Innovativeness and Corporate Governance of New Ventures[1]

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Abstract

Established firms often face significant obstacles to innovation. As a solution, it has been suggested to form corporate ventures. Based on a sample of corporate and independent ventures in German manufacturing, we show that corporate ventures are more innovative than the control group of independent ventures. In particular, corporate ventures are more successful at developing radical innovations. This effect, however, decreases with the ventures' degree of ownership concentration. We conclude that corporate ventures with a high ownership concentration are more likely to be controlled and monitored by their corporate sponsors, resulting in less favorable conditions for radical innovation.

Keywords: corporate entrepreneurship; start-ups; radical innovation
JEL-Classification: L26, M13, O31, O32

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1. Introduction

Since Schumpeter (1942) and Arrow (1962) put forward the importance of firm incumbency and market structure for innovation, the academic literature continued discussing these topics controversially. In the industrial organization literature, scholars emphasized the threat of entry as a feasible incentive for incumbents (monopolists) to invest in innovation (Lee and Wilde 1980, Reinganum 1983, 1984, 1985, Gilbert and Newbery 1982, Leininger 1994, Etro 2004). This argument is based on the notion that innovations can help incumbent firms to defend their leadership position against challengers. However, incumbent firms can also be reluctant to create breakthrough innovations since the returns from existing products could be cannibalized. Depending on the model assumptions, the results concerning the innovativeness of incumbents differ.

The management and organizational literature, on the contrary, has documented the difficulties of incumbent firms to stay up front in terms of developing or adopting new technologies within an industry (Tripsas and Gavetti 2000, Sull 1999, Tushman and Anderson 1986). While incumbents invest more in innovation, they turn out to be less successful at exploiting radical innovations than industry entrants (Henderson, 1993). This strand of literature suggests that the innovation performance of established companies is typically found to decline while new entrants succeed at introducing radically new products to the market, setting forth the process of creative destruction (Christensen and Bower 1996). Explanations for this phenomenon focus on the inability of incumbent firms to renew their capabilities so that an upcoming technology can be adopted and finally commercialized (Tripsas and Gavetti 2000).

In contrast to the economics literature, however, management studies argue that incumbent firms can take measures to overcome their apparent disadvantage, if compared to industry entrants, at adopting or developing new technologies. Several management scholars claim that corporate entrepreneurship in general and corporate venturing in particular form valid strategies for established firms to pioneer innovations (Christensen 1997, Hill and Rothaermel 2003, Vanhaverbeke and Peters 2005). Corporate venturing entails both the creation of new businesses within the incumbents' organizational domain and the investment in external ventures at the time of their foundation (Sharma and Chrisman, 1999).[2]

Such corporate ventures (CVs) have the advantage of being autonomous or semi-autonomous from their corporate sponsor. This allows them to make their own strategic decisions without being constrained by "inertial forces" stemming from parent companies' focus on existing technologies, rigid routines, and well-established value networks (Hill and Rothaermel 2003, Fast 1979, Biggadike 1979, von Hippel 1977, Sharma and Chrisman 1999, Burgelman 1983a). As a result, CVs are faster and more flexible in their response to emerging radical investment opportunities than industry incumbents (Thornhill and Amit 2001, Hill et al. 2009). The question remains however, to which degree CVs can actually operate independently. Ginsberg and Hay (1994) assert that incumbent parent companies will never grant full autonomy and flexibility to their ventures because they have to bear the financial risk in case the ventures fail. In a similar vein, Zahra (1996) argues that parent companies might show some signs of resistance towards the activities of their ventures, thereby denying them the autonomy that is required for developing innovations.

[2] Prominent examples of incumbent firms that have been known for creating corporate ventures include 3M, General Electric, Hewlett Packard, DuPont, Unilever, Procter and Gamble, British Telecom or the Degussa AG, which is one of the world's largest chemical companies (Block and MacMillan 1993, Miles and Covin 2002, Maine 2008). See Narayan et al. (2009) for a recent survey on corporate venturing.

Based on the described ambiguity related to the usefulness of CVs for the innovation process, this paper presents an empirical investigation of the innovation performance of CVs as compared to a control group of independent ventures (IVs). If CVs are conducive to radical innovation, as theory predicts, we would expect that they innovate at least as radically as IVs. The reason for this is twofold. First of all, incumbent firms can be expected to engage in corporate venturing activities with an explicit focus on radical innovations. Secondly, CVs are better able to access financial and non-financial resources than IVs as they can rely on the support of their sponsoring firms. If IVs, which are the challengers of incumbents and their CVs, turn out to be more innovative than CVs, we could dismiss the usefulness of the incumbents' strategy to create radically innovating CVs. We further investigate the effect of corporate governance on the ventures' innovativeness. If ownership is concentrated, the incumbent firm has a strong incentive to monitor the venture as - given the large amount of capital invested - the return from venturing is significant. A lack of operational independence, however, diminishes the venture's ambition and freedom to engage in radical innovation projects. In case multiple owners decide to establish a venture, monitoring incentives are lower because the financial stakes invested by each party are small. Furthermore, a free-rider problem arises as every action taken by an individual shareholder to improve the venture's performance, has to be agreed on by all shareholders. The venture's freedom to operate is higher in this situation, increasing the chance of radical innovations.

Based on a sample of about 2,500 ventures in German manufacturing, corresponding to almost 6,000 venture-year observations, we investigate the innovation performance of CVs and IVs. Our database allows a distinction between innovations that are new to the market and innovations that constitute an improvement to already existing products. The contribution of CVs to innovations that are new to the market, i.e. the more radical type of innovation, is

particularly interesting since exploring new technological opportunities is one of the major reasons for corporate venturing.

Our results reveal that CVs in general are more innovative than IVs. However, the distinction between innovations that improve existing products and innovations that are new to the market shows that – as theory predicts – CVs are more effective at fostering radical innovation sales than they are at boosting incremental innovation sales. We employ instrumental variables regression to exclude reverse causality in the sense that inventors with a radical technology or idea might approach corporate investors for financial support in order to convert their idea into a marketable product. Moreover, our results show that a concentrated ownership structure diminishes the radical innovativeness of the venture. This suggests that corporate parents with a large ownership stake concede less autonomy to their ventures. We conclude that the success of CVs in terms of radical innovation depends on the corporate investor's ability to strike the balance between resource provision and venture control.

The remainder of the paper is organized as follows. The next section reviews the literature on incumbent firms' difficulty to innovate and outlines how corporate venturing can serve as a solution. Section three introduces our data and the fourth section describes the estimation results. Section five concludes and elaborates on management advice for corporate venturing.

