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In a subset of 564 VC-backed firms, start-ups are less likely to choose a joint venture as a governance structure in comparison to established firms. When firms are backed by a larger number of venture capitalists, they are also less likely to share equity in a collaboration. This article improves our understanding of the effect of VC on governance decisions in inter-firm relations, and presents evidence of a trade-off between joint venture equity and VC equity in the formation of collaborations. It also shows that this trade-off becomes even more substantial when syndication of venture capitalists is present.

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1. Introduction

In recent decades a growing body of literature has emerged examining the role of venture capital in the formation, operation and evaluation of strategic alliances (Hsu 2006; Lindsey 2008; Wang et al. 2012). The growth of this literature on venture capital in strategic alliances largely reflects the observed challenges of inter-firm collaboration, such as uncertainty, information asymmetry and asset intangibility, and which have been addressed by studies on venture capitalists (VCs) (Kaplan and Lerner 2014). These challenges have been experienced by new firms, but increasingly also established firms undergoing radical restructuring have benefitted from the involvement of venture capitalists (Wright and Robbie 1998; Ning et al. 2015).

This body of literature comes from, at least, three different streams; one with an interest in the different roles venture capitalists may have (Baum and Silverman 2004; Colombo and Grilli 2010); one with a focus on the hazards involved in inter-firm collaboration (Oxley 1997; Oxley and

Sampson 2004)); and one in which VC-backed start-ups are engaged in strategic alliances (Colombo et al. 2006; Hsu 2006). This study contributes at the intersection of these three streams of literature, examining the influence that venture capital has on the governance structure of strategic alliances, in particular when one of the partners in the inter-firm collaboration is a start-up firm. In one stream of this literature, some authors have argued that venture capitalists contribute substantially to the formation of strategic alliances, by exploiting their ability to pick the winners (e.g. Baum and Silverman 2004; Colombo et al. 2006; Colombo and Grilli 2010). Others have argued that venture capitalists have the expertise and the network to improve the operation of the alliance, by offering advice or replacing management (e.g. Hellmann and Puri 2002). Also the reputation and valuation of the alliance have been connected to the involvement of venture capital, leading to smaller underpricing of VC-backed IPO's compared to non-VC-backed IPO's (e.g. Hsu 2006; Wang et al. 2012). We acknowledge that venture capitalists may do all of the above,

but this article focuses on the effect venture capitalists may have on the efficient formation and operation of alliances, and the choice for a governance structure as a defining factor of efficiency in inter-firm relations.

In a second stream of the literature, inter-firm collaborations have been observed to be hazardous endeavours, running serious risks due to incomplete contracts and weak property rights (Williamson 1996; Oxley 1997), and consequently being exposed to opportunistic behaviour. This is most apparent in R&D alliances and in alliances involving start-ups, in which the hazard of leakage of sensitive and strategic information has been reported to lead to opportunistic behaviour (Sampson 2007). These hazards in inter-firm collaboration have been discussed extensively in terms of governance adaptations, with evidence of firms choosing safeguards in the form of equity in joint ventures (Oxley and Sampson 2004). Some authors have argued that venture capitalists can also relieve the consequences of incomplete contracts and mitigate opportunistic behaviour among alliance partners, e.g. by introducing sanctions and retaliations (Lerner 1994; Colombo et al. 2006). For instance, Colombo et al. (2006) argue that venture capitalists may provide a shield against opportunistic behaviour on the part of the alliance partners of new technology-based firms: “NTBFs can reduce the transaction costs of alliance formation including those generated by appropriability hazards, if they manage to get support from a “sponsor”” (Colombo et al. 2006, p. 1192). We will argue that firms may find protective measures against hazards of leakage in a trade-off between equity in joint ventures and equity supplied through the involvement of a venture capitalist and clusters of venture capitalists (syndicates). A third stream of the literature connects the venture capital financing of start-up firms with the formation, operation and evaluation of strategic alliances. Hsu (2006) finds more strategic alliances

among VC-backed start-ups than among those start-ups that are not financed by venture capital. This positive relationship between venture capital backing of start-ups and the amount of strategic alliances involving start-ups is mainly confined to the number of VC firms that are involved and not to the total amount of venture funding (Wang et al. 2012). This literature emphasizes the positive relationship between alliance formation and syndication of VCs. The advantage for start-ups of venture capitalists would lie in the shielding of their operations against external risks, primarily through a series of funding rounds of clusters of venture capitalists (Wang et al. 2012). We will therefore argue that venture capital backing of firms will replace equity sharing in all alliances, but the effect will be stronger in alliances involving start-ups and in alliances backed up by clusters of venture capitalists.

Our article draws on theoretical insights from transaction cost economics (Williamson 1996; Oxley 1997), along with empirical work from financial economics on venture capital investments (Wright and Robbie 1998; Lindsey 2008) to construct testable hypotheses that explain the role of venture capital in governance decisions of alliances involving start-ups. Our paper contributes to an emerging literature on strategic alliances and venture capital by exploring two related research questions: how does VC funding affect the choice for equity governance of alliances, and how different is this for start-up firms?

