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Why do contracts differ between venture capital types?

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Abstract The main objective of the present paper is to investigate differences in the design of contracts between venture capitalists and their portfolio firms across venture capital (VC) types. By controlling for selection effects, we focus on contract design differences which reflect differences in corporate governance approaches across VC types. To address this issue, we use a unique, hand-collected German data set consisting of all contractual details of VC investments into 290 entrepreneurial firms in the period 1990–2004. By employing various matching procedures, we show that VC types differ in their corporate governance approach vis-à-vis their portfolio firms. It turns out that independent VCs, when compared to captive VCs, use significantly more contract mechanisms which induce active intervention.

Keywords Venture capital · Corporate governance · Matching · Contract design

JEL Classifications G24 · G32 · G34

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1 Introduction

The contractual relation between venture capitalists (VCs) and their portfolio firms has received growing attention in recent years (see, for example, Gompers 1997; Cumming 2005a, b; and Kaplan and Strömberg 2003, 2004 for early studies), in particular, because it offers the possibility to study the role of explicit contracts in an environment of complex informational asymmetries and control problems. A predominant concern has always been the search for the prototype VC contract. Nevertheless, it is unclear if such a prototype corporate governance approach really exists or if there are not instead persistent differences across VC types (i.e. VCs with different types of main investors) and countries which prevail over time.

The aim of this paper is to explore potential differences in corporate governance and contract design across different VC types using a German data set with a large variety of different VC types and all the contractual details of VC investments into 290 entrepreneurial firms during the period from 1990 to 2004. We thereby distinguish between independent VCs (i.e. VCs with many different institutional and private investors) and captive VCs (those with one main investor, e.g. a bank or a public entity). Observing, however, different contract approaches between different VC types does not necessarily imply that different types of VCs apply different corporate governance approaches. Observed differences may also be due to a selection effect. Different VC types finance different types of firms and

thus need to use different types of contracts. Hence, it is crucial to disentangle the firm selection effects and the actual differences in the corporate governance approaches between VC types. In order to do so, the present study will apply different matching procedures.

Our main finding is that there does not exist a prototype VC contract but that there exist significant corporate governance differences across VC types even when financing similar firms. In fact, independent VCs use significantly more contract mechanisms which induce active intervention than do captive VCs, though the differences are not significant with respect to control mechanisms. This result has further important implications for cross-country comparisons. It shows that observed differences in contract design may be rather due to differences in the market composition of the respective VC industries than to actual differences in the behavior of specific VC types.

The existing empirical research on venture capital issues is normally limited to take into account a potential VC type effect (regarding contract design, investment behavior, active engagement as well as performance) by using different dummy variables or by looking into the differences of contracts between different VC types without disentangling selection and governance effects (see e.g. Bascha and Walz (2007) and Cumming (2006)).[1] Our matching approach points in the same direction, but goes a significant step beyond. Rather than only testing for the significance of such a VC type dummy, we are able to give a comprehensive picture of the differences in contract design between VC types after controlling for selection.

The paper is organized as follows. In the next section, we derive our empirical hypotheses based on the existing (theoretical) literature focusing on the behavior of different VC types as well as on their differing objectives and on VC contracting in general. Section 3 describes the data set which we use in our empirical analysis. After explaining the matching procedure in the fourth section, we present our empirical results. The fifth section contains some robustness checks and yields additional insights of the differences between the various groups of captive VCs. Finally, Sect. 6 concludes.

2 Hypotheses

In what follows, we will derive our hypotheses based on the literature with respect to our research question whether different VC types differ with respect to their corporate governance approaches. But in order to be able to understand the foundation for these differences, it is important to know the main characteristics of each of these VC types.

The literature on venture capital perceives VCs as being active (hands-on) investors which provide risk capital for entrepreneurial firms (see e.g. Cumming and Johan 2009). This leads VCs—in comparison to other financiers—to invest in high-risk, high value projects (see e.g. Ueda 2004) whose potential they further increase through their activities (see Chemmanur and Chen 2006). Although, this perception of the VC market is mainly focused on the business model of independent VCs which share the common objective of maximizing only monetary returns stemming directly from their investments. In addition to independent VCs, there exist, however, a significant number of so-called captive VCs.[2] One clear difference between independent and captive VCs lays in the fact that captive VCs follow additional objectives beyond the aim of maximizing direct monetary returns. Typically, these objectives are complementary to the "assets" of the main investor of the captive VC. We can differentiate three types of captive VCs: corporate VCs (CVCs), i.e. VC firms owned by a strategic investor (see Hellmann 2002), bank-dependent VCs (owned by a bank), and public VCs (financed mainly with public money). Given the limited number of CVCs in our data set, we only focus on the latter two types of captive VCs in the empirical analysis. Nevertheless, as we think that the literature on CVCs allows us to draw helpful inferences for the other captive VCs as well, we briefly include the most important studies on CVCs in our discussion.

Even if the specific objective may differ between CVCs (see e.g. Birkinshaw et al. 2002; Cumming 2006), there is a general agreement that CVCs acquire

[1] A partial exception to this is Masulis and Nahata (2009) who correct for the selection effect; however, only for a subsample of their corporate VC sample rather than between different VC types in general. Furthermore, they have only limited information about the overall contract design.

[2] This market segmentation can also be observed in the US VC industry even if it is more pronounced in Europe (see Bottazzi et al. 2004; as well as Mayer et al. 2005).

portfolio firms which are complementary to the assets of the company which is the main investor (see Gompers and Lerner 2000, as well as Masulis and Nahata 2009, for detailed empirical evidence, and Arping and Falconieri 2010, for a theoretical analysis). In the same line, banks use venture capital investments to build relationships which lead to future profitable lending to successful ventures (see Hellmann et al. 2008). As to public VCs, Murray (1998) emphasizes the important role of development goals as well as their lack of managerial capabilities. Cumming and MacIntosh (2006) argue in the same direction. By analyzing a specific type of Canadian public VC, they show that they have an organizational structure which induces agency costs and makes them follow regional objectives besides financial ones (see also Leleux and Surlemont 2003). Finally, Secrieru and Vigneault (2004) underline three potential reasons for government intervention in the VC market: positive externalities, liquidity constraints, as well as the potential certification provided by the public VC.