2. Corporate venturing and innovation

2.1. The difficulty of incumbent firms to innovate

Previous studies have proposed a variety of reasons why established firms have difficulties to develop radical innovations[3]. Hill and Rothaermel (2003) summarize these arguments and classify them as being either of an economic, organizational or strategic nature. The economic explanation focuses on the incentives of incumbent firms to innovate radically. Neoclassical models expect that incumbents, if compared to challengers, have an incentive to invest more in innovation so that new entry can be pre-empted (e.g. Gilbert and Newbery 1982). Other models in the field of industrial organization predict that incumbents with a powerful market position will, under conditions of uncertainty about the research and development process, invest less in the production of radical innovations than industry entrants (e.g. Reinganum 1983).[4] Such innovations can decrease customers' demand for already existing products which explains the incumbents' diminished incentive to develop them. Accordingly, established firms can be expected to introduce innovations that are incremental and as a result will not cannibalize the rent streams from already existing products (Reinganum 1983).

Explanations from organization theory revolve around incumbent firms' capabilities and the routines upon which they are determined (Winter 2003).[5] Dougherty and Hardy (1996) argue that the organizational structure of incumbent firms tends to reinforce existing practices and routines. Over time, established firms have developed structured routines to efficiently process information that is coherent with their existing technological competencies (Tripsas 1997). These routines evolved around the competencies that led to the incumbent

[3] We always refer to radical innovations that are of a technical kind and not of organizational or managerial nature.

[4] Like the predictions from the theoretical models, empirical studies in the field of industrial organization on the same subject matter reach different conclusions as well (Lerner 1997, Czarnitzki and Kraft 2004a, 2010).

[5] Instead of covering incumbents' incentives to engage in radical innovation, organization theory argues that incumbents' are less successful at developing and introducing radical innovations than challengers (e.g. Henderson, 1993).

firms' initial success, while restricting managers' ability to search for information outside this predefined frame. Structured routines, however, appear to be most valuable in stable environments (Miller 1993, Ahuja and Lampert 2001). In case the organizational environment is shaken by the upcoming of a radically new technology, established firms are unable, unlike new entrants, to recognize the potential of this technology. Thus, incumbent firms may fail to respond appropriately to the arrival of a radical technology because of their structured and rigid routines.

Furthermore, firms are heavily committed to their value networks comprising of customers, suppliers and investors. This commitment marks Hill and Rothaermel's (2003) strategic explanation for incumbent firms' inability to adopt and commercialize radical technologies. Resource allocation processes in large firms are oriented towards the needs of powerful external parties like customers for instance (Pfeffer and Salancik 1978, Christensen and Bower 1996). As a result, incumbent firms will only introduce innovations that are demanded by existing customers in mainstream markets. However, when a radically new technology is "disruptive" in the sense that it aims at different customers in emerging markets, established firms will not allocate parts of their research budget to its development and exploitation (Christensen and Bower 1996, Christensen 1997, Sull, Tedlow and Rosenbloom, 1997, Tripsas 1997).[6] It can, thus, be said that the value networks of incumbent firms make them incapable to commercialize radical technologies that do not appeal to existing customers.

Having understood the factors that hamper the incumbents' innovativeness, another strand in the management literature emerged emphasizing means by which also large firms

[6] A radical technology can also be "competence destroying" in the sense that it renders the competencies of industry incumbents obsolete (Tushman and Anderson 1986).

can develop and introduce breakthrough innovations (Rosenbloom 2000, Ahuja and Lampert 2001, Rothaermel 2001). In particular, it is argued that corporate venturing as a distinct form of corporate entrepreneurship (Stopford and Baden-Fuller 1994, Guth and Ginsberg 1994) can constitute a valid strategy for incumbent firms to overcome their obstacles to innovation and to develop radical products through new ventures (Day 1994, Christensen 1997, Stringer 2000, Vanhaverbeke and Peters 2005, Covin and Miles 2007, Maine 2008, Narayanan, Yang and Zahra, 2009).

2.2. Corporate Ventures as a solution to a lack of innovativeness

Corporate Venturing refers to the "entrepreneurial efforts" of incumbent firms which can involve the creation of new businesses or the investment in external start-up companies (Sharma and Chrisman 1999). The central argument in the management literature that explains why CVs are more successful at developing radical innovations than their parent companies centers on the operational independence of the ventures. In fact, CVs are described to be autonomous or semi-autonomous from the day to day business operations of their incumbent parent companies (e.g. von Hippel 1977, Burgelman 1983a, 1983b, 1985, Siegel, Siegel and MacMillan, 1988). This enables the ventures to make informed strategic and operating decisions (Fast 1979, Biggadike 1979, Zajac, Golden, Shortell, 1991) as they are faster and more flexible in their response to emerging radical investment opportunities (Hill et al. 2009). At the same time, however, CVs can benefit from their parents' resources, which are an important requirement for enhancing the innovation process (Thompson 1965). CVs cannot only rely on the financial resources of their corporate sponsors but are also given access to non-financial resources like marketing capabilities, distribution networks or manufacturing facilities (Zahra and George 1999, Block and MacMillan 1993, Teece 1986). The ventures' superior access to resources in combination with the parent companies' explicit

aim to create radical innovations when engaging in corporate venturing activities leads us to the first hypothesis:

H1: CVs are more successful in terms of radical innovations than a control group of IVs.

However, the success of CVs in terms of radical innovations cannot be taken for granted. Although CVs are supposed to be autonomous entities (von Hippel 1977, Burgelman 1985, Kanter et al. 1990, Thornhill and Amit 2001, Siegel, Siegel and Mac Millan, 1988), some researchers claim that, in practice, CVs are often characterized by a rather tight relationship with their corporate parents (Zahra 1996, Stringer 2000). Without a sufficient degree of autonomy, however, CVs are affected by bureaucratic processes that can prevail within sponsoring companies. These processes usually entail complicated and formal reporting requirements for all planned (innovation) projects (Kanter et al. 1990, Thornhill and Amit 2001). As a result, the decision making process of CVs is slowed down and constrained by the parent companies' control function. This in turn lowers the ventures' effectiveness at developing and implementing radical innovation projects (Ginsberg and Hay 1994, Zahra 1996, Stringer 2000). Hence, a lack of independence could be one possible explanation for the absence of empirical support for H1. This explanation is confirmed by Zahra (1996) who concludes in his study on 112 ventures in the biotechnology industry that IVs are more successful at developing radical innovations than CVs. Whereas CVs with a lack of independence have to inform their parents regarding promising radical innovation projects, IVs have simpler organizational structures, which allow them to make decisions more quickly and introduce radical innovations ahead of CVs (Zahra, 1996).

In the next section we draw from the literature on ownership and control in order to have a closer look at the effect of venture independence on venture innovativeness.