We suggest that venture capitalists may serve as a mechanism to mitigate contractual hazards and act as a substitute for equity sharing in strategic alliances. Whereas others have suggested alternative mechanisms for similar problems (e.g. ‘steering committees’ (Reuer and Devarakonda 2015)), or have suggested similar solutions for alternative problems, this article is to our knowledge the first to address the impact of venture capital on

governance decisions for alliances.

In order to address these questions we combine data on alliances from the SDC database with data on venture capital from Thomson One. We analyze 5405 bilateral alliances that were formed between 2009 and 2014, and find that VC-backed firms are less likely to share equity in alliances. In a subset of 564 VC-backed firms, start-ups are less likely to choose a joint venture as a governance structure in comparison to established firms. Firms that are backed by a larger number of venture capitalists are also less likely to share equity in a collaboration. We control for industry, continent and year of the alliance, for industry and continent of the firm, and for industry focus of the venture capitalist. Our results are robust in different contexts, such as different geographical regions and different types of alliances (R&D vs. non-R&D alliances).

The following sections of this article are structured as follows. Section 2 combines the respective bodies of literature on venture capital and strategic alliances to construct our hypotheses concerning the governance choice of alliances with VC-backed firms. First, we examine the effect of venture capitalists on the choice for equity alliances; then, we examine the relationship between VC syndication and governance choice of collaborations involving start-ups. In Section 3 we describe the data collection procedure and the method adopted. Section 4 presents our empirical results. Section 5 summarizes our findings, and suggests opportunities for future research.

2. Literature review and hypotheses

The motivation for firms to collaborate in a strategic alliance has been documented extensively (Jolink and Niesten 2012; Niesten and Jolink 2015). A diverse set of explanations have been developed in the literature to explain why firms engage in collaboration, how the collaboration can be maintained and governed, and what affects the performance of the collaboration. The

explanations have branched out into theoretical perspectives as diverse as agency theory, property rights theory, the resource-based view or transaction cost theory (Jolink and Niesten 2012). The literature has shown that strategic collaboration can reduce agency costs (Lafontaine 1992; Combs and Ketchen 1999; Lafontaine and Slade 2007) or create a ‘mutual commitment device’ (Cai 2003). Strategic alliances have also been inspired by the opportunities offered by the joint extraction and creation of value in a collaboration (Das and Teng 2000), or by the need to safeguard against contractual hazards (e.g. opportunistic behavior by a contracting party) (Oxley 1997).

The contractual incompleteness of inter-firm relations has led to a well-documented distinction between equity alliances (joint ventures) and non-equity alliances (e.g. Hennart 1988; Gulati 1995; Tsang 2000). In joint ventures the partners in the collaboration contribute equity, and therefore ownership claims, to the joint venture. In non-equity alliances, the collaborations are founded on contracts between the alliance partners, such as licensing agreements or marketing arrangements. There is a consensus in the literature that joint ventures are better equipped to deal with contractual incompleteness, although the reasoning may differ. From a property rights perspective equity in joint ventures can mitigate the hold-up problem created by ex post bargaining through a pre-established division of benefits (Dasgupta and Tao 1998). In transaction cost economics, alliance partners economize on transaction costs when transactions are aligned with the governance structure (Williamson 1991). From this perspective, joint ventures possess governance attributes such as additional monitoring rights and administrative controls that make them better safeguards for contractual hazards (Oxley 1997).

Modern corporate finance has entered the literature on strategic alliances by

documenting the facilitating role of venture capitalists in the formation of strategic alliances (e.g. Lindsey 2008) or IPO's of alliance partners (e.g. Chang 2004). Venture capitalists are financial intermediaries specialized in investments and in syndicating investments with other VCs (Wright and Lockett 2003). They have been allotted 'scout' capabilities, identifying potential winners, and 'coach' capabilities, providing firms with additional competences (Baum and Silverman 2004; Colombo and Grilli 2010). A growing number of articles have addressed the possible impact of venture capital backing on inter-firm collaborations. Hsu (2006) finds evidence of a correlation between VC funding and cooperative activities. Lindsey (2008) attains a similar result for US firms, where alliances are more frequent among VC-backed firms, particularly when they share a common venture capitalist and when contracting problems are prominent.

The overall costs of contracting, integral to alliance formation and operation including finding potential partners, writing contracts and ex-post bargaining, can be substantial. In the literature, venture capitalists, as sponsors of reputation (Stuart et al 1999), brokers of ideas (Gans and Stern 2003) and management experts (Gans et al. 2002), have mitigated the obstacles to collaboration (Hsu 2006) and risks from the environment (Wang et al. 2012). Wang et al. (2012) have emphasized that because of the scout and coach roles that venture capitalists perform, venture capitalists also impart the funded firms with legitimacy, and thereby reduce opportunistic behaviour through their censoring and "punishment of non-cooperative behavior" (Wang et al. 2012).

