Agency Risk and Firm Valuation: An Empirical Analysis of Venture Capitalists' Private Expectations

Thomas Hartmann-Wendels, Georg Keienburg and Soenke Sievers

Abstract

This study empirically evaluates the price impact of agency risk in firm valuation. Using a unique data set comprised of internal valuation documents, we find that venture capitalists use firm value discounts to cope with expected agency costs. These effects are economically large: e.g., whenever investors deem the management team inexperienced or cast doubt on management's efforts, a firm's equity value drops by 17-25%. This effect is robust to i) controlling for private business risk expectations, ii) controlling for financial statement data, firm and market characteristics, and iii) examining the effect of financial contracting mechanisms to reduce agency risks.

JEL classification: G24, G34
Keywords: agency risk, firm valuation, venture capital

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1. Introduction

Starting with the seminal work of Jensen and Meckling (1976), finance theory has studied the economic impact of agency problems intensively. Agency conflicts will result in costs, comprising the cost of binding and monitoring activities as well as the residual loss. Inevitably, these conflicts result in lower firm cash flows. Rational investors try to anticipate by how much agency problems presumably will reduce the net return of their investment and price their investment accordingly. In this paper, we use venture capitalists' private assessments of potential agency conflicts to address whether and to what degree these agency risk expectations are priced in firm valuation. To be precise, we will use the notion agency risk for the likelihood and the estimated magnitude of agency conflicts.

Since the work of Berle and Means (1932) and Coase (1937), agency theory has emerged as an important framework with which to understand the nature of the conflict between ownership and control as well as its possible resolution. The primary view is that agency problems are rooted in motivational causes, such as deliberate effort shrinking and other types of opportunism. Additionally, agency problems arise not only from harmful wrongdoing, but also from lack of agent ability, as suggested by Walsh and Seward (1990). To overcome those problems, investors install independent management board oversight (Linck, Netter, and Yang, 2008) and sign ex ante incentive contracts, such as stock options or share ownership (Schleifer and Vishny, 1997). However, this does not come for free, and neither monitoring nor financial incentives will reduce agency problems completely as long as information gathering is costly. Thus, rational investors will price investments taking into account the impact of agency problems on net returns.

Previous research, including Gompers, Ishii, and Metrick (2003), Krishnaswami and Subramaniam (1999) or Ang, Cole, and Lin (2000) or Singh and Davidson (2003), use indirect measures such as firm size, residuals of the market model, dispersion of analysts' forecast

and ownership structure as proxies for risk of adverse selection and moral hazard. These measures have limitations: first, residuals of the market model may not measure the risks investors actually care about. Second, for public firms, individual price assessments are not observable, although each investor may have an individual agency cost expectation and risk aversion. Third, using external proxies, it is difficult to disentangle agency influence from important unobservable factors, such as market development and business risk expectation.

In this paper, we address the role of expected agency costs in firm valuation using direct measures of agency problem expectations based on a unique and hand-collected data set of 309 venture capital investments. The venture capital industry is a particularly good setting to observe agency problems because there exists a direct relationship between principal and agent. The importance of the agency problem has been analyzed in theoretical work including that of Bergemann and Hege (1998), Trester (1998), Casamatta (2003), Schmidt (2003) and Dessein (2005).

Empirically, Gompers (1995), Lerner (1995) and Kaplan and Strömberg (2004) analyze agency problems in the venture capital context and its impact on deal structure, financial contracting and management oversight. Their research shows that venture capitalists are well aware of agency problems, assess the risk of facing conflicts of interests, and subsequently act to reduce them. Thus, unlike retail investors, venture capitalists know about expected agency costs and can price them accordingly. However, previous studies only focus on the mitigation of agency problems by monitoring, advice or the design of incentive schemes, we revisit the venture capital framework, focusing on firm valuation. For each investment, the venture capitalist provided us with all internal documents related to the deal. Based on this information, we were able to overcome the limitations of indirect agency risk measures. First, we obtain information about the risks investors are concerned about and observe individual agency risk expectations. Additionally, having complete insights, we are able to disentangle

agency effects from other internal concerns regarding market developments, key competitors or business strategy.

Our results show that investors' expectations about agency problems play a primary role in venture valuations. Investors impose agency risk discounts, a firm value penalty for expected risk, to price monitoring costs and charge for the residual loss. These effects are economically large. For example, whenever venture capital investors note agency risk given by an inexperienced management team, firm equity values drop by approximately 20%. Our findings are robust to individual business risk expectations, market influence, accounting measures and qualitative control variables (e.g., patents, strategic alliances, etc.) used in previous research by Gompers and Lerner (2000), Hand (2005) and Armstrong, Davila, and Foster (2006). In addition to controlling for several firm and market characteristics, our findings hold if we control for the use of financial contracts aimed at aligning incentives. Thus, the findings suggest that expected agency costs are significant value drivers in firm valuation. We contribute to the corporate finance literature, as we are the first to quantify precisely the price effect of agency cost expectation disentangled from other concerns regarding the investment prospects.

The remainder of this paper is structured as follows. Section 2 presents our agency risk measure. Section 3 introduces the sample, and section 4 includes the empirical analysis. Section 5 presents further analysis and robustness, while a final section concludes and discusses limitations.

2. Impact of agency risk on firm valuation

Fama and Jensen (1983) and Jensen and Meckling (1976) both suggest that agency problems are a general issue, existing in all organizations and affecting all corporate efforts. Despite

this general framework, research on this subject has focused predominantly on the context of investor control over managements' efforts. Within the venture capital industry, investors arrange milestone-based capital infusions (Gompers, 1995), make use of complex covenants and monitor their investments closely to overcome agency risk (Kaplan and Strömberg, 2004). Additionally, Walsh and Seward (1990) emphasize agents' inability as another difficult-to-stipulate component of agency risk. Inevitably, for public as well as private organizations, all these efforts will never reduce agency risk completely, either because it is technically infeasible or because the associated costs are prohibitively high. Apparently, astute investors will consider both in their investments: the expected costs of monitoring activities and the residual loss in market value stemming from unresolved agency problems.

Previous empirical research analyzes the consequences of these costs with regard to equity valuation in a variety of settings using indirect proxies. Using a corporate governance index to approximate shareholder rights, Durney and Kim (2005) and Gompers, Ishii, and Metrick (2003) implicitly address the negative price effect of moral hazard. Using management's equity ownership as a proxy for agency risk, Denis, Denis, and Sarin (1997) provide empirical evidence that agency costs are related to value-reducing corporate diversification strategies. Based on financial ratios, including asset and income diversity, Laeven and Levine (2007) explain conglomerate discounts in the financial industry via intensified agency problems. However, all these indirect measures have limitations, as they cannot relate agency caused firm value discounts to one single factor, as noted by Leaven and Levine (2007).

In contrast to these studies, Kaplan and Strömberg (2004) introduce direct measures of agency risk expectations to explain financial contracting and monitoring behavior in the venture capital industry. Following their approach, we measure the risks and uncertainties venture capitalists face and classify those risks depending on whether they specifically relate to agen-

cy problems or other concerns, which we divide into business risks and current firm and market characteristics.

2.1. Obtaining agency risk expectations

In a perfect world, one would measure agency risk using investors' private expectations about the agent's ability and expected behavior following the investment. Thus, in analyzing the price effect, one has to define a measure that most directly relates to an investor's expected monitoring costs and his expectation about the remaining agency costs. Therefore, in defining an agency risk measure, we strive to define variables that describe those concerns that will lead to post-investment monitoring efforts or an increase in residual loss. In line with Kaplan and Strömberg (2004), we obtain these variables based on investors' directly mentioned risk expectations within the investment memorandum. The investment memorandum is a document prepared by the lead investor's investment manager to inform senior management about the investment opportunity. Within this document there exists a section setting "reasons to invest" against "reasons not to invest." Based on the factors the investor seemed worthwhile to mention in these sections, we analyze agency risk expectations based on the following five categories: 1) management quality, 2) performance to date, 3) funding and financial structure, 4) co-investors and 5) portfolio fit.

Management quality

Intuitively, agency risk is directly associated with the investor's assumptions about management quality. In the venture capital setting, Amit, Glosten, and Muller (1990) argue that at the heart of entrepreneurial success lies the entrepreneur's ability. This ability may be known to entrepreneurs but unknown to potential investors. Walsh and Seward (1990) define the agency problem in this context as being driven by management's effort and ability. First,

the investor might worry that the entrepreneur will pursue different goals and maximize private benefits (shirking). In this context, Sapienza and Gupta (1994) argue that investors will monitor and control firms more closely. In addition, given that the investor's managerial resource is scarce and his effort costly, as expressed by Kanniainen and Keuschnigg (2004), an investor will assign a valuation at which he is compensated for the additional efforts required to deal with an inexperienced founding team. Second, the entrepreneur may simply be incompetent. As this uncertainty is not to be mitigated by financial contracts, the investor will have to provide additional costly monitoring and advice. Thus, venture capitalists will assign lower valuations to compensate for increased monitoring costs or other causes of lower expected returns.