2.3. Exploring the effect of parent control on the ventures' innovativeness

The literature on ownership and control predicts that a high ownership concentration makes the owners want to control the venture managers' actions more severely in order to secure their investment by reducing agency problems (Burkart, Gromb and Panunzi, 1997, Aghion and Tirole 1997, Czarnitzki and Kraft 2009). If venture managers lack discretion, they have fewer opportunities to spend the parents' resources on private benefits (Gertner, Scharfstein and Stein, 1994). With a dispersed ownership structure, in contrast, the venture managers have more autonomy and discretion for a variety of reasons (Burkart, Gromb and Panunzi, 1997). First of all, the more shareholders there are, the more difficult it is to agree on a common course of action to effectively monitor the ventures' management. Furthermore, all shareholders benefit equally if an individual shareholder is determined to control the work of the venture managers, giving rise to the well known free rider problem (Grossman and Hart 1980, Hart 2001). As a consequence, shareholders underinvest in monitoring the CVs' management. It can thus be said that "the management of a [venture] with many shareholders will be under little pressure to perform well" (Hart 2001, p. 1090).

The comparison of different ownership structures alludes to the fact that ventures with a high ownership concentration are more likely to be closely monitored so that their autonomy becomes significantly constrained. In particular, incumbent parent companies can make use of their control rights to monitor and supervise their ventures. Following Grossman and Hart (1986), the residual control rights enable the corporate sponsors to make the final decision regarding the use of the ventures' assets. This implies that the incumbent parent companies can also decide whether certain radical innovation projects, as proposed by the ventures, are

implemented or not (Gertner, Scharfstein and Stein, 1994). Having the decision rights (control rights) over the ventures' innovation projects leads to two opposing results. At first, the control rights protect the incumbents from venture managers who are only interested in pursuing private benefits (Gertner, Scharfstein and Stein, 1994, Hart 2001). But monitoring the ventures by having such a tight grip on the decision process for radical innovation projects can also diminish the innovative incentives of the venture managers. Burkart, Gromb and Panunzi (1997) for example demonstrate that venture managers are unlikely to search for new investment projects (like a radical innovation project) if they are closely monitored by their corporate sponsors. The argument is that venture managers are unwilling to exercise the effort to come up with radically new innovation projects if they can always be overruled by the owners' management. Similarly, Aghion and Tirole (1997) scrutinize that venture managers' incentive to acquire information for radical innovation projects is reduced if the parent company is likely to interfere. This suggests that ventures with a concentrated ownership structure are hindered to innovate radically because they lack the discretion to do so (Zajac, Golden and Shortell, 1991). Hence, our second hypothesis reads:

H2: The more concentrated the ownership structure, the less radical innovations can be achieved by CVs.

3. Data and Descriptive Statistics

The underlying database is the Mannheim Innovation Panel (MIP), a survey which is conducted annually by the Centre for European Economic Research (ZEW) on behalf of the German Federal Ministry of Education and Research (BMBF) since 1993. The MIP is the German part of the Community Innovation Survey (CIS) of the European Commission which is designed to collect harmonized data on innovation in the European Community. The CIS is

in accordance with the OSLO manual, which defines international guidelines for collecting innovation data from the business sector (Eurostat and OECD 2005).[7]

For our study, we focus on the German manufacturing sector in the period 1993-2007. We only consider firms that have been founded in 1990 or later because we are not interested in established ventures. In addition, we introduce the restriction that firms cannot be larger than 50 employees at the time of their foundations as we intend to avoid a misclassification of new production plants as new ventures. This cut off point is proposed by Almus, Engel and Prantl (2000), Engel and Fryges (2002) as well as Fritsch (1992). Further, we checked the ventures' names in order to exclude production plants that are not captured by our cut off point. Altogether, this leaves us with a final sample of 5,986 venture-year observations corresponding to 2,451 different ventures. Note that the MIP has a pooled cross sectional structure which does not allow us to conduct meaningful panel econometrics: 47 percent of the firms in the sample are only observed once.[8] To attain information on the corporate structure of German manufacturing firms, we linked the MIP data to the database of CREDITREFORM, which is the largest German credit rating agency. CREDITREFORM collects information about basically all firms in Germany in order to predict the probability of default for the firms in question. This information is used by potential lenders, such as banks and suppliers (Czarnitzki and Kraft 2007). By means of the CREDITREFORM database, we identify ventures that have at least one corporate shareholder *at the time of their foundation* (CVs) and ventures that start off without any company backing. The latter type of venture will be referred to as IVs in the following. In total, almost one quarter of the observations in our sample (1,421 out of 5,986) are CVs. Our parent firms (owners) have, on average, 6,598

[7] For a detailed description of the CIS, see e.g. Eurostat (2004).
[8] Table 6 in Appendix A shows the structure of the unbalanced panel.

employees, which makes us confident that we indeed have incumbent parent companies in our database.[9]

Furthermore, the CREDITREFORM database contains information regarding the ventures' ownership structure. A list of all shareholders and the size of their shares *at the time of venture foundation* is available to us. This information allows us to test for the effect of ownership concentration on venture innovativeness. Lastly, we can differentiate between different types of investors like individual investors, firm investors in manufacturing and the service sector, foreign investors, financial investors and others.

3.1. Variable Description

3.1.1. Dependent Variables

Our dependent variables measure the innovation performance of CVs and IVs. Within the MIP survey, respondents are requested to classify their sales into three types: A) products introduced in the recent three years that were new to their main product market, B) products introduced in the recent three years that were not new to their main product market, but only new to the firm's product portfolio, and C) sales due to unchanged or marginally changed products. This implies that a venture's total sales is the sum of sales with A, B and C (total sales = A+B+C). Since we are only interested in a venture's *innovation sales* in our empirical analysis, we only consider product sales of types A and B. In particular, we distinguish between total innovation sales as the ventures' sales with products of types A and B (*INNO*), innovation sales generated by market novelties as sales generated by type A sales (*NOVEL*) and the ventures' sales with incremental innovations as described by type B innovations

[9] One example of an incumbent firm in our dataset would be the Jenoptik AG (10,400 employees), which is specialized in photonic and mechatronic technologies. Jenoptik AG set up a CV, called Jenoptik Mikrotechnik Gmbh. This venture, which is also based in Jena, is creating manufacturing systems for polymeric microcomponents and nanostructures.

(*INCRE*). We consider market novelties as radical innovations that the ventures have newly developed and introduced to the market. This definition also emphasizes that we are only interested in technological innovations and not in organizational or managerial innovations. In order to account for differences in total sales we divide our innovation sales measures by the total sales of the venture. As an example, radical innovation sales (*NOVEL*) is calculated as: A/(A+B+C). The advantage of distinguishing between different innovation types allows us to be closer to the theoretical literature that focuses on the importance of corporate venturing for radical innovations (e.g. Hill and Rothaermel 2003, Stringer 2000). Previous empirical studies on CVs and innovation use qualitative information to construct measures for the radicalness of CVs' innovativeness (Day 1994, Zahra 1996, Zahra and George 1999, Zahra and Bogner 1999). Our variables, in contrast, present sales figures for different types of innovations.