These differences in the objectives entail that captive VCs and independent VCs finance different firms and develop different financing skills. Hence, each VC type should have its proper corporate governance approach and thus, we also expect to observe differences with respect to contract design. Indeed, the literature has underlined these differences.

As independent VCs are the prototype of active investors providing not only money but also advice to their portfolio firms and using their relationship networks to nurture their portfolio firms (see e.g. Fairchild 2004), they present the following characteristic features in their corporate governance approach towards their portfolio firms: equity-oriented financing or even more convex schemes which provide adequate incentives for the VCs to actively intervene in the firm, staged financing (see Bienz and Hirsch 2011), as well as the allocation of control rights towards the VC.[3] This means that we should observe that independent VCs hold significant control rights and use contract mechanisms which induce active intervention.

As concerns captive VCs, Hellmann (2002) points out that the choice between an independent VC and a CVC has a significant effect on the contract design between the new venture and the respective VC. The same finding emerges from de Bettignies and Chemla (2008) who show that CVCs control entrepreneurs less intensively than independent VCs. Arping and Falconieri (2010) argue that the complementarities which emerge by financing the venture via a captive VC (see Riyanto and Schwienbacher 2006 for CVCs) lead to lower incentives of captive VCs to liquidate their portfolio firms, a fact which has to be accounted for in the optimal contractual design: captive VCs should have a stronger incentive to acquire credible put-options like milestones. Hellmann et al. (2008) stress that, as for bank-dependent VCs, the priority lies in building-up lending relationships, providing value-adding support is not their main concern. Finally, Secrieru and Vigneault (2004) analyze the optimal level of advice which should be provided by the public VC and show that public VCs should not interfere in the operations of their portfolio firms unless they have accumulated a high level of expertise in the past which is rather doubtful. This means that it is optimal for public VCs to be rather inactive investors.

Altogether, these papers suggest that, due to their strategic objectives, captive VCs have smaller incentives to invest in acquiring expertise and technology, making them less active investors and thus they will also provide less active support to their portfolio firms. Hence, we expect that the contracts between captive VCs and their portfolio firms should include less measures that induce active intervention of the VC. Differences with respect to the allocation of control rights are less clear since captive as well as independent VCs both have strong incentives to monitor their investments closely. The following hypotheses summarize these findings:

Hypothesis 1 Captive VCs (i.e. bank-dependent and public VCs) should use significantly less mechanisms which induce active intervention by the VC than independent VCs.

Hypothesis 2 The differences between captive VCs and independent VCs concerning the usage of control rights should be smaller than those concerning active intervention mechanisms.

[3] See Kaplan and Strömberg (2003) for a general empirical analysis; Kaplan et al. (2007) and Cumming et al. (2010) for related work on an international data set; and Bienz and Walz (2010), Cumming (2008) as well as Cumming and Johan (2008) for detailed studies on the relation between contract design and VC exits.

3 The data set

3.1 Data source and sampling

Our analysis uses a proprietary, hand-collected data set from KfW Bankengruppe (formerly Kreditanstalt fuer Wiederaufbau) based on contracts between VCs and their portfolio firms. KfW has a unique position in Germany's venture capital market: being Germany's largest promotional bank, it supports innovative firms by promoting the investment of the VCs. Although, in our sample, KfW never directly invests in any of the portfolio firms, it becomes indirectly involved in the venture capital deals in Germany. In order to obtain support from KfW, VCs have to apply by submitting the key details of their relationship with the portfolio firm, most notably, the term sheets, the business plans and the shareholder's agreements. By providing us with access to these documents, KfW gave us the unique opportunity to collect—under strict confidentiality—detailed information on the relationship between the VC and its portfolio firm based on actual contract data.

In order to reduce the very time-intensive task of collecting detailed information from the numerous documents to a manageable size, we drew a random sample of 300 portfolio firms based on investment date and program type through which KfW supported the VCs.[4] Our random sample finally consists of 290 portfolio companies that were financed in 464 investment rounds between 1990 and 2004. In this study, we will limit to first rounds in order to focus on the choice of a specific VC type and the initial contract design and blind out temporal effects in contract design.

3.2 Representativeness and possible selection biases

We are confident that our sample is a representative sample of the German VC market in the time period considered. First, as we were responsible for the sample selection process ourselves, we ensured that no selection bias occurred via the provider of all our documents (KfW). In addition, as KfW supported about 60%[5] of all investments in the German VC market in the period we consider, we are confident that the sample is representative of the whole market. Finally, as during our sample period KfW's policy mandate was to support the German market, the prerequisites which had to be fulfilled in order to get support by KfW were mainly related to general firm characteristics and not to contract characteristics. Thus, we are sure that these conditions should not matter for our sample.

These arguments are further confirmed if we compare our sample with data of the whole German VC market based on data from the German Venture Capital Association (BVK). The most important difference is that our sample focuses more on early-stage financing. Indeed, we observe that our sample contains 73% of early-stage observations versus only 48% in the German Market (see BVK 2007). This difference is further reflected in the industry composition of our sample. Whereas we have approximately the same percentage of observations from life sciences and traditional high-tech industries in our sample as in the data of the German Venture Capital Association, our sample includes significantly more observations from the sectors of IT, telecommunications and software (36.2% in our sample versus 24.1% in the BVK data). This latter difference may further be due to the fact that in our sample, the boom period is overrepresented with respect to the data of BVK. Although, the increase of VC activity from period 1 (1990–1997) to period 2 (1998–2000), the boom period, as well as the subsequent decrease from period 2 to period 3 (2001–2004), which we observe in our sample, is also confirmed in the BVK data. Finally, independent VCs are the most important type in both data sets; and if we compare investment amounts, they are also similar. Thus, we can conclude that with the exception of our focus on early-stage investments, our data set is very similar to the data of BVK of the whole German VC market.