Performance to date

Investors' uncertainty regarding the management will be influenced whenever new information is released. In the venture capital context, investors primarily emphasize the compliance of previously negotiated milestones and other performance-related objectives (Gompers, 1995). Receiving information on successful target achievement will render agency risk less severe. On the contrary, unmet targets will give rise to doubt regarding management quality. In such cases, the entrepreneur might simply strive to maintain his office in situations in which the initial investment idea has failed. Additionally, in such a situation, a gamble for resurrection is likely to occur. Any approach to cope with these risks, including increased monitoring and advice or otherwise a reduced return expectation, will subsequently lead to lower valuations.

Funding and financial structure

The benefit of incentive contracts in the venture capital context is analyzed by Casamatta (2003), Schmidt (2003) or Dessein (2005). Empirically, Gompers (1995) and Kaplan and Strömberg (2003) show that incentive contracts, including staged financing, performance-related compensation and extraordinary veto rights, are instruments often applied to mitigate agency risks. Whenever appropriate financial contracts are applied, an investor's concerns regarding opportunism should decrease. Still, there will be situations in which appropriate incentive contracts are complex to define and venture capitalists cannot fully trust negotiated incentives terms (Admati and Pfleiderer, 1994). Put differently, not every state of the world is covered by the negotiated contracts. As a result, investors will face persistent moral hazard risk and are likely to price protect by assigning lower valuations.

Co-investors

The role of syndication partners in mitigating adverse selection risks has been explored by Casamatta and Haritchabalet (2007). Additionally, co-investors may help to discipline the management team in the sense of Brandner, Amit, and Antweiler (2002). Monitoring costs are therefore likely to be lower, given a skilled syndication partner. On the other hand, there may be situations in which different investors might pursue individual and private goals, and syndication might even increase agency problems, as stated in Cumming (2005).

Portfolio fit

A leading explanation for the performance-enhancing ability of venture capitalists is experience (Hochberg, Ljungqvist, and Lu, 2007). To provide adequate support, investors specialize in certain industries and stages addressed by Norton and Tenenbaum (1993). Within their focus industries, geographic regions or core strategy, investors will find it easier to assess and

guide portfolio firms. We assume that in this case, monitoring costs will be low. When dealing with firms out of their focus, investors will face additional adverse selection as noted by Casamatta and Haritchabalet (2007). At the same time, the cost of monitoring and advice will be more pronounced. As a result, portfolio structure will have an impact on expected agency risks, and consequently, investors use firm value discounts for improper portfolio fit.

2.2. Constructing an agency risk measure

The previous section addressed a way to classify factors that are likely to increase agency costs. However, within their deal evaluation, investors will not exclusively focus on the downside, but will also address reasons to invest. In terms of agency risk, we argue that such reasons to invest to some extent mitigate expected agency risks.

For each transaction, we read the investment memorandum, a document summarizing the proposed transaction and count investment risks and reasons to invest separately. In a second step, we calculate a "net agency risk position," which can take the following values [-1;0;1]. Consider three potential settings: In the first situation, the investor mentions the risk of an inexperienced management team but gives no additional positive association regarding the team. In this case, we set the net management quality risk variable to 1. Consider a second situation in which the investor deems the management team inexperienced but also highlights the team's superior research capabilities. In that case, the net management quality risk variable is set to 0, assuming that risk and risk mitigation offset each other. In situation three, the investor may exclusively note the team's positive characteristics and does not mention additional risk. In this case, the net management quality risk variable becomes -1. We approach the other four agency risk categories identically, which yields a net agency risk position for each of the five categories described above. In a second step, we calculate the

sum over the five net agency risk positions and call this the investment's "net agency risk position".

Of course, one might criticize this approach, since all factors are equally weighted. We agree that certain factors could deserve more weight than others. Still, while this net agency risk measure might not accurately reflect the relative impact of directly mentioned risks and reasons to invest, it is a transparent measure and easily reproducible. Additionally, by summing over all five risk categories, the proposed agency risk measure does not require any judgments about the efficacy or monitoring costs related to any of the categories. We will present additional results regarding the potential bias of this measure following the basic empirical analysis.

2.3. Additional firm value drivers

We primarily try to disentangle agency risk expectation from "other" individual risk assessments, which we will subsume under business risk expectations. Naturally, with higher business risk expectations, investors will assign lower valuations. However, Kaplan and Strömberg (2004) argue that these risk variables are primarily external to management behavior. Important business risk factors are the market's size and growth, expected customer acceptance, business strategy, and estimates regarding financial markets condition. Regarding these categories, we assume that the investor will not suffer from any informational disadvantage, and therefore, that agency costs should be insignificant. In line with the agency risk measure presented within the previous section, we develop a direct "net business risk" measure to disentangle risks related to the business from risks related to adverse selection and opportunistic behavior. Consequently, we are endowed with two risk figures, an agency risk and a business risk measure. We believe that these measures fulfill two important requirements. First, they are precise because they are obtained from internal deal

documentations, and second, they are as distinct as possible, since investors address both risk dimensions in their records. This allows us to overcome limitations of previous indirect risk proxies and to relate agency caused firm value discounts to distinct causal factors. In the empirical analysis, we will describe the agency risk measure and our business risk variable in more details. Furthermore, influential work by Hand (2005) or Armstrong, Davila, and Foster (2006) shows that accounting data and other observable firm characteristics, such as patents, determine the valuation of venture capital backed firms. Thus, we also illustrate a comprehensive control framework to quantify the impact of each factor separately.

3. Data

3.1. Sample origination

Our analysis is based on 296 venture capital financing rounds by 339 different venture capital investors. We use a hand-collected data set from Kreditanstalt fuer Wiederaufbau (KfW), which is the largest promotional bank in Germany and also supports the financing of innovative firms. Owing to the sensitive nature of the analyzed data in this project, we went into a research cooperation agreement with KfW to guarantee that all analyzed data will be collected strictly anonymously and considered confidential. Within their venture capital program, KfW invests as co-investor in innovative firms on equal terms and at the same time with the lead investor. Being a purely financial co-investor KfW does not carry out individual due diligence but rather bases its investment decision on the lead investor's internal documentation and investment evaluation. As a consequence, KfW has access to all documentation regarding the lead investor's decision making. Exemplary, lead investors cover the following within their deal evaluation: due diligence concerning the management team, the product, technology and innovation, legal issues, the market, competition, business strategy, historical financial statements, valuation, invested amount and external surveys.

Additionally, the lead investor's documents contain statements regarding the investment decision. These are e.g.: reasons to invest, reasons not to invest, explanation of the technology, market and competition analysis, expectations about market volume, potential market shares and patent situation, founder resumes and appraisal of founder qualification. Finally, we could analyze articles of association, shareholder agreements, by-laws and cooperation contracts. Based on these documents, we were able to follow the complete investment process of the involved venture capital investments.

3.2. Sample selection issues

In this section, we address potential selection biases of our sample. Most seriously, we only see investments in which Kreditanstalt fuer Wiederaufbau was a co-investor. Therefore, our sample might be biased towards deals for which the lead investor is interested in having KfW as a syndication partner. This might raise two concerns: First, being a purely financial co-investor, KfW, and with that our sample, may suffer from high risks of adverse selection. Lead investors could strive to share only those deals they deem less promising. Regarding this argument, we are only partly concerned as the investor himself invested under identical conditions.[1] Astute investors will simply not invest once they deem an investment not promising. Second, one may challenge why KfW compared to other investors was asked to join the syndicate. However, with regard to this argument, we find that on average 72% of all transactions are syndicated (not considering KfW) and that an average of four investors syndicate for each of the 296 analyzed transactions. Therefore, we assume that although somewhat selected, our analysis is not seriously biased by focusing on deals in which KfW was one of the co-investors.

[1] Therefore, KfW faces identical legal protection and pay-off rights.

Additionally, KfW only acts as a co-investor if the investment opportunity is primarily based in Germany. Thus, our sample is biased towards firms with headquarters in Germany. Still, within our analysis, we primarily focus on the economic value of agency risk expectations. Lead investors in our sample are not limited to German origin. We find several among them from the United States, Europe and the Middle East. Therefore, we assume that a bias towards German portfolio firms does not bias our results on investors' agency risk expectations. Overall, considering the obvious biases mentioned above, we do not see any major issues impairing our research question.

3.3. Data description

Our data is comprised of information regarding 296 venture capital investments in 168 innovative firms between January 1999 and May 2008. The details of these transactions are given in Table 1.