3.1.2 Independent Variables

We distinguish between CVs and IVs by means of a binary variable, which takes the value one if a venture has at least one corporate shareholder *at the time of foundation* and zero otherwise (*CV*). Since we are also interested in the relationship between ownership concentration and innovativeness, we calculated a Hirschman-Herfindahl index (*HHI*) of ownership concentration *at the time of the ventures' foundation* (*Ownership Concentration*). We calculated the *HHI* as the sum of squared shares that parent firms hold in their ventures. The index takes the value one for the highest possible degree of ownership concentration. In that case the venture has only one investor. Since also IVs could be owned by more than one individual, the concentration variable does not need to be equal to one for the control group. As we are primarily interested in the impact of ownership concentration on the innovativeness of CVs, we include an interaction term (*CV*×*Ownership Concentration*). For

these variables, we focus on the time of venture foundation as it typically takes a couple of years until a new venture has developed and marketed innovations. If we were measuring corporate investment and ownership concentration contemporaneously, we would miss later returns resulting from the presence of a corporate investor or the venture's corporate governance structure.

We argue that CVs with a high ownership concentration are less effective at developing radical innovations because they are tightly controlled by their sponsoring firms. To make sure that ownership concentration reflects a lack of freedom and not the access to fewer resources, we also control for the number of owners ventures have *at the time of their foundation* (*Number of Owners*). If ventures with multiple owners benefit from more resources, we would expect a positive effect on innovation sales. However, the number of owners could also impact innovation sales negatively. In this case, the positive effect resulting from superior resource access would be outweighed by the increased coordination problems that go along with multiple owners.

We also create a set of dummy variables to distinguish between different types of co-investors that our CVs can have in addition to corporations. The reason we do this is because different investors may follow different objectives when taking a share in a new venture. Besides corporate owners from the manufacturing sector, our ventures can also have owners from the financial sector (holdings, banks, and insurances) or the service sector. Similarly, we control for foreign owners and other owners like foundations, municipalities, the government etc.

Moreover, we include several control variables. Venture size is measured by employment (*Size*). We account for venture age as well. Young ventures might turn out to be

more innovative than older ones because the start up phase usually coincides with the commercialization of innovations. Since both the age and employment distributions are skewed, we use the logarithm of the two variables in all regression models. In addition, we control for R&D investment by taking the ratio of R&D expenditures to total sales (*R&D intensity*).

Right after Germany's reunification in 1990, eastern German firms received various tax incentives and subsidies from the government in order to promote their development (Czarnitzki and Kraft, 2004b). To account for this, we add a dummy variable (*East*) that takes the value one for ventures operating in Eastern Germany and zero otherwise.

Finally, we include four different cohorts based on the ventures' years of establishment and also add a full set of time dummies to control for business cycle effects. Heterogeneity across sectors not captured by any of the variables mentioned above is accounted for by 12 industry dummies (see Table 7 in Appendix A).

3.2. Descriptive Statistics

Our final sample consists of 5,986 observations for German manufacturing firms. 24 percent (1,421) of these observations are CVs in the sense that they had at least one corporate shareholder at the time of foundation. Table 1 shows descriptive statistics of our final sample.

Insert Table 1 about here

The descriptive statistics show that CVs are more successful at innovating than IVs as is reflected by the higher mean values for all three innovation measures. CVs, for instance, make 21 percent of their sales with innovative products whereas IVs earn only 16 percent of

their total sales with innovations. The distinction between radical and incremental innovation reveals that both CVs and IVs are, on average, more engaged in incremental innovations than in radical innovations. Furthermore, the ownership concentration of CVs is significantly higher than the one for IVs, which is also mirrored in the fact that the former have fewer owners than the latter. CVs have a higher R&D intensity than IVs and are, on average, twice as large in terms of employment. This underlines the fact that CVs are likely to have better access to resources. Finally, the descriptive statistics reveal that 70 percent of all CVs have at least one manufacturing co-investor and 37 percent a co-investor from the financial sector. Service sector co-investors are relatively rare but about a third of the ventures have a foreign co-investor.

4. Empirical Results

Our empirical models focus on the innovation outcome of CVs as compared to IVs. Tobit models are estimated to account for the fact that our innovation sales variables are censored at zero percent as there are firms that have no sales with radical or improved innovations. We also account for right censoring as the maximum of the dependent variables is 100 percent. The resulting empirical model can be written as:

$$y_{it}^{*} = X_{it}^{'}\beta + u_{it} \qquad (1)$$

where y^{*} is the unobserved latent variable that presents radical, incremental or total innovation sales respectively. X_i represents the vector of regressors, β are the coefficients to be estimated and u is the disturbance term. The observed dependent variable is:

$$y = \begin{cases} 100 & \text{if } y^* \geq 100 \\ y^* & \text{if } 0 < y^* < 100 \\ 0 & \text{if } y^* \leq 0 \end{cases} \quad (2)$$

One characteristic of standard Tobit models is that they assume homoscedasticity. If this assumption is not satisfied, the estimated coefficients are inconsistent (Greene 2005). Consequently, we estimate heteroscedastic Tobit models, in which the homoscedastic standard error σ is replaced by $\sigma_{it} = \sigma \exp\left(W_{it}'\alpha\right)$ in the likelihood function, where W denotes a set of regressors possibly causing heteroscedasticity and α are the additional coefficients to be estimated. We use three size class dummies based on the distribution of the ventures' size in terms of employment and 12 industry dummies to model groupwise heteroscedasticity. Wald tests indicate heteroscedasticity for all but two of our regression models (test results are reported at the bottom of the regression tables). Therefore, we only report the heteroscedastic estimation results.[10] As some firms appear more than once in our sample, we calculate clustered standard errors.

4.1. The innovation performance of CVs versus IVs

The first step is to empirically estimate the innovativeness of CVs as compared to the control group of IVs in a multivariate setting. This means that we regress the three innovation measures on the CV variable and the set of control variables. The results are presented in Table 2.

Insert Table 2 about here

[10] Our results do not change if we estimate these two regression specifications with homoscedastic tobit models.

The results show that CVs, i.e. firms with at least one corporate investor at their time of foundation, have higher total innovation sales (*INNO*) than IVs as the positive coefficient of the dummy variable indicates. If we distinguish between sales with radical innovations (*NOVEL*) and sales with incremental innovations (*INCRE*) an interesting difference appears. Whereas CVs do better in terms of sales with radical innovations, there is no evidence that CVs are superior in developing incremental innovations. Accordingly, CVs favor radical innovations, which could be explained by the argument that they are often created with the explicit aim of creating radical innovations. Furthermore, CVs have access to the resources of their parents, which are necessary for enhancing the innovation process and creating radical innovations (Thompson 1965). The marginal effect of the CV dummy (calculated as a discrete jump from 0 to 1) amounts to 1.51 percentage points, all else constant. As the sample mean of radical innovation sales is 4.9 percent, this is a sizeable impact. Overall, the results support our first hypothesis, stating that CVs are more successful at innovating radically than IVs.

Regarding the control variables, we find a weakly significant effect of the number of owners on innovation sales. In fact, the more owners a venture had at its founding date, the higher its total and radical innovation sales. The positive coefficient is in line with our expectation that a venture with more owners has access to more resources. We find no effect of the number of owners on incremental innovation sales.