Furthermore, we are not aware of any selection bias that could affect our variables. The contracting behavior could differ between those firms or VCs which received KfW support and those which did not.

[4] As the objective of the project was to analyze different aspects of venture capital contracting in Germany, we aimed at getting a representative sample of VC contracts and not at including a preferably high number of different types of VCs.

[5] According to BVK (2003) there were 11,854 seed, start-up and expansion deals by its members in the relevant time period; KfW supported almost 7,100 deals of potential members. This implies a market coverage of approximately 60%.

We think that this is not the case. KfW never directly invested in any of the companies (being prevented to do so by its mandate) and there did not exist specific rules related to the implementation of any specific contract design or any particular incentives for the contracting parties to choose any particular form.

3.3 Contracting variables

In order to be able to test our hypotheses, we have to translate each specific contract design into quantifiable variables. According to our hypotheses, it is important to distinguish two types of contract elements. On the one hand, contract elements that allow the VC to actively intervene in the portfolio firm and, on the other hand, contract elements that serve as control mechanisms. In order to translate each contract into quantifiable variables, we interpret each contracting element according to its economic mechanism and not according to its legal form. This procedure allows us to make our results comparable and applicable to other VC markets as well. In addition, it is important to underline that the vast majority of the portfolio firms of our data set are limited liability companies. As German corporate law for limited companies allows for quite flexible arrangements, this implies that all US type control and decision rights can be implemented in the framework of German corporate law (see Baums and Möller 2002 for a very detailed legal study on this point).

We define two variables to measure the degree of active intervention by the VC: Incentive Mechanism Design (IMD) and VOTING RIGHTS. IMD relates to the incentives which are given to the VC through the design of the cash-flow rights implied by the financing instrument(s) used. This means that, for example, pure equity financing where cash-flows directly depend on the firm's value should give the VC higher incentives than pure debt financing where the cash-flow is mainly independent. In addition, the theoretical literature on optimal security design in venture capital frameworks with a double-sided moral hazard problem (see, for example Casamatta 2003), shows that convex cash-flow schemes seem to offer the highest incentive scheme to the VC. In order to be able to take into account both of these aspects, we define the IMD variable as categorical variable. It takes a value of zero with nonstandard debt and pure debt and becomes one with debt-equity mixes where the debt component is larger than the equity component. IMD is two with debt-equity mixes where the debt component is smaller than the equity component while having a value of three with pure equity and equity with a liquidation preference, and a value of four with convertibles. Convertibles are assigned the highest value, because they lead to a call-option type of payoff structure, leading to the steepest incentives for the VC.[6] The second variable we use is the variable VOTING RIGHTS which captures the percentage of voting rights which are held together by all VCs. We again create a categorical variable on the basis of the specific thresholds which are necessary to be able to decide about different categories of firm affairs. The variable is zero if the VCs together do not hold any voting rights, a value of one for the interval (0%, 25%), a value of two for (25%, 50%), a value of three for (50%, 75%) and a value of four if the VCs hold at least 75% of the voting rights. Finally, it is important to underline that we exclude board rights from our analysis as many of the firms we are looking at are not required to have a board due to their legal constitution.

With regard to control mechanisms, we also define two variables. First, a categorical variable VETO RIGHTS which represents the sum of all types of veto rights of the VCs: the veto right against changes in the firm's line of business, the veto against certain financial decisions such as capital expenditures or the use of derivative instruments, the veto against changes in the firm's head count and veto rights against other decisions.[7] As some of the veto rights are given directly to the VCs if they hold a specific percentage of voting rights, we further create a variable OPERATIONAL VETO RIGHTS which only includes the veto rights which are independent of the VCs' voting rights and which govern the entrepreneur's actions in the firm (namely, the first four mentioned veto rights). It is important to underline that we opted for creating categorical variables and not for separately analyzing each veto right because we are rather interested in the degree of

[6] In order to check this result for robustness, we create a continuous variable DEBTPERC which measures the degree of debt financing by the analyzed VC.

[7] These other decisions embrace decisions against lawsuits on behalf of the firm as well as the veto right against changes in the shareholder's agreement, the veto that forbids the firm's dissolution and the veto against changes in the firm's capital structure such as giving out new shares.

Table 1 The different VC types across time

VC types	Total sample		Period 1		Period 2		Period 3	
	Observations	Percentage	Observations	Percentage	Observations	Percentage	Observations	Percentage
Bank-dependent VCs	28	9.93	7	12.96	16	9.52	5	9.09
Bank-dependent-Public VCs	44	15.60	10	18.52	25	14.88	8	14.55
Public VCs	44	15.60	18	33.33	20	11.90	5	9.09
Independent VCs	163	57.80	19	35.19	104	61.90	37	67.27

The table reports the importance of the different types of VCs across time periods for the 290 first investment rounds in our data set. The first column indicates the number of observations while the second column reports the percentage of observations of the respective VC in the indicated time period. BANK-DEPENDENT VCs are VCs which depend on a private bank. BANK-DEPENDENT-PUBLIC VCs are bank-dependent VCs who have at the same time a public mandate (such as the so-called Landesbanken and Sparkassen). PUBLIC VCs depend on a public institution. INDEPENDENT VCs do not pursue any strategic objectives but only aim at maximizing monetary returns. PERIOD 1 includes the years 1990–1997, PERIOD 2 indicates the boom period between 1998 and 2000 and PERIOD 3 indicates the period between 2001 and 2004

monitoring of the VCs and not the type of monitoring they are realizing.