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Panel A indicates that out of the 296 investments, 194 had cooperation partners, i.e., the funded firm already possessed a partner with whom to cooperate in product development, research activity or market entry. Panel B reports individual firms' information. On average, firms are 38 months old by the time of financing and possess about six patents. The median age of exactly three years shows that the firms within our sample are mainly early stage investments. Panel C reveals the number of deals by year. Out of the 296 investments, the majority of deals (215) took place after the year 2004. For this reason, our analysis presents a rare opportunity to analyze investments after the new economy downturn. Panel D shows that the industry range targeted by venture capital investors is rather focused. We distinguish be-

tween life science firms (biotech and medicine technology), internet and telecommunication, traditional high-technology companies, industrial manufacturing companies and other industries. While the investment focus clearly lies on life science firms (138), there are also several traditional high-technology companies (65) producing lasers and optoelectronic equipment. Panel E gives worldwide yearly inflows in million euros into venture capital funds for the time period January 1999 until May 2008 as reported by Thomson Venture Economics. What can be seen is the variation over time. With commitments of 170 EUR billion in 2000, fund inflows decline to 16 EUR billion in 2003. We use this information to construct a variable *ww_fund_inflows*. For each transaction date, *ww_fund_inflows* measures aggregated worldwide fund inflows over the preceding four quarters.

Table 2 summarizes median financial statement and valuation data by investment round. Panel A gives an overview of the financing round distribution.

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On average, the start-up firms were receiving the second round of financing. Compared to other studies, such as Hand (2005) and Armstrong, Davila, and Foster (2006), the observed firms are younger and smaller, and therefore represent a typical venture capital portfolio as reported in Kaplan and Strömberg (2003). Panel B reports median pre- and post-money values on a round to round basis. Pre-money values steadily increase beginning with a median of 1.9 million EUR for first round investments and a median of 8.5 million EUR for rounds higher than four. Still, the agreed pre-money values vary significantly within all investment rounds. Even controlling for extreme outliers, that is, taking the 90% decile minus the 10% decile, we find a significant range of pre-money values of 6.5 million EUR within round one and up to 22 million EUR within rounds larger than four. Median post-money values by

round vary from 2.9 million EUR up to 12.7 million EUR. Panel C reports median founder's and lead investor's equity share distributions by round. Overall, the founding team owns 53% of the firm. However, their shares decrease steadily as the firm becomes more valuable. Owning 70% of all shares in the first round of investment, the founders' equity shares decrease to 24% in rounds higher than four. Still, by that time, their shares are worth about 3.1 million EUR. By contrast, the lead venture capitalist's equity stake does not increase at the pace of the decline in the founder's share. Lead investors hold median shares of 19% in round one, 20% in round three and 32% in rounds larger than four. Panel D reports financial statement information per round. For each investment, we obtain data from the previous year's financial statement. First, it is noteworthy that 52 out of the 296 investments were done without any historical financial statements available. Of course, the majority of cases in which financial statements are not available take place within the first two rounds (50). In one deal, the lead venture capitalist did not rely on financial information in round five, as the underlying firm was subject to recent merger activity.[2] We observe a pattern for increasing median values for almost all financial statement items except for net income, which becomes increasingly negative from round to round.

Prior research, including that of Sahlman (1990), Gompers (1995) or Kaplan and Strömberg (2003), has established that venture capitalists use extensive control mechanisms to manage agency risks. Primarily, one can divide the most common control mechanisms into four categories: contingent financing, cash flow rights, board and voting rights and anti-dilution protection. Table 3 gives an overview of incentive contracts used within our sample and details of the investment memorandum regarding the financial structure.

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[2] The inclusion or exclusion of this transaction from the analysis does not quantitatively influence our results.

Panel A reports the number of times that the respective provision was used. The role of milestone-based capital infusion in mitigating agency risks has been discussed in Gompers (1995). Under a milestone covenant, only a small fraction of the total financing demand is paid up-front, while further financing is contingent upon the achievement of defined targets. The milestones dummy variable indicates that contingent financing was used in 214 investments. Most common defined targets are based on sales development or the accomplishment of prototypes or market entry. Liquidation preference is a dummy variable that takes the value 1 whenever the investor has senior cash flow rights that exceed his initial investment. We find that senior cash flow rights exceeding the initial investment are used in 67% of all deals. The maximum liquidation preference in our sample even exceeds the venture capitalist's investment by a factor of 3.5. While this provision may increase the management's risk taking behavior it may also likely be an instrument to screen for good entrepreneurs in the context of Ross (1977) and Diamond (1991). As a result, we follow Kaplan and Strömberg's (2004) argumentation and expect that this provision primarily minimizes adverse selection risk, as the management team will only participate in an exit or liquidation once the investor's priority claim is settled. VC board majority reports the number of transactions (90) in which the venture capitalist possessed board majority. Given board majority, the venture capitalist can easily take control in case the venture performs poorly. Thus, one might expect reduced agency risk expectation given this provision. In approximately 60% of all deals, the venture capitalist has negotiated a protection against future financing rounds at lower valuations. Given this provision and a future investment round at a decreased firm value, the entrepreneurial management team has to compensate the investor for his loss by transferring shares. Subsequently, accepting this provision may reduce risks of adverse selection and moral hazard. Finally,

the sum of covenants indicates the number of deals in which at least three of the above mentioned covenants were used.

Naturally, all these covenants are explained within the investment memorandum. The investment memorandum is a document prepared by the lead investor's investment manager to inform senior management about the investment opportunity. Based on this document, the partnership decides whether or not to invest. Enclosed in the memorandum, we find a section regarding the financial structure of the proposed investment. Panel B reports the number of rows in the investment memorandum devoted to the transaction structure. On average, the venture capitalists write 28 lines on financial structure, with a minimum of 1 and a maximum of 180 lines. Total pages gives the total size of the investment memorandum. This document, summarizing the transaction, numbers, on average, 12 pages.

The internal investment memorandum is the primary source for our analysis, as it additionally covers the venture capitalist's assessment regarding the investment. Key content of the investment memorandum includes an executive referral dealing with "reasons not to invest" and "reasons to invest".[3] We analyze these documents and note whether the lead investor named specific categories as investment risks or strengths. Table 4 gives an overview of investors' expectations regarding risk, reasons to invest and the net risk position of the investment.

----Please insert Table 4 approximately here----

Panel A reports agency characteristics that investors have explicitly mentioned within the investment recommendation. We distinguish among management quality, performance to date, financial structure/funding, co-investors and actual portfolio fit. Column 1 reports the

[3] Primarily, the referral is given as an executive summary spanning the first pages or as a final conclusion at last pages of the investment memorandum.

frequency with which investors have mentioned these factors as risks. Column 2 reports the number of times that investors have mentioned these factors as a reason to invest.[4] Column 3 reports mean and standard deviation of the net risk position, which is (risk assessment - reason to invest), for each of the subcategories on a firm level. With regard to agency risk, management quality is a major concern for most investments. In 126 out of the 293 investments,[5] the investor mentioned risks with regard to management quality. Exemplary comments regard the lack of business experience or strong dependencies on one key founder. Management quality is also a major issue in the evaluation of firms' strengths. In 73% of all investments, investors mentioned management quality as a favorable component of a deal. A typical assessment is "Management team is fully established. The CSO is one of the world's leading researchers on that topic. CEO and CFO are both financially committed and have very good business contacts." The net risk assessment regarding management quality is -0.31. The negative coefficient reflects that management quality is seen more often as a reason to invest than an investment risk. However, we do also find cases in which investors evaluate the scientific strength of the founders as positive but will still argue that the team lacks an experienced CFO. Recent performance was cited as a risk in 12% of cases and as a reason to invest in about 41% of them. This results in an average net previous performance risk position of -0.29. Exemplary risks of previous performance are "Founding team missed milestones in previous round" or "Management delivers liquidity status too late and incomplete." Investors saw factors like a firm's being on schedule with the business plan from the previous round as reasons to invest. Funding or financial structure is mentioned as problematic in about 16% of all investments. A typical concern is adequacy of proper covenants, e.g., "Difficult to define reliable milestones at this stage." Funding is only mentioned as a reason to invest in 7% of all investments, e.g., "Financial structure ensures downside protection in case of bankruptcy

[4] Deviating from Kaplan and Strömberg (2004), we do not report valuation as a reason to invest or as a source of risk. Including investors' valuation assessments might lead to problems of endogeneity.

[5] Three values were missing.

event." The resulting net funding risk position of 0.08 is an interesting finding. Given the broad literature on financial contracting to mitigate agency risks in the venture capital industry, one might have expected more observations in the "reason to invest" section. Finally, the role of co-investors and general portfolio fit are addressed. Only 9 out of the 293 investment recommendations cite co-investors as a threat. An exemplary evaluation is "There are substantial frictions among existing investors." In about 15% of cases, co-investors are seen as a reason to invest, often when corporate co-investors possess extensive product and technology knowledge. Six times investors mentioned risks of portfolio fit. This happened when they considered themselves to be not very experienced in the company's industry. In 9% of all cases, investors mentioned positive effects of portfolio fit, mostly when they were well-experienced within the industry.

