluations regarding the quality of the entrepreneurial firms.

Regarding venture lending, there are experimental indications that patents serve as collateral to debt providers and, in particular, to venture lenders (Fischer & de Rassenfosse, 2012). In this study, we build on these results and delve deeper into the role of patents in structuring venture lending contracts. So far, there has been no empirical study regarding this topic, and the signaling effect of patents on venture capitalists is not readily transferrable to venture lending. Equity investors focus on the upside return potential (Cumming, 2005a, 2007; Sahlmann, 1990) whereas venture lenders focus on the downside risks (Ibrahim, 2010). While venture capitalists invest in start-ups that are likely to maximize their returns through a successful exit, venture lenders are focused on gaining constant income streams through regular interest payments during a limited time period. Thus, venture lenders are focused on limiting the downside risk rather than seeking the maximum return. Due to the different business models of these two capital providers, their perception of quality signals based on patents might also be different.

Patents protect inventions and treatments for a long time (e.g. 20 years) and thus secure advantages against competitors by ensuring constant revenues on certain products.

Despite these advantages, patents also need a long time horizon until any revenue or profits can be generated. In the meantime, patents can—especially in start-ups—put pressure on liquidity and thus hinder growth and development. For venture lenders, whose business model is based on the start-up's ability to meet interest and principal payments, pending patents could particularly negatively affect the venture's liquidity due to the invention and patenting costs. The term of a venture loan might be too short to profit from the revenue-building effect of patents. Granted patents, in particular, put pressure on a firm's future liquidity due to maintaining claims, geographical expansion, or service costs. Additionally, previous costs due to patenting are irrelevant for the venture lender as they are properly captured by the valuation. In addition, even if the patent is used as collateral for the venture lender, it is questionable whether the lender is able to liquidate those intangible assets. These arguments would imply that in contrast to venture capitalists, patents might not be a relevant quality signal for venture lenders. Venture lenders might interpret their claims on the start-up primarily as being dependent on the venture capitalists. Quality signals for the start-up might thus be less relevant.

However, as patents signal quality to venture capitalists, and the involvement of venture capitalists is an essential condition for future equity-financing rounds to pay back venture loans, patents could have a positive effect on the lending decision of venture lenders. Venture lenders are piggybacking off the venture capitalists, and the venture lending business model is centered on extending the liquidity runway of venture capitalists. Despite the fact that venture lenders and venture capitalists are different in their risk perception, overall, we expect that the positive effect of patents on the exclusion of competitors and the prospect of future profits still lead to a quality signal from patents

to venture lenders. However, it remains an empirical question whether this expectation can be seen in actual venture lending contracts.

Accordingly, we analyze whether holding patents or patents that are still pending have a positive signaling effect to venture lenders and, as a consequence, reduce capital costs for the borrower. As measures for the capital costs in venture lending contracts, we use the credit spread and the warrant that were applied by the venture lender. The credit spread is the main income source for the venture lender and thus reflects the risk perception of the venture lender regarding the borrower. Furthermore, credit spreads in debt-financing contracts can also be seen as a direct function of the probability of failure (Cressy, 1996). In order to take into account the indirect costs for the borrower, we additionally use the warrant as another variable for measuring capital costs. The warrant has, compared to the credit spread, no direct impact on the borrower's liquidity. Furthermore, it neither has a direct impact on the revenue stream for the venture lender, as the option will only exercise in the case of a liquidation event. Despite the different impacts on the borrower's liquidity, the warrant and credit spread are the main cost drivers for the borrower. For the venture lender, the credit spread ensures constant revenue streams, which have to ensure the intended internal rate of return and the warrant is like a bonus on top of this and constitutes the upside return potential. We hypothesize the following:

Hypothesis 1a: The presence of at least one granted or pending patent reduces the credit spread in venture lending contracts.

Hypothesis 1b: The presence of at least one granted or pending patent reduces the warrant coverage in venture lending contracts.

2.2 Firm maturity and its influence on the relation between patents and capital costs

The maturity of a firm influences information asymmetries between start-ups and capital providers (Achleitner, Braun, Lutz, & Reiner, 2014; Cumming, 2005a; Gompers, 1995; Sahlmann, 1990). In later stages, more information about the business model is available and future profits and cash flows can be more easily projected (Hellmann & Puri, 2002). Accordingly, the signaling effect of patents towards venture capitalists is more relevant for early-stage companies that lack other attributes to credibly convey information to venture capitalists (Hsu & Ziedonis, 2013). There is also evidence from traditional bank loans indicating that a more mature company lifecycle (measured as the loan volume) leads to a decrease in the credit spread (Hanley & Girma, 2006). Consequently, smaller loans are charged a premium price to compensate for their higher risk. Cressy (1996) found that smaller loans are less likely to be collateralized but that the risk adjustment was depicted by higher credit spreads instead. Furthermore, he has shown that larger loans are charged lower credit spreads and that credit spread is a direct function of the probability of failure.

The existing literature focuses on the more traditional debt instruments that are used in less innovative contexts than venture lending. For venture lenders, company lifecycle stage is likely to be particularly relevant due to the more pronounced risks than in traditional debt contracts. However, if venture lenders finance companies in an early stage, the negative effect of patents on liquidity might be particularly relevant. This could dampen the impact of maturity on the role of patents.

Companies that are at a later stage, and thus have already exhibited a successful development, might be less dependent on patents to convey information and signal quality

whereas younger and premature firms have a higher risk of default due to the liability caused by newness and smallness. Thus, the effect of patents on capital costs is expected to be more relevant for early-stage companies than for later-stage companies. It could be that for venture loans in early-stage companies, an exit lies so far in the future that the impact of patents on the warrant is less pronounced than on the credit spread. We again analyze credit spread and warrant separately and hypothesize the following:

Hypothesis 2a: The effect of patents on the credit spread is stronger for early-stage companies than for later-stage companies in venture lending contracts.

Hypothesis 2b: The effect of patents on the warrant coverage is stronger for early-stage companies than for later-stage companies in venture lending contracts.

3. Empirical strategy and descriptive statistics

Our study builds on a unique dataset that contains the complete investment history of a European venture lending fund. With detailed deal-level data, we are able to analyze the complex structure of venture lending contracts. In particular, we collected and analyzed the underlying transaction proposals of the fund by which we get the exact information about the contract details of the venture lending deals. Our final sample consists of 119 venture loans that were issued between 2002 and 2009 in Europe, the United States, and Israel. The initial sample contained 132 observations. We deleted four observations because they were classified by the venture lender as working capital or a convertible loan. Another nine observations were deleted due to unavailability of data such as operating profit for the last fiscal year of the companies or the total number of

employees in the companies. Table C. – 1 presents the descriptive statistics of our final sample.

Table C. – 1: Sample description

Variables	Description	N	Mean	Median	Min	Max	SD
Dependent variables							
creditspread	Credit spread is measured in basis points between 3-year-swap rate and actual interest	119	804.81	773.60	507.10	1269.3	132.08
warrant	Warrant coverage is expressed in percent in dependency of the loan amount.	105	0.1358	0.1250	0.0450	0.2380	0.0437
Firm-specific variables							
patents_dummy	One for the presence of at least one granted or pending patent.	119	0.54	1.00	0.00	1.00	0.50
employees	Total number of employees in the borrower's company.	119	68	50	2	331	60
valuation	Valuation of the borrower in € million of the last equity round.	119	25.64	18.74	0.00	247.22	31.59
drawdowntotal	Total drawdown of the venture loan in € million. Includes all tranches.	119	2.189	1.906	0.448	8.544	1.579
op_profit_last_yr	Operating profit/loss of the last fiscal year of the borrower in € million.	119	-3.735	-2.980	-20.148	2.844	3.595
country_uk	One for borrower's headquarters is in the United Kingdom.	119	0.46	0.00	0.00	1.00	0.50
industry_R&D_intensive	One for borrower belongs to healthcare or semiconductor sector.	119	0.29	0.00	0.00	1.00	0.46
no_of_vcs	Number of venture capitalists invested in the company.	119	3.04	3.00	1.00	8.00	1.71
Environmental variables							
vl_deals_total	Number of venture lending deals in Europe per year of the three main suppliers of	119	91.10	87.00	7.00	127.00	34.01
vc_volume_europe	Venture capital volume per year in Europe in € million.	119	5,502	5,551	4,150	6,446	629

This table provides descriptive statistics and specification of variables we used in the econometric models. The sample consists of 119 observations and shows that the credit spread is on average 804.81 basis points. The warrant coverage ranges from 0.045 at the lowest to 0.2380 at the highest. The average drawdown is 2.189 million Euro and the companies employ on average 68 people. We also report the number of venture capitalists per company to show that the involvement of venture capitalists is an essential condition to obtain a venture loan. Furthermore, we report environmental variables to control for market changes.

3.1 Dependent variables

Credit spread

As the first dependent variable, we use the credit spread to cover direct and monetary measurable costs for the borrower. We measure credit spread as the difference between the three-year swap rate at the time of the loan issuance and the actual interest rate that was applied in the venture lending deal. We use the three-year swap rate to calculate the credit spread because it is the measure that was used by the venture lender to calculate the risk premium for the venture lending deals. Furthermore, by using the credit spread, we eliminate market fluctuations that arise due to changes in the macroeconomic interest levels. In our data, the credit spread was on average (median) 804.81 (773.60) basis points. For building the variable credit spread, we calculated the weighted average of all tranches that were issued to a company weighted by the amount of each tranche. We use the credit spread to illustrate the costs because it is the main direct-cost driver in venture lending deals.

Warrant coverage

As the second dependent variable, we use the warrant coverage as a measure indirect costs for the borrower and to represent the lender's option on the borrower's equity stake. Through a warrant, the lender receives the right to exercise an option on a share of the borrower's equity in case of an exit. The option entails the right to purchase a fixed amount of shares at a fixed price. That means, if the valuation of the borrower at the time of an exit is higher compared to the time of the loan issuance, the lender benefits by exercising the equity option. In our sample, the average (median) warrant is 13.58%

(12.50%), which means that the venture lender is, on average and if, for example, the loan amount is 1 million Euro, able to buy shares to the amount of 135,800 Euro at a fixed price. We use this variable to measure the indirect costs for a borrower in venture lending deals. The number of observations for the variable warrant is reduced due to the fact that the venture lender for some deals applied an exit incentive, which was not expressed in a warrant.

3.2 Independent variables

patents_dummy

The main independent variable of interest indicates whether a start-up has at least one patent granted or at least one patent pending. Due to the fact that pending, as well as granted, patents have a signaling effect, we use a dummy variable that accounts for having at least one patent granted or pending. The variable *patents_dummy* is coded 1 if the company holds at least one patent or has filed at least one patent, and 0 otherwise. We use a dummy variable for the analysis because the innovativeness and the signal that is sent by holding a patent depend less on the number of patents a company holds than on holding at least one patent (Mann & Sager, 2007). In Table C. – 2, we show the patent distribution within our sample. Fifty-four percent of the companies in our sample hold or had filed at least one patent. On average, the companies hold 4.00 patents and have filed 3.84 patents that are still pending, while 39% already hold granted patents and 35% of the companies have filed patents that are still pending.

Table C. – 2: Patent distribution

Variables	N	Mean	Median	Min	Max	SD
patents_dummy	119	0.54	1	0	1	0.50
patentsgranted	117	4.00	0	0	100	11.51
patentsgranted_dummy	119	0.39	0	0	1	0.49
patentspending	117	3.84	0	0	51	8.15
patentspending_dummy	119	0.35	0	0	1	0.48

Table C. – 2 presents the patent distribution within our sample's companies and illustrates a heterogenous distribution.

Independent variables for interaction

For the firm's maturity, we include various proxies and use these variables to interact with the variable *patents_dummy* to examine the influence of a firm's maturity on the relation between patents and capital costs. First, we use the total number of employees to take account of the firm's lifecycle. In particular, in highly innovative firms that are simultaneously high-growth-potential firms, the number of total employees displays the growth and maturity of an entrepreneurial firm (Davila, Foster, & Gupta, 2003).

Second, we include the valuation of the company as a proxy for the firm's development stage because the valuation is dependent on factors such as the number of funding rounds, total funding, future development opportunities, and validity of the business model. The valuations were taken from the transaction proposals that were prepared by the venture lender. The variable reflects the valuation of the last equity funding round.

Third, we include the total amount of the venture loans that were issued to depict the maturity of a firm. The higher the total amount of debt the companies obtain, the higher the maturity of those firms (Hanley & Girma, 2006).

Fourth, we include the operating profit of the last fiscal year as another proxy for maturity. The operating profit or loss indicates whether a start-up is able to create a monetary value that is competitive with other companies. In addition, an operating profit reduces the risk and uncertainty for the debt provider and ensures the repayment of a venture loan. Thus, increasing operating profit indicates a more mature lifecycle of an entrepreneurial firm (Engel & Keilbach, 2007; Gompers, Kovner, Lerner, & Scharfstein, 2010).

By taking into account the total number of employees, valuation, total drawdown, and profitability, we increase the robustness of our analysis of how the maturity of a firm has an effect on the relation between patents and capital costs of a venture loan.

Control variables

In our study, we control for macroeconomic aspects such as the number of venture lending deals and venture capital volume in Europe, as well as the company characteristics like geography and industry. By including the variable *vl_deals_total* for the total number of venture lending deals, we depict the market sentiment and dynamic of the venture lending market in Europe. A higher activity in the venture lending market might influence capital costs for borrowers due to higher competition among venture lenders, as well as the volatility of demand and supply of venture loans. Thus, the variable

vc_volume_europe for the venture capital investment volume in Europe controls for the overall dynamic in the venture capital financing market.

We roughly control for the spatial proximity between the venture lender and the start-ups that have received venture loans by taking into account whether the headquarters of the borrower is in the same country as the venture lender's headquarters. Several studies have shown that the probability of getting funded by venture capitalists decreases if the journey time from the investor to start-up increases (Gupta & Sapienza, 1992; Lutz, Bender, Achleitner, & Kaserer, 2013). Additionally, a study that included 14,871 observations from small and medium-sized firms showed that credit spreads increase with the distance between the lender and borrower (Bellucci, Borisov, & Zazzaro, 2013). Therefore, we include the dummy variable *country_uk*, which is coded 1 for start-ups with headquarters in the United Kingdom and 0 otherwise.