3.4 VC type variables and other independent variables

We can identify the analyzed VC of our first financing round and thus we are able to determine its type.[8] In a first step, we group the VCs in four different categories. First of all, independent VCs are all those VCs which receive their funds from several private investors who do not pursue any other objective apart from maximizing their revenues. Second, we distinguish bank-dependent VCs. These VCs receive their funds from private banks whereby the bank may have an additional interest in building future lending relationships. Third, we distinguish public VCs which are related to a public institution and are therefore interested in the welfare of the whole economy. Fourth, we identify bank-dependent VCs with a sort of public mandate due to their structure such as VCs of the so-called German "Landesbanken" and "Sparkassen". These institutions are organized as private banks but due to their dependence from the regional or local governments also pursue—up to a certain degree—public objectives. Thus, they can be interpreted as an in-between type between bank-dependent VCs and public VCs.[9] Table 1 shows the importance of the different types of VCs in our data set across time.

Due to the small number of observations of some of the VC groups and the thereby implied difficulties with our matching strategies, we concentrate on two main groups of VC types: captive VCs and independent VCs. We think that this pooling of the different types of captive VCs is not a problem because their main difference with respect to independent VCs lies in the fact that they pursue further objectives apart from maximizing value. Nevertheless, we will question this strategy in Sect. 5.2 and discuss potential differences among the different types of captive VCs.

Concerning further independent variables used in the descriptive statistics as well as in the estimation of the propensity score, we construct different variables which give us information about the project and the respective portfolio company, especially its development stage, its age, and whether it has already finished its product development process. Furthermore, we make use of information about the entrepreneur, most

[8] In this step, we do not consider whether syndication takes place or not. Though, in the extension section, we will only include those captive VCs which do not syndicate. We adopt this procedure because we think that it may be the case that a captive analyzed VC syndicates with an independent VC who is really determining the contract design. We do not think that this problem should be crucial for the case of independent analyzed VCs, however.

[9] This is the only German peculiarity of our data set. We account for this in our later analysis.

notably whether he already had experience in managing a firm. Finally, we create variables which describe more precisely the industry of the portfolio firm, for example, the average market-to-book value of the industry or its R&D intensity. All variables used throughout the paper are described in the Appendix.

4 Empirical analysis

Table 2 shows the observed differences in contract design between independent and captive VCs. With regard to financing instruments which give the VCs the incentive to actively intervene in the company (IMD), as well as voting rights, observed differences are pronounced. The difference continues to be significant with veto rights. There are, however, no significant differences with respect to operational veto rights which are completely independent of voting right. This result seems to indicate that independent VCs use significantly more active intervention mechanisms but that there do not exist important differences with respect to control mechanisms. Although, the observed differences must not be interpreted directly. They may be due to the fact that independent and captive VCs finance different types of firms and that these firms are in need of different kinds of contracting mechanisms.

Table 2 Observed differences in contract design between independent and captive VCs

Contract design parameters	Independent VCs	Captive VCs	*t*-value
IMD	2.03	0.90***	7.63
Voting rights	2.04	0.96***	9.41
Veto rights	6.16	5.30***	3.43
Operational veto rights	2.74	2.44	1.57

The table reports the observed differences in means in contract design between independent and captive VCs. Statistical significance at the 1, 5 and 10% level is denoted by *, ** and ***, respectively. The different contracting elements which we consider are the following. IMD is a categorical variable which takes value 0 with nonstandard debt and pure debt, value 1 with debt-equity mixes where the debt component is larger than the equity component, value two with debt-equity mixes where the debt component is smaller than the equity component, value three with pure equity and equity with a liquidation preference, and value four with convertibles. VOTING RIGHTS is a categorical variable which takes value zero if the VCs together do not hold any voting rights, value one for the interval (0%, 25%), value two for (25%, 50%), value three for (50%, 75%) and value four if the VCs hold at least 75% of the voting rights. VETO RIGHTS is a categorical variable which represents the sum of all types of veto rights of the VCs: the veto right against changes in the firm's line of business, the veto against certain financial decisions such as capital expenditures or the use of derivative instruments, the veto against changes in the firm's head count and veto rights against other decisions, i.e. against lawsuits on behalf of the firm as well as the veto right against changes in the shareholder's agreement, the veto that forbids the firm's dissolution and the veto against changes in the firm's capital structure such as giving out new shares. OPERATIONAL VETO RIGHTS is a categorical variable which only includes the veto rights which are independent of the VCs' voting rights and which govern the entrepreneurs actions in the firm (namely, the first four mentioned veto rights)

In order to disentangle the potential real differences in the corporate governance approach between independent and captive VCs from this selection effect, we will adopt propensity score matching as we think that the assumptions of this method are well justified in our context. Moreover, we opt for this method because we think that the focus on the pure differences in contract design between independent VCs and captive VCs will give us a comprehensive and clear picture whereas regression analysis, for example, could show us further determinants of contract design but they may distract from our main research question.

As concerns the main assumption underlying propensity score matching, the unconfoundness assumption (see Lechner 2002), we think that it is a reasonable assumption in our context as the information which is available to the investor and the portfolio firm before signing the financing contract is contained in our data set. Indeed, we conjecture that the contracts between the VC and the portfolio firm depend on the market situation as well as individual firm characteristics such as the development stage or the industry of the firm. The same information should also determine the VC choice.

We estimate the propensity score using a simple probit model where we control for the firm's development stage, its industry, the supply of venture capital as well as the time period. We then implement two forms of propensity score matching. First, we use nearest neighbor matching with replacement, where the observation with the most similar propensity score is matched. Note that in case there exist controls with identical propensity scores, all observations are matched. Second, we use Gaussian kernel matching with a default bandwidth of 0.06. With both matching methods, we impose the common support assumption

whereby we drop all the treatment observations whose propensity score is higher than the maximum or less than the minimum propensity score of the controls.