Panel B reports business factors that investors mentioned within the investment recommendation. Market size was seen as a threat in only 18% of cases. A typical example is "Have to develop niche strategy due to limited market potential." In contrast, 63% of all proposals deemed the market as potentially large and underdeveloped. Risks involving competition seem to be a major threat in venture capital investing, as almost 70% of all investment proposals refer to them. Less often (44%), the opportunity of nonexistent competition is highlighted.[6] This results in a net risk competition position of 0.26. Firm strengths with regard to the likelihood of customer adoption are mentioned about 44% of the time. First order entry or positive customer feedbacks on prototypes are typical examples. Risks regarding customer adoption are noted in 34% of all transactions. Finally, positive financial market conditions with regard to refinancing or a scheduled exit are described in about 30% of cases. Risks involving the financial markets seem to be less severe. They are mentioned in only 13 proposals, e.g., "Extremely difficult to find follow-on financing for

[6] In 14% percent of all deals, the investor named competition as both a risk and a strength. A typical example would be: "While we see huge market potential, there are several large cap corporations who could imitate the venture's approach".

early biotech firms right now." With regard to product development, investors named complexity and obstacles in about 58%. Product development was seen as a reason to invest in 87% of the cases. Finally, the implemented business strategy was seen almost as often as a risk (40%) as it was as a strength (32%). Exemplary arguments for these findings are "The expansion into Middle East markets guarantees first mover effects" and "Complex product development hinders quality improvement."[7]

Panel C reports net risk positions. To construct the aggregate variable Δ Agency risk, we calculate the sum over the five dummy variables for management quality, performance to date, funding, co-investors and portfolio fit risk given in column 1 less their reasons to invest given in column 2. Thus, delta agency risk is bounded within [-5;5], and we interpret a value of 5 as a high risk transaction and a value of -5 as a transaction in which the investor assumed zero agency risk. On average, we find a net agency risk position of -0.69, indicating that we find slightly more reasons to invest than reasons not to invest.[8] Regarding agency problems, the riskiest transaction within our sample has an assigned value of 3, while the least risky transaction possesses a value of -3. To construct the aggregate delta business risk position [-6;6], we calculate the sum over the six net business risk assessments reported in Panel B. We face two transactions in which the respective investors named one business risk and six reasons to invest within the investment memorandum (Δ Business risk =-5). Additionally, we find nine transactions in which risks exceed reasons to invest by three.

Overall, it is noteworthy that we face significantly more reasons to invest (1301) than risks associated with the investment (878). This results in negative values for delta agency and delta business risk. This is naturally the case, as we only observe positive investment

[7] Obviously, there are some sentences which could be interpreted as either an investment risk or a reason to invest. An example would be the following sentence: "Successful expansion into Middle Eastern markets might hinder further product quality improvement." Note however that we simply follow the investor's classification scheme. Thus, if this sentence would be written in a section "reasons to invest", we would count it as strength while in case it is stated within the "investment risk" section, we would count it as a risk.

[8] 57% of all transactions are negative net agency risk deals.

recommendations. Still, we do not believe that our sample suffers from any form of selection bias as without a positive investment recommendation, venture capital-backed firms do not possess any positive net present value.

Turning from the summary statistics to the empirical analysis, Table 5 presents pairwise correlations of our explanatory variables.

----Please insert Table 5 approximately here----

To construct the aggregate variables Δ Agency risk and Δ Business risk, we calculate the sum over the respective net risk categories shown in Table 4, column 3. We find the two risk expectation measures uncorrelated. This suggests that factors given in the agency risk measure capture other expectations than the business model assessment. Sum of covenants represents the sum over the four dummy variables for the commitment to the following covenants: milestones, liquidation preference larger than the venture capitalist's initial investment, board majority and anti-dilution protection. Round indicates the actual financing round. Prototype is a dummy variable that takes the value 1 if the portfolio firm possessed a prototype at the time of investment. Age denotes a firm's age in months, and patents is the number of awarded patents by the time of the investment. Both variables are log-transformed according to $\log_e[Z+1]$.[9] Cooperation partner shows whether the firm had already had a strategic cooperation by the time of the investment. Corporate lead investor is a dummy variable for corporate lead investors. *ww_fund_inflows* measures worldwide fund inflows into the venture capital industry in million of euros within the four quarters prior to the investment date. This information is taken from the Thomson Venture Economics Database. All explanatory financial statement variables are taken from the most recent fiscal year

[9] Within all log transformations, we add one to each observation since our sample includes zero patent or pre-revenue firms. For these firms, it would not be possible to calculate the log of zero.

immediately prior to the valuation date. We obtain a rather strong positive correlation among all financial statement variables. This result is not surprising, as expenses intuitively rise with growing firm size. Except for the correlation between non-cash assets and R&D and SG&A and non-cash assets, none of these correlations exceeds 0.6. These results suggest that the explanatory variables are not likely to be redundant. Nevertheless, for additional robustness, we conduct the variance inflation factor test (VIF) based on the regression of an explanatory variable on all other explanatory variables (not reported). As a result collinearity does not appear to be a serious problem in interpreting the regressions. None of the VIF coefficients exceeds values greater than six.

4. Basic econometric analysis

Valuation of venture capital-backed firms has been analyzed by Gompers and Lerner (2000), Hand (2005) and Armstrong, Davila, and Foster (2006). Their research establishes that quantitative factors, i.e., market conditions, financial statements and qualitative company characteristics, such as patents, determine pre-money valuations. However, prior analysis is detached from agency risk influences due to data limitations, as stated by Hand (2005). Their variables therefore provide a well-grounded framework in which to analyze the influence of agency risk expectations on the valuation of young and innovative firms. Consequently, we use these measures of quantitative and qualitative company and market characteristics as a control framework. Additionally, we control for business risk expectations directly mentioned within investors' due diligence documentation. To assess these influences, we use a log-linear model according to the following equation,[10]

[10] Using a log-linear model provides a more outlier robust framework than using linear models and is the standard within the venture valuation literature, used in Lerner (1994), Gompers and Lerner (2000) or Hand (2005).

$$LnPREMV_i = \alpha + \zeta\,\Delta\,Agency\ risk_i + \Upsilon\,\Delta\,Business\ risk_i + \sum_a \theta_a LnFS_{ai} + \sum_b \Psi_b LnNFS_{bi} + \varepsilon_i\,,$$

where LnPREMV is the natural log of firm i's pre-money value. Net agency and business risk expectations are given by Δ Agency risk and Δ Business risk, respectively. To obtain these measures, we calculate the sum over the respective net risk categories shown in Table 4, column 3. Thus, delta agency risk may takes values between -5 (no risk) and 5 (high risk), while Δ business risk is scaled between -6 (no risk) and 6 (high risk). LnFS is the natural log of all financial statement information. LnNFS represents the natural log of our qualitative and observable variables. Table 6 provides regression results of the multivariate analysis. All results are reported using robust standard errors clustered on the firm level (Peterson, 2009). All models report results restricted to those 222 observations, where financial statement information was available. Additionally, our data include 22 other missing values, subject to missing firm characteristics, contracts or agency risk analysis.

----Please insert Table 6 approximately here----

Model I shows the impact of net agency risk expectation on assigned pre-money values. We find a highly significant and negative impact. With each additional risk investors document within the investment memorandum, the firm's equity value drops by 25%.

Model II introduces our comprehensive control sample, including private business risk estimates, non-financial and financial statement data.[11] Despite adding these control variables, agency risk remains a significant value driver. Economically, each additional risk that investors mentioned in the information memorandum results in a firm value discount of

[11] Financial variables are log-transformed according to $\log_e[Z+1]$ from the most recent fiscal year immediately prior to the valuation date. We add one to each observation as our data include several pre-revenue or zero patent firms. For these firms, it would not be possible to calculate the log of zero.

approximately 17%. As expected, we find a strong (-17%) and significant impact of investor's expectations regarding the business risk. Turning to our control variables, we observe that equity value increases with increasing round size. Compared to valuations in financing rounds after the fourth, valuations within financing rounds one to three are significantly lower. Next to investment rounds, we control for industry variations. Still, we do not find any significant influence caused by the type of industry. Additionally, we find that neither the existence of prototypes nor firm age increases venture valuations. Hence, getting older does not have additional explanatory power given the round number of the investment. Reputation effects due to the existence of cooperation partners have a statistically significant and economically large impact on entrepreneurial valuations. Firms that possessed a cooperation partnership by the time of the investment had an enterprise value that was 27% higher than those of firms without established partners. The same relation holds true for the number of issued patents. With regard to investor governance, we find a negative but insignificant impact of the corporate investor dummy on venture valuations. To control for market influence, we add worldwide fund inflows into the venture capital industry over the last four quarters immediately prior to each investment. In line with Gompers and Lerner (2000), we find that an increase of fund inflows increases venture valuation. Additionally, we control for several financial figures analyzed in Hand (2005) and Armstrong, Davila, and Foster (2006). All accounting data is obtained from the most recent financial statement prior to the investment date. The two balance sheet asset variables, cash and non-cash assets (that is, total assets less cash), have the expected positive sign and are statistically significant. Long-term debt has the predicted negative effect on pre-money valuations. In line with Hand (2005), we do not find significant value relevance of historical revenues. The same relation holds true for research and development as well as selling, general and administrative

expenses. Overall, we find a significant share of variation in venture valuations (R^2=61%) explained by the model.