Moreover, we control for the industry of the companies that received a venture loan. We subdivided the sample into two groups and build the variable *industry_R&D_intensive*, which is coded 1 if the company belongs to an industry that has high research and development costs, such as biotech, pharma, or semiconductors, and 0 if the company is associated with software, e-commerce, or others. By distinguishing these two groups of industries, we differentiate industries in which companies have high R&D costs and, as a consequence, are faced with higher liquidity pressure due to these costs compared to companies from other industries. As venture lending seeks to extend the cash runway, pressure on liquidity is relevant and has to be considered by including this variable. Additionally, we include year dummies to control for time effects in our regression models.

3.3 Methodology

We conduct ordinary least square (OLS) and Tobit regressions to examine the effect of the presence of granted and pending patents on venture lending capital costs. The regression models are used with clustered errors by company identification numbers and take into account the error term that multiple observations of the start-ups are not independent of each other. Hence, we are able to calculate models with robust errors. Furthermore, we test interaction terms regarding the maturity of the companies to verify our results and to examine whether the maturity of a firm influences the relation between patents and capital costs.

To verify our results and to test the robustness, we conduct a propensity score-matching model. The propensity score-matching model estimates the difference between a treated and non-treated group. In our study, we differentiate between start-ups who have granted or pending patents and those that do not have patents. To match the most suitable pairs of start-ups with and without patents, we run a probit regression to estimate the likelihood of having patents that are dependent upon the matching variables. After that, we match the start-ups with their nearest neighbor, which is measured by the propensity score and the country dummy, to ensure a more precise matching result, and we then run a t-test to calculate the mean differences. We remove observations if they are not suitable, i.e., we restrict the maximum distance between a matching pair to a value of 0.1 as measured in the propensity score.

4. Empirical results

Table C. – 3 reports the results from the OLS and Tobit regression models for the effect of the presence of at least one granted or filed patent on capital costs in venture lending deals which refer to Hypothesis 1a and 1b. In particular, Model 1 and 2 analyze the effect of the variable *patents_dummy* on the applied credit spread in the venture lending deal, and Model 3 and 4 estimate the effect on the applied warrant in the deal.

Table C. – 3: Results of OLS and tobit regression models

	Model 1	Model 2	Model 3	Model 4
	OLS	Tobit	OLS	Tobit
VARIABLES	credit spread		warrant	
patents_dummy	-62.58***	-62.58***	-0.0242***	-0.0242***
	(16.19)	(15.20)	(0.00657)	(0.00611)
valuation	0.0888	0.0888	0.000107	0.000107
	(0.533)	(0.500)	(0.000210)	(0.000195)
employees	-0.0725	-0.0725	-0.0000826	-0.0000826
	(0.227)	(0.213)	-0.0000754	-0.0000702
drawdowntotal	-18.12**	-18.12**	-0.0111***	-0.0111***
	(8.490)	(7.970)	(0.00285)	(0.00265)
op_profit_last_yr	-7.181**	-7.181**	-0.00227*	-0.00227*
	(3.002)	(2.818)	(0.00128)	(0.00119)
vl_deals_total	-0.0883	0.854	-0.000203	-0.000340
	(0.300)	(0.753)	(0.000290)	(0.000220)
vc_volume_europe	-0.0746	-0.141***	-0.0000133	-0.00000361
	(0.0518)	(0.0298)	-0.0000269	-0.00000722
country_uk	17.74	17.74	-0.00636	-0.00636
	(15.92)	(14.94)	(0.00701)	(0.00652)
industry_R&D_intensive	40.33**	40.33**	0.0188**	0.0188**
	(18.32)	(17.20)	(0.00804)	(0.00747)
Year dummies	yes	yes	yes	yes
Constant	1,382***	1,632***	0.240*	0.204***
	(274.3)	(142.1)	(0.125)	(0.0401)
Observations	119	119	105	105
R-squared	0.551		0.622	

Table C. – 3 presents estimates of the OLS and Tobit regressions to examine the effect of the presence of at least one granted or filed patents on the applied credit spread or warrant in venture lending deals. Model 1 and 3 report the estimates for the OLS regressions and Model 2 and 4 report the estimates for Tobit regressions. The number of observations vary because in some cases there was no warrant applied. Robust standard errors are in parentheses. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

The regression results for Model 1 and 2 show evidence that the presence of granted or pending patents has an effect on the credit spread of the venture loans. The variable *patents_dummy* shows a significant and negative effect at the 1% significance level. The regression coefficients in Model 1 and 2 reveal that if a company holds or has filed at least one patent, the credit spread decreases by 62.58 basis points, which shows an economically relevant negative effect of patents on credit spread. Furthermore, Model 3 and 4 also show evidence that patents also have an effect on the warrant. The results are significant at the 1% level and indicate a reduction in the warrant coverage of 2.42 percentage points if the company has pending or granted patents. The high R-squared values of 0.55 in Model 1 and 0.62 in Model 3 show that we have considered the key variables in our regression models. Our results confirm our hypotheses 1a and 1b that the presence of granted or pending patents has an effect on capital costs in venture lending contracts both on credit spread and warrant coverage. Thus, patents serve as a signal for the quality of entrepreneurial firms and convey relevant information regarding the downside risk for venture lenders.

In

Table C. – **4**, we show the interaction effects between the independent variable *patents_dummy* and the variables total number of employees, valuation, total drawdown, and operating profit, which are used as proxies for the maturity of a firm. We present four regressions models that illustrate the effect of the maturity of a firm on the relation between patents and credit spread.

Table C. – 4: Results of interaction with proxies for maturity on credit spread

VARIABLES	Model 1 credit spread	Model 2 credit spread	Model 3 credit spread	Model 4 credit spread
patents_dummy	-117.0***	-99.52***	-97.09***	-88.59***
	(25.57)	(21.70)	(25.66)	(20.87)
patents_dummy * employees	0.779**			
	(0.340)			
patents_dummy * valuation		1.585**		
		(0.653)		
patents_dummy * drawdowntotal			16.00*	
			(9.543)	
patents_dummy * op_profit_last_yr				-8.021*
				(4.485)
employees	-0.601*	-0.0359	-0.105	-0.0601
	(0.307)	(0.212)	(0.226)	(0.227)
valuation	0.0648	-1.323**	0.101	-0.0710
	(0.473)	(0.621)	(0.541)	(0.504)
drawdowntotal	-18.22**	-12.80	-26.71***	-15.96*
	(7.671)	(8.485)	(7.404)	(8.266)
op_profit_last_yr	-7.015**	-5.966*	-6.856**	-1.964
	(2.813)	(3.098)	(3.016)	(3.836)
vl_deals_total	-0.361	0.275	0.776	0.527
	(0.885)	(0.801)	(0.785)	(0.805)
vc_volume_europe	-0.143***	-0.143***	-0.145***	-0.140***
	(0.0299)	(0.0321)	(0.0317)	(0.0319)
country_uk	13.73	18.28	15.36	14.25
	(15.59)	(16.11)	(15.91)	(16.48)
industry_R&D_intensive	47.37***	45.16**	40.90**	36.94**
	(17.48)	(18.39)	(18.32)	(17.93)
year dummies	yes	yes	yes	yes
Constant	1,830***	1,729***	1,680***	1,679***
	(158.5)	(160.1)	(155.7)	(158.1)
Observations	119	119	119	119
R-squared	0.573	0.568	0.558	0.558

Table C. – **4** presents the results of the interaction effects of maturity of a firm on the relation between the presence of at least one or granted patent on credit spread. To estimate the effect we use OLS regressions. Robust standard errors in parentheses. The symbols *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

In Models 1 to 4, we interact the variable *patents_dummy* and the proxies for maturity to analyze the moderation effect of the proxies on the relation between the presence of at least one granted or pending patent and credit spread. Model 1 and 2 show the interaction term between patents and employees, as well as the valuation of the company, which are significant at the 5% level and indicate that the total number of employees and the valuation of the company negatively influence the relation between patents and credit spread. Furthermore, Model 3 indicates that the total drawdown also has a negative impact on the relation between patents and credit spread, which is significant at the 10% level. This result is in line with the previous interaction term result that the impact of patents is also influenced by the maturity of the firm. In Model 4, we estimate the effect of the operating profit on the relation between patents and credit spread, but we could not find evidence for an interaction as the variable operating profit is not significant.

To illustrate and interpret our results, we plot the significant interaction terms (see Figs. C. – 1, 2, and 3, below) of employees, valuation, and drawdown on the relation between patents and credit spread. Figure C. – 1 illustrates that if the total number of employees is low (high), represented as the mean minus (plus) one standard deviation, the presence of patents is more (less) relevant. Furthermore, the gradient of the slope for a small number of employees is considerably higher (−105.01) compared to the gradient of the slope for a large number of employees (−15.93). This means that the effect of the interaction term on the relation between patents and credit spread is also of economic importance for the borrower, which is reflected in considerably higher credit spread if the company is at an earlier stage and does not have any patents. This shows that the presence

of patents has a higher impact on credit spread for less mature firms and that the more mature a firm, the less important is the presence of patents.

Figure C. – 1: Plot of interaction effect of employees on relation between patents and credit spread

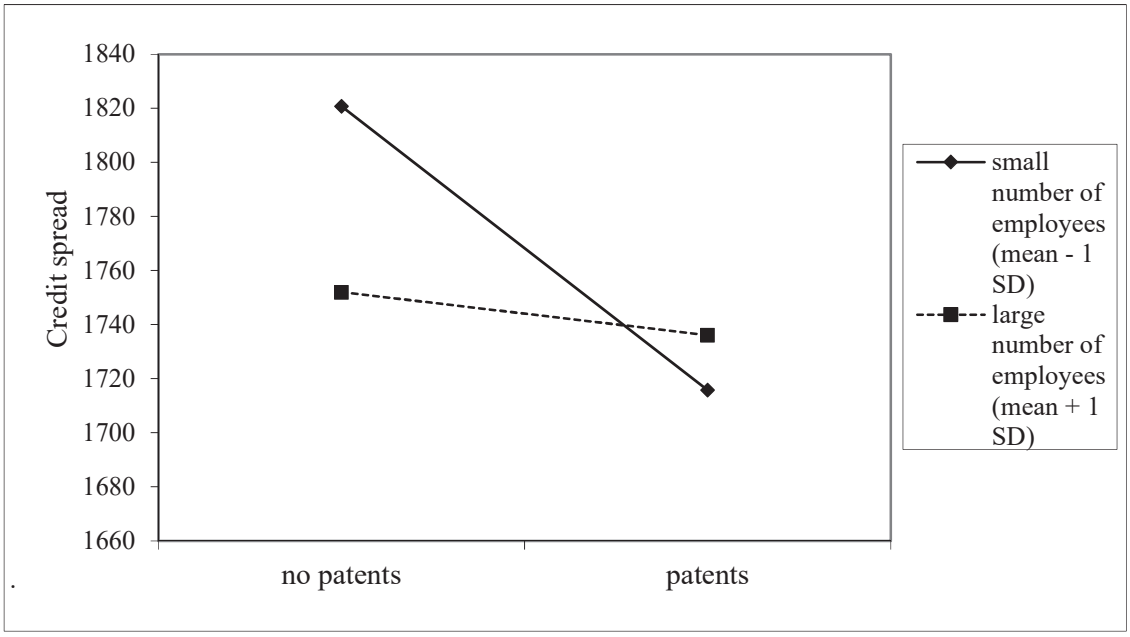


Figure C. – 1 presents the plot of the interaction effect of employees on the relation between the presence of at least one granted or pending patent and the credit spread in venture lending contracts.

In Figure C. – 2 we present the plot of the interaction of valuation on the relation between patents and credit spread. This plot also illustrates that a high (low) valuation, represented as the mean plus (minus) one standard deviation, reinforces (mitigates) the effect of patents on the credit spread. The economic effect is similarly strong to the effect of the total number of employees on this relation. The gradient of the slope for a low valuation is −102.92 compared to a gradient of −7.56 for a high valuation.

Figure C. – 2: Plot of interaction effect of valuation on relation between patents and credit sSpread

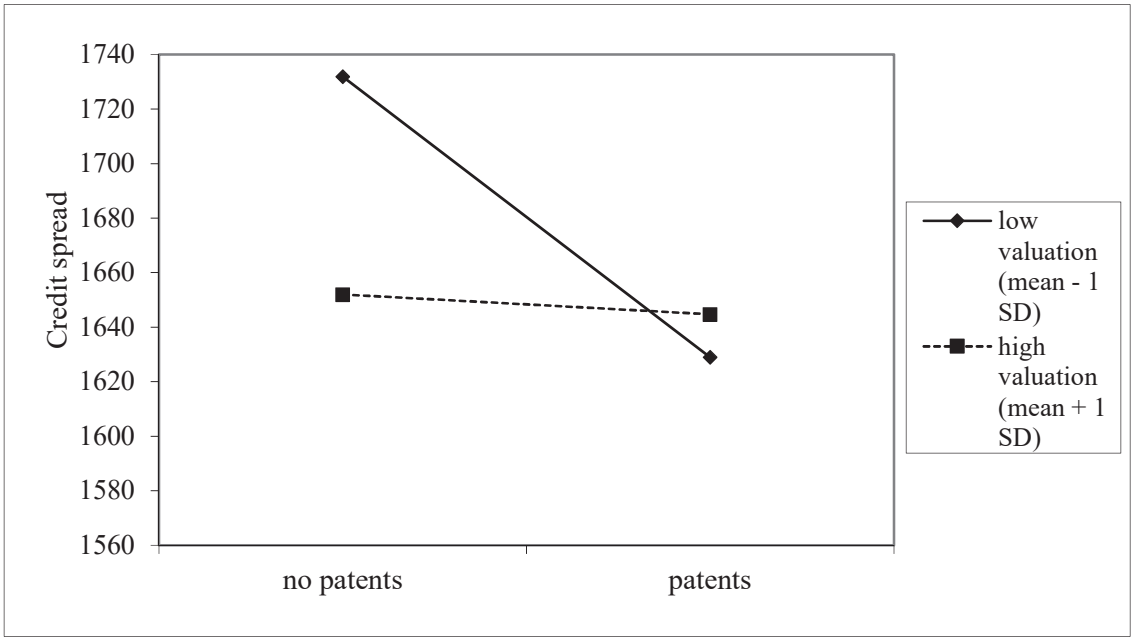


Figure C. – 2 presents the plot of the interaction effect of the valuation on the relation between the presence of at least one granted or pending patent and the credit spread in venture lending contracts.