Further, the results show that the relationship between the dependent variable and R&D intensity turns out to be an inversely U-shaped curve. However, the curve peaks at the 99th percentile of the R&D distribution. Thus, we basically find a positive relationship with decreasing marginal returns.

Moreover, it can be seen that venture size has a significantly positive impact on all three innovation measures. Large ventures cannot only profit from economies of scale and scope but are also more likely to realize complementarities between different departments of the firm (Galbraith 1952). Contrary to our expectations, older ventures appear to be more innovative. However, the estimated coefficient is only significant at the 10 percent level for radical innovations and is insignificant for incremental innovations. Venture location matters for radical and incremental innovations. Firms located in Eastern Germany have lower sales with radical innovations, but higher sales with incremental innovations. The reason for this result might be that after reunification Eastern German firms are still catching up with their Western German counterparts so that they remain less innovative during Eastern Germany's transformation process into a market economy (Czarnitzki and Kraft, 2006).

Lastly, year dummies are jointly significant throughout all three regression models as Wald tests at the bottom of Table 2 show. Interestingly, the industry dummies are not jointly significant in the radical innovation model. This reassures our model specification as we do not find unobserved heterogeneity across sectors. It appears that our included regressors account decently for the variation of the dependent variable. The founding cohort dummies are only weakly significant if at all.

4.2. Does ownership concentration of CVs matter?

In the next step of the empirical analysis, we add initial ownership concentration and an interaction term of this ownership concentration and the CV dummy to our previous specification. The results of the heteroscedastic tobit models are reported in Table 3.

Insert Table 3 about here

As in Table 2, firms that were founded by at least one corporate investor (*CV*) are superior in terms of total innovation sales (*INNO*) and radical innovation sales (*NOVEL*). By taking the ownership concentration of the CVs into consideration, we observe a significantly negative effect on total innovation sales and on radical innovation sales. Hence, CVs' sales with radical innovations decrease with the degree of initial ownership concentration, yielding support for our second hypothesis. This result indicates barriers to radical innovativeness for CVs with only a few influential shareholders in the start-up phase. A high ownership concentration seems to motivate the owners to use their control rights and exert power and control on their ventures (Burkart, Gromb and Panunzi, 1997, Aghion and Tirole 1997, Czarnitzki and Kraft 2009). By doing this, however, the autonomy of the CVs is narrowed and they are inhibited from being innovative (Ginsberg and Hay 1994, Zahra 1996). Accordingly, we can conclude that CVs are less effective in terms of radical innovativeness if their autonomy is constrained.

There are two additional observations to be mentioned. First, the degree of ownership concentration does not impact the incremental innovation activities of CVs, which is reflected by the insignificant coefficient estimate in Model 6. Since incremental innovations are known to be less risky than radical innovations (Henderson and Clark 1990, Damanpour 1996), it can be assumed that corporate owners have fewer incentives to monitor and control these venture activities (Holmstrom 1989). Second, ownership concentration in the venture's start-up phase does not matter in general. The coefficient of the ownership concentration variable is much smaller than the coefficient of the interaction term and not significantly different from zero. This suggests that corporate capital holders in particular exert significant control on the new venture. We further investigate the relationship between owner type and innovativeness of the venture in the next subsection.

As the tobit model is non-linear, it is instructive to study the marginal effect of ownership concentration on radical innovation, the CV dummy and their interaction term over the whole range of the ownership concentration distribution. Figure 1 depicts the expected values of the radical innovation measure for both CVs and IVs as a function of the ventures' ownership concentration. The predictions are based on Model 5 in Table 3 and are calculated at the means of all other regressors.

As the marginal effect of ownership concentration per se is negative but not significantly different from zero, we obtain almost a flat relationship for the IVs. As Figure 1 shows, however, the curve for CVs is shifted upwards because of the positive CV dummy. The positive difference between CVs and IVs diminishes as ownership concentration of the former increases, though.

The estimated coefficients of the other control variables do not change significantly in sign and magnitude if compared to the results for the first specification presented in Table 2. The only notable difference is that the number of owners turns insignificant in the augmented specification.

Insert Figure 1 about here

4.3. Does the type of owner matter?

As not all of our CVs have only corporate owners at the time of their foundation, this section accounts for the possibility that different investor types may take a stake in new ventures for different reasons. While financial investors are presumably interested in achieving short term financial gains, corporate investors are presumably more focused on spurring radical innovations through CVs (Siegel, Siegel and MacMillan 1988, Dushnitzky

and Lenox 2005). Accordingly, corporate investors can be argued to be driven by strategic motives other than achieving profits in the short term. In order to control for the fact that different owners follow different motivations, which could possibly be reflected in the innovativeness of their ventures, we incorporate four owner dummies in our regression models (Table 4). These dummy variables take into account that at the time of their foundation, the ventures might have co-investors from service firms, foreign firms or financial firms. The last category depicts a residual group of different owners including foundations, municipalities, the government and others. Manufacturing firms serve as the benchmark type of owners.

Insert Table 4 about here

In all three regression models the four owner dummies are insignificant with the exception of the financial owner dummy in Model 8. The financial owner dummy has a significantly negative impact on sales with radical innovations. Hence, CVs' radical innovativeness is lower if they also have financial owners (Hoskisson et al. 2002, Tribo, Berrone and Surroca, 2007). A likely explanation for this result is that financial owners are mainly driven by short term financial goals rather than by motives related to innovation. To maximize the chances that these goals are achieved, financial owners may have a strong interest to monitor their ventures and pressure them into following an intended course of action. This lack of autonomy, however, lowers the CVs' share of sales with radical products.

All other estimation results are robust regarding the signs and magnitudes of the estimated coefficients. The only notable change is that the CV dummy for incremental innovations is not significant at the 10 percent level anymore.

4.4. Robustness check I: Endogeneity of CV variable

We performed two robustness checks concerning potential endogeneity of the CV variable in Table 2. In case of external corporate venturing[11], it could be that parent companies systematically invest in ventures that promise higher innovativeness making the CV variable endogenous. Our robustness checks seek to show that we can eliminate this reverse causality. First, we perform a non-parametric nearest neighbor matching as it is common in treatment effects studies (see e.g. Imbens and Wooldridge 2009 for a methodological overview). We match CVs with comparable IVs and test whether the differences regarding the innovation performance of the matched sample is statistically significant. The results confirmed our previous findings: CVs are more innovative in terms of radical and total innovation sales. We present the results in Table 9 in Appendix B along with a description of the matching procedure (Table 8).

Whereas an advantage of the matching is that it does not rely on functional form assumptions, a drawback is that it can only control for selection on observables. In order to check robustness concerning selection on unobservables, we estimate an instrumental variable model where the CV variable is treated as an endogenous regressor. Heteroscedastic Tobit instrumental variable models are estimated using Full Information Maximum Likelihood.