Venture capitalists and sharing equity in a joint venture can thus serve the same safeguarding purpose in alliances; they can both facilitate alliance formation and operation by reducing transaction costs and acting as a proper governance mechanism for contractual hazards in an inter-firm

relation (Colombo et al. 2006; Wang et al. 2012). The implicit assumption in the literature is that, although the reduction in transaction costs is never measured, changes in the transactions will be realigned with an efficient governance mechanism that reflects the level of risks (Sampson, 2004). We build upon these assumptions of transaction cost economics and propose that firms make a trade-off between the two types of capital, and either choose to use venture capital or to share equity in a joint venture, as alternative ways to reduce uncertainty. This gives rise to the following hypothesis:

H1. *The likelihood of equity governance of an inter-firm relation is lower when one (or both) of the alliance partners is backed by venture capital.*

The problem of incomplete contracts and subsequent opportunistic behavior of alliance partners is applicable to established firms and start-up firms alike. Start-ups are like established firms assumed to engage in strategic alliances to fortify their competitive position (e.g. Park et al. 2002). Compared to established firms, however, start-ups lack the reputation, the experience, the network and the finance to mitigate the obstacles related to alliance formation (Eisenhardt and Schoonhoven 1996). Start-ups may encounter higher transaction costs to find the right alliance partner and to mitigate hazards of leakage (Gulati 1998). They may also lack alliance capabilities and management skills to fully benefit from the strategic alliance. In the studies on venture capitalist's involvement in alliance formation start-ups therefore figure prominently (e.g. Hsu 2006; Colombo et al. 2010; Wang et al. 2012). The start-ups in all these studies enjoy lower transaction costs due to VC involvement (Wang et al. 2012). We will argue that the participation of venture capitalists in alliances involving start-ups may not only lower transaction costs for start-ups, but start-ups will need

to rely more on the reputation, the experience, the network and the finance offered by venture capitalists than established firms. Start-ups will, hence, trade off equity alliances for venture capital backing, thus treating these two types of safeguards as alternative ways of reducing transaction costs.

H2. *VC-backed start-ups are less likely to choose equity governance in an inter-firm relation than VC-backed established firms.*

The literature on venture capital involvement in alliance formation has also improved our understanding about the contribution of the type of VC participation to inter-firm collaborations. Authors in this field have found that the number of strategic alliances formed by a VC-backed firm is positively related to the amount of venture capitalists involved (Wang et al. 2012). This finding aligns with studies on syndication of venture capitalists.

Syndication is a common practice among venture capitalists creating clusters of investors to share and hedge their investment decisions (Lerner 1994; Wright and Lockett 2003; Ferrary 2010; Hopp 2010). These syndicates increase the assessment capabilities of the cluster of venture capitalists and signal a broader shared understanding of quality (Bygrave 1987; Brander et al. 2002; Hsu 2006). A syndicate of venture capitalists also has a higher impact than a standalone VC, in terms of returns for the syndicate, but also in terms of safeguarding the alliance from hazards (Brander et al. 2002).

Within a transaction cost perspective, the extended involvement of a VC syndicate may not only reduce the transaction costs but will also affect the governance of the inter-firm collaboration. The syndicate of investors may therefore replace the equity provided by partner firms in a joint venture.

H3. *VC-backed firms are less likely to choose equity governance in an inter-firm relation when a larger number of venture capitalists backs the firms.*

3. Data collection and method

3.1 Data collection

The data was obtained by combining the SDC Platinum database of alliances and joint ventures for the years 2009-2014 with the database of VC-backed firms from Thomson One for the years 2005-2014. The SDC Platinum database has a wide coverage of industries and countries. Consistent with other existing databases, the SDC Platinum database also has biases and limitations (Schilling 2009). One of the biases of the SDC Platinum is a strong representation of bio- and high-tech collaborations in the database. For our purpose, i.e. the governance choice of VC-backed start-ups, this industry bias may coincide with the industry focus of venture capitalists, and should thus be weighted in our final conclusions.

We restrict our dataset to bilateral inter-firm collaborations that were formed during the period of study. We therefore only include the ‘completed/signed’ alliances and joint ventures and exclude ‘intended’ and ‘pending’ alliances and joint ventures. We also exclude from the SDC database all collaborations involving more than two partners, instances of undisclosed partners, and collaborations involving national governments, non-commercial research institutes and universities. We limit the data to collaborations between firms, because the focus on venture capital and the transaction cost perspective may not extend the interpretation of our results to public governance decisions. This selection resulted in 5405 collaborations.