Another interaction term, the variable total drawdown, shows similar effects at a significance level of 10%, which is not as strong as the effect of the previous proxies for maturity. Figure C. – 3 clarifies that the effect of the total drawdown as an interaction term with patents is weaker due to a smaller difference between the gradients of the slopes for low (−86.70) and high drawdown (−25.15) but is still economically relevant. This result is plotted in Figure C. – 3.

Figure C. – 3: Plot of interaction effect of drawdown on relation between patents and credit spread

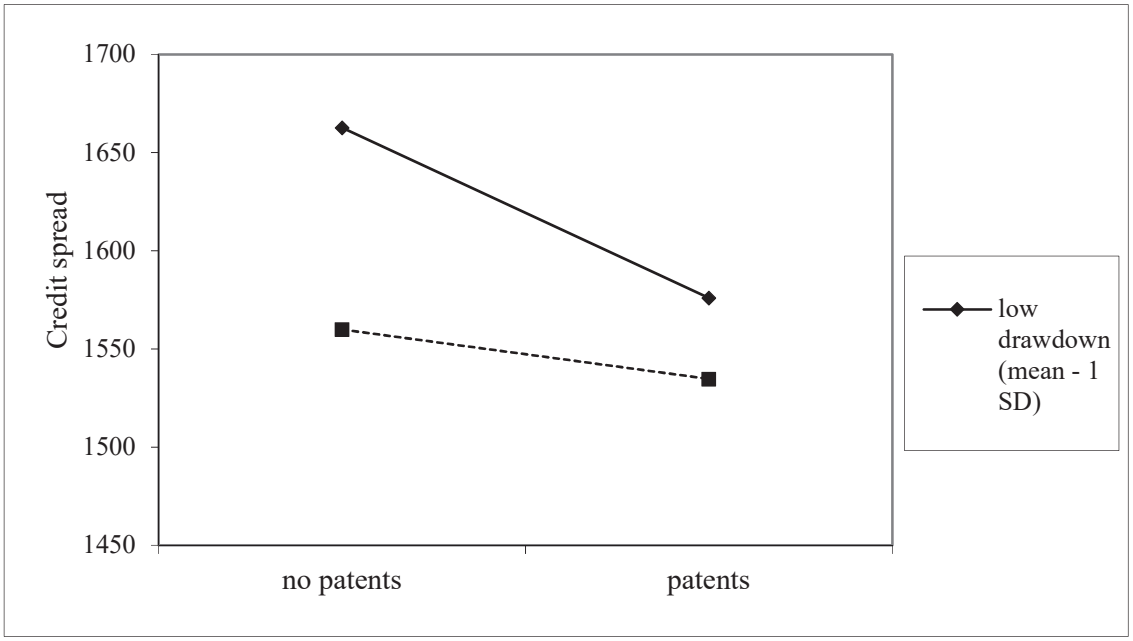


Figure C. – 3 presents the plot of the interaction effect of the total drawdown on the relation between the presence of at least one granted or pending patent and the credit spread in venture lending contracts.

Overall, we show that three out of four proxies of a firm's maturity significantly moderate the effect of patents on credit spread. Our results suggest that patents have a more relevant effect on early-stage companies than on later-stage companies. Thus, patent signaling seems to be stronger regarding venture lenders when companies are in early development stages.

In Table C. – 5, we present the results for the interaction with the variable warrant coverage as the dependent variable. The interaction between the presence of patents and employees, valuation, and total drawdown, as well as operating profit, do not reveal any statistically significant effects on the indirect costs of a venture loan. Nevertheless, the results point in the expected direction. This could be a hint that the maturity of a firm also influences the warrant in venture lending contracts even though it is not statistically significant.

Table C. – 5: Results for interaction with proxies for maturity on warrant

VARIABLES	Model 1 warrant	Model 2 warrant	Model 3 warrant	Model 4 warrant
patents_dummy	-0.0281**	-0.0344***	-0.0263**	-0.0192*
	(0.0109)	(0.00953)	(0.0120)	(0.0101)
patents_dummy * employees	0.0000619			
	(0.000131)			
patents_dummy * valuation		0.000459*		
		(0.000231)		
patents_dummy * drawdowntotal			0.000974	
			(0.00382)	
patents_dummy * op_profit_last_yr				0.00161
				(0.00214)
employees	-0.000114	-0.0000479	-0.0000813	-0.0000806
	-0.0000766	-0.0000836	-0.0000753	-0.0000772
valuation	0.0000932	-0.000328	0.000105	0.000135
	(0.000209)	(0.000281)	(0.000212)	(0.000216)
drawdowntotal	-0.0109***	-0.00897***	-0.0116***	-0.0115***
	(0.00277)	(0.00301)	(0.00295)	(0.00299)
op_profit_last_yr	-0.00219*	-0.00181	-0.00224*	-0.00337**
	(0.00125)	(0.00127)	(0.00128)	(0.00156)
vl_deals_total	-0.000414*	-0.000467**	-0.000340	-0.000265
	(0.000230)	(0.000223)	(0.000236)	(0.000251)
vc_volume_europe	-0.00000396	-0.00000397	-0.00000377	-0.00000383
	-0.00000783	-0.00000779	-0.00000777	-0.00000777
country_uk	-0.00638	-0.00539	-0.00640	-0.00581
	(0.00706)	(0.00700)	(0.00703)	(0.00715)
industry_R&D_intensive	0.0195**	0.0200**	0.0189**	0.0194**
	(0.00855)	(0.00839)	(0.00814)	(0.00799)
year dummies	yes	yes	yes	yes
Constant	0.217***	0.224***	0.205***	0.192***
	(0.0428)	(0.0436)	(0.0432)	(0.0444)
Observations	105	105	105	105
R-squared	0.623	0.635	0.622	0.625

Table C. – 5 presents the results of the interaction effects of maturity of a firm on the relation between the presence of at least one or granted patent on warrant. To estimate the effect we use OLS regressions. Robust standard errors in parentheses. The symbols *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Regarding the included control variables, the macroeconomic variables, as well as the geographic variable, do not have any effect on the capital costs. The regression

estimates a significantly positive effect of the variable for high R&D expenditures on loan costs, which is in line with higher information asymmetries in those industries.

5. Robustness check

By applying the matching procedure, we control for endogeneity problems, which may arise from unobservable factors that potentially affect both the dependent and independent variables. Unobservable factors in our econometric model, such as the qualification and job experience of employees, could influence the capital costs in venture lending deals. So far, we have not controlled for a selection bias, which arises due to the constellation the quality signal does not stem from the patents the company owns but from the employees behind the inventions. Therefore, we apply the matching model to verify our results. The results of the matching model are shown in Table C. – 6.

Table C. – 6: Results for matching

Outcome variables	N	Mean delta	Result of t-test on mean difference
credit spread	52	57.5896	Significance at 5% level
warrant	41	0.0214	Significance at 5% level
Matching variables			
employees		13.4808	Not significant
drawdowntotal		0.2064	Not significant
op_profit_last_yr		-0.3309	Not significant
vl_deals_total		-6.7692	Not significant
vc_volume_europe		-115.4212	Not significant
industry_R&D_intensive		-0.0577	Not significant
year dummies		not reported	Not significant

This table displays the results of the propensity score matching model. N= Number of matched pairs.

The results of the propensity score-matching confirm our results that the presence of granted or pending patents influences the direct and indirect costs of a venture loan. The results also show that we can control for the endogeneity problem and that our results are robust. Regarding credit spread, we have matched 52 pairs, whereas, in the analysis of warrants, we matched 41 pairs. The mean delta of the credit spread shows a difference of 57.59 basis points between start-ups with and without patents, which is significant at the 5% level. The mean delta of the warrants shows a difference of 0.0214 between the two groups, which is also significant at the 5% level. The t-tests referring to the matching variables are not significant and confirm the robustness of the results.

6. Conclusion

In this study, our aim was to investigate whether patents convey information about the downside risk of a young and innovative company and thus are able to serve as a quality signal for venture lenders. We set out to empirically examine the influence of patents on direct as well as indirect capital costs of the borrower. Moreover, we were interested in identifying contexts in which the business and financial risks of the start-up are high, thus leading to a particularly strong impact of patents as a quality signal. Our study is based on a unique dataset consisting of 119 deals of a European venture lending fund issued between 2002 and 2009 in Europe, the United States, and Israel.

We find that the presence of at least one granted or pending patent negatively influences the credit spread and the warrant in venture lending contracts, which indicates that the signaling effect of patents is prevalent in venture lending deals. Despite a negative impact on liquidity during the term of the loan, patents serve as a valuable signal for

venture lenders and reduce both direct and indirect costs of the borrower. We further investigated whether the maturity of the start-up has an impact on the importance of patents as a quality signal for the venture lender. For this purpose, we used different proxies for the maturity of start-ups including the number of employees, the valuation of the last equity-financing round, the total loan drawdown, and the operating profit. The effect of patents on the credit spread is stronger for early-stage companies than for later-stage companies. Start-ups can hence profit from patents, particularly in early development stages. In contrast, we do not find significant evidence that the company stage influences the relation between patents and warrant coverage. The warrant represents an additional income possibility for the venture lender that only becomes relevant in the case of a successful exit. It might be that even in later-stage deals, the possibility of a successful exit is still so uncertain that the role of patents remains equally important as in early-stage deals. However, in light of our small sample size, this non-significant result has to be interpreted with caution.

With our study, we make various contributions to the literature. First, we extend the entrepreneurial finance literature by providing empirical insights into an innovative debt-based financing instrument in the context of entrepreneurial firms, which are characterized by the unavailability of tangible securities and high business risks as well as financial risks. The existing venture lending literature has theoretically or experimentally examined factors that influence the lending decision and what the underlying lending criteria are (Fischer & de Rassenfosse, 2012; Ibrahim, 2010). With our study, we contribute to this literature by empirically examining how patents influence the terms of lending contracts and thus the future liquidity of the innovative young companies receiving the venture loans. In addition, we add to the patent signaling theory

by showing that despite the negative effect of patents on the liquidity of start-ups, patents serve as a quality signal for venture lenders. The positive effect of patents on the exclusion of competitors and the prospect of future profits seems to outweigh the negative impact on short-term liquidity.

Various limitations need to be taken into account when considering our results, but these may also become starting points for new studies on venture lending. The results we have shown have to be considered under the limitation that our sample stems from a single European venture lending fund. Hence, our results are not necessarily representative for other venture lenders; however, the behavior of venture lenders is likely to be similar due to this specialized financing instrument being targeted towards a niche group of appropriate target firms. Additionally, as we use one venture lending fund, we are able to provide a tight control group regarding the decision-making process of our sample.

As the prior literature suggests, an important factor for venture lenders is the prior involvement of venture capitalists in the start-up. Our study does not take into account potential differences between venture capitalists and their influence on the terms of venture loans. Additionally, it would be interesting to investigate whether networks between the venture lender and venture capitalists lead to differences in venture lending contracts. The involvement of corporate venture capitalists may have a stronger impact on loan-cost drivers than other investors due to their strategic advantages and access to technological support from the corporate sector (Dushnitsky & Lenox, 2006). Furthermore, several studies have confirmed that the founders and the management team are important for a firm's success and development. In the context of venture lending, it would be relevant to analyze the role of the founding team in structuring venture lending

contracts. We encourage future quantitative empirical studies in these directions to better understand venture lending as an innovative form of financing for entrepreneurial companies.

D. Study 3: Venture Capitalist Reputation and the Effect on Venture Lending Contracts

1. Introduction

One of the key challenges that young and innovative firms have to overcome is the access to sufficient financial resources. Investors in the field of innovative businesses are facing high risks which are reflected in liability of smallness and newness (Brüderl et al., 1992; Stinchcombe, 1965). Venture capital is an appropriate form of financing for young and innovative companies as it provides the venture not only with capital, but also with additional non-financial support (e.g. Hellmann & Puri, 2002; Sahlmann, 1990). Due to the nurturing and monitoring of venture capitalists, start-ups grow faster and become more successful than non-venture-capital-backed start-ups (Brav & Gompers, 1997; Lee & Wahal, 2004). However, venture capitalists differ in their ability to add value, e.g. due to their entrepreneurial, industry and/or investment experience. Reputation is an indicator for the value adding capabilities of venture capitalists and can serve as a positive signal for outsiders regarding the quality of a start-up (Krishnan, Ivanov, Masulis, & Singh, 2011; Nahata, 2008).

The current literature has mainly focused on long-run effects of the reputation of venture capitalists, e.g. on changes in long term performance or on share price development subsequent to an initial public offering (Hsu, 2004; Krishnan et al., 2011; Nahata, 2008). Little is known about the effect of venture capitalist reputation on the behavior of additional financial intermediaries like debt providers and eventually on the directly measurable effects on contractual designing. The terms of financial contracts are

essential for start-ups as they contain financial agreements like capital costs, collateral and ownership agreements. Thus, examining factors that could influence these terms are relevant for start-ups and financial intermediaries. The potential effect on another financial contract would show immediate effects of venture capitalist reputation.