We use two different instruments. First, we use a dummy variable indicating whether the CEO of the venture owns real estate at the time of firm foundation. In case the CEO owns securities, she is more likely to approach a bank instead of a corporate investor to finance a radical innovation project. By doing so, the CEO avoids a loss of control over the venture.

[11] External CVs refers to equity investments that facilitate the foundation of external start up companies (Miles and Covin, 2002).

Second, the likelihood to engage in corporate venturing at the industry level is used. If corporate venturing is a common practice in a certain industry, our sample firms are expected to be more likely to engage in corporate venturing themselves. The key assumption behind industry level instruments is that the unobserved firm characteristics do not significantly affect the industry variables (see e.g. Jaffe 1986).

Staiger and Stock (1997) emphasize that instrumental variable regressions and endogeneity tests can be misleading in case of weak instruments. They propose evaluating the partial correlation of the endogenous variable and the instruments as a test for weak instruments. As a rule of thumb, the partial F-statistic for the instrument(s) should be larger than 10 to ensure that instruments are not weak. Our instruments have the expected sign in the first stage regression. The real estate dummy has a negative sign and is significant at the 1 percent level. The industry mean of corporate venturing activity is positively significant at the 1 percent level. The partial F-statistic on joint significance amounts to 153.18. Thus we can reject the concern that our regressions suffer from possible weak instrument bias.

Based on a Smith and Blundell (1986) test for endogeneity, we reject exogeneity of the CV variable. In order to test whether our instruments are valid, i.e. exogenous, we performed a Sargan test, which did not reject the Null hypothesis of validity of our instrumental variables. The regression results are presented in Table 10 in Appendix B. The models confirm our previous findings that CVs are more successful in terms of radical innovation than IVs.

We also considered the possibility that the ventures' number of owners could be endogenous. Radical innovation projects are known to be quite risky. As a result, inventors might approach multiple incumbent firms so that the risk of the project is spread and its

financing assured. If this explanation holds, our results would be subject to reverse causality. We created two instrumental variables capturing the ventures' average number of owners per 2-digit NACE industry level. We distinguish between Eastern and Western Germany as ownership structures in the Eastern part are likely to be influenced by the reunification, which resulted in the privatization of formerly public companies. These variables account for industry heterogeneity in terms of demand for financial resources, innovation conditions and the associated risk which influences ownership structures. We find that our instruments are relevant in the first stage regression since the partial F-statistic amounts to 29.01. A Sargan test did not reject the validity of the two instruments. A Smith-Blundell test, however, revealed that exogeneity of the number of owners could not be rejected at any significance level. Consequently, we only instrumented the CV dummy and not the ventures' number of owners in the instrumental variable regressions in Table 10.

4.5. Robustness check 2: restricting the analysis to CVs

Up until now our regressions are based on the full sample of manufacturing ventures including CVs and IVs. We argued before that CVs should be at least as effective as IVs in terms of generating radical innovations. In order to show that our results regarding the ownership concentration (Table 3) and the owner types (Table 4) are not driven by the control group of IVs, we re-run the regressions for the subsample of 1,421 CV observations (Table 5).

The estimation results of all three regression models (model 10 – model 12) are consistent with previous findings. A high initial ownership concentration diminishes the radical innovativeness of CVs. For incremental innovations, however, the CVs' ownership concentration has no significant effect, as was apparent from the previous results already.

Finally, CVs with at least one financial owner in the start-up phase are less innovative than CVs with only manufacturing owners.

A notable change is that the number of owners turns significantly negative. In the full sample regression (Table 2) this effect was either positive, suggesting a superior access to resources, or insignificant. The negative effect in the CV subsample could indicate that the decision making process is more complex when multiple owners are involved, resulting in less innovation. While this argument is stronger within the CV subsample, our first argument regarding the superior resource access only seems to hold for the full sample.

For the same reasoning as described above (section 4.4) we also considered that the venture's ownership concentration could be endogenous. Again, we created two variables, serving as instrumental variables. Our instruments capture the average firm ownership concentration per 2-digit NACE industry level. The two instruments distinguish between the ownership concentration of Eastern German and Western German ventures. In the first stage regression, we find that the instruments are relevant. The partial F-statistic amounts to 29.01. Performing a Sargan test did not reject the validity of our two instruments. However, the result of the Smith- Blundell test showed that the exogeneity of the number of owners can never be rejected so that we did not estimate instrumental variable models.

Insert Table 5 about here

5. Discussion and Conclusion

Established firms have often been found to be less innovative than industry entrants (Schumpeter, 1942, Rosenbloom and Cusumano 1987, Utterback 1994, Christensen 1997).

Reasons for this have been classified as being of an economic, organizational or strategic nature (Christensen 1997, Hill and Rothaermel 2003). Especially the development of radical innovations, which requires a high degree of organizational and technological flexibility, is a challenge for many established firms. Recent literature has proposed corporate venturing as a way to overcome inertial forces hampering radical innovation in incumbent firms (Day 1994, Christensen 1997, Stringer 2000, Hill and Rothaermel 2003, Vanhaverbeke and Peters 2005, Covin and Miles 2007, Maine 2008).

In this paper we investigate the innovativeness of CVs in comparison to a subsample of IVs. Our sample of German manufacturing firms in the period 1993-2007 allows us to distinguish between radical innovations and improvements on existing products. The first part of our analysis shows that CVs are more innovative than IVs with respect to radical innovations (hypothesis 1). The access to the resources of the parent companies might be a factor driving this result. In the second part of the study, we investigate if the ventures' superior access to resources is outweighed by the parent companies' controlling needs. If the operational freedom of the ventures is limited, we would expect a negative impact on their innovativeness. Our results show that the CVs' commitment to radical innovations decreases with increasing ownership concentration (hypothesis 2). This supports the argument that a high ownership concentration sets incentives for increased monitoring efforts by the owners (e.g. Czarnitzki and Kraft 2009). As a result, however, CVs lose the freedom to invest in radical innovation projects.

Our finding has important implications. The results suggest that incumbent firms could benefit from setting up CVs that have the autonomy to invest in radical innovation projects. This is because the inventions that the CVs develop can presumably spur the innovation process of established companies. But incumbent companies should not exert too much

control on their ventures if they don't want to jeopardize their innovativeness (Shrader and Simon 1997). In particular, the decision rights for innovation projects should be granted to the venture (Aghion and Tirole 1997). A more flexible handle of CVs, however, also increases agency problems. Hence, it is a challenge for corporate investors to balance control over the venture in order to limit opportunistic behavior against the venture's operational independence which is essential for radical innovations. In other words, the corporate investor must balance risk-bearing of the venture management against incentives to act in the corporate investor's interest must be reached.