Model III additionally controls for negotiated incentive covenants aimed at mitigating agency risks. According to our measure, each transaction has a sum of covenants between 0 and 4 representing the use of milestones, liquidation premiums, board control and anti-dilution rights. However, we do not find any significant impact of the use of financial covenants on assigned pre-money values. We see one possible explanation in the fact that risk mitigation by financial structure is directly addressed within the agency risk measure. Therefore, the expected risk reduction by financial covenants may already be integrated within an investor's risk expectation. The simple presence of incentive covenants therefore does not change the net risk position. Second, the use of covenants and an assigned firm valuation could well be endogenous, which would cause our results to be biased. To address this issue, Model IV reports a two-stage least squares specification in which the sum of covenants is instrumented by the size of the investment memorandum and the number of rows within the investment memorandum devoted to the financial structure. Consider the case of a milestone provision: at the least, a proper milestone, such as sales exceeding a certain threshold, has to be defined. Second, one has to define the capital amount provided up front and in the event that this milestone is reached. Third, one has to consider actions if milestones are missed. Thus, we find it convincing that increasing the use of covenants will lead to an increase in lines written to describe the financial structure and an increase in memorandum size. In addition, both measures should be fairly independent of firm value, and thus provide a good instrument. Regarding our analysis, and in line with Model III, we do not find any significant impact of incentive covenants on firm valuation. More importantly, though, we find the coefficient for agency risk expectation unchanged.

5. Further empirical analysis and robustness

The results from the previous section clearly show that agency risk is an economically significant value driver in firm valuation (firm value reduction of 17-25%). Our agency risk measure has the appealing feature of being plain and easily reproducible, since we simply sum over dummy variables that indicate net components of agency risk. However, forming net positions and aggregating them in this way assumes that all factors are equally important. This might be a rather strong assumption, as some relevant provisions may deserve more weight than others. Consequently, the following analysis sheds light on the importance of each component by following a two-step procedure: first, we analyze the influence of each net agency risk measure separately. Thus, delta agency risk is split into its five subcategories (Δ Management risk, Δ Performance to date risk, Δ Funding risk, Δ Co-Investor risk, Δ Portfolio fit risk). Second, we further disentangle the net risk positions into their individual components. Thus, each net position is disentangled from the risk and the reason to invest factor. In each step, tests of equality of the disentangled risk factors are performed to evaluate if our aggregation procedure imposes binding constraints on the aggregated agency risk measure.

----Please insert Table 7 approximately here----

Turning to the first part, Table 7 Model I shows that three out of five delta agency risk components (Δ Management risk, Δ Performance to date risk, Δ Co-Investor risk) are highly significant with an expected negative coefficient.[12] Introducing our comprehensive control framework in Table 7, Model II, we observe the intuitive result that the most clear cut agency

[12] Note that these findings are likely not influenced by multicollinearity. None of the pairwise correlations between the five delta risk categories exceeds a value greater than the absolute value of 0.18. Additionally, a variance inflation test shows no value greater than 1.05.

risk measure, delta management risk, has the most profound impact on firm valuation. Specifically, company values drop by 25% if investors cast doubt on the management team. The second risk category, net performance to date, shows lesser importance once we control for business risk and other firm and market characteristics. With a coefficient of -0.12, its impact on equity value is 13 percentage points lower compared to delta management risk. The three other components, net funding risk, net co-investor risk, net portfolio risk, all have the expected negative coefficient but are insignificant. The findings are in line with the summary statistics, which show that investors name the latter categories less often compared to net management risk and net previous performance risk (see Table 4). Although Model III and Model IV control for risk management via the use of incentive contracts, the results remain qualitatively unchanged. More importantly, a Wald test for the equality of coefficients for the five delta agency risk categories shows that our simplification procedure, i.e., summing over all five categories, is a non-binding constraint. In all four models, the null hypothesis that all five coefficients are equal cannot be rejected. As a result of this analysis, we conclude that net management risk is by far the most important agency risk factor. However, summing over all coefficients, that is, applying an equal weighting scheme to each risk category, does not significantly impair our analysis.

----Please insert Table 8 approximately here----

While the previous section addressed the relative importance of each net agency risk category, we still do not know about the individual impact of risk and reasons to invest. Thus, Table 8 completely disentangles our net agency risk measure. Consequently, we show coefficient estimates for all five agency risk categories and the five reasons to invest factors. In line with the previous findings, all four estimated models (Model I - Model IV) clearly

show that management risk is by far the most important issue. Whenever investors perceive the management quality as a threat, firm values drop by 35%. This result is robust across all model specifications. Closely related to management risk is the performance to date category. Across all model specifications, company value drops by around 30% if the previous performance is seen as a risk, for example in case the management team failed to achieve defined milestones.

Regarding the next section in Table 8, agency factors to invest, we observe in all models that coefficients are, as predicted, positively related to company values and that all coefficients but co-investors are insignificant. While surprising at first glance, note that we are measuring agency risk. If management performs as expected, firm value does not increase significantly. Additionally, financial contracting is not additionally rewarded. Thus, even if the funding structure for the investment is well-designed, no additional value is created. The only significant positive impact is observed from the role of co-investors. This result is related to the empirical findings presented by Brander, Amit and Antweiler (2002) regarding the value enhancing role of co-investors. Table 8 further shows that our overall agency risk figure is a well-suited measure for agency risk expectations, since the Wald test of equality of all five risk categories and their respective counterparts is not rejected (minimum p-value is 0.22 for Model II).[13] Certainly, we acknowledge that the power of such tests is limited because certain measures are only sparsely mentioned in the investment memorandum.

So far, our sample was restricted to observations where all control variables are available. In particular, we required that key financial statement data, such as total assets or cost figures, could be observed. Thus, as a final robustness check, we include observations without financial statements. This enhances our sample size by 45 observations or 20%, respectively.

[13] Note that these findings are likely not influenced by multicollinearity. None of the pairwise correlations between all five risk categories and their respective counterparts exceeds a value greater than the absolute value 0.24. Additionally, a variance inflation test shows no value greater than 1.11.

Consequently, Table 9 shows the results for all agency risk regressions without any financial statement requirements.

----Please insert Table 9 approximately here----

Disregarding the impact of financial statements on firm valuation, we find that the importance of agency risk expectation has increased. This is no surprise given that the added observations are primarily first and second round investments. For these early stage firms, agency risk should be especially pronounced. Otherwise, we do not find significant changes whether we use or disregard financial statement information.

6. Conclusion and discussion

This article has identified by how much expected agency costs are priced in firm valuation. In contrast to previous studies that use indirect proxies to capture a firm's inherent agency risk, we employ direct measures based on investors' private expectations. Having complete insights into venture capitalists' internal valuation documents, we are able to disentangle agency problems from other internal concerns regarding the market development, key competitors or the business strategy. Therefore, we can quantify the price impact of expected monitoring costs and the residual loss introduced by Jensen and Meckling (1976). Our results show that agency costs are economically large. For each additional agency risk factor that investors mention within the investment proposal, a firm's equity value drops by approximately 20%. Our findings are robust to individual business risk expectations, market influence, financial statement and qualitative control variables used in previous research. Thus, the results suggest that expected monitoring costs and the residual loss are substantial value drivers in firm valuation.

One might argue that our findings are only valid for a venture capital setting, and agency risks are most pronounced for young and innovative firms. Undoubtedly, business risks are more severe in the venture capital context, and CEOs of public firms face substantial oversight by boards, financial analysts or banks. Thus, asymmetrical information will be more pronounced in the financing of young and innovative firms. Mitigating the risks faced by common investors is exactly the role of venture capitalists (Admati and Pfleiderer, 1994). Their instruments for resolving agency problems are extensive due diligence, industry insights, monitoring and appropriate financial contracts. Due to venture capitalists' role as inside investors (Lerner, 1994), we argue that it is likely the case that the principal in the venture capital context faces less informational asymmetry than does the average retail investor investing in a blue chip company. Therefore, we believe that our findings provide a reasonable estimate of agency costs inherent in publicly listed firms. As one of the few occasions where management quality risk becomes observable in public equity markets, we see the following example: the moment that Steve Jobs (CEO of Apple) announced a medical-related leave of absence, trading in Apple's stock was halted and resumed, later falling more than 7%. The following day, the Wall Street Journal noted, ""*Steve Jobs health" factor could cause the stock to fall an additional 10% to 15%*" (Wall Street Journal, January 15th 2009). While no fundamental business-related information was released that day, we believe that the observed discounts provide a valid proxy for investors' aggregate risk expectations regarding the CEO's replaceability.