Information on the VC-backed firms was obtained from Thomson One by selecting venture deals only. We manually searched for the names of all the alliance partners (taken from the SDC database) in

Thomson One, to determine whether the partners are backed by venture capital. We assume that the effect of venture capital backing on governance choices surrounds the announcement date of the collaboration, due to the preparation and implementation time of funding. The partners in the collaboration are coded as VC-backed when they receive venture capital in the year of the announcement date of the collaboration or any of the four years preceding the year of the announcement. The period of four years was selected to make the possible impact that venture capital may have on governance choices comparable across years (Wang et al. 2012)¹. Although VC-backed partners may have been backed by venture capital before this 4-year period this was disregarded in the analysis, assuming a diminishing effect of venture capital on governance choice after a certain period of time. We have included the year of the announcement date of the collaboration as a cut-off point for venture capital backing, to allow for a maximum lag of 12 months in funding implementation, parallel to the governance choices made in the collaborations. We assume that when choices on inter-firm collaboration and funding by a venture capitalist occur in the same year, it is likely that firms consider the trade-off between capital of a joint venture or venture capitalist.

In the exceptional cases of a VC-backed daughter of two allying parent companies, or of a VC-backed parent of an allying daughter, we excluded the first and included the latter. The reasoning adopted here, was that the daughter's collaboration may benefit from a venture capitalist involvement with the parent but the parent's collaboration will not benefit from

a VC-backed daughter firm. Furthermore, we focused on the venture capital backing of individual firms and excluded venture capital backing of collaborations as separate entities.

3.2 Variables

Dependent variable

The dependent variable 'equity governance' refers to the governance structure of the inter-firm relation, and can be equity governance or governance in which no equity is shared. In order to include data on equity and non-equity governance structures, we combined two sets of data from the SDC Platinum database on inter-firm relations: one on joint ventures (collaborations in which equity is shared), and another on collaborations in which no equity is shared. The dependent variable is a binary variable, with 1 reflecting the choice for equity, and 0 reflecting the choice for a non-equity governance structure. Since the dependent variable is a binary variable, we use a binary logit model to estimate our results.

Independent variables

In our first model, we include 'VC backing of alliance partners' as an independent nominal variable. When only one of the two alliance partners is backed by venture capital, we coded the alliance as one-VC-backed (OVB). When the two alliance partners are backed by venture capital, we coded the alliance as both-VC-backed (BVB). When the two partners are not backed by venture capital, we coded the alliance as no VC. We used the latter category as a base or reference category in the binary logit model, to determine the relation between VC backing and equity governance.

In our second model we determine the influence of characteristics of VC-backed firms on their choice for equity sharing in an alliance. We constructed a subset of 564 firms out of the 5405 alliances and created variables at the level of the firm. In the

¹ Wang et al. (2012) allow for a variable period between the time venture capital funding is received and the time collaborations are formed, with a minimum of four years for the final year. We have opted for a period of four years between venture capital funding and collaborations formed to exclude a time-bias in the VC-effect on governance choice.

subset, we only included alliance partners that were backed by venture capital. Thomson One provides information on different stages of funding by venture capitalists, which can be funding in seed, early, expansion or later stages. When firms received seed or early stage funding in the four years preceding alliance formation, we coded them as start-ups. When firms received funding in the expansion or later stages, we coded them as established firms. In model 2, we include 'VC-backed start-ups' as an independent binary variable. In model 2, we also include the 'number of venture capitalists' as an independent count variable. This variable reflects the number of venture capitalists that provided funding to the firm in the four years preceding alliance formation.

Control variables

The 'industry of the alliance' is a control variable in model 1, and we use SIC codes to measure this variable. SIC refers to the Standard Industrial Classification system that classifies industries by a four-digit code. The SIC codes are grouped into 10 divisions (www.osha.gov), representing a collection of industries: division A is agriculture, forestry and fishing (codes 0111-0971); division B is mining (1011-1499); division C is construction (1521-1799); division D is manufacturing (2011-3999); division E is transportation, communications, electric, gas, and sanitary services (4011-4971); division F is wholesale trade (5012-5199); division G is retail trade (5211-5999); division H is finance, insurance, and real estate (6000-6799); division I is services (7011-8999); and division J is public administration (9111-9721). We collected information on SIC codes from the SDC database, and used the primary SIC code of the alliance to determine the industrial division of each alliance. We include this control variable,

because in some industries alliances are more often governed by equity (Harrigan 1988).

The 'continent of the alliance partners' is also a control variable in model 1. The SDC database provides information on the country in which a firm that has entered into an alliance is located. We have combined this information on the country of the two partners to describe the continent in which the combination of partners is located. The categories of this variable include Africa, Asia, Australia, Europe, North America, South America, and a cross-continent category, with the latter category referring to two alliance partners that are located in different continents. We include this control variable, because in some continents, such as North America, alliance partners more often rely on contractual alliances and use less equity to govern the inter-firm relation (e.g. Beamish and Banks 1987).