In a first step, we have to estimate the propensity scores based on the covariates X. We include the early-stage dummy in order to control for the development stage of the company. In addition, due to the high correlations between the industry indicator variables (such as the market-to-book ratio, for example) and the industry dummy variables, we use only the industry dummy variables in the regressions. Finally, we employ the supply variable in order to control for the possibility to obtain financing by an independent VC or a captive VC as well as the Period 3 (2001–2004) dummy. Including the Period 3 dummy allows us to control for the fact that there may have been changes in the financing choices after the boom. The results of the probit model can be found in the first panel of Table 3. We use the results of the probit model to calculate the propensity scores.[10]

Based on the estimated propensity scores, we applied our matching procedures (see the first panel of Table 4). Although, before presenting the results, it is important to assess the matching quality. Frequently used indicators for the matching quality are the following. First, we should observe a substantial decrease in the pseudo-R^2 values from the unmatched to the matched sample resulting from a probit model for each of the two samples with the VC dummy as endogenous variable and the identified covariates (see, for example, Sianesi 2008). In the same way, a sharp increase in the p-value of the likelihood ratio test testing for joint insignificance of all the covariates should be observed between the unmatched and matched sample in order to guarantee a good matching quality. And finally, a reduction of the median bias can also serve as a signal for the validity of the unconfoundness assumption. As can be seen in the lower part of the first panel of Table 4, all indicators evidence a good matching quality. In addition, it is important to underline that the loss of observations due to the common support assumption is quite small.

Table 4 indicates the means of the single contracting elements for independent and captive VCs before matching, i.e. before disentangling the selection and the treatment effect in the first line. The second and

Table 3 The determinants of the choice between independent and captive VCs

Independent variable	Dummy captives—independents	Dummy non-syndicated captives—independents
Early stage	0.31	0.34*
	(0.19)	(0.20)
Supply	−1.94	−1.58
	(1.23)	(1.28)
Life sciences	0.64**	0.56*
	(0.28)	(0.29)
Internet	1.04***	1.16***
	(0.40)	(0.44)
IT telecom	0.37	0.44*
	(0.25)	(0.26)
Trad. high-tech	−0.28	−0.37
	(0.27)	(0.28)
Period 3	0.28	0.41*
	(0.22)	(0.24)
Constant	1.11	0.94
	(0.95)	(0.97)
Pseudo R^2	0.1056	0.1266
LR $\chi^2(7)$	35.72	38.67
$p > \chi^2$	0.0000	0.0000
Log likelihood	−151.31	−133.43
Observations	251	234

The table reports the results of probit regressions which are used to estimate the propensity scores. Coefficients are shown and standard errors are indicated in parentheses. In the first panel the dependent variable is the dummy variable, CAPTIVES–INDEPENDENTS, which takes value one with an independent VC and value zero with a captive VC, i.e. a public VC, a bank-dependent VC or a bank-dependent-public VC. In the second panel, we use the dummy variable NON-SYNDICATED CAPTIVES INDEPENDENTS as dependent variable. This dummy variable take value one with independent VCs and value zero with captive VCs but only if the captive VCs do not syndicate with any other VC. *, **, *** indicate the 10, 5 and 1% levels of significance, respectively. EARLY STAGE is a dummy variable that indicates whether we face an early-stage firm. SUPPLY is a continuous variable that indicates the importance of captive VCs with respect to independent VCs in the market. It simply divides the number of existing captive VCs and independent VCs in a respective year according to the information of Venture Economics about the German market. LIFESCIENCES, INTERNET, IT TELECOM and TRAD. HIGH-TECH are all industry dummy variables that indicate the industry in which the portfolio firm operates. PERIOD 3 is a dummy that indicates whether financing took place after 2000

[10] If we run the probit regression with standard errors clustered by firm year, the results remain almost unaltered.

third line, on the contrary, show the means after nearest neighbor matching and Gaussian kernel matching. Thus, here the difference between the two means corresponds to the actual treatment effect. The significance of the difference is indicated with asterisks. The change in the differences between the means of the two groups of VCs indicates the selection effect. As can be noted in the table, the differences in the corporate governance approaches diminish significantly when controlling for the selection effect. However, they continue to be still substantial and significant in the case of active intervention mechanisms.

When we look, for example, at voting rights, we observe that the mean for independent VCs is 2.05. This means that they hold, on average, between 25 and 50% of the voting rights. Captive VCs, on the contrary, show a mean of only 0.96. This means they hold less than 25% of the voting rights, on average. However, when controlling for the selection effect, the average increases to 1.09 after nearest neighbor matching and 1.33 after kernel matching. This result implies that captive VCs would still use less voting rights than do independent VCs if they financed similar firms. Though, the difference is a little bit less pronounced because part of the difference which we observe in the data is due to the fact that the two groups of VCs finance different types of firms (selection effect). Nevertheless, the difference continues to be statistically significant and also economically meaningful because the degree of involvement of the VCs is fundamentally different if they hold more or less than 25% of the voting rights.

The same is true for the use of financing instruments which give the VC incentives to actively intervene in the portfolio firm. The mean of the IMD variable for independent VCs is 2.03 which signifies that they use, on average, financing instruments whose incentive scheme corresponds to debt equity mixes where the equity component is predominant. For captive VCs, the mean increases from 0.90 to 1.18 (1.20) with nearest neighbor matching (Gaussian kernel matching) implying still not only a statistically but also an economically significant difference in means for independent VCs relative to captive VCs, the latter seeming to use predominantly financing instruments with a strong debt component.[11] Hence, our results clearly indicate that after controlling for selection effects, captive VCs use significantly fewer mechanisms which induce active intervention as compared to the group of independent VCs.

How do the results with regard to control rights look? With veto rights, the difference is no longer significant after controlling for the selection effect. The difference drops from 0.86 (see Table 4) to 0.40 with nearest neighbor matching and 0.35 with Gaussian kernel matching, with both differences being statistically insignificant. In the case of operational veto rights the difference continues to be insignificant even after matching.