In addition to objections against the validity of our findings for public firms, several objections against our agency risk measure might exist. First, aggregation might lead to a loss of information and bias our findings, since all variables are equally weighted. We agree that certain factors could deserve more weight than others. For example, management quality risk could be more important than the risk of inappropriate portfolio fit. We address this issue

within the empirical analysis and find that management quality is in fact of central importance. However, once we constrain our estimates to be equally weighted across all agency risk factors, we find the loss of information is rather small and is outweighed by the benefit of having a transparent agency risk measure.[14] Alternatively, it would have been difficult to define possible weights ex ante. Second, our classification scheme might simply be incorrect. Factors classified as agency risk might instead be business risk. For example, previous performance failure could be related to complex product development or market decline rather than to management inability. While we are sympathetic to this argument, we tried to minimize such biases by explicitly controlling for all business related risks, such as product or market development risk, within the business risk category. Thus, we categorized only those factors with which the investor associated an increase in necessary monitoring efforts as agency risk. Vice versa, categorized business risk factors could instead be agency risks. We are less concerned with this objection. The primary source of agency risk is asymmetrical information. Given the categories in the business risk section, including market development, business strategy or competition, venture capitalists are unlikely to suffer from any informational disadvantage. Finally, some factors within agency and business risk could be closely intertwined and could pose identical risks, but we could find zero correlation between both net risk measures. Therefore, we assume that both categories measure different economic factors.

Overall, we acknowledge that the presented agency risk measure might have limitations. However, we believe it is a reasonable attempt to measure the uncertainty that investors face regarding opportunism and non contractible residual loss. It thereby outperforms all prior attempts to capture agency risk expectation in firm valuation by the use of indirect proxies.

[14] Gompers, Ishii, and Metrick (2003) and Bebchuk, Cohen, and Ferrell (2008) employ a similar methodology in related corporate governance research.

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Appendix

Table 1: Summary statistics

Panel A: General data					**N**					
# Investments					296					
# Individual firms					168					
# Investments given portfolio firms had cooperation partner					194					
Panel B: Portfolio firm data				**Mean**		**Median**				
Age (months)				38		36				
Number of patents				6		2				
Panel C: Valuation dates										
Year	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Obs.	3	15	12	13	11	25	57	82	73	5
Panel D: Portfolio firm's industry										
	Life Science		**Internet**	**Telecom**		**Traditional high technology**			**Industry**	**Other**
Obs.	138		61	17		65			11	4
Panel E: Market data	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Worldwide vc fund inflows (EUR mil.)	75,384	170,051	68,332	18,574	15,853	24,003	39,433	47,109	50,719	22,207

This table reports summary statistics for 296 venture capital investments between 1999 and 2008 in 168 different firms. Investments given portfolio firms had cooperation partners counts all 194 investments in which the funded venture already had a strategic cooperation agreement. Panel B reports firm age in months and the number of patents funded firms possessed at the time of investment. Panel C reports the distribution of valuation dates by year. Panel D reports industry type distribution. Panel E reports yearly worldwide fund inflows in million of euros into the venture capital industry between January 1999 until May 2008 as reported by Thomson Venture Economics Database.

Table 2: Financial summary statistics by financing round

Panel A: Distribution of financing rounds						
Round	**Total**	**Round 1**	**Round 2**	**Round 3**	**Round 4**	**Round >=5**
Obs.	296	85	117	61	23	10
Panel B: Valuations by round in 1000 EUR						
Pre-money value (Median)	3,000	1,855	2,289	4,659	6,026	8,500
Pre-money value (Min)	149	149	398	355	1,950	3,468
Pre-money value (Max)	33,800	15,800	20,000	32,000	33,800	27,000
Post-money value (Median)	4,500	2,903	3,420	6,180	7,661	12,700
Panel C: Share distribution						
Lead investor equity share (%)	20%	19%	18%	20%	25%	32%
Founder team equity share (%)	53%	70%	54%	38%	33%	24%
Panel D: Financial information by round						
Obs. with no financial statements	52	41	9	1	0	1
Balance sheet data in 1000 EUR						
Cash	48	0	63	158	227	202
Total assets	530	25	544	1,292	3,114	3,305
Long term debt	0	0	0	0	0	79
Income statement data in 1000 EUR						
Sales	47	0	28	233	187	254
Net income	-302	-44	-239	-579	-1,454	-1,832
R&D expenditures	166	4	141	493	726	1,111
SG&A expenditures	263	0	231	649	1,324	1,529

This table reports summary statistics of financial statement information and valuations in 296 venture capital investments in the time 1999 and 2008. Panel A gives an overview of the firm observations by investment round. Panel B reports the median, minimal and maximum pre-money value and the median post-money value by round in 1000 EUR. Panel C reports founder team's equity shares and lead investor's shares by investment round. Panel D reports financial statement information by round. Obs. with no financial statements shows the number of investments that were financed while the firms did not have any historical financial statements at the time of the investment. Financial statement information is obtained from the last financial statement preceding the transaction and reported in 1000 EUR. Cash reports firms' median amount of cash. Total assets is median total assets. Long term debt is the median amount of debt. Sales reports firms' median sales. Net income reports firms' median net income. R&D expenditures is median R&D expenditures. SG&A is median selling, general and administrative expenditures.

Table 3: Incentive contracts

Panel A: Key incentive covenants		N		%	
# Milestones		214		74%	
# Liquidation preference > 1		194		67%	
# VC board majority		90		31%	
# Anti-dilution rights		167		58%	
# Sum of covenants >2		174		60%	
Panel B: Investment memo details	Min	Mean	Median	Max	Std.
Rows regarding transaction structure	1	28	21	180	26
Total pages	1	12	10	46	7

This table reports the use of incentive covenants and investment memorandum size in 296 venture capital deals. Within Panel A, column 1 reports the number of times investors used the mentioned covenants. % reports relative frequency in percent. All covenants are coded as dummy variables. Milestones takes the value 1 if performance-linked capital infusion was provided in the contract. Liquidation preference denotes the number of investments in which investors possessed a liquidation preference larger than their initial invested amount. VC board majority takes the value 1 if the investor controls the board. Anti-dilution rights takes the value 1 if the venture capitalist has contracted anti-dilution rights. Sum of covenants > 2 gives the number of deals in which at least three of the above-mentioned covenants were used. Panel B reports details of the investment memorandum. Rows regarding transaction structure counts number of rows in the investment memorandum that outline transaction details with regard to the financial structure. Total pages is the size of the investment memorandum.

Table 4: Agency and Business risk

Investor assessment Total sample N =293	**Reason not to invest**		**Reason to invest**		**Δ risk assessment**	
Panel A: Agency risk	**N**	**%**	**N**	**%**	**Mean**	**Std.**
# Management quality	126	43%	215	73%	-0.31	0.68
# Previous performance	36	12%	120	41%	-0.29	0.64
# Funding	46	16%	21	7%	0.08	0.44
# Co-Investors	9	3%	44	15%	-0.12	0.40
# Portfolio fit	6	2%	26	9%	-0.07	0.32
Panel B: Business risk	**N**	**%**	**N**	**%**	**Mean**	**Std.**
# Market size and growth	52	18%	185	63%	-0.45	0.64
# Competition	203	69%	128	44%	0.26	0.68
# Customer acceptance	100	34%	128	44%	-0.10	0.71
# Financial markets and exit conditions	13	4%	87	30%	-0.25	0.51
# Product or technology development	170	58%	254	87%	-0.29	0.58
# Business strategy or model	117	40%	93	32%	0.08	0.70
Panel C: Net risk positions	**Mean**	**Median**	**Min**	**Max**	**Std.**	
Δ Agency risk	-0.69	-1	-3	3	1.21	
Δ Business risk	-0.75	-1	-5	3	1.72	

This table reports explicitly mentioned investment risks and strengths of 296 venture capital investments. We face three missing values. Panel A reports agency risk factors. Column 1 reports investors' risk assessments. It shows the number of times investors noted agency risks and risks regarding the business concept in the investment memorandum. Column 2 reports investors' reasons to invest. Column 3 reports mean and standard deviation of risk minus strength on the transaction level. Management quality reveals the number of times investors named management quality as an investment risk or as a reason to invest. Performance to date is a dummy variable that takes the value 1 once the management's or firm's performance up to the investment was named as risk or strength. Funding reveals whether investors noted financial structure as a risk or strength. Co-investors reports whether syndication partners were named as a risk or strength in the investment proposal. Portfolio fit shows risk/strength appraisal with regard to the actual portfolio structure and costs of monitoring. Panel B reports dummy variables that investors noted with regard to the business concept. Market size/growth counts the number of times investors named the market size as a risk against or reason for investing. Competition counts risks and strengths related to competition. Customer acceptance counts whether customer demand was named within the risk/strength assessment. Financial markets counts the number of times investors saw reasons to invest or threats related to exit conditions. Risk/strengths of product development are denoted in the dummy variable product or technology development. Business strategy reveals the number of times investors expected business strategy as risk or reason to invest. Panel C reports net risk positions. Δ Agency risk is the sum of the five Δ risk assessments in Panel A, column 3. Δ Business risk is the sum of the six Δ risk assessments in Panel B, column 3.