The 'year of the inter-firm relation' is a control variable in model 1. To control for unobserved heterogeneity during the study period (2009-2014), we included a variable reflecting the year in which firms entered into the alliance (e.g. Lin et al. 2009; Reuer and Lahiri 2014).

In model 2 we included the 'industry focus of the venture capitalist' as a control variable. Thomson One provides information on the industry focus of venture capitalists and offers three categories: venture capitalists with an IT focus, a medical focus or a non-high-tech focus. This industry focus refers to the type of firms that venture capitalists tend to invest in. We included a rest category 'other' when Thomson One does not include a venture capitalist in one of the three categories. We expect that venture capitalists with an IT or medical focus may want to avert their portfolio firms to enter into an equity relation with another firm.

Table 1. Definition of variables and summary statistics

Variables	Measurement Scale	Frequency	Min	Max
Equity governance	Binomial	No equity: 2965 Equity: 2440	0	1
VC backing of alliance partners	Nominal	One partner is VC-backed: OVB: 510 Both partners are VC-backed: BVB: 27 No partner is VC-backed: NoVC: 4868	1	3
Industry of alliance	Nominal	Agriculture, forestry and fishing: 23 Mining: 347 Construction: 129 Manufacturing: 1531 Transportation, communication, electric, gas and sanitary services: 544 Wholesale: 286 Retail: 138 Finance, insurance and real estate: 608 Services: 1783 Public administration: 16	1	10
Continent of alliance partners	Nominal	Africa: 33 Asia: 906 Australia: 78 Cross-continent: 2163 Europe: 533 North America: 1660 South America: 32	1	7
Year of alliance	Nominal	2009: 721 2010: 346 2011: 795 2012: 1362 2013: 1532 2014: 649	2009	2014
VC-backed startup	Binomial	VC-backed firms that did not receive seed/early stage VC: 379 VC-backed firms that received seed/early stage VC: 185	0	1
Number of venture capitalists	Count	Number of venture capitalists that provide funding to a firm. <i>Mean: 4.15</i>	1	21
Industry focus of venture capitalist	Nominal	IT Focus: 73 Medical Focus: 68 Non High-Tech Focus: 33 Other: 390	1	4
Industry of VC-backed firm	Nominal	Agriculture, forestry and fishing: 1 Mining: 2 Construction: 1 Manufacturing: 234 Transportation, communication, electric, gas and sanitary services: 26 Wholesale: 3 Retail: 5 Finance, insurance and real estate: 20 Services: 269 Public administration: 3	1	10

Continent of VC-backed firm	Nominal	Africa: 1 Asia: 104 Australia: 10 Europe: 91 North America: 358	1	5
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The venture capitalists may want to avoid that the new alliance partner gets proprietary access to valuable knowledge and technologies that are often developed in the medical and IT industries, and for which the venture capitalists have supplied the funding (Hsu 2006). We therefore include this variable as a control variable, as it may affect firms' choice for equity in an inter-firm relation. In model 2 we also included the industry of the VC-backed firm and the continent of the VC-backed firm as control variables. These variables contain the same categories as in model 1, but are measured at the level of the firm. The industry and continent of the VC-backed firm were introduced in model 2 to control for firm characteristics that may affect equity choice.

4. Empirical results

Table 1 presents the summary statistics. Our sample of 5405 collaborations includes 2440 joint ventures, or collaborations in which equity is shared, and 2965 alliances in which no equity is shared. In 510 of these collaborations, one of the alliance partners received venture capital in any of the four years preceding the date of alliance formation. In 27 collaborations, both alliance partners were backed by venture capital in the four years preceding alliance formation. Table 1 also provides information on three control variables (Industry of the alliance, Continent of the alliance partners, Year of the alliance) that are used in model 1 relating VC backing of alliance partners to equity sharing in the collaboration.

The number of observations in the subset of VC-backed firms is 564, including the 510 firms that entered into an alliance in which they were backed by venture capital and their partners were not; and 54 firms

that constituted the 27 collaborations in which both firms were backed by venture capital. 33 per cent of this subset are start-up firms. The number of venture capitalists that backed the 564 firms ranges from 1 to 21, with a mean of 4.15. 30 per cent of the venture capitalist(s) that provided funding to the firms in the subset have a specified industry focus. Table 1 also provides information on two other control variables (Industry of the VC-backed firm, Continent of the VC-backed firm) that are used in model 2.

We tested our dataset and found that there is no problem with multicollinearity of our independent and control variables. The maximum variance inflation factor is 2.28, which is well below the recommended level of 10 (Kutner et al. 2005, p. 409).