We analyze how venture capital reputation influences the credit spread as well as the warrant coverage in venture lending contracts as proxies for capital costs. Thus, we are able to measure the immediate effect of venture capitalist reputation on the start-ups' performance . In addition to capital costs, the timing of venture loans relative to equity financing rounds plays an important role for the involved parties, and has an effect equity structure of the start-up. Due to the extended cash runway by a venture loan, the start-up's valuation should increase. The start-up and the existing venture capitalist (in case he does not want to invest further) suffer less dilution in the next equity round. Therefore, we analyze whether the venture capitalist reputation influences the duration between the last venture capital round and the venture loan issuance. We conduct a survival analysis to investigate the duration and to understand dilution effects of highly reputable venture capitalists.

We use a measure for venture capitalist reputation which follows the approach of Lee, Pollock, and Jin (2011) and take several factors such as the age of the venture capitalist, total number of deals or IPOs into account. We use a unique dataset of 118 venture lending contracts which were issued between 2002 and 2009 in Europe, the United States, and Israel. Our results show that a higher venture capitalist reputation leads to lower capital costs for the start-ups. This effect is strongest for the lead venture capitalist's reputation and the most reputable venture capitalist involved in a syndicate. High reputable venture capitalists are able to send positive signals to additional financial

intermediaries like venture lenders. Consequently, venture capitalist reputation has an immediate effect on the start-ups' financials and performance. Furthermore, we show that a high venture capitalist reputation reduces the duration between the last venture capital round and the venture loan issuance. Highly reputable venture capitalists on average use venture loans earlier than less reputable venture capitalists which might be due to higher deal flow of venture capitalists with a superior market position.

Our study makes several contributions to the current literature. First, we extend the literature in the field of entrepreneurial finance on venture lending and venture capital. We show the first empirical results on how venture capitalists with different reputation influence the design of venture lending contracts. Venture capitalist reputation not only influences the start-ups' long-run performance but also further capital providers, such as venture lenders, by affecting contract details, therefore, the immediate performance. Thus, the affiliation with high reputable venture capitalists can reduce capital costs of debt financing instruments which counteracts higher costs that are usually imminent in equity rounds of reputable venture capitalists due to the higher equity share they gain (Hsu, 2004). Second, we contribute new findings to the field of relationship lending. Research on the relation between banks and companies is well established but mainly focuses on the direct link between these two parties. Our study indicates that this link is also affected by the relation between two financial intermediaries such as venture capitalists and venture lenders. Third, our study contributes to the signaling theory by indicating that the reputation of venture capitalists is able to convey positive signals to external financial intermediaries like venture lenders. Thus, the venture capitalist reputation has a direct signaling effect on financial contracting between the venture lender and the start-up.

The remainder of this study is organized as followed. Section 2 provides the theoretical background on reputation in regard to the financing industry and venture capital. We then derive our hypotheses regarding capital costs in venture lending contracts based on the previous literature and our theory. In the second part of the theoretical framework, we discuss two different hypotheses regarding the duration between the last venture capital round and the venture loan issuance. In Section 3 we describe our measure for reputation and the variables used in our study. Section 4 presents the results and Section 5 concludes with key contributions and a future research outlook.

2. Theory and hypotheses

2.1 Venture lending business model

Venture lending is a complex debt financing instrument for young and innovative firms backed by venture capital, which aims to extend the cash runway. The specific configuration of venture lending contracts enables young firms to obtain debt despite lacking traditional securities. Due to the extended cash runway, the start-ups might postpone the subsequent equity round, and the venture capitalist profits from valuation increase in case he does not want to participate in the next equity financing round. Additionally, the start-ups suffer less dilution and have more time to reach milestones set by the venture capitalists. The venture lender has multiple income sources which are composed of interest payments, fees and warrants (Hesse, Lutz, & Talmor, 2016). The interest payments are the main income source and ensure a stable revenue for the venture lender. They depend on the risk and uncertainty regarding the company. The

warrant coverage is an equity option for the venture lender and is an on top revenue in case of a successful exit of the start-up.

Besides risk reduction instruments such as subordination, tranching and the right to explore the start-ups' intellectual property in case of insolvency, an essential factor in the venture lending business model are venture capitalists which serve as security for the venture lender and are able to reduce information asymmetries between venture lender and start-ups (Fischer & de Rassenfosse, 2012; Hesse et al., 2016; Ibrahim, 2010). As there has been no empirical evidence of the certification effect of venture capitalists in venture lending deals, we aim to close this research gap by empirically analyzing the effect of venture capitalist reputation on venture lending contracts.

2.2 Reputational effects in the context of entrepreneurial finance

Reputational aspects of an organization can have an influence on the organization itself as well as on related market participants and thus on the financial performance (Podolny, 1993). The economic dimension of reputation results from a company's observable actions, performance and experience in the past which reflects the capabilities about the company's potential and actions in the future (Milgrom & Roberts, 1982; Shapiro, 1983). The focus on past actions is contingent on asymmetric information between stakeholders and organization as present actions of the organization can not properly be observed by stakeholders (Milgrom & Roberts, 1982). The institutional theory describes reputation as collective perception of stakeholders of a certain organization (Fombrun, 1996; R. Hall, 1992; Rao, 1994). This perception is based on emotional reactions of stakeholders which were assessed and accumulated over a certain

period of time (Deephouse, 2000; Fombrun & Shanley, 1990; R. Hall, 1992). The evaluation of these ratings by consumers lead to a collective accordance about the products' and services' quality as well as the organization's abilities (Lang & Lang, 1988).

2.2.1 Venture capitalist reputation and the effects on capital costs

In regard to venture capital and from the entrepreneur's perspective, it is not only important to get financed but it is also of high relevance who provides the capital. Thus, for start-ups it is more important to get the optimal value adding from venture capitalists than the optimal contract terms (Bygrave & Timmons, 1992; Hellmann & Puri, 2002; Sahlmann, 1997). Besides value adding activities, it is relevant who provides these services in regard to specialization and expertise in different fields. Venture capitalists differ in regard to their value adding skills, and thus in the ability to positively influence the start-ups' quality, development and success.

Due to their access to internal reports and detailed information about the companies, venture capitalists have a superior position to monitor their portfolio companies compared to debt providers. Venture capitalists invest an extensive effort to monitor their portfolio companies, especially in case of risky firms such as high-tech firms. Frequently visitations which implies transaction costs (Gorman & Sahlman, 1989) and accordingly, spatial proximity has an effect on the intensity of their monitoring activities (Joshua Lerner, 1995). The involvement of venture capitalists leads to a professionalization of those firms, including e.g. improvements of human resources policies, introduction of stock option plans and changes of executive positions within the

start-up (Hellmann & Puri, 2002) which potentially improves the performance (Gorman & Sahlman, 1989). Due to the monitoring activities, the start-ups benefit from the experience and advice of the venture capitalists which also leads to further funding options and a higher likelihood of a successful exit (Gompers, 1995). Based on a hand-collected dataset of 173 start-up firms from California's Silicon Valley, Hellmann and Puri (2000) suggest that due to the involvement of venture capitalists, portfolio companies accelerate the product development and significantly reduce the time to market entrance of the product.

Value adding activities and the involvement of venture capitalists in association with stronger control rights can have a direct influence on the exit performance of entrepreneurial firms (Cumming, 2008; Cumming & binti Johan, 2008). However, venture capitalists depending on their reputation differently affect several measures of firm performance. For instance, venture capital reputation positively affects several measures of firm performance such as the likelihood of successful exits, the velocity to initial public offerings and the asset productivity (Nahata, 2008). Moreover, venture capitalists with a high past market share of venture capital backed initial public offerings are significantly and positively related to better long-run performance. A possible reason for these findings is explained by changes in the corporate governance activities (Krishnan et al., 2011). Furthermore, if venture capitalists keep a significant stake of their portfolio company, it can result in a better long-run performance (Lee & Wahal, 2004; Megginson & Weiss, 1991). Thus, due to different levels of venture capitalist reputation, start-ups can benefit by achieving better exits, performance or further funding from additional investors. Our aim is to add the role of venture capital reputation by analyzing its effect on venture lending contracts. hence, besides the effects of venture capitalist

reputation on the long-run performance, there might be immediate value adding effects regarding better venture lending contract terms. The improvement of the long-run performance from high reputable venture capitalists might also be caused by immediate effects on the start-ups as lower capital costs lead to more liquidity for growth activities.

The main income sources for venture lenders are the interest rate and the warrant coverage. These are the core contents of a venture lending contract both for the venture lender as main income source and the start-up as main capital cost driver. The interest rate assures a stable income for the venture lender and has to be paid monthly by the start-up. Thus, if venture capitalist reputation plays a role in venture lending contracting, the interest rate could be influenced by reduced information asymmetries between the venture lender and the start-up through the involved venture capitalist. The same holds true for the applied warrant coverage if venture capitalist reputation is able to reduce uncertainties between the venture lender and the start-up.

We examine the effect of the lead venture capitalist's reputation on the capital costs in venture lending contracts. Several studies have defined the lead investor in a syndicate who has the largest equity stake of the company (Yael V Hochberg, Ljungqvist, & Lu, 2007; Krishnan et al., 2011; Lin & Smith, 1998). Lead venture capitalists usually have the strongest impact on a start-up's development and performance. They have strong control and veto rights as well as the power to replace positions within the start-up and they are involved in all major decisions in the company. Due to the power and the position of the lead venture capitalist, he might also have the strongest influence on the contractual design of external financing. Lead investors are actively involved in the board of their portfolio companies. In particular, highly reputable investors have more board seats than their lower reputable counterparts (Rosenstein, Bruno, Bygrave, & Taylor, 1993).

Consequently, the reputation of the lead investor might be relevant for capital costs of venture loans. Due to the important position of the lead venture capitalist, he might be the key reference for the venture lender. Furthermore, the more reputable the lead venture capitalist, the more aware is the venture lender about the positive track record and the investors' ability to add value to the company. Therefore, venture lenders are likely to be largely influenced by the reputation of the lead venture capitalist, as well as in terms of contractual design of venture lending deals. We therefore hypothesize the following:

Hypothesis 1a: The reputation of the lead venture capitalist involved in a venture lending deal negatively influences (i) the credit spread and (ii) the warrant in venture lending contracts.

The lead investor in a syndicate is not invariably the most reputable investor, even though he has the biggest stake of the company. It is possible that there is another venture capitalist who has a minor stake but a better reputation than the lead venture capitalist. The venture capitalist with the highest reputation in the syndicate, even without having the role of lead investor, is likely to also send a quality signal to other capital providers, despite of possibly having less control rights than the lead venture capitalist. If a venture capitalist has a high reputation, the signaling is relevant regardless of his equity stake of the start-up. This implies that the investor is convinced of the business model, the company's team and a further successful development. Even though the most reputable venture capitalist may not be the chief negotiator in regard to the venture lending contract, he might influence contract design due to the signal of high value adding skills to venture lenders. In addition, the venture lender might appreciate the involvement

of a high reputable venture capitalist, because high reputable venture capitalists are more likely to convince other investors to join the investment syndicate due to their superior network compared to lower reputable venture capitalists (Yael V Hochberg et al., 2007). Thus, we expect a reputation effect on capital costs for the most reputable venture capitalist and hypothesize the following:

Hypothesis 1b: The reputation of the most reputable venture capitalist involved in a venture lending deal negatively influences (i) the credit spread and (ii) the warrant in venture lending contracts.

In our sample, on average three venture capitalists are invested in a start-up. Therefore, it is reasonable to examine whether the accumulated venture capitalist reputation has an impact on capital costs as well. The venture capitalist syndicate might jointly influence the contract design of venture lending deals because they often pursue the same interests within a start-up, and are interconnected. Thus, the overall reputation of the syndicate could have an impact on venture lending contract as well, because a stronger syndicate might have more power to enforce their interests. However, due to the superior position of the lead venture capitalist, we expect that the effect might be less strong for the overall syndicate reputation. However, the aggregated reputation controls for the possibility that the effect of venture capital reputation is not dependent on a single venture capitalist, but rather on the syndicate's reputation. Thus, we hypothesize the following:

Hypothesis 1c: The aggregated reputation of all venture capitalists invested in a company negatively influences (i) the credit spread and (ii) the warrant in venture lending contracts.

2.2.2 Venture capitalist reputation and the effect on duration

Besides capital costs in venture lending contracts, the timing of these deals is a relevant factor for the start-up and the existing venture capitalists in terms of dilution. In order to analyze the timing of venture lending deals, we use the duration between the last venture capital round and the venture loan issuance. The duration represents the time between these financing events in days. The start-up usually seeks a venture loan to extend the cash runway, to postpone the next equity funding round and thus to increase its valuation which leads to less dilution in the next equity round. Furthermore, it is favorable for a start-up to keep cash reserves to signal stability and to attract further investors. For the invested venture capitalists which are not willing to invest more equity, it is reasonable to prolong the next equity round to suffer less dilution due to the valuation increase of the start-up (Hesse et al., 2016).

While the duration between the last venture capital round and venture loan issuance was not yet analyzed, the duration between equity funding rounds already received attention in research. For instance, funding durations decrease when R&D intensity or market-to-book-ratio is high and longer durations are likely for older firms due to better information availability (Gompers, 1995). Furthermore, the start-up's lifecycle should have an influence on the duration due to availability of information about the company. Thus, information asymmetry issues are prevalent in financing decisions.

The reputation of venture capital firms is able to reduce the information asymmetries (Krishnan et al., 2011) and thus possibly influences another financial intermediary like venture lenders. It might also influence the duration between the last venture capital round and the venture loan issuance. We deploy two argumentations that could explain the effect of venture capitalist reputation on the duration. A higher deal flow of venture capitalists with high reputation might lead to shorter durations. Highly reputable venture capitalists have a larger deal flow and may have manifold opportunities to invest equity. Furthermore, they could be more inclined to use venture loans earlier, investing less of their own capital and postponing external equity rounds in order to suffer less from dilution. In contrast, less reputable venture capitalists are more restrained in getting access to good deals (Megginson & Weiss, 1991). They do not have promising alternatives to invest their equity. Instead they might invest relatively more of their own equity in a single deal rather than using a venture loan – postponing a venture loan to a later point in time. In summary, that would lead to shorter duration between venture capital round and venture loan for highly reputable venture capitalists. We hypothesize that the lead venture capitalist's reputation and the most reputable venture capitalist's reputation have a negative influence on the duration.