Thus, these results confirm Hypotheses 1 and 2: Even after controlling for the selection effect, independent VCs use significantly more active intervention mechanisms than captive VCs but there do not exist any differences with respect to control mechanisms. This result suggests that captive VCs—due to their different objectives—indeed have less incentives to invest in value-adding technology and to acquire the necessary experience in order to actively intervene in their portfolio firms. Nevertheless, due to the nature of firms financed by all VCs (rather young and risky firms), monitoring is important for all types of VCs. Thus, we do not observe any significant differences with respect to control mechanisms.

5 Extensions

5.1 Only non-syndicated captive VCs as control group

A further potential concern is the fact that our analyzed VC in the data set may be a captive VC but that this captive VC syndicates with other independent VCs which actually decide in the syndicate. In order to address this problem, we use again all captive VCs as our control group but we exclude all captive VCs which syndicate. We employ this rather extreme path

[11] We check the robustness of our results by using the alternative continuous variable debtperc measuring the degree of debt financing by the analyzed VC. Using this variable yields even stronger results: the mean for independent VCs is only 0.46 whereas it lies at 0.82 (0.77) after nearest neighbor (Gaussian kernel) matching for captive VCs. This means that both variables go in the same direction. Nevertheless, as the IMD variable takes into account the details of the financing instruments (like, for example, conversion), we think that it is better suited.

Table 4 Differences in contract design between independent and captive VCs

Measure	Independent VCs (IVCs) vs. all captive VCs (CVCs)									
	IMD		Debtperc		Voting rights		Veto rights		Op. veto rights	
	IVC	CVC	IVC	CVC	IVC	CVC	IVC	CVC	IVC	CVC
Before	2.03	0.90***	0.46	0.82***	2.05	0.96***	6.16	5.30***	2.74	2.44
After NN	2.03	1.18***	0.46	0.82***	2.05	1.09***	6.16	5.76	2.76	2.76
After GK	2.03	1.20***	0.46	0.77***	2.05	1.33***	6.16	5.81	2.76	2.48
Measure	Before	After	Before	After	Before	After	Before	After	Before	After
Median bias	35.72	2.27	35.26	2.33	30.41	1.97	20.80	2.43	21.94	2.81
Pseudo R^2	0.106	0.005	0.105	0.006	0.094	0.005	0.090	0.010	0.092	0.011
$p > \chi^2$	0.000	0.943	0.000	0.939	0.000	0.961	0.004	0.932	0.003	0.902
Observations	150	101	147	101	145	95	86	76	92	77
Lost C. S.	0		0		1		5		5	
Measure	Independent VCs (IVC) vs. all non-syndicated captive VCs (CVC)									
	IMD		Debtperc		Voting rights		Veto rights		Op. veto rights	
	IVC	CVC	IVC	CVC	IVC	CVC	IVC	CVC	IVC	CVC
Before	2.03	0.86***	0.46	0.85***	2.05	0.91***	6.16	5.46***	2.74	2.61
After NN	1.96	1.18***	0.47	0.76***	2.07	1.14***	6.16	5.93	2.80	2.80
After GK	1.96	1.30***	0.47	0.74***	2.07	1.30***	6.16	5.78	2.80	2.53
Measure	Before	After	Before	After	Before	After	Before	After	Before	After
Median bias	38.67	3.77	38.23	3.29	31.78	2.99	20.49	0.61	22.33	2.45
Pseudo R^2	0.127	0.010	0.126	0.041	0.110	0.008	0.100	0.003	0.105	0.010
$p > \chi^2$	0.000	0.806	0.000	0.857	0.000	0.886	0.005	0.999	0.002	0.931
Observations	140	84	137	84	135	78	86	61	90	62
Lost C. S.	10		10		11		5		7	

NN nearest neighbor, *GK* Gaussian kernel

The table reports the means of each VC type before and after two types of matching, namely, tied nearest neighbor matching with replacement and Gaussian kernel matching. With both matching procedures, we impose the common support assumption. The first line of each panel reports the means before matching. The second line reports the means after nearest neighbor matching and the third line after Gaussian kernel matching. Statistical significance at the 1, 5 and 10% level is denoted by *, ** and ***, respectively. The standard errors after matching are bootstrapped with 50 replications. The following three lines are indicators of the matching quality. Namely, we report the median bias of the covariates used to estimate the propensity scores before and after matching (see Table 3). Then we report the pseudo R^2 before and after matching, and the third variable indicates the *p*-value of the likelihood ratio test testing for joint insignificance of all the covariates. Finally, we indicate the number of observations in our control group (UT) and the number of treated observations (T) as well as the number of observations which we lose due to the common support assumption. The treated groups are always the firms which are financed by an independent VC. Though, to check our results for robustness, we use two different groups of untreated observations. First, we use all captive VCs, bank-dependent VCs, bank-dependent-public VCs and public VCs. In the second panel, we only consider those captive VCs which do not syndicate. The different contracting elements which we are looking at are the following. IMD is a categorical variable which takes value 0 with nonstandard debt and pure debt, value 1 with debt-equity mixes where the debt component is larger than the equity component, value two with debt-equity mixes where the debt component is smaller than the equity component, value three with pure equity and equity with a liquidation preference, and value four with convertibles. DEBTPERC is a continuous variable which indicates the percentage of debt financing or debt equivalent financing among all the financing instruments which are used by the analyzed VC in the current financing round. VOTING RIGHTS is a categorical variable which takes value zero if the VCs together do not hold any voting rights, value one for the interval (0%, 25%), value two for (25%, 50%), value three for (50%, 75%) and value four if the VCs hold at least 75% of the voting rights. VETO RIGHTS is a categorical variable which represents the sum of all types of veto rights of the VCs: the veto right against changes in the firm's line of business, the veto against certain financial decisions such as capital expenditures or the use of derivative instruments, the veto against changes in the firm's head count and veto rights against other decisions, i.e. against lawsuits on behalf of the firm as well as the veto right against changes in the shareholder's agreement, the veto that forbids the firm's dissolution and the veto against changes in the firm's capital structure such as giving out new shares. OPERATIONAL VETO RIGHTS is a categorical variable which only includes the veto rights which are independent of the VCs' voting rights and which govern the entrepreneurs actions in the firm (namely, the first four mentioned veto rights)

because we cannot identify whether they syndicate with other captive VCs or with independent VCs.