Table 5: Pairwise correlation between estimation variables

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	**Δ Agency risk**	1															
2	**Δ Business risk**	0.01	1														
3	**Sum of covenants**	-0.03	-0.20	1													
4	**Round**	-0.04	-0.24	0.19	1												
5	**Prototype**	-0.10	-0.10	0.00	0.23	1											
6	**Ln (1 + age)**	-0.06	-0.24	0.11	0.54	0.20	1										
7	**Cooperation partner**	-0.07	-0.20	0.06	0.11	0.07	0.20	1									
8	**Ln (1 + number of patents)**	0.02	-0.35	0.26	0.30	0.13	0.26	0.24	1								
9	**Corporate lead investor**	-0.08	0.00	-0.09	0.01	0.01	0.11	0.06	-0.02	1							
10	**Ln (1 + ww_fund_inflows)**	0.01	-0.09	-0.05	-0.07	0.06	-0.17	0.06	-0.07	0.11	1						
11	**Ln (1 + cash)**	-0.17	-0.17	0.25	0.35	0.08	0.22	0.11	0.31	-0.14	-0.09	1					
12	**Ln (1 + noncash assets)**	-0.04	-0.15	0.10	0.53	0.29	0.61	0.17	0.32	0.03	-0.16	0.28	1				
13	**Ln (1 + long term debt)**	0.15	0.02	-0.18	0.18	0.05	0.23	0.09	-0.04	0.01	0.04	-0.30	0.30	1			
14	**Ln (1 + sales)**	-0.01	-0.02	-0.07	0.35	0.30	0.46	0.12	0.11	0.05	-0.04	0.04	0.56	0.32	1		
15	**Ln (1 + R&D expense)**	-0.08	-0.29	0.21	0.52	0.20	0.54	0.17	0.34	-0.01	-0.14	0.32	0.71	0.22	0.44	1	
16	**Ln (1 + SG&A expense)**	0.05	-0.09	0.01	0.38	0.27	0.50	0.08	0.19	0.00	-0.13	0.26	0.65	0.13	0.54	0.55	1

This table provides pairwise correlations. Δ Agency risk reports transaction level agency risk minus strength expectations. Δ Business risk reports transaction level business risk minus strength expectations. Sum of covenants counts the covenants provided in the financial contract with regard to the use of milestones, liquidation preference, venture capitalist's board control and anti-dilution provision. Round is the number of the investment round. Prototype is a binary variable. Prototype takes the value 1 if firm i has a product prototype developed by the time of the investment. Age denotes firm i's age in months at the time of the investment log transformed according to $\log_e[Z+1]$. Cooperation partner indicates whether firm i had a cooperation partner at the time of the investment. Number of patents counts the number of patents firm i owns at the time of the investment log transformed according to $\log_e[Z+1]$. Corporate lead investor indicates whether the lead investor is a corporate investor. ww_fund_inflows measures worldwide fund inflows into the venture capital industry within the four quarters prior to the investment in EUR mil. This information is taken from Thomson Venture Economics Database and transformed according to $\log_e[Z+1]$. All accounting variables are defined as in Table 2, based on the most recent financial statement immediately prior to the investment and log transformed according to $\log_e[Z+1]$. Correlation coefficients larger than the absolute value of 0.12 are significant at the 5% level.

Table 6: Agency risk regressions

	Exp. Sign	Model I (OLS) Coeff	p-value	Model II (OLS) Coeff	p-value	Model III (OLS) Coeff	p-value	Model IV (2SLS) Coeff	p-value
Δ Agency risk	-	-0.25	(0.00)	-0.17	(0.00)	-0.17	(0.00)	-0.17	(0.00)
Δ Business risk	-			-0.17	(0.00)	-0.17	(0.00)	-0.17	(0.00)
Sum of covenants	+					0.07	(0.24)	0.09	(0.32)
Non-financial information									
Dummy round 1	-			-0.72	(0.00)	-0.67	(0.00)	-0.65	(0.00)
Dummy round 2	-			-0.75	(0.00)	-0.72	(0.00)	-0.72	(0.00)
Dummy round 3	-			-0.62	(0.00)	-0.60	(0.00)	-0.59	(0.00)
Dummy round 4	-			-0.47	(0.00)	-0.45	(0.00)	-0.44	(0.00)
Life science	+/-			0.18	(0.18)	0.19	(0.15)	0.19	(0.12)
Internet	+/-			0.26	(0.14)	0.27	(0.12)	0.27	(0.10)
Telecommunications	+/-			0.13	(0.56)	0.16	(0.48)	0.17	(0.42)
Traditional high technology	+/-			0.06	(0.67)	0.06	(0.66)	0.06	(0.64)
Prototype	+			0.07	(0.55)	0.07	(0.51)	0.07	(0.47)
Ln (1 + age)	+			-0.09	(0.30)	-0.10	(0.25)	-0.10	(0.21)
Cooperation partner	+			0.27	(0.02)	0.28	(0.01)	0.28	(0.01)
Ln (1 + number of patents)	+			0.13	(0.07)	0.12	(0.09)	0.12	(0.08)
Corporate lead investor	+/-			-0.18	(0.46)	-0.15	(0.53)	-0.14	(0.51)
Ln (1 + ww_fund_inflows)	+			0.23	(0.07)	0.23	(0.08)	0.23	(0.06)
Financial statement data									
Ln (1 + cash)	+			0.12	(0.00)	0.12	(0.00)	0.12	(0.00)
Ln (1 + noncash assets)	+			0.10	(0.04)	0.10	(0.04)	0.10	(0.02)
Ln (1 + long term debt)	-			-0.05	(0.04)	-0.04	(0.07)	-0.04	(0.07)
Ln (1 + sales)	+			0.01	(0.25)	0.01	(0.22)	0.01	(0.18)
Ln (1 + R&D expense)	+			0.05	(0.51)	0.04	(0.56)	0.04	(0.56)
Ln (1 + SG&A expense)	-			-0.04	(0.12)	-0.04	(0.15)	-0.03	(0.15)
Constant	+/-	14.76	(0.00)	9.80	(0.00)	9.75	(0.00)	9.73	(0.00)
No. of obs.		222		222		222		222	
Adj. R^2		0.09		0.61		0.61		0.61	
Prob.		0.00		0.00		0.00		0.00	

This table presents regression estimates of the determinants of pre-money values in 222 venture capital investments. The dependent variable is the natural log of firm i's pre-money equity value. Model I explanatory variable is Δ Agency risk. Δ Agency risk is the sum of investor's directly mentioned agency risk minus strength expectations. Model II reports results for Δ Agency risk controlling for business risk, non-financial information and financial statement data. Δ Business risk reports transaction level business risk minus strength expectations. We include four round dummy variables and report results relative to omitted round five and higher round valuations. Additionally, we use industry dummies for life science, internet, telecommunication and traditional high technology firms and report results relative to other industries. Further non-financial and financial statement variables are defined in Table 5. Model III additionally controls for the use of financial contracts. Sum of covenants is the sum of the following covenants: 1) milestones, 2) liquidation preference larger than the venture capitalist's initial invested amount, 3) vc board control, 4) vc has anti-dilution rights. Model IV is a 2-stage least squares (2SLS) regression in which the sum of covenants variable is instrumented by 1) the total number of pages of the investment memorandum and 2) the number of rows that outline transaction details with regard to the financial structure. p-values are reported using robust (Huber/White) standard errors clustered at the firm level. We drop 52 values, as financial statements are not available. Additionally, we face 22 other missing values.