The theoretical literature on principal-agents conflicts proposes several solutions to this problem (Miller 2005). These models are typically based on a production function that transforms executive efforts into output. The output is also influenced by the [venture] manager's utility function, her risk-aversion and effort-aversion. If the venture manager is risk-averse the corporate investor would need to set incentives to induce the investment in risky projects. Otherwise, the venture manager would prefer less risky projects like investments in physical assets. In this case, the corporate investor has to impact the allocation of resources within the venture. If the venture management is effort-averse the corporate investor has to "motivate" the venture management. Depending on the context, the theoretical literature proposes monitoring, tournaments, high management wages and collaborative solutions between principal and agent as possible measures against principal-agent problems. It should be kept in mind though that the theoretical models do not always have an explicit focus on innovative projects. In particular, the models do not consider that radical R&D projects are characterized by a high degree of outcome uncertainty which is independent of the venture manager's risk aversion or effort input. Nevertheless, some solutions to the principal-agent problem can be applied to the context of corporate entrepreneurship.

Is monitoring the venture a solution? And if so, how should a venture be monitored? Monitoring diminishes information asymmetries between corporate investor and venture. However, monitoring does not always lead to valuable information for the corporate sponsor. This is the case if the venture management is risk-neutral and if we can only observe the outcome of the venture's innovation activities but not the invested effort level. In this scenario, an outcome-based contract can be written that induces optimal efforts (Harris and Raviv 1979). Monitoring would hence be a waste of resources. Gains from monitoring, however, can be derived if the venture management is risk-averse and effort-averse. In this scenario, a (second-best) contract implies that the risk-averse venture management takes some risk at the cost of non-efficient risk sharing (Harris and Raviv 1979, Shavell 1979, Holmstrom 1979, Miller 2005). In other words, the venture management's compensation should be tied to the riskiness of the project so that the management has incentives to invest in radical innovation projects.

Alternatively the literature proposes tournaments (e.g. Nalebuff and Stiglitz 1983). The problem with monitoring is that agents typically dislike that their actions are observed and potentially punished. The tournament solution, in contrast, is based on the relative performance of different agents and on rewards for the best performer such as promotions or bonus payments. We consider this solution as not applicable to the context of corporate venturing. The reason is that a necessary pre-condition for the tournament solution would be that all agents face a similar risk so that their relative performance is informative. This is typically not the case in the context of corporate venturing because different ventures are associated with different risk levels. For the same reason, a tournament between the management of the venture and management units of the sponsoring firm would not work out either because the former should bears more risk than the latter.

Another possible solution would be to pay the venture management higher wages than are offered by the market. Higher wages not only make the best managers compete for the job but also make them spare no effort to keep it. The implication is that the authority of the corporate investor would be strong as the venture management wants to avoid dismissal. Consequently, the venture management would be willing to accept more directions from the corporate investor and would also be more open for monitoring. In other words, the agent accepts giving up some operational freedom over the venture. Hence, we suggest that this solution is only applicable to the case of corporate venturing if there is a contract in place that enforces the investment in radical innovation projects at the same time.

Other theoretical models question whether any action by the principal is needed to avoid principal-agent problems. Given that the theoretical, contract based models typically lead to inferior second best solutions, where either risk-sharing or effort level are suboptimal, some scholars emphasize the importance of management skills to mitigate principal-agent problems rather than relying on contractual solutions. Akerlof (1982) for instance argues that leniency, in our case greater venture autonomy, leads to a performance above the minimum expectations as defined by the principal. The author interprets this result as a gift to the principal to reward leniency. An alternative argument against intervention by the corporate investor is put forward by Radner (1985). He argues that if principal-agent problems are considered as a repeated game, agency losses can be recaptured over time. With respect to corporate venturing, it has to be kept in mind though that ventures do not necessarily have a long-term perspective, which influences their incentive structure. This would then question the applicability of a repeated games or leniency framework to the case of corporate venturing.

In summary, it appears advisable to the corporate investor to not only limit control but also to employ monitoring means that reward risk-taking behavior by the venture management.

As any, our study is not free of limitations. First of all, we rely on ownership concentration as a measure for control that is exerted on the venture. Although this is common practice in the empirical literature (e.g. Czarnitzki and Kraft 2004, 2009, Kraft and Niederprüm 1999, Leech and Leahy 1991), one has to keep in mind that this variable can only serve as a proxy for ownership control. Second, it would be desirable to move beyond a cross-sectional analysis. Unfortunately, our database does not allow longitudinal investigations, as a large proportion of ventures is only observed once in the sample. Furthermore, our focus is limited to the innovation performance of the venture. It would be interesting for future research to investigate potential learning effects for the parent company through corporate venturing (Dushnitzky and Lenox 2005). Another possible venue for future research would be to have a closer look at the different types of ventures. In particular, a distinction between external and internal corporate venturing projects would be interesting as the level of independence from the corporate investor should be different for both venture types. A related topic concerns the management and inventive labor force. It would be of interest to investigate the impact of insider versus outsider managers on the success of the venture. Another relevant question would be if the ownership of CVs changes over time. Do corporate investors integrate the venture after it proved to be successful? Do they keep it independent or do they rather sell it and invest in a new venture?

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Appendix A: Panel Structure and Industry Classification

Insert Table 6 about here

Table 6 shows how our 5961 venture year observations, which correspond to 2451 ventures, are distributed over the 15 year time frame of our study (1993-2007). It can be seen that 1150 ventures are only observed once in the sample. Similarly, 3 ventures appear 14 times.

Insert Table 7 about here

Appendix B: Robustness Tests

As has already been explained before, we performed an econometric matching as a first robustness test for our basic model. For each firm in our sample, we search for the nearest neighbor in the control sample of IVs by means of a Mahalanobis distance matching. Table 8 provides details on how we implemented the matching for this study.

Insert Table 8 about here

The matching results can be found in Table 9. We found matching partners for all but five CVs. For these five excluded CVs we did not find common support. It can be seen in Table 9 that the heterogeneity in the characteristics, which was apparent in the descriptive statistics for the full sample (Table 1), vanishes as the two groups of firms are balanced by nearest neighbor matching. For all of our 1,416 CVs, we picked one nearest neighbor out of the pool of IVs. Now the two samples are comparable in terms of all control variables that

have been used to estimate the probit model, i.e. firm size, R&D intensity, firm age etc. After having eliminated differences between CVs and IVs that can be traced back to their firm characteristics, CVs are still more innovative in terms of total innovation sales and radical innovation sales. Hence, we can conclude that the superior innovativeness of CVs is driven by the presence of a corporate investor rather than by systematic differences between ventures.

Insert Table 9 about here

To account for possible endogeneity of the CV variable, we estimate heteroscedastic instrumental variable Tobits. The estimation results are displayed in Table 10. It can be seen that the presence of a corporate investor still has a significantly positive impact on total innovation sales and radical innovation sales. Compared to the heteroscedastic Tobit regressions in Table 2, however, the results show that CVs can also have a weakly significant effect on incremental innovation sales. Most of the other estimation results are as expected. Accordingly, the results in Table 2 are mainly supported by our instrumental variable approach.