Hypothesis 2a: The higher the lead venture capitalist's reputation, the shorter is the duration between the last venture capital round and the venture loan.

Hypothesis 2b: The higher the most reputable venture capitalist's reputation, the shorter is the duration between the last venture capital round and the venture loan.

In contrast, highly reputable venture capitalists might be better in judging the capital requirements of their start-ups. They might be in a position to provide larger equity rounds preserving cash also for unexpected events. They would then require a venture loan later than less reputable venture capitalists. In contrast, less reputable venture capitalists are less experienced and could be more surprised by unexpected events (Sørensen, 2007). They do not or are not able to provide equity rounds large enough to handle such unexpected events. That would lead to longer durations between venture capital rounds and venture loans for highly reputable venture capitalists.

Hypothesis 3a: The higher the lead venture capitalist's reputation, the longer is the duration between the last venture capital round and the venture loan.

Hypothesis 3b: The higher the most reputable venture capitalist's reputation, the longer is the duration between the last venture capital round and the venture loan.

Overall, we have two opposing theoretical arguments regarding the relationship between venture capital reputation and the duration between the last venture capital round and the venture loan. It remains an empirical question to show which argument is more relevant.

3. Empirical analysis

3.1 Data and sample

Our sample consists of 118 venture lending contracts and entails data from a European venture lending fund which issued venture loans from 2002 to 2009 in Europe, United States and Israel. Due to the access to non-public deal-level data, we were able to analyze detailed contract designs including capital costs. The database reveals contractual details such as interest rates, warrant coverages and other terms of the loan. Additionally to the contracts, we have access to the venture lender's due diligence reports about financial statements, equity structures and investors. To enrich our database and to analyze the venture capitalists' reputation, we collected data about the venture capitalists from the ThomsonONE database. Table D. – 1 presents descriptive statistics of our sample which will be elucidated in the following chapter.

Table D. – 1: Sample description

Variables	Description	N	Mean	Median	Min	Max	SD
Dependent variables							
creditspread	Credit spread, in bp between 3-year-swap rate and actual interest rates.	118	804.70	772.66	507.10	1,269.30	132.64
warrant	Warrant coverage, in percentage points in dependency of the loan amount.	104	13.52	12.50	4.50	23.80	4.35
duration	Days between the last venture capital round and the venture loan issuance.	118	598.35	465.50	0.00	3,021.00	495.22
Venture capital reputation							
RepLeadVC	Reputation of the lead venture capitalist.	118	169.07	114.52	0.00	1,000.00	193.43
RepVCMax	Reputation of the most reputable venture capitalist.	118	276.92	194.93	0.00	1,000.00	224.26
RepVCSum	Aggregated reputation of all venture capitalists.	118	507.44	347.90	0.00	2,428.25	457.95
Control variables							
additional_cash_runwway	Total drawdown divided by monthly cash burn. Variable in months.	118	10.26	6.57	0.00	128.60	13.95
patentsgranted	Number of patents the company owns.	118	2.44	0.00	0.00	32.00	5.90
noofvcs	Number of venture capitalists invested in the company.	118	3.05	3.00	1.00	8.00	1.71
stakevcs	Aggregated stake of the venture capitalists.	118	0.63	0.67	0.23	1.00	0.18
stake_founder_mgmt	Aggregated stake of the founders and management.	118	0.20	0.18	0.00	0.75	0.15
total_vc	Total venture capital investment in the company in € million.	117	19.17	15.28	0.89	98.13	16.04
number_vc_rounds	Total number of venture capital funding rounds.	116	2.70	3.00	1.00	6.00	1.21
valuation	Valuation of the last venture capital round for the company in € million.	118	25.80	18.87	0.00	247.22	31.68
employees	Total number of employees in the borrower's company.	118	68.69	50.50	2.00	331.00	59.77
op_profit_last_yr	Operating profit/loss of the last fiscal year of the borrower in € million.	118	-3.76	-2.99	-20.15	2.84	3.60
vl_deals_total	Number of venture lending deals in Europe per year of the three main	118	91.81	87.00	8.00	127.00	33.25
vc_volume_europe	Venture capital volume per year in Europe in € million.	118	5,511	5,551	4,150	6,446	624
country_uk	One for borrower's headquarter is in the United Kingdom.	118	0.46	0.00	0.00	1.00	0.50
industry_R&D_intensive	One for borrower belongs to healthcare or semiconductor sector.	118	0.29	0.00	0.00	1.00	0.45

This table provides descriptive statistics and specification of variables we used in the econometric models. The sample consists of 118 observations and shows that the credit spread is on average 804.70 basis points. The warrant coverage ranges from 4.5% at the lowest to 0.2380 at the highest. We present our venture capital reputation variables as well as firm-specific control variables and environmental variables to control for market changes.

3.2 Variables and measures

3.2.1 Dependent variables

Credit spread

As first dependent variable in our study regarding capital costs, we use the credit spread in venture lending contracts to cover direct and monetary measureable costs for the borrower. We measure credit spread as the difference between the 3-year swap rate in time of the loan issuance and the actual interest rate which was applied in the venture lending deal. We use this rate because it was used by the venture lender to calculate the risk premium for the venture lending deals. Furthermore, by using the credit spread we eliminate market fluctuations which arise due to changes in the macroeconomic interest levels. In our data, the credit spread was on average (median) 804.70 (772.66) basis points. For building the variable credit spread, we calculated the weighted average of all tranches which were issued to a company weighted by the amounts of each tranche amount.

Warrant coverage

As second dependent variable regarding capital costs, we use the warrant coverage to constitute indirect costs for the borrower. Through a warrant, the lender receives the right to exercise an option on a share of the borrower's equity in case of an exit. The option entails the right to purchase a fixed amount of shares at a fixed price. That means, if the valuation of the borrower at the time of an exit is higher compared to the time of the loan issuance, the lender benefits by exercising the equity option. In our sample, the average (median) warrant is 13.52% (12.50%) which means that the venture

lender is – if the loan amount is 1 million Euro – on average able to buy shares of the amount of 135,200 Euro at a fixed price. We use this variable to measure the indirect costs for a borrower in venture lending deals. The number of observations for the variable warrant is reduced due to the fact that the venture lender applied an exit incentive for some deals, which was not expressed in a warrant.

Duration

As dependent variable for the duration analysis, we measure the *duration* between the last venture capital round and the venture loan issuance in days. On average (median) the duration is 598 (466) days.

3.2.2 Independent variables

3.2.2.1 Venture capitalist reputation

Our independent variable of interest is the venture capitalist reputation. In order to estimate the effect of venture capitalist reputation on capital costs and the duration, we distinguish between the different venture capitalists in the syndicates. First, we use the variable *RepLeadVC* to estimate the effect of the lead venture capitalist's reputation on capital costs and duration. This entails that we estimate the effect of the lead venture capitalist who has the highest stake of the company on capital costs and the duration. Thus, the other venture capitalists that are invested in the start-up were left out of consideration in this estimation. Second, we use the variable *RepVCMax* to estimate the effect of the venture capitalist with the highest reputation invested in the portfolio

company. Third we built the variable *RepVCSum* by cumulating the single venture capitalist reputation ratios of all venture capitalists invested in a portfolio company to capture the aggregated reputation of the venture capital syndicate.

Academic researchers have used different variables and approaches to capture venture capitalist reputation that led to little consensus on how to measure venture capitalist reputation appropriately. For instance, venture capitalist reputation was measured by the age of the venture capitalists (Gompers, 1996) or the relative initial public offering capitalization share of their portfolio companies (Megginson & Weiss, 1991; Nahata, 2008). While these variables are capable to partly capture venture capitalist reputation, the approach comes along with difficulties which could lead to biases. For instance, it is not clear that older venture capitalists, which are able to raise larger funds and have resisted market fluctuations, necessarily perform better than younger venture capitalists. It is also conceivable that venture capitalists who survived in the market for many years only have moderate internal rates of return which do not exceed the average (Lee et al., 2011). In addition, younger venture capital firms may tend to push their portfolio companies earlier to initial public offerings to gain faster reputation (Gompers, 1996).

Our approach of a multi-item index for the venture capitalist reputation diminishes these limitations of single indicators. We avoid biases caused by omitting factors by following the approach of Lee et al. (2011) and create a multi-item venture capitalist reputation index which consists of the age of the venture capitalists, and for a five year period prior the venture loan issuance the number of portfolio companies, the number of funds, the number of IPOs, and the aggregated total investment of each venture capitalist. We collected these data for 194 venture capitalists and created the index by

standardizing the measures and building z-scores to make them comparable to each other. As a result, we got an index which reaches from zero to one thousand, whereby zero represents the lowest, and one thousand the highest possible reputation.

3.2.2.2 Control variables

Firm-specific variables

One of the main reasons to raise a venture loan is to extend the cash runway to postpone the next equity round and to suffer less dilution (Hesse et al., 2016). Therefore, we include a variable which represents the *additional cash runway* a start-up receives by taking the venture loan. The variable is measured in days and is calculated by the total drawdown divided by the monthly cash burn of the last fiscal year.

The variable *patentsgranted* indicates how many patents a start-up has granted at the time of the venture loan issuance. Patents are able to convey positive information to third parties and thus reduce information asymmetries (Long, 2002). Furthermore, intellectual property plays an important role in the venture lending business model as it serves as collateral for the venture lender and might influence capital costs (Fischer & de Rassenfosse, 2012; Ibrahim, 2010).

We use the total number of *employees* to take account of the firm's lifecycle in our linear regression models. The number of total employees controls for the growth and maturity of an entrepreneurial firm (Davila et al., 2003).

We include the *operating profit* of the last fiscal year which indicates whether a start-up is able to create a monetary value and is competitive to other companies. In

addition, an operating profit reduces the risk and uncertainty for the debt provider and ensures the repayment of a venture loan. Thus, increasing operating profit shows a functioning business model and a more mature lifecycle of an entrepreneurial firm (Engel & Keilbach, 2007; Gompers et al., 2010). We use this variable in our capital cost analysis.

We roughly control for the spatial proximity between the venture lender and the start-ups, which have received venture loans by taking into account whether the headquarters of the borrower is in the same country as the venture lender's headquarters. The probability of getting funded by venture capitalists decreases if the journey time from investor to start-up increases (Gupta & Sapienza, 1992) and credit spreads increase with the distance between lender and borrower (Bellucci et al., 2013). Therefore, we include the dummy variable *country_uk* which is coded 1 for start-ups who's headquarters is in the United Kingdom and 0 otherwise.

We subdivided the sample into two groups and build the variable *industry_R&D_intensive*. Said variable is coded 1 if the company belongs to an industry which has high research and development costs like biotech, pharma or semiconductors; and 0 if the company is associated with software, e-commerce or others. Thus, we differentiate industries in which companies have high R&D costs, and as a consequence have higher pressure, on the liquidity compared to companies from other industries. As venture lending seeks to extend the cash runway, pressure on liquidity is relevant for capital costs as well as the duration.

Venture capitalist related variables

The number of venture capitalists (*noofvcs*) controls for the aspect that a higher number of investors could imply that the start-up was able to convince several venture capitalists about their business model and thus plays an important role in sending positive signals to outside parties due to the ability of better performances (Nahata, 2008). This is true both in regard to the capital costs and the duration.

The equity stake of the venture capitalists (*stakevcs*) controls for the venture capitalists influence within the company. The higher the stake of the venture capitalists in a company, the higher are control and veto rights as well as monitoring activities which could influence capital costs as well as the timing of the venture loan issuance. A higher influence by venture capitalists could be seen as an advantage for the venture lender as it ensures professionalized acting regarding decision processes within the company (Cumming, 2008). In contrast, a low equity stake of venture capitalists implies controls for the decision rights of the actual founders of the company. A high stake of them could be accompanied by opportunistic behavior of these groups which possibly lead to actions which are not in line with the venture capitalists as they pursue different goals than the investors (Gompers, 1995; Sahlmann, 1990). This control variable applies for both empirical methods.

The total venture capital investment (*total_vc*) represents the total amount invested by all venture capitalists. The variable controls for the commitment and the horizon of disappointment of the venture capitalists about the business model (Hesse et al., 2016) which is important in regard to the duration of a venture loan. The horizon of disappointment describes the intention of a venture capitalist to invest further before cutting the equity funding.

The valuation (*valuation*) of the start-up controls in the duration analysis for the lifecycle of the company. The lifecycle could influence the timing due to the expectation of positive cash flows or further funding with additional financing instruments for more mature firms.

The number of venture capital rounds (*number_vc_rounds*) control for the financing stage of the start-ups. In the venture lending business model, we have the paradoxical causality that early stage firms are more likely to get financed by venture lenders than mature firms because they are safer for the venture lender due to the expectation of further equity rounds (Hesse et al., 2016). We include this variable in the duration analysis.

Macroeconomic variables

By including the total number of venture lending deals (*vl_deals_total*) we depict the market sentiment and dynamic of the venture lending market in Europe which might influence capital costs in venture lending contracts. The data are collected from a study about the European venture lending market (Sage, 2010). A higher activity in the venture lending market might influence capital costs for borrowers due to higher competition among venture lenders and volatility of demand and supply of venture loans. Thus, the venture capital investment volume in Europe (*vc_volume_europe*) controls for the overall dynamic in the venture capital financing market. The data are provided by Thomson Reuters.

Additionally, we include year dummies to control for time effects in our regression models regarding capital costs.

4. Results and discussion

4.1 Effect on capital costs

We use ordinary least square (OLS) and tobit regressions to estimate the effect of venture capital reputation on capital costs in venture lending contracts. For our regression models, we estimate the effect of all three venture capitalist reputation variables on the credit spread and the warrant coverage in venture lending contracts.