4.1 Main results

Table 2 depicts the results of model 1 in which we relate VC backing of alliance partners to the governance of the collaborations. It shows that the odds of equity governance are 0.267 times lower for collaborations in which one of the firms is backed by venture capital, in comparison to collaborations in which none of the alliance partners are funded by venture capital. In addition, the odds of equity governance are 0.355 times lower for collaborations in which the two partners are backed by venture capital, again in comparison to collaborations with no VC-backed firms. The relations are significant at the 0.001% and 0.1% level, respectively. This result confirms hypothesis 1, in which we proposed that the likelihood of equity governance of an inter-firm relation is lower when one or

Table 2. Regression results: Predicting equity governance of VC-backed alliances

Model 1	Dependent variable: Equity governance
<i>Variables</i>	<i>Coefficients/Odds ratios (standard errors)</i>
VC backing of alliance partners - BVB - OVB (Base category: NoVC)	-1.035 / 0.355 (0.570)* -1.319 / 0.267 (0.130)****
Industry of alliance - Agriculture, forestry and fishing - Mining - Construction - Manufacturing - Transportation, communications, electric, gas and sanitary services - Wholesale - Retail - Finance, insurance and real estate - Public administration (Base category is 'Services')	2.258 / 9.567 (0.525)**** 1.893 / 6.639 (0.144)**** 1.971 / 7.177 (0.223)**** 0.782 / 2.186 (0.079)**** 0.961 / 2.613 (0.107)**** 0.428 / 1.534 (0.139)*** 0.628 / 1.874 (0.189)*** 1.281 / 3.601 (0.104)**** 1.247 / 3.480 (0.549)**
Continent of alliance partners - Africa - Asia - Australia - Cross-continent - Europe - South America (Base category is 'North America')	0.914 / 2.495 (0.376)** 1.273 / 3.572 (0.095)**** 0.848 / 2.336 (0.272)*** 0.687 / 1.989 (0.075)**** 0.744 / 2.105 (0.111)**** 1.162 / 3.197 (0.407)***
Year of alliance - 2010 - 2011 - 2012 - 2013 - 2014 (Base category is 2009)	1.163 / 3.199 (0.150)**** 0.844 / 2.345 (0.115)**** 0.379 / 1.461 (0.103)**** -0.006 / 0.995 (0.101) -0.164 / 0.847 (0.124)
Constant	-1.661 / 0.190 (0.110)****
Model fit N=5405 alliances	Nagelkerke R ² = 24.4% LR Chi ² = 1090.59****

* significant at 0.1 level; ** significant at 0.05 level; *** significant at 0.01 level; **** significant at 0.001 level.

both of the alliance partners is backed by venture capital. Table 2 also illustrates that collaborations in all industries are more likely to be governed by equity in comparison to collaborations that provide services. Inter-firm relations are less likely to be governed by equity governance when the partners are both located in North America. Inter-firm relations are more likely to be governed by equity in the years 2010 until 2012, when compared to 2009. Table 3 shows the results of model 2 in which we relate characteristics of VC-

backed firms to their choice for equity in an inter-firm relation². The odds of a firm choosing equity to govern an inter-firm relation decrease by a factor 0.530 when the firm is a start-up. For each additional venture capitalist that supplies funding to a firm, the odds of the firm choosing equity to govern the collaboration are decreased by a factor 0.809, holding all other variables constant. The relations are

² In model 2, the analysis is at the level of the VC-backed firm (and not at the level of the alliance as in model 1).

significant at the 0.05% and 0.001% level, respectively. These results confirm hypotheses 2 and 3, in which we proposed that VC-backed firms are less likely to choose equity in an inter-firm relation when they are start-up firms and when the number of venture capitalists that fund the firm increases. When firms are backed by venture capitalists that focus on funding non-high-tech ventures, the odds of choosing equity are more than 12 times higher, when compared to venture capitalists with another focus. VC-backed firms from the manufacturing industry have lower odds of choosing equity to

govern their alliances when compared to VC-backed firms from the services industry.

In addition to the interpretation of the results in terms of odds ratios, we also calculated predicted probabilities. These probabilities that, in our case, predict the use of equity governance are often easier to interpret than odds ratios (Hoetker 2007). Figure 1 illustrates that the probability of choosing equity for start-ups that are backed by one venture capitalist is 10 per cent lower when compared to VC-backed established firms.

Table 3. Regression results: Predicting choice for equity with characteristics of VC-backed firms