The results of the probit model to estimate the propensity scores can be found in the second panel of Table 3 and the matching results in the second panel of Table 4. The results of the probit model do not change fundamentally. As concerns the matching procedure, we can see that the matching quality continues to be high. Interestingly, the loss due to the common support assumption increases. It now varies between 5 and 11 observations. This may be due to the fact that the portfolio firms which receive financing from a syndicated captive VC are more similar to the firms which receive financing from an independent VC than the firms which receive financing from a non-syndicated captive VC. Nevertheless, for this subgroup which falls in the common support range, our results continue to hold. Again the differences are reduced if we control for the selection effect, but they continue to be statistically significant in the case of voting rights and the IMD variable. With voting rights, the respective numbers are 1.14 (1.30) as compared to 2.07. Thus, we can note that non-syndicated captive VCs would use significantly less active intervention mechanisms than independent VCs if they financed the same types of firms but that there are no differences with respect to control mechanisms. Hypotheses 1 and 2 are thus again confirmed.

Table 5 Different captive VCs

Contract design parameters	Public VCs (PVCs)		Bank-dep. VCs with public mandate (BPVCs)		Bank-dep. VCs (BVCs)		PVC–BPVC	PVC–BVC	BPVC–BVC
	Contract elements								
	Number	Mean	Number	Mean	Number	Mean			
IMD	44	0.41	44	1.07	28	1.46	−0.66***	−1.05***	−0.39
Voting rights	41	0.59	43	1.37	25	0.96	−0.78***	−0.37*	0.41*
Veto rights	39	4.64	35	5.69	15	6.00	−1.05***	−1.36**	−0.31
Oper. veto rights	39	2.18	35	2.71	16	2.50	−0.53**	−0.32	0.21

The table shows descriptive statistics for different variables for the different types of independent VCs. The first column of each group indicates the number of observations. The second column the mean of the respective variable. Furthermore, we depict differences in means. Statistical significance of differences in means at the 1, 5 and 10% level is denoted by *, ** and ***, respectively. EARLY STAGE is a dummy variable that indicates whether we face an early-stage firm. AGE is a continuous variable that indicates the age of the portfolio firm at the contracting date. FINISHED PRODUCT is a dummy that indicates whether the firm has finished the product development process or not. REVENUES is a dummy variable that indicates whether the firm generated revenues in the year prior to the contracting date or not. REPEAT ENTREPRENEUR is a dummy variable that indicates whether the founder has already been involved in the management or was CEO of a company. FAR is a continuous variable which indicates the average fixed asset ratio of the Compustat database companies situated in Europe which operate in the same industry as the portfolio firm. PER is a continuous variable which indicates the average price to earnings ratio of the Compustat database companies situated in Europe which operate in the same industry as the portfolio firm. MTB is a continuous variable which indicates the average market-to-book ratio of Compustat database companies situated in Europe which operate in the same industry as the portfolio firm. RD INTENSITY is a continuous variable which indicates the RD intensity of the Compustat database companies situated in Europe which operate in the same industry as the portfolio firm. LIFESCIENCES, INTERNET, IT TELECOM and TRAD. HIGH-TECH are all INDUSTRY dummy variables that indicate the industry in which the portfolio firm operates. IMD is a categorical variable which takes value 0 with nonstandard debt and pure debt, value 1 with debt-equity mixes where the debt component is larger than the equity component, value two with debt-equity mixes where the debt component is smaller than the equity component, value three with pure equity and equity with a liquidation preference, and value four with convertibles. VOTING RIGHTS is a categorical variable which takes value zero if the VCs together do not hold any voting rights, value one for the interval (0%, 25%), value two for (25%, 50%), value three for (50%, 75%) and value four if the VCs hold at least 75% of the voting rights. VETO RIGHTS is a categorical variable which represents the sum of all types of veto rights of the VCs: the veto right against changes in the firm's line of business, the veto against certain financial decisions such as capital expenditures or the use of derivative instruments, the veto against changes in the firm's head count and veto rights against other decisions, i.e. against lawsuits on behalf of the firm as well as the veto right against changes in the shareholder's agreement, the veto that forbids the firm's dissolution and the veto against changes in the firm's capital structure such as giving out new shares. OPERATIONAL VETO RIGHTS is a categorical variable which only includes the veto rights which are independent of the VCs' voting rights and which govern the entrepreneurs actions in the firm (namely, the first four mentioned veto rights)

5.2 Differences between the various types of captive VCs

Until now, we have separated captive VCs from independent VCs treating all captive VCs as a homogenous group. Nevertheless, it is interesting to see whether there exist differences between the various types of captive VCs and, especially, whether the differences between captive and independent VCs which we presented in the preceding sections really apply for all different types of captive VCs or if there are outliers. Table 5 presents summary statistics with respect to the corporate governance of the three important groups of captive VCs in our data set: bank-dependent VCs, public VCs as well as bank-dependent VCs with a public mandate.

Even if we do not control for the selection effect, we conjecture that the result should hold analogously for the different types of captive VCs if there does not exist any outlier group, since we know from our analysis above that the observed differences are only reduced but not eliminated if we would control for the selection effect. The lower part of Table 5 reveals two things. First, we find that the contracts employed by public VCs differ significantly from the one employed by the other two subgroups of captive VCs. They use significantly less of all the contractual mechanism we are investigating, hence indicating that public VCs are the least active type of captive VCs. Second, and more important for our analysis, our findings also reveal that the differences between all three types of captives VCs and independent VCs, respectively, point in the same direction. We interpret this as a clear justification of our former assumption of treating all three types of captives as a homogenous group, when comparing them to independent VCs. All captive VCs use less financing instruments which give them incentives to actively intervene in the firm (the corresponding value of independent VCs being 2.03) and they also use less voting rights than independent VCs (for which the value is 2.05). A very similar picture can be observed with regard to veto rights and operational veto rights: the numbers are lower for all captive VCs. Overall, this clearly indicates that our results are not driven only by one group of captive VCs (namely, PVCs) but rather hold for the different types of captive VCs.