Table D. – 2 reports the results of our OLS and tobit regression models for the effect of the lead venture capitalist's reputation on capital costs in venture lending contracts. In particular, Model 1 and 2 analyze the effect on the applied credit spread; and Model 3 and 4 show the effects on the warrant coverage. The results regarding the credit spread show that the lead venture capitalist's reputation has a negative effect on the credit spread which is significant at the 5% level in the tobit model and 10% in the OLS model. The regression coefficients show that an increase in the variable for the lead investor's reputation by one standard deviation leads to a reduced credit spread by 0.078 basis points. Furthermore, the reputation has a negative impact on the warrant coverage which is significant at the 1% level. The model also shows that an increase of the reputation by one standard deviation leads to a reduced warrant coverage of 0.0043 percentage points. Due to the access to contract details, we can present a high R-squared in our models of 0.52 and 0.55, which shows that we have included main influential variables. Our results confirm the Hypothesis 1a that the lead venture capitalist's reputation has a negative effect on capital costs in venture lending contracts. Consequently, the venture capital reputation conveys positive related information to the venture lender and is able to reduce information asymmetries which lowers capital costs.

Table D. – 2: Results of OLS and tobit regression models for lead venture capitalist's reputation

	Model 1 OLS	Model 2 Tobit	Model 3 OLS	Model 4 Tobit
VARIABLES	creditspread		warrant	
RepLeadVC	-0.0782*	-0.0782**	-0.00426***	-0.00426***
	(0.0410)	(0.0383)	(0.00137)	(0.00126)
additional_cash_runway	-1.187**	-1.187**	-0.0324	-0.0324*
	(0.516)	(0.481)	(0.0206)	(0.0190)
patentsgranted	-2.863*	-2.863*	-0.0424	-0.0424
	(1.597)	(1.491)	(0.0636)	(0.0587)
noofvcs	-4.071	-4.071	-0.267	-0.267
	(5.389)	(5.032)	(0.302)	(0.279)
stakevcs	-23.34	-23.34	-4.925**	-4.925**
	(59.09)	(55.17)	(2.378)	(2.198)
employees	-0.121	-0.121	-0.00177	-0.00177
	(0.201)	(0.188)	(0.00986)	(0.00911)
op_profit_last_yr	-4.427	-4.427	-0.137	-0.137
	(3.469)	(3.239)	(0.136)	(0.126)
vl_deals_total	-0.145	0.289	0.00508	-0.0496**
	(0.935)	(0.734)	(0.0800)	(0.0245)
vc_volume_europe	-0.112**	-0.130***	-0.00204	0.000221
	(0.0540)	(0.0313)	(0.00365)	(0.000778)
country_uk	21.58	21.58	-0.875	-0.875
	(17.59)	(16.42)	(0.796)	(0.736)
industry_R&D_intensive	7.492	7.492	0.808	0.808
	(19.96)	(18.63)	(0.812)	(0.751)
year dummies	yes	yes	yes	yes
Constant	1,576***	1,638***	28.11*	20.25***
	(249.9)	(143.5)	(14.66)	(4.130)
Observations	118	118	104	104
R-squared	0.517		0.548	

Table D. – 2 presents estimates of the OLS and tobit regressions to examine the effect of the lead venture capitalist's reputation on the applied credit spread or warrant in venture lending deals. Model 1 and 3 report the estimates for the OLS regressions and Model 2 and 4 report the estimates for tobit regressions. The number of observations varies because in some cases there was no warrant applied. Robust standard errors are in parentheses. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

Table D. – 3 shows the results regarding Hypothesis 1b that aims to analyze the relation between the most reputable venture capitalist involved in the venture lending deal

and capital costs. In Model 1 and 2 the results indicate that the reputation of the most reputable venture capitalist has a negative effect on the credit spread which is significant at the 5% level. The economical relevance is comparable to the lead venture capitalist's reputation. Model 3 and 4 show the effect on the warrant coverage which is also negative and significant at the 5% level and indicates a lower economic relevance compared to the lead venture capitalist. Thus, we can confirm Hypothesis 1b as well.

Table D. – 3: Results of OLS and tobit regression models for most reputable venture capitalist

	Model 1 OLS	Model 2 Tobit	Model 3 OLS	Model 4 Tobit
VARIABLES	creditspread		warrant	
RepVCMax	-0.0836**	-0.0836**	-0.00328**	-0.00328**
	(0.0349)	(0.0326)	(0.00137)	(0.00127)
additional_cash_runway	-1.305**	-1.305**	-0.0373*	-0.0373*
	(0.550)	(0.513)	(0.0219)	(0.0203)
patentsgranted	-2.894*	-2.894*	-0.0551	-0.0551
	(1.640)	(1.531)	(0.0642)	(0.0594)
noofvcs	-0.435	-0.435	-0.162	-0.162
	(5.450)	(5.088)	(0.315)	(0.291)
stakevcs	-18.92	-18.92	-4.401*	-4.401**
	(58.32)	(54.46)	(2.384)	(2.204)
employees	-0.136	-0.136	-0.00220	-0.00220
	(0.205)	(0.191)	(0.0106)	(0.00984)
op_profit_last_yr	-4.600	-4.600	-0.142	-0.142
	(3.636)	(3.395)	(0.153)	(0.142)
vl_deals_total	-0.753	0.200	-0.0202	-0.0559**
	(0.822)	(0.740)	(0.0699)	(0.0264)
vc_volume_europe	-0.0947*	-0.134***	-0.00139	8.78e-05
	(0.0517)	(0.0313)	(0.00339)	(0.000802)
country_uk	21.42	21.42	-0.864	-0.864
	(17.54)	(16.38)	(0.832)	(0.769)
industry_R&D_intensive	2.921	2.921	0.598	0.598
	(19.70)	(18.39)	(0.851)	(0.787)
year dummies	yes	yes	yes	yes
Constant	1,536***	1,673***	26.61*	21.48***
	(244.0)	(142.5)	(14.33)	(4.374)
Observations	118	118	104	104
R-squared	0.519		0.533	

Table D. – 3 presents estimates of the OLS and tobit regressions to examine the effect of the most reputable venture capitalist on the applied credit spread or warrant in venture lending deals. Model 1 and 3 report the estimates for the OLS regressions and Model 2 and 4 report the estimates for tobit regressions. Robust standard errors are in parentheses. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

The following Table D. – 4 presents the results for Hypothesis 1c. We estimate the effect of the aggregated venture capital reputation of all invested venture capitalists on the capital costs. Model 1 and 2 show a negative effect on credit spread which is not statistically significant. Furthermore, Model 3 and 4 show a negative effect on the warrant coverage which is significant at the 1% level and a comparable economic relevance referring to the most reputable venture capitalist.

Table D. – 4: Results of OLS and tobit regression models for the aggregated venture capital reputation

	Model 1 OLS	Model 2 Tobit	Model 3 OLS	Model 4 Tobit
VARIABLES	creditspread		warrant	
RepVCSum	-0.0439	-0.0439	-0.00299***	-0.00299***
	(0.0325)	(0.0303)	(0.00107)	(0.000989)
additional_cash_runway	-1.290**	-1.290**	-0.0386*	-0.0386*
	(0.565)	(0.528)	(0.0229)	(0.0212)
patentsgranted	-2.845*	-2.845*	-0.0438	-0.0438
	(1.668)	(1.557)	(0.0644)	(0.0595)
noofvcs	3.216	3.216	0.211	0.211
	(7.929)	(7.404)	(0.378)	(0.349)
stakevcs	-17.30	-17.30	-4.549*	-4.549**
	(58.65)	(54.77)	(2.347)	(2.169)
employees	-0.147	-0.147	-0.00348	-0.00348
	(0.208)	(0.194)	(0.0107)	(0.00990)
op_profit_last_yr	-4.619	-4.619	-0.168	-0.168
	(3.773)	(3.523)	(0.149)	(0.138)
vl_deals_total	-0.811	0.314	-0.0410	-0.0484*
	(0.821)	(0.774)	(0.0564)	(0.0267)
vc_volume_europe	-0.0885	-0.135***	-0.000330	-2.53e-05
	(0.0539)	(0.0316)	(0.00292)	(0.000784)
country_uk	19.24	19.24	-0.965	-0.965
	(17.89)	(16.70)	(0.806)	(0.745)
industry_R&D_intensive	3.993	3.993	0.559	0.559
	(19.71)	(18.40)	(0.831)	(0.768)
year dummies	yes	yes	yes	yes
Constant	1,492***	1,653***	21.81*	20.75***
	(258.3)	(144.5)	(13.04)	(4.434)
Observations	118	118	104	104
R-squared	0.513		0.542	

Table D. – 4 presents estimates of the OLS and tobit regressions to examine the effect of the aggregated venture capital reputation on the applied credit spread or warrant in venture lending deals. Model 1 and 3 report the estimates for the OLS regressions and Model 2 and 4 report the estimates for tobit regressions. Robust standard errors are in parentheses. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

Overall, we can confirm our Hypotheses 1a, 1b and 1c in the first part of our study. The results suggest that the venture capitalist reputation has a negative effect on capital costs in venture lending contracts. The results between the different measures for venture capitalist reputation are comparable but differ in their strength and significance. The lead venture capitalist's reputation seems to have the strongest impact on the credit spread which is in line with the theory as these investors have the strongest control rights and the highest influence in decision processes. In addition, it seems to be relevant to have a venture capitalist with a high reputation in the syndicate, regardless of his role as lead or co-investor. The aggregated reputation's effect is lower compared to the other two reputation variables. This leads to the interpretation that the effect of reputation is rather dependent on a single venture capitalist with a relatively high stake or reputation than on the sum of the venture capitalists. Thus, the aggregated reputation of several venture capitalists with average reputation does not compensate one single high reputable venture capitalist.

In regard to the warrant coverage that represents the indirect costs in venture lending contracts, we find similar results referring to our Hypotheses. The lead investor's reputation has both the statistically and economically highest effect on the warrant coverage. The economic effect of *RepVCMax* and *RepVCSum* is roughly the same but differs slightly in the significance. The higher impact of the lead venture capitalist's reputation on the warrant coverage suggests that this investor has the highest influence on the contract design. It also indicates that the higher the lead venture capitalist's reputation the more he is able to put pressure on the venture lender, because he benefits from his reputation which leads to advantages for the venture lender as well.

Furthermore, we included several control variables. A higher additional cash runway created through the venture loan leads to lower capital costs. The larger the time period of additional liquidity to the firm, the lower will be the immediate risk of insolvency. Additionally, a higher number of patents reduces capital costs in venture lending contracts. A better collateral position for the venture lender is favorable due to the possibility to exploit the intangible assets of the start-up in case the company fails.

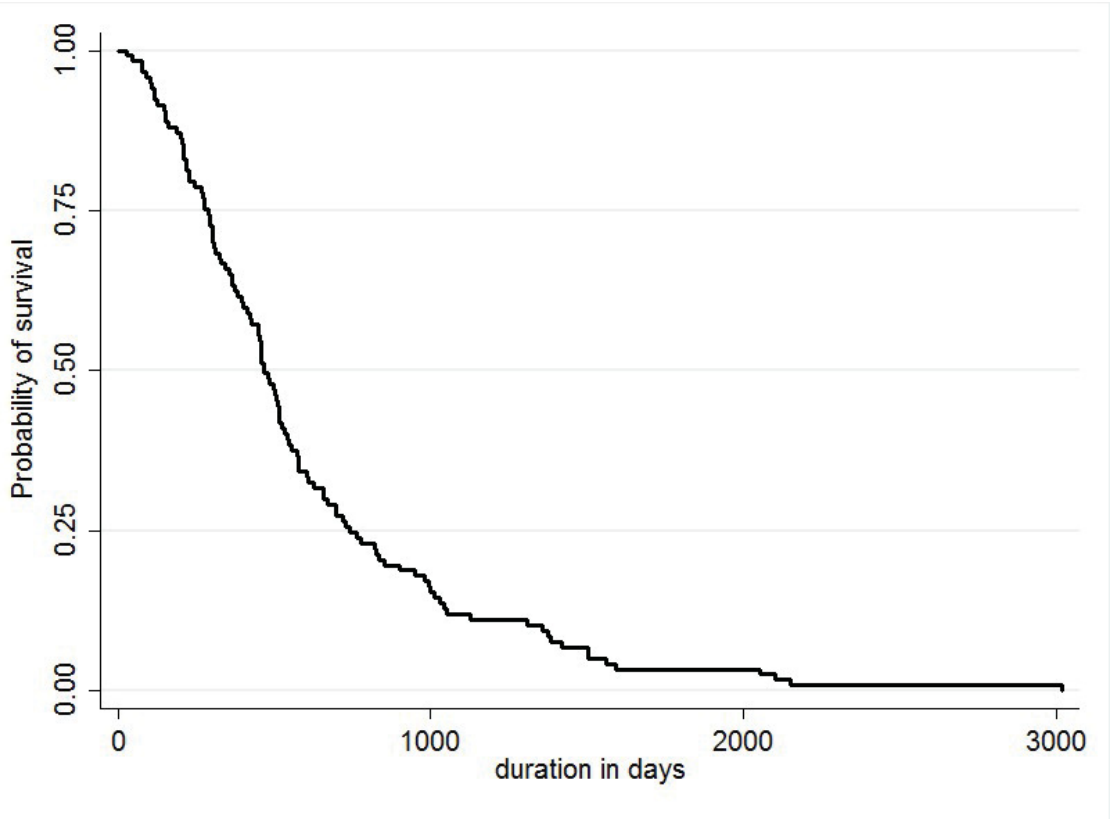
In summary, the results show that the start-ups benefit from the venture capitalist reputation as the capital costs of the venture loan decrease. Besides advantages for start-ups to get financed by reputable venture capitalists, there may also be disadvantages such as costs for those start-ups. For instance, start-ups are more likely to accept venture capital offers by venture capitalists with high reputation, and these venture capitalists get a discount on the shares of 10-14%. Hence, start-ups tend to provide more shares to venture capitalists with a high reputation than to venture capitalists with a lower reputation (Hsu, 2004). Thus, besides higher costs due to the affiliation of highly reputable venture capitalists, capital costs of additional financing instruments such as venture loans might decrease.