Model 2	Dependent variable: Equity governance
<i>Variables</i>	<i>Coefficients/Odds ratios (standard errors)</i>
VC-backed start-up	-0.634 / 0.530 (0.310)**
Number of venture capitalists	-0.212 / 0.809 (0.055)****
Industry focus of venture capitalist	
- IT Focus:	0.068 / 1.070 (0.454)
- Medical Focus:	-0.369 / 0.691 (0.570)
- Non High-Tech Focus:	2.515 / 12.368 (0.447)****
(Base category is 'Other')	
Industry of VC-backed firm	
- Mining	1.519 / 4.566 (1.480)
- Manufacturing	-0.515 / 0.598 (0.270)*
- Transportation, communications, electric, gas and sanitary services	-0.165 / 0.848 (0.611)
- Wholesale	0.623 / 1.865 (1.382)
- Retail	-0.011 / 0.989 (1.169)
- Finance, insurance and real estate	-0.572 / 0.564 (0.821)
(Base category is 'Services')	
Continent of VC-backed firm	
- Asia	0.087 / 1.091 (0.357)
- Australia	-0.266 / 0.767 (1.123)
- Europe	0.255 / 1.291 (0.342)
(Base category is 'North America')	
Constant	-0.777 / 0.460 (0.247)***
Model fit	Nagelkerke R ² = 13.4%
N = 558 VC-backed firms ^a	LR Chi ² = 66.36****

* significant at 0.1 level; ** significant at 0.05 level; *** significant at 0.01 level; **** significant at 0.001 level.

^a In this model the number of observations is reduced from 564 to 558 due to the lack of variation in the dependent variable for some categories of the control variables 'industry of VC-backed firm' and 'continent of the VC-backed firm'.

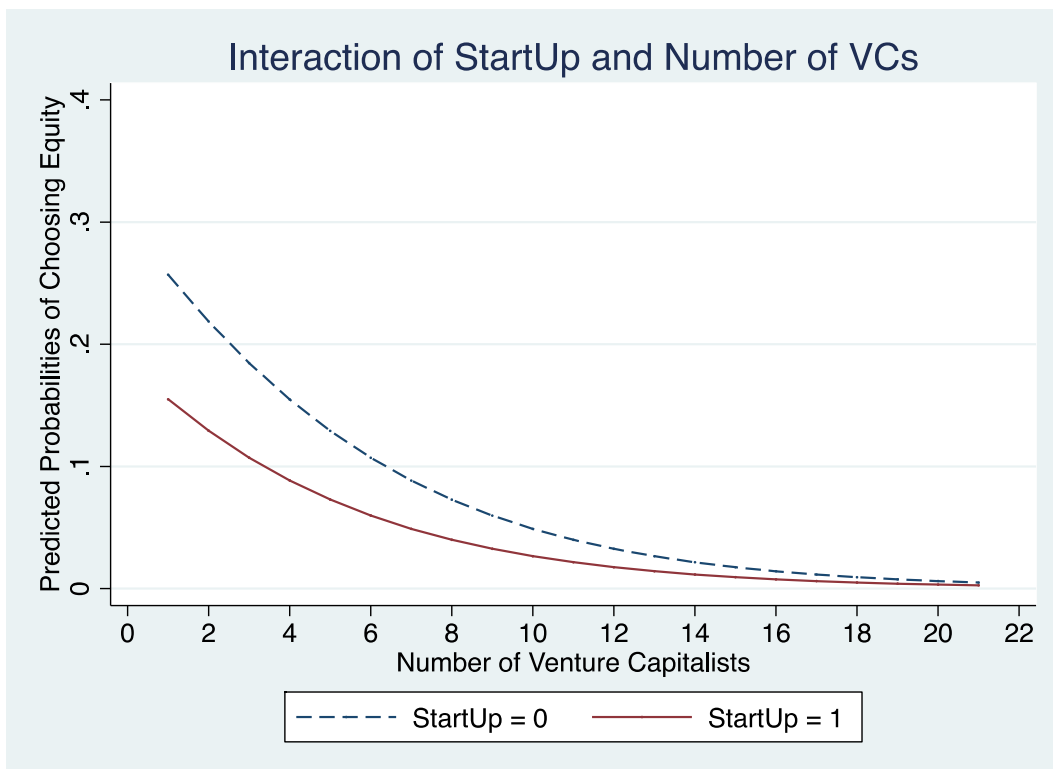
When the number of venture capitalists that provide funding to firms is larger, the probability of choosing equity in an inter-firm relation decreases, and even approaches zero at high numbers of venture capitalists. The latter holds for both VC-backed start-ups and established VC-backed firms.

4.2 Robustness

In order to test whether our results hold in different contexts, we have divided our sample of 5405 collaborations into two subsets, based on SDC activity descriptions of inter-firm relations: one subset of 885 R&D collaborations and a remaining subset of 4520 collaborations. In the first subset, inter-firm relations are included with an activity description

“research and development” and “software development”. We test whether the negative relation between VC-backed collaborations and equity governance holds for the subset of R&D collaborations and the subset of non-R&D collaborations. We opted to focus on an R&D subset, because venture capitalists may find it especially problematic that a firm enters into a joint venture when the firm is investing a lot in R&D, and has received funds from the venture capitalists for its R&D activities. The inter-firm relation may lead to a transfer of valuable knowledge from the VC-backed firm to the new alliance partner, who may get ownership rights of the proceeds of this valuable knowledge.