6 Conclusion

The objective of this paper was to disentangle firm selection effects and actual differences in the corporate governance approaches between different types of VCs. On the basis of our German contract data set we have shown that even after using matching in order to disentangle corporate governance differences from selection effects, independent VCs use significantly more contract mechanisms which induce active intervention as well as more voting rights than captive VCs. Nevertheless, there do not exist significant differences with respect to veto rights. Given that there are neither legal nor institutional peculiarities to the German VC market, we think that our results can be applied in a rather straightforward way to other VC markets even if they do not display such a wide variation in VC types. We would like to stress, however, one caveat of our analysis: we were limited to public and bank-dependent VCs as captive VCs and did not analyze CVCs—an issue which definitively calls for future research.

Our results tell important lessons regarding differences in corporate governance approaches across different types of VC companies. In particular, our findings have important implications for assessing observed changes in VC contract design over time. Our results imply that it is crucial to control for the composition of the VC pool in a country when evaluating changes of contract design over time because observed changes in VC contract design may be due to changes in the composition of the VC pool rather than real changes in the contract design over time. This procedure is also crucial for cross-country comparisons of VC contracts because differences may also be due to differences in the composition of the VC market and not (only) to different levels of sophistication of the VCs.

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Appendix

See Table 6.

Table 6 Description of the independent variables

Independent variables	Description
Firm and entrepreneur characteristics	
EARLY STAGE	Dummy variable that indicates whether we face an early-stage firm
AGE	Continuous variable that indicates the age of the portfolio firm at the contracting date
FINISHED PRODUCT	Dummy variable that indicates whether the firm has finished the product development process or not
REVENUES	Dummy variable that indicates whether the firm generated revenues in the year prior to the contracting date or not
REPEAT ENTREPRENEUR	Dummy variable that indicates whether the founder has already been involved in the management or was CEO of a company
Industry characteristics	
INDUSTRY DUMMIES	Dummy variables that indicate the industry in which the portfolio firm operates
FAR	Continuous variable which indicates the average fixed asset ratio of the Compustat database companies situated in Europe which operate in the same industry as the portfolio firm
PER	Continuous variable which indicates the average price to earnings ratio of the Compustat database companies situated in Europe which operate in the same industry as the portfolio firm
MTB	Continuous variable which indicates the average market-to-book ratio of Compustat database companies situated in Europe which operate in the same industry as the portfolio firm
RD INTENSITY	Continuous variable which indicates the RD intensity of the Compustat database companies situated in Europe which operate in the same industry as the portfolio firm
VC characteristics	
INDEPENDENT VC	Dummy variable that indicates whether the analyzed VC is an independent VC
PUBLIC VC	Dummy variable that indicates whether the analyzed VC is a public VC
BANK-DEPENDENT VC	Dummy variable that indicates whether the analyzed VC is a bank-dependent VC
BANK-DEPENDENT- PUBLIC VC	Dummy variable that indicates whether the analyzed VC is a bank-dependent VC but has at the same time a public mandate (such as the so-called Landesbanken and Sparkassen)
CORPORATE VC	Dummy variable that indicates whether the analyzed VC is a corporate VC
DUMMY CAPTIVES-INDEP	Dummy variable that takes value one if the VC is an independent VC and value zero if it is a captive VC, i.e. a public VC, bank-dependent VC with or without a public mandate
DUMMY PURE CAPTIVES- INDEP	Dummy variable that takes value one if the VC is an independent VC and value zero if it is a captive VC, and there do not exist any syndication partners of the captive VC
INDEP-INT VC	Dummy variable that indicates whether the analyzed VC is an independent VC which has at least one office in a country outside of Germany
INDEP-NAT VC	Dummy variable that indicates whether the analyzed VC is an independent VC with all offices in Germany

Table 6 continued

Independent variables	Description
Contracting elements	
IMD	Categorical variable which takes value zero with nonstandard debt and pure debt, value 1 with debt-equity mixes where the debt component is larger than the equity component, value two with debt-equity mixes where the debt component is smaller than the equity component, value three with pure equity and equity with a liquidation preference, and value four with convertibles
DEBTPERC	Continuous variable which indicates the degree to which financing by the analyzed VC takes place via debt or debt equivalent instruments
VOTING RIGHTS	Categorical variable which takes value zero if the VCs together do not hold any voting rights, value one for the interval (0, 25%), value two for (25%, 50%), value three for (50%, 75%) and value four if the VCs hold at least 75% of the voting rights
VETO RIGHTS	Categorical variable which represents the sum of all types of veto rights of the VCs: the veto right against changes in the firm's line of business, the veto against certain financial decisions such as capital expenditures or the use of derivative instruments, the veto against changes in the firm's head count and veto rights against other decisions, i.e. against lawsuits on behalf of the firm as well as the veto right against changes in the shareholder's agreement, the veto that forbids the firm's dissolution and the veto against changes in the firm's capital structure such as giving out new shares
OPERAT. VETO RIGHTS	Categorical variable which includes the veto rights which are independent of the VCs' voting rights and which govern the entrepreneurs actions in the firm (namely, the first four mentioned rights)
Time and market characteristics	
SUPPLY	Continuous variable that indicates the importance of captive VCs with respect to independent VCs in the market. It simply divides the number of existing captive VCs and independent VCs in a respective year according to the information of Venture Economics about the German market
PERIOD 1	Dummy variable that indicates whether financing took place between 1990 and 1997
PERIOD 2	Dummy variable that indicates whether financing took place between 1998 and 2000
PERIOD 3	Dummy variable that indicates whether financing took place between 2001 and 2004

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