4.2 Duration analysis

To analyze the duration between the last venture capital round and the time of the loan issuance, we use the Weibull survival model. Survival models are used to examine the influence on the occurrence of a certain event. In our case, the event is the venture loan issuance in relation to the last venture capital round. The Weibull model fits best for our analysis due to the following reasons. The Kaplan-Meier curve of our data is

illustrated in Figure D. – 1 below, and it shows the probability of the venture loan issuance after the last venture capital round. The x-axis shows the duration in days and the y-axis the probability of survival. The curve shows an exponentially decreasing survival probability, which is non-linear and makes it reasonable to use the Weibull model for our analysis instead of a linear regression model. Furthermore, hazard models are a common method to analyze the duration between funding rounds (e.g. Cumming & MacIntosh, 2001; Gompers, 1995) and are also common to examine durations in general (Kalbfleisch & Prentice, 2011; Kiefer, 1988).

Figure D. – 1: Kaplan-Meier survival estimate



The duration is measured in days between the last venture capital round and the loan issuance and can be expressed as *T*. Thus, the shorter the duration, the sooner the

start-up gets a venture loan after the last venture capital round. The survival function of the duration can be described through the following equation:

$$S(t) = p(T \geq t),$$

which shows that the probability of T at least lasts to t. The Weibull model is a two parameter distribution ($\gamma > 0$ and $\alpha > 0$). The hazard function can be described as:

$$\lambda\,(t) = -\gamma\alpha t^{\alpha-1}$$

The variable γ is a function of the explanatory variables and a parameter that indicates the variety of the hazard. The parameter α describes the shape of the distribution of the duration. The Weibull distribution is suitable for modeling data with monotone hazard rates that either increase or decrease exponentially with time. The coefficients of the Weibull regression model can be directly interpreted as the independent variables influence on the duration between the last venture capital round and venture loan issuance. We report our results in the proportional hazard metric which is comparable to the cox regression coefficients. A coefficient ß > 0 shows decreased lifetimes which means sooner financing by a venture loan after the last venture capital round in our study. To analyze the duration, we estimate all three venture capitalist reputation variables like in the regression models for the capital costs.

Our data shows the characteristics, funding and financial statements of the start-ups at a specific date, which is the event of the loan issuance. Hence, we cannot include control variables such as the number of employees or the operating profit due to the unavailability of panel data. A change of these variables during the duration would lead to biased results.

In Table D. – 5 we present the results of our Weibull model. We present 9 Models which are distinguished by the reputation variable. The Wald chi square tests show that all the models are statistically significant.

Table D. – 5: Results of weibull survival model

	1	2	3	4	5	6	7	8	9
	duration	duration	duration	duration	duration	duration	duration	duration	duration
	0.00296	0.00198	0.00430	0.00448	0.00509	0.00445	0.00384	0.00282	0.00499
	(0.00613)	(0.00605)	(0.00615)	(0.00622)	(0.00616)	(0.00613)	(0.00623)	(0.00592)	(0.00604)
	0.133	0.146*	0.116	0.0349	0.0902	0.0426	-0.0104	0.103	0.0460
	(0.0824)	(0.0813)	(0.0844)	(0.0913)	(0.0845)	(0.0879)	(0.129)	(0.0914)	(0.0936)
	-0.0246**	-0.0213**	-0.0243**	-0.0198**	-0.0203**	-0.0221**	-0.0209**	-0.0193*	-0.0217**
	(0.0102)	(0.00996)	(0.00984)	(0.00999)	(0.0101)	(0.00979)	(0.00999)	(0.0101)	(0.00987)
	0.289***	0.268***	0.290***	0.318***	0.276***	0.336***	0.312***	0.275***	0.318***
	(0.101)	(0.0987)	(0.0982)	(0.104)	(0.100)	(0.101)	(0.105)	(0.100)	(0.102)
	0.341	0.0350	0.0232	0.190	0.0914	0.194	0.218	0.0997	0.183
	(0.767)	(0.769)	(0.755)	(0.765)	(0.766)	(0.766)	(0.763)	(0.776)	(0.750)
	0.00480	0.00436	0.00539	0.00345	0.00358	0.00353	0.00388	0.00341	0.00342
	(0.00390)	(0.00393)	(0.00386)	(0.00391)	(0.00395)	(0.00379)	(0.00389)	(0.00396)	(0.00384)
	0.414*	0.314	0.436*	0.507**	0.477*	0.422*	0.477*	0.429*	0.483**
	(0.244)	(0.249)	(0.248)	(0.244)	(0.244)	(0.240)	(0.246)	(0.242)	(0.245)
	0.460*	0.410*	0.504**	0.490**	0.565**	0.488**	0.526**	0.518**	0.548**
	(0.238)	(0.241)	(0.234)	(0.236)	(0.240)	(0.234)	(0.235)	(0.237)	(0.235)
	0.00142***								
	(0.000547)								
		0.358*							
		(0.206)							
			0.770***						
			(0.242)						
				0.00130**					
				(0.000558)					
					0.446**				
					(0.221)				
						0.737***			
						(0.284)			
							0.000609		
							(0.000387)		
								0.253	
								(0.234)	
									0.624**
									(0.302)
	-11.91***	-11.41***	-11.77***	-11.83***	-11.61***	-11.82***	-11.50***	-11.38***	-11.59***
	(1.064)	(1.013)	(1.026)	(1.064)	(1.037)	(1.064)	(1.032)	(1.023)	(1.034)
	0.465***	0.443***	0.475***	0.464***	0.454***	0.479***	0.450***	0.440***	0.458***
	(0.0741)	(0.0730)	(0.0736)	(0.0744)	(0.0737)	(0.0754)	(0.0743)	(0.0737)	(0.0743)
	1.5920	1.5574	1.6080	1.5904	1.5746	1.6145	1.5683	1.5527	1.5809
	28.57***	26.04***	32.24***	27.90***	27.06***	29.29***	25.46***	24.22***	27.07***
	114	114	114	114	114	114	114	114	114

Table D. – 5 presents the results of our hazard analysis about the duration between the last venture capital round and the loan issuance. Additionally, to the effect of our main venture capital reputation variables, we built several dummy varibales to test the robustness of the

Variables	
additional cash runway	
noofvcs	
total vc	
number vc rounds	
stakevcs	
val	
industry R&D intensive	
country uk	
RepLeadVC	
RepLeadVC high	
RepLeadVC high upper quartile	
RepVCMax	
RepVCMax high	
RepVCMax high upper quartile	
RepVCSum	
RepVCSum high	
RepVCSum high upper quartile	
Constant	
ln p	
p	
Wald chi square	
Observations	

The results show that the variable *RepLeadVC* has a significant impact on the duration at the 1% level. The coefficient is positive and indicates that an increase of the reputation by one point leads to a higher hazard of 0.14% (standard deviation 0.000545). Thus, a higher lead venture capitalist's reputation by 100 points would lead to a reduction of the duration by 14%. The most reputable venture capitalist's reputation shows statistically evidence at the 5% level, and a similar increase relating the lead's reputation of the hazard of 0.13% per reputation point increase. The dummy variables support the results for the reputation variables. For example, if the lead venture capitalist belongs to the upper quartile in regard to reputation, the hazard is 77% greater compared to the lower reputable venture capitalists. In addition, the Weibull parameter p in Table D. – 5 shows that the hazard is increasing over time (p>1) which means that the venture loan issuance becomes more likely with time. In sum, the coefficients for the lead and most reputable venture capitalists' reputation show support for the first argument that high reputable venture capitalists have a larger deal flow as well as more opportunities to invest equity than low reputable venture capitalists. Thus, the duration is shorter the higher the reputation of the venture capitalist. This argument seems to be stronger than the experience and capital provision argument.

The variable *RepVCSum* does not have an effect on the duration. As we have pointed out, high and low reputable venture capitalist probably have different goals regarding the timing of the venture loan issuance. Moreover, the timing is dependent on whether the venture capitalist is willing to invest more equity in the next financing round. As a consequence, it is likely that the effect of the aggregated venture capitalist reputation is compensated by high and low reputations of the venture capitalists which leads to an insignificant result.

To test the robustness of our analysis, we conduct a linear regression and a cox regression model as well. In addition to our main venture capital reputation variables, we built dummy variables. These variables are coded 1 if the reputation of the venture capitalist is above the median or above the upper quartile, and 0 otherwise, to test the robustness of our results in the survival models. Table D. – 5 and Table D. – 7 show positive regression coefficients that support our hypotheses regarding the duration analysis. The Cox regression models show similar statistical significances as well as similar economic relevance compared to the Weibull model and also confirms the results (see Table D. – 7, G. Appendix). The OLS regression models suggest that the venture capitalist reputation negatively influences the duration as well. We estimated the OLS model with the same control variables like in the models regarding the capital costs. The variables *RepLeadVC* and *RepVCMax* (including the dummy variables) show statistical significance at the 5% and 10% level and the other variables point towards the right direction (see Table D. – 6, G. Appendix).

5. Conclusion

The main objective of this paper was to examine whether venture capitalist reputation is able to influence the behavior and financial contracting of another financial intermediary, such as a venture lender. Theoretical, choice-based and interview-based studies highlighted that the involvement of venture capitalists is a crucial factor in the venture lending business model as they serve as a security for the venture lender (Fischer & de Rassenfosse, 2012; Hesse et al., 2016; Ibrahim, 2010). Furthermore, venture capitalist reputation has a positive effect on the long-run performance of start-ups (Nahata, 2008). We have gone one step further and focused on the immediate effect of venture capitalist reputation on another financial intermediary and specific factors which might influence venture lending contract designs.

We used a data set from a European venture lending fund with 118 venture lending deals in Europe, the United States and Israel. Our proprietary sample with deal-level data allows detailed analyses of venture lending contract design and timing. Controlling for several firm-specific factors, market conditions, and venture capitalist related measures, the data indicate a statistically and economically significant negative association between venture capitalist reputation and capital costs in venture lending contracts. In particular, we show that the lead venture capitalist's reputation and the most reputable venture capitalist's reputation have a higher impact on the credit spread compared to the aggregated venture capitalist reputation. We show that the lead investor's reputation and the most reputable investor's reputation also have a higher effect on the warrant coverage. Thus, the effect of venture capitalist reputation is rather dependent on a single relatively strong venture capitalist than on an average syndicate. Furthermore, the duration between the last venture capital round and the loan issuance decreases the higher the venture capitalist reputation of the lead or the most reputable investor. This

finding is justifiable due to a higher deal flow and more investment opportunities of high reputable venture capitalists compared to low reputable venture capitalists. High reputable venture capitalists seem to opt for earlier venture loans to avoid dilution whereby low reputable venture capitalists might try to postpone the venture loan to invest more of their own equity.

We extend the current literature in different fields of academic research. First, we contribute to the literature on venture capital and venture lending by presenting the effect of venture capitalist reputation on the financial contracting of another financial intermediary. Second, earlier studies focused on the relation between banks and companies whereas we present that relationship lending could also be affected by a third party. Third, we extend the signaling literature by focusing on the signaling effect of investors on third party financial intermediaries.

Our study has several practical implications. The results could help entrepreneurs to improve their funding behavior by adjusting the selection of different financing instruments and to weigh their funding costs more precisely. Due to reduced capital costs in venture lending contracts they could compensate higher prices of venture capital rounds by reputable venture capitalists. Venture loans lead to higher valuations in the next equity round, thereby decreasing the dilution of entrepreneurs. However, venture loans imply monthly interest payments, and eventually the repayment of the loan which reduces the financial slack available in the firm and might dampen growth. Additionally, the venture loan is secured by the intellectual property which is often the core asset of the firm.

Our results have to be considered under the limitation that our sample stems from a single European venture lending fund. Hence, our results are not necessarily representative for other venture lenders. However, the behavior of venture lenders are likely to be similar due to this specialized financing instrument targeted towards a niche group of appropriate target firms. Furthermore, as there were only few active venture lenders in the market in 2000's, we capture a reasonable market share with our study.

Gaining access to reliable data on the venture lending market and actual venture lending deals is a key concern. Thus, empirical studies regarding venture lending are rare in the entrepreneurial finance literature. Does the investment behavior of venture capitalists affect venture lending contracts? And if so which factors are most influential? Additionally, studies on the impact within the start-ups would help optimize this financing instrument. Are founders willing to change their cash management due to the debt financing instrument? And what are consequences on the liquidity management? Furthermore, studies could take into account the role of the start-ups' founders and their background in getting access to venture loans. A comparison between accepted and declined venture loan applications would help to understand the requirements for a venture loan.

E. Final remarks

In the following chapter, I conclude this dissertation by summarizing the core results and presenting the practical implications. Further, I outline limitations of the analyses and reveal directions for future research, based on the results from the three studies presented above.

1. Core results

The source of funding for young and innovative start-ups is essential for their development and success. In the past years, many studies have been published on the financing structure and financing decision in entrepreneurial finance and focused on either the decision regarding different financing instruments for entrepreneurial firms or the contract design of these different financing instruments (e.g. Cumming, 2005b; De Bettignies & Brander, 2007; Denis, 2004; Robb & Robinson, 2014; Winton & Yerramilli, 2008). While financing instruments, such as venture capital or bank debt, have received great attention in academic research, venture lending as alternative and complementary source of funding has been largely left out in academic studies. Especially, regarding the design of venture lending contracts, there has been no empirical studies that examine the effect of certain company characteristics on capital costs and the timing of these contracts. I aim to close this research gap by theoretically and empirically analyzing which factors influence venture lending contracts. Therefore, I have designed three studies on this topic to deepen the understanding of this specialized debt financing instrument for young and innovative companies. The analyses also help entrepreneurs, venture lenders, and venture

capitalists to improve their activities, regarding the contract design of venture lending deals.