Figure 1. Predicted probabilities: Interaction of number of VCs and start-ups



Our results indicate³ that the results are similar for the R&D collaborations and the non-R&D collaborations. In both subsets, there is a negative relation between collaborations with one VC-backed firm and equity governance, and the relation is significant at the 0.001% level. The effect size is slightly larger for the R&D collaborations with an odds ratio of 0.18, compared to an odds ratio of 0.31 for the collaborations that do not pursue R&D.

We also tested the effect of VC backing of firms in inter-firm relations on equity governance in different geographical regions. Most of the studies on venture capital and collaborations are restricted to North America (e.g. Lindsey 2008). In our sample, we have included collaborations in a variety of continents (see table 1). Our results show that there exists a negative relation between inter-firm relations with one VC-backed firm and equity governance in North America, Europe and Asia⁴, and these results are significant at the 0.001% level. Hence, our results are robust for different geographical regions. The effect size is the largest for Europe with an odds ratio of 0.05, and the smallest for North America with an odds ratio of 0.30.

5. Discussion and conclusion

Our study has examined the impact of venture capital on the governance structure of collaborations involving start-ups. We first looked into the general case of VC-backing and governance structures of collaborations and then focused on the governance choices of start-up firms among all VC-backed firms. We subsequently looked at the influence of more than one VC, i.e. syndicated VCs, on governance structure.

Previous research has confirmed that venture capital is instrumental in the

formation of collaborations and has established a pivotal role of venture capitalists in mitigating external risks for inter-firm relations and reducing transaction costs. Studies in financial economics have also established an essential role for syndicates of venture capitalists in the formation of collaborations involving start-up firms.

Incorporating the literature on inter-firm collaboration, in particular transaction cost economics, we have hypothesized that the reduction of transactions costs in the formation of collaborations through the involvement of venture capital may have an effect on the governance structure of the collaboration. We expected to see a trade-off between equity supplied by partners in a joint venture and equity supplied by venture capitalists. We also expected this trade-off to be more pronounced in collaborations involving start-ups. Furthermore, we have hypothesized that the involvement of more than one venture capitalist, i.e. the syndication effect observed in the empirical financial literature, would also have repercussions on the governance structure of VC-backed firms.

Our results present a better understanding of the effect of venture capital in alliance formation involving start-ups and the trade-off between joint venture equity and VC equity. We have observed a negative relation between VC-backed alliance partners and equity governance of the inter-firm relation. These results lend support to earlier studies demonstrating that venture capitalists and joint venture partners are used as substitutes for capital through their ability to mitigate risks (Wang et al. 2012). The trade-off is more pronounced for start-up firms and for firms that are backed by more VCs.

Our results also indicate that this trade-off effect is relatively robust. Although previous studies have suggested that R&D collaborations are more susceptible to opportunistic behavior, due to the governance of intangible assets (e.g. Gulati

³ The results can be obtained from the authors.

⁴ We did not test the relation for the continents Africa, Australia and South America, because of the limited number of observations for collaborations in these continents.

1995; Lindsey 2008), our results indicate only minute differences between R&D collaborations and non-R&D collaborations. Similarly, the trade-off between joint venture equity and VC equity is hardly affected by the geographical location of the collaboration. We suggest that venture capitalists are not only scouts, financiers and coaches of alliances (Baum and Silverman 2004) involving start-ups but also have a 'liaison role', by offering protection for firms against internal risks in a collaboration. Our results indicate that this role becomes even more substantial when syndication of venture capitalists is present. The predicted probability of choosing equity for VC-backed start-ups and VC-backed established firms is lower with syndicates compared to funding by a single venture capitalist. With a large number of venture capitalists involved in the syndicate the predicted probability of choosing equity to govern a VC-backed collaboration is close to zero. When we compare start-ups to established firms, our results show that start-ups have a lower probability of choosing equity to govern collaborations with a low number of venture capitalists. This may be attributed to the lack of reputation, experience, networks and finance that differentiates the start-ups from established firms, and which leads start-ups to favor equity of a VC over joint ventures. The contribution of our study lies, moreover, in opening up new avenues at the intersection of the three streams of literature discussed above. One avenue for further research is to scrutinize the mechanism of the trade-off between joint venture equity and venture capital equity. More knowledge is needed on when firms decide to acquire funding from a venture capitalist, and when they decide to enter into a joint venture, and on how firms make this trade-off. Another avenue relates to further research on partner dissimilarity, in order to take into account more variables that explain the choice for equity

governance in an inter-firm relation or the trade-off between venture capital and joint ventures. From a TCE perspective, firms choose equity to govern an inter-firm relation when there is a large amount of transaction uncertainty, which may be caused by differences between firms in terms of their industrial or technological background. When more variables are included that characterize the transactions between partners, future research will be able to disentangle the effects on governance that occur at the alliance formation and operation stages. This type of research may provide more insights in how firms make a choice between the type of equity used in collaborations.

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