Table 7: Agency risk components

	Exp. Sign	Model I (OLS) Coeff	p-value	Model II (OLS) Coeff	p-value	Model III (OLS) Coeff	p-value	Model IV (2SLS) Coeff	p-value
Δ Agency risk									
Δ Management risk	-	-0.24	(0.03)	-0.25	(0.00)	-0.26	(0.00)	-0.26	(0.00)
Δ Performance to date risk	-	-0.29	(0.01)	-0.12	(0.09)	-0.13	(0.09)	-0.13	(0.06)
Δ Funding risk	-	-0.10	(0.48)	-0.04	(0.68)	-0.03	(0.72)	-0.03	(0.72)
Δ Co-investor risk	-	-0.42	(0.01)	-0.16	(0.14)	-0.16	(0.16)	-0.16	(0.14)
Δ Portfolio fit risk	-	0.09	(0.69)	-0.05	(0.76)	-0.04	(0.79)	-0.04	(0.79)
Business risk and covenants									
Δ Business risk	-			-0.17	(0.00)	-0.17	(0.00)	-0.17	(0.00)
Sum of covenants	+					0.07	(0.19)	0.11	(0.21)
Non-financial information		no		yes		yes		yes	
Financial statement data		no		yes		yes		yes	
Constant	+/-	14.74	(0.00)	9.75	(0.00)	9.70	(0.00)	9.68	(0.00)
No. of obs		222		222		222		222	
Adj. R^2		0.09		0.60		0.61		0.61	
Prob.		0.00		0.00		0.00		0.00	
Wald-coefficient test of equality		p-value		p-value		p-value		p-value	
Δ Management risk = Δ Performance to date risk = Δ Funding risk = Δ Co-investor risk = Δ Portfolio fit risk		0.39		0.58		0.49		0.38	

This table presents regression estimates of the determinants of pre-money values in 222 venture capital investments. The dependent variable is the natural log of firm i's pre-money equity value. Model I explanatory variables are five Δ Agency risk variables. Δ Management risk reports the expected net management risk, calculated as the difference between management risk and management strength dummies. The other four delta risk positions are calculated accordingly. Model II reports results for Δ Agency risk controlling for business risk, non-financial information and financial statement data. We control (unreported) for the same non-financial and financial statement data as in Table 6. Model III additionally controls for the use of financial contracts. Sum of covenants is the sum of the following covenants: 1) milestones, 2) liquidation preference larger than the venture capitalist's initial invested amount, 3) vc board control, 4) vc has anti-dilution rights. Model IV is a 2-stage least squares (2SLS) regression in which the sum of covenants variable is instrumented by 1) the total number of pages of the investment memorandum and 2) the number of rows that outline transaction details with regard to the financial structure. p-values are reported using robust (Huber/White) standard errors clustered at the firm level. We drop 52 values, as financial statements are not available. Additionally, we face 22 other missing values. The Wald-coefficient test of equality tests whether all delta risk positions are equal (reported in p-values).

Table 8: Agency risk decomposition

	Exp. Sign	Model I (OLS) Coeff	p-value	Model II (OLS) Coeff	p-value	Model III (OLS) Coeff	p-value	Model IV (2SLS) Coeff	p-value
Δ Agency risk decomposition									
Agency factors not to invest									
Management (-)	-	-0.36	(0.02)	-0.35	(0.00)	-0.35	(0.00)	-0.35	(0.00)
Performance to date (-)	-	-0.22	(0.28)	-0.30	(0.07)	-0.31	(0.06)	-0.31	(0.04)
Funding (-)	-	-0.10	(0.64)	0.06	(0.62)	0.04	(0.72)	0.03	(0.77)
Co-investor (-)	-	0.07	(0.83)	-0.01	(0.97)	-0.04	(0.88)	-0.06	(0.81)
Portfolio fit (-)	-	0.25	(0.34)	0.21	(0.38)	0.20	(0.44)	0.19	(0.44)
Agency factors to invest									
Management (+)	+	0.14	(0.43)	0.11	(0.37)	0.12	(0.30)	0.13	(0.23)
Performance to date (+)	+	0.34	(0.01)	0.05	(0.64)	0.05	(0.64)	0.05	(0.62)
Funding (+)	+	0.10	(0.68)	0.20	(0.18)	0.16	(0.23)	0.14	(0.26)
Co-investor (+)	+	0.55	(0.01)	0.23	(0.05)	0.22	(0.07)	0.21	(0.07)
Portfolio fit (+)	+	-0.10	(0.76)	0.12	(0.56)	0.11	(0.57)	0.10	(0.56)
Business risk and contracts									
Δ Business risk	-			-0.17	(0.00)	-0.17	(0.00)	-0.17	(0.00)
Sum of covenants	+					0.06	(0.30)	0.09	(0.28)
Non-financial information		no		yes		yes		yes	
Financial statement data		no		yes		yes		yes	
Constant	+/-	14.78	(0.00)	9.45	(0.00)	9.43	(0.00)	9.42	(0.00)
No. of obs		222		222		222		222	
Adj. R^2		0.09		0.61		0.61		0.61	
Prob.		0.00		0.00		0.00		0.00	
Wald-coefficient test of equality		p-value		p-value		p-value		p-value	
Management (-)									
= Performance to date (-)									
= …		0.48		0.22		0.35		0.26	
= (-1)*Co-investor (+)									
= (-1)*Portfolio fit (+)									

This table presents regression estimates of the determinants of pre-money values in 222 venture capital investments. The dependent variable is the natural log of firm i's pre-money equity value. Model I explanatory variable are the ten variables of the agency risk decomposition. Management (-) takes the value 1 if the investor named management quality as a potential weakness. Management (+) takes the value 1 if the investor named management as a reason to invest. The other agency risk factors are calculated accordingly. Model II reports results for the agency risk decomposition controlling for business risk, non-financial information and financial statement data. We control (unreported) for the same non-financial and financial statement data as in Table 6. Model III additionally controls for the use of financial contracts. Sum of covenants is the sum of the following covenants: 1) milestones, 2) liquidation preference larger than the venture capitalist's initial invested amount, 3) vc board control, 4) vc has anti-dilution rights. Model IV is a 2-stage least squares (2SLS) regression in which the sum of covenants variable is instrumented by 1) the total number of pages of the investment memorandum and 2) the number of rows that outline transaction details with regard to the financial structure. p-values are reported using robust (Huber/White) standard errors clustered at the firm level. We drop 52 values, as financial statements are not available. Additionally, we face 22 other missing values. The Wald-coefficient test of equality tests whether all agency factors are equal to each other (reported in p-values).

Table 9: Agency risk regressions excluding financial statements

	Exp.	Model I		Model II		Model III		Model IV	
	Sign	Coeff	p-value	Coeff	p-value	Coeff	p-value	Coeff	p-value
Δ Agency risk	-	-0.24	(0.00)	-0.20	(0.00)	-0.20	(0.00)	-0.20	(0.00)
Δ Business risk	-			-0.19	(0.00)	-0.18	(0.00)	-0.18	(0.00)
Sum of covenants	+					0.11	(0.06)	0.05	(0.61)
Non-financial information									
Dummy round 1	-			-1.12	(0.00)	-1.07	(0.00)	-1.10	(0.00)
Dummy round 2	-			-0.79	(0.00)	-0.77	(0.00)	-0.78	(0.00)
Dummy round 3	-			-0.54	(0.00)	-0.51	(0.00)	-0.52	(0.00)
Dummy round 4	-			-0.28	(0.11)	-0.24	(0.15)	-0.26	(0.11)
Life science	+/-			0.30	(0.04)	0.29	(0.04)	0.30	(0.03)
Internet	+/-			0.38	(0.03)	0.38	(0.03)	0.38	(0.02)
Telecommunications	+/-			0.30	(0.16)	0.34	(0.11)	0.31	(0.12)
Traditional high technology	+/-			0.15	(0.40)	0.14	(0.39)	0.14	(0.37)
Prototype	+			0.09	(0.43)	0.09	(0.40)	0.09	(0.39)
Ln (1 + age)	+			-0.00	(0.96)	-0.02	(0.79)	-0.01	(0.89)
Cooperation partner	+			0.32	(0.01)	0.33	(0.01)	0.32	(0.01)
Ln (1 + number of patents)	+			0.19	(0.01)	0.17	(0.01)	0.18	(0.01)
Corporate lead investor	+/-			-0.36	(0.13)	-0.32	(0.15)	-0.34	(0.11)
Ln (1 + ww_fund_inflows)	+			0.28	(0.01)	0.27	(0.01)	0.28	(0.01)
Constant	+/-	14.70	(0.00)	11.62	(0.00)	11.47	(0.00)	11.56	(0.00)
No. of obs		267		267		267		267	
Adj. R^2		0.08		0.51		0.52		0.52	
Prob.		0.00		0.00		0.00		0.00	

This table presents regression estimates of the determinants of pre-money values in 267 venture capital investments. The dependent variable is the natural log of firm i's pre-money equity value. The estimated models are identical to Table 6 but excluding financial statement information. This increases our sample to 267 observations. Model I explanatory variable is Δ Agency risk. Δ Agency risk is the sum of investor's directly mentioned agency risk minus strength expectations. Model II reports results for Δ Agency risk controlling for business risk, non-financial information and financial statement data. Δ Business risk reports transaction level business risk minus strength expectations. We include four round dummy variables and report results relative to omitted round five and higher round valuations. Additionally, we use industry dummies for life science, internet, telecommunication and traditional high technology firms and report results relative to other industries. Further non financial statement variables are defined in Table 5. Model III additionally controls for the use of financial contracts. Sum of covenants is the sum of the following covenants: 1) milestones, 2) liquidation preference larger than the venture capitalist's initial invested amount, 3) vc board control, 4) vc has anti-dilution rights. Model IV is a 2-stage least squares (2SLS) regression in which the sum of covenants variable is instrumented by 1) the total number of pages of the investment memorandum and 2) the number of rows that outline transaction details with regard to the financial structure. p-values are reported using robust (Huber/White) standard errors clustered at the firm level. We face 29 missing values.