Chapter B theoretically analyzes the first research question by underlining the gained results with empirical data from our unique dataset, which entails detailed deal-level information about the contract design. This Chapter highlights and explains the interdependencies between venture lenders, start-ups, and venture capitalists and deals with the issue how missing track records, tangible assets, and positive cash flows can be substituted in venture lending deals. I show that venture capitalist involvement and intangible assets serve as positive signal to venture lenders. The extended cash runway caused by venture loans has different effects on invested venture capitalists, who will invest further and on new investors. If old investors are not willing to continue their investments, it is favorable to obtain venture loans to avoid dilution for the old investors and the entrepreneurs. Additionally, I depict the importance of risk reduction instruments and explain how these instruments mitigate default risks, despite high volatility and a lack of conventional collaterals.

Chapter C deals with the design of venture lending contracts and, in particular, the role of patents in this context. I empirically analyze whether patents convey positive related information to venture lenders and how reduced information asymmetries in this context influence direct and indirect costs in venture lending contracts. Based on the dataset, I found that the presence of at least one granted or pending patent significantly reduces the credit spread and the warrant coverage in venture lending deals. Furthermore, I investigated whether a company's lifecycle affects the relation between patents and capital costs. I used four proxies for a company's maturity – number of employees, valuation after the last venture capital round, total drawdown of the venture loan, and the

operating profit – to analyze this relation. The empirical analysis shows the effect of patents on the credit spread is stronger for early stage companies than for later stage companies. Due to higher information asymmetries in early stage companies, patents become even more important.

The fourth Chapter addresses the question of how venture capitalist reputation affects the venture lending contract design, regarding capital costs and the timing of the venture loan issuance. The empirical analysis suggests a statistically and economically significant negative effect of venture capitalist reputation on capital costs in venture lending contracts. That means, the higher the reputation of the invested venture capitalists the lower are the capital costs for the start-ups. The timing of venture lending deals is influenced by venture capitalist reputation. The higher reputation of the lead or most reputable venture capitalist, the shorter the duration between the last venture capital round and the venture loan issuance. This result supports the hypothesis that a higher deal flow and more investment opportunities of high reputable venture capitalists lead to shorter durations, compared to low reputable venture capitalists. High reputable venture capitalists seem to opt for earlier venture loans to avoid dilution, whereby low reputable venture capitalists might try to postpone the venture loan to invest more of their own equity. Venture capitalist reputation can influence another financial intermediary and can have immediate effects on start-ups, contrary to long-run performance effects shown in prior studies.

2. Practical implications

Since venture lending has become a viable financing instrument, this dissertation provides important implications for practitioners, such as entrepreneurs, venture lenders, and venture capitalists. The findings gained in this thesis may help these involved parties to design and implement venture lending in the financing strategy of young and innovative companies.

By outlining the risk reduction instruments, entrepreneurs can better negotiate venture lending contracts and outweigh the advantages and disadvantages of the specific deal details. They can better prove whether their start-up is suitable for a venture loan and adjust their financing strategy, regarding the selection of equity investors, before the venture loan. It is favorable for young and innovative companies to pursue patenting soon to improve their financing opportunities. However, patenting processes are costly, and start-ups should prove their gains and costs of these two opposing cost drivers. The selection of highly reputable venture capitalist comes with higher costs (Hsu, 2004). Entrepreneurs should remember that high venture capital reputation could be costlier, but they also benefit by reducing capital costs in venture lending contracts. The timing of venture loans is also influenced by the venture capital reputation. The postponement of venture loans leads to less dilution for entrepreneurs, because company valuation should increase due to extended liquidity runway until the next equity round. However, venture loans imply monthly interest payments and eventually the repayment of the loan, which reduces the financial slack available in the firm and might dampen growth.

This dissertation also has valuable implications for venture lenders and venture capitalists. Developing trust and credibility during difficult times gives rise to a repeated game mentality and, therefore, to a bilateral need to build long-term relationships and

joint engagements in multiple transactions. As a consequence, building networks with venture capital firms and regular communication with venture partners intensify the relationships between the business partners, mitigating risks and providing additional deal flow. Altogether, building a reliable network with multiple lenders or venture capitalists reduces moral hazard and facilitates smoother loan renegotiations if start-ups become insolvent.

Due to the inherent risk of venture capital investments, venture capitalists pursue the strategy of diversification, avoiding investing in a narrow number of firms. Syndication is a common phenomenon in the venture capital industry. Venture loans can substitute some of the need to syndicate the equity, which additionally, has the advantage of a less dilutive financing form.

3. Future research

This dissertation is not without limitations and is a starting point for further investigations, as it opens new directions for future research on venture lending. In the following, I conclude this dissertation by addressing open fields for future research on this topic.

As we have analyzed a European venture lending fund, it would be of interest to analyze further venture lending funds with different industry or geographic focuses to extend the overall sample on venture lending deals. A comparison between European and American venture lending funds might indicate their investment behavior. There might be also distinctions due to the different investment behavior of the venture capitalists from different countries, which result from differences in the size of investment rounds or the

willingness of taking risks. This leads to whether venture lending contracts are influenced by this factor and which are most relevant. In this context, corporate venture capitalists could be also of interest. In contrast to venture capitalists that pursue profit maximization, corporate venture capitalists may have a different influence on venture lending deals because of their strategic goals and their technological support.

The founders and management team are one of the most influential factors whether start-ups will develop successfully. Therefore, future research efforts could aim at aspects that consider personal skills and professional background of the founding and management team. Personal and professional skills could influence capital costs and even the probability of receiving venture loans. Therefore, an analysis about the management team's ability to handle different and complex financing instruments within a start-up would help venture lenders to optimize their funding strategy. Subsequently, a data sample that depicts declined and accepted loan applications would help to understand the requirements for venture loans and uncover possible exclusion criteria for venture lending. It is reasonable to assume that factors, which influence the capital costs in venture lending contracts, also influence the probability of getting a venture loan, but this remains an empirical question. Another field of interest that is still unexplored is the effect of venture loans within the start-up. Due to the nature of debt, which implies principle and interest payments, changes in a start-up's cash management are likely. Therefore, detailed analyses – for example, on the basis of interviews with founders who received venture loans – about the professionalization or changes in the liquidity management would give new insights on the impact within the young companies.

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Table D. – 6: Robustness check duration OLS

VARIABLES	1 duration	2 duration	3 duration	4 duration	5 duration	6 duration	7 duration	8 duration	9 duration
additional_cash_runway	-1.178	-0.814	-1.392	-1.683	-1.967	-1.931	-1.591	-1.396	-1.701
	(2.587)	(2.532)	(2.599)	(2.795)	(2.877)	(2.979)	(2.799)	(2.952)	(2.920)
patentsgranted	3.852	3.956	6.510	3.673	4.517	3.165	3.627	3.278	3.927
	(7.778)	(7.921)	(7.782)	(7.904)	(8.071)	(7.642)	(7.887)	(8.149)	(8.052)
noofvcs	-44.27*	-48.86*	-41.71	-29.56	-37.95	-29.14	-22.79	-44.43	-34.81
	(26.30)	(26.31)	(26.46)	(26.50)	(27.14)	(28.92)	(35.65)	(30.27)	(32.34)
stakevcs	33.55	90.77	68.79	55.22	99.10	48.21	71.05	113.5	65.02
	(253.4)	(255.7)	(241.6)	(253.4)	(244.2)	(247.6)	(254.9)	(249.5)	(252.8)
employees	1.119	1.118	1.023	1.051	1.025	1.023	1.010	1.015	1.026
	(0.865)	(0.838)	(0.846)	(0.851)	(0.876)	(0.826)	(0.852)	(0.861)	(0.842)
op_profit_last_yr	-0.421	0.421	-2.704	-0.992	-1.037	0.223	-0.265	0.806	-1.206
	(15.00)	(14.92)	(14.91)	(14.77)	(14.95)	(14.28)	(14.97)	(16.22)	(15.47)
vl_deals_total	-6.454***	-5.878***	-6.070***	-8.973***	-7.293***	-7.850***	-8.581***	-6.749***	-7.230***
	(1.804)	(1.812)	(1.786)	(2.572)	(1.845)	(2.076)	(3.149)	(1.844)	(2.396)
vc_volume_europe	0.473***	0.454***	0.447***	0.542***	0.444***	0.442***	0.536***	0.438***	0.492**
	(0.157)	(0.154)	(0.150)	(0.162)	(0.149)	(0.144)	(0.192)	(0.144)	(0.189)
country_uk	-125.1	-119.6	-149.2	-126.0	-145.5	-129.0	-134.0	-129.9	-136.6
	(89.12)	(86.33)	(90.06)	(91.00)	(88.99)	(88.99)	(89.86)	(90.58)	(90.13)
industry_R&D_intensive	-149.4	-138.4	-147.9	-168.5*	-153.5	-151.0	-161.4*	-155.6	-159.1*
	(94.67)	(95.84)	(91.61)	(95.06)	(94.62)	(92.80)	(94.71)	(94.00)	(93.74)
RepLeadVC	-0.340**								
	(0.170)								
RepLeadVC_high		-176.5*							
		(96.43)							
RepLeadVC_high_upper_quartile			-237.1***						
			(85.11)						
RepVCMax				-0.346*					
				(0.194)					
RepVCMax_high					-143.7				
					(124.1)				
RepVCMax_high_upper_quartile						-182.2*			
						(107.2)			
RepVCSum							-0.140		
							(0.129)		
RepVCSum_high								-53.14	
								(148.5)	
RepVCSum_high_upper_quartile									-112.1
									(135.3)
year_dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes
Constant	-1,484*	-1,430*	-1,384*	-1,636**	-1,222	-1,178	-1,692*	-1,278	-1,574
	(825.7)	(819.4)	(802.3)	(793.0)	(824.3)	(744.9)	(907.0)	(772.6)	(979.3)
Observations	118	118	118	118	118	118	118	118	118
R-squared	0.181	0.195	0.204	0.181	0.181	0.181	0.170	0.167	0.170

Table D. – 6 presents the results of the OLS regression analysis about the duration between the last venture capital round and the loan issuance. We built several dummy varibales to test the robustness of the results. The symbols *, **, and ***denote statistical significance at 10%, 5%, and 1% level, respectively.

Table D. – 7: Robustness check cox model

VARIABLES	1 duration	2 duration	3 duration	4 duration	5 duration	6 duration	7 duration	8 duration	9 duration
additional_cash_runway	0.00310	0.00226	0.00447	0.00441	0.00519	0.00450	0.00389	0.00295	0.00536
	(0.00621)	(0.00614)	(0.00624)	(0.00631)	(0.00625)	(0.00625)	(0.00632)	(0.00601)	(0.00612)
noofvcs	0.118	0.129	0.100	0.0277	0.0740	0.0319	-0.0171	0.0836	0.0239
	(0.0826)	(0.0817)	(0.0845)	(0.0917)	(0.0842)	(0.0886)	(0.130)	(0.0910)	(0.0939)
total_vc	-0.0224**	-0.0191*	-0.0226**	-0.0179*	-0.0184*	-0.0198**	-0.0185*	-0.0171*	-0.0196**
	(0.0103)	(0.0100)	(0.00992)	(0.0100)	(0.0102)	(0.00985)	(0.0100)	(0.0101)	(0.00991)
number_vc_rounds	0.274***	0.251**	0.277***	0.301***	0.264***	0.314***	0.293***	0.260***	0.304***
	(0.101)	(0.0989)	(0.0987)	(0.105)	(0.101)	(0.102)	(0.106)	(0.101)	(0.102)
stakevcs	0.385	0.0907	0.0985	0.269	0.168	0.246	0.278	0.161	0.232
	(0.769)	(0.770)	(0.759)	(0.767)	(0.767)	(0.766)	(0.764)	(0.774)	(0.752)
val	0.00445	0.00404	0.00518	0.00323	0.00345	0.00328	0.00353	0.00320	0.00317
	(0.00390)	(0.00394)	(0.00385)	(0.00389)	(0.00392)	(0.00378)	(0.00387)	(0.00394)	(0.00382)
industry_patentintensive_dummy	0.356	0.266	0.381	0.432*	0.404*	0.361	0.404*	0.355	0.423*
	(0.242)	(0.246)	(0.247)	(0.244)	(0.242)	(0.240)	(0.244)	(0.240)	(0.244)
country_uk	0.447*	0.394	0.484**	0.474**	0.544**	0.465**	0.501**	0.492**	0.526**
	(0.239)	(0.242)	(0.236)	(0.238)	(0.243)	(0.237)	(0.237)	(0.240)	(0.238)
RepLeadVC	0.00126**								
	(0.000551)								
RepLeadVC_high		0.323							
		(0.207)							
RepLeadVC_high_upper_quartile			0.758***						
			(0.243)						
RepVCMax				0.00117**					
				(0.000560)					
RepVCMax_high					0.449**				
					(0.221)				
RepVCMax_high_upper_quartile						0.672**			
						(0.284)			
RepVCSum							0.000554		
							(0.000387)		
RepVCSum_high								0.254	
								(0.233)	
RepVCSum_high_upper_quartile									0.643**
									(0.305)
wald_chi_square	21.72***	19.69**	26.13***	21.20**	21.33**	22.47***	19.26**	18.43**	21.42**
Observations	114	114	114	114	114	114	114	114	114

Table D. – 7 presents the results of our cox analysis about the duration between the last venture capital round and the loan issuance. Additionally, to the effect of our main venture capital reputation variables, we built several dummy varibales to test the robustness of the results. The symbols *, **, and ***denote statistical significance at 10%, 5%, and 1% level, respectively.

Eidesstattliche Versicherung

Ich, Herr Mischa Hesse, versichere an Eides Statt, dass die vorliegende Dissertation von mir selbständig und ohne unzulässige fremde Hilfe unter Beachtung der ‚Grundsätze zur Sicherung guter wissenschaftlicher Praxis an der Heinrich-Heine-Universität Düsseldorf' erstellt worden ist.

Düsseldorf, 13. September 2016

Mischa Hesse