Insert Table 10 about here

TABLES

Table 1: Descriptive statistics

	Corporate Ventures (N = 1421)				Independent Ventures (N = 4565)			
Variables	Mean	SD	Min	Max	Mean	SD	Min	Max
NOVEL	6.74	16.75	0	100	4.37	13.69	0	100
INCRE	14.73	24.05	0	100	11.32	21.83	0	100
INNO	21.47	29.98	0	100	15.69	26.75	0	100
Ownership Concentration	0.75	0.30	0.06	1	0.63	0.26	0.01	1
Number of Owners	2.25	2.04	1	22	2.46	1.75	1	42
R&D Intensity	3.85	9.82	0	90.91	3.05	8.23	0	100
Size	117.77	253.79	1	5000	44.72	169.29	1	4700
Age	9.58	4.09	0	18	9.29	4.50	0	18
Founding Cohort1	0.57	0.49	0	1	0.59	0.49	0	1
Founding Cohort2	0.23	0.42	0	1	0.17	0.38	0	1
Founding Cohort3	0.15	0.36	0	1	0.12	0.33	0	1
East	0.66	0.47	0	1	0.63	0.48	0	1
Manufacturing Owner	0.70	0.46	0	1	0	0	0	0
Financial Owner	0.37	0.48	0	1	0	0	0	0
Service Owner	0.07	0.25	0	1	0	0	0	0
Foreign Owner	0.30	0.46	0	1	0	0	0	0
Other Owner	0.07	0.26	0	1	0	0	0	0

Note: Industry dummies and year dummies are omitted

Table 2: Heteroscedastic tobit regressions on the innovation performance of CVs versus IVs

Endogenous Variables	INNO	NOVEL	INCRE
	Model 1	*Model 2*	*Model 3*
CV	6.89***	7.30***	3.86
	(2.44)	(1.98)	(2.40)
Number of Owners	0.86*	0.75*	0.64
	(0.52)	(0.44)	(0.57)
log(Size)	7.72***	5.31***	8.39***
	(0.84)	(0.78)	(0.84)
log(Age)	9.15**	6.01*	6.32
	(4.36)	(3.59)	(4.09)
R&D Intensity	4.41***	2.91***	3.96***
	(0.27)	(0.23)	(0.31)
R&D Intensity^2	-0.04***	-0.03***	-0.05***
	(0.01)	(0.00)	(0.01)
East	-1.38	-8.16***	3.46*
	(2.11)	(1.82)	(2.04)
Intercept	-55.61***	-64.60***	-69.35***
	(8.45)	(13.50)	(8.58)
Test of Joint Significance of Industry Dummies, $\chi 2$ (11)	51.16***	9.45	39.39***
Test of Joint Significance of Year Dummies, $\chi 2$ (14)	137.12***	53.77***	150.13***
Test of Joint Significance of Founding Cohorts, $\chi 2$ (3)	7.01*	7.04*	5.27
Test on Heteroscedasticity, $\chi 2$ (14)	31.53***	20.84	35.57***
Log-Likelihood	-14805.61	-8317.23	-12918.48
Observations	5986	5986	5986

Notes: Clustered standard errors in parentheses; *** (**, *) indicate a significance level of 1% (5%, 10%). The heteroscedasticity term includes the three size class dummies based on the ventures' employment and the industry dummies.

Table 3: Heteroscedastic tobit regressions on the effect of ownership concentration on innovation

Endogenous Variables	INNO	NOVEL	INCRE
	Model 4	*Model 5*	*Model 6*
CV	17.45***	16.95***	11.06*
	(6.01)	(4.75)	(6.18)
Ownership Concentration	-2.51	0.68	-1.83
	(5.66)	(4.87)	(5.61)
CV x Ownership Concentration	-14.29*	-13.67**	-9.68
	(8.03)	(6.34)	(8.05)
Number of Owners	0.15	0.33	0.15
	(0.68)	(0.63)	(0.80)
log(Size)	8.11***	5.71***	8.63***
	(0.86)	(0.79)	(0.86)
log(Age)	9.52**	6.52*	6.66
	(4.36)	(3.59)	(4.10)
R&D Intensity	4.41***	2.90***	3.96***
	(0.27)	(0.23)	(0.31)
R&D Intensity^2	-0.04***	-0.03***	-0.05***
	(0.01)	(0.00)	(0.01)
East	-1.63	-8.25***	3.26
	(2.12)	(1.81)	(2.04)
Intercept	-53.26***	-65.05***	-67.46***
	(9.52)	(14.29)	(9.69)
Test of Joint Significance of Industry Dummies, $\chi 2$ (11)	51.58***	9.41	39.67***
Test of Joint Significance of Year Dummies, $\chi 2$ (13)	138.42***	54.78***	150.75***
Test of Joint Significance of Founding Cohorts, $\chi 2$ (3)	7.28*	7.40*	5.39
Test on Heteroscedasticity, $\chi 2$ (14)	32.92***	23.47*	35.34***
Log-Likelihood	-14799.90	-8311.96	-12915.76
Observations	5986	5986	5986

Notes: Clustered standard errors in parentheses; *** (**, *) indicate a significance level of 1% (5%, 10%). The heteroscedasticity term includes the three size class dummies based on the ventures' employment and the industry dummies.

Table 4: Heteroscedastic tobit regressions on the effect of ownership concentration and different owner types

Endogenous Variables	INNO	NOVEL	INCRE
	Model 7	*Model 8*	*Model 9*
CV	18.70***	21.56***	9.20
	(6.67)	(5.25)	(6.92)
Ownership Concentration	-2.56	0.57	-1.82
	(5.65)	(4.87)	(5.58)
CV x Ownership Concentration	-16.38**	-17.18***	-9.79
	(8.27)	(6.45)	(8.32)
Number of Owners	0.14	0.32	0.14
	(0.68)	(0.63)	(0.79)
log(Size)	8.01***	5.74***	8.49***
	(0.87)	(0.79)	(0.87)
log(Age)	9.57**	6.74*	6.69
	(4.35)	(3.58)	(4.08)
R&D Intensity	4.42***	2.91***	3.95***
	(0.26)	(0.23)	(0.31)
R&D Intensity^2	-0.04***	-0.03***	-0.05***
	(0.01)	(0.00)	(0.01)
East	-1.43	-8.18***	3.42*
	(2.15)	(1.82)	(2.06)
Financial Owner	-0.67	-6.16**	3.46
	(3.84)	(2.98)	(3.91)
Foreign Owner	4.15	3.10	3.24
	(3.91)	(3.07)	(3.90)
Service Owner	-5.28	-6.10	-1.60
	(7.43)	(6.02)	(6.57)
Unknown Owner	-4.27	-4.63	-1.75
	(5.47)	(5.45)	(7.05)
Intercept	-52.45***	-64.74***	-66.51***
	(9.51)	(14.23)	(9.67)
Test of Joint Significance of Industry Dummies, $\chi 2$ (11)	51.73***	9.77	39.85***
Test of Joint Significance of Year Dummies, $\chi 2$ (13)	137.85***	55.42***	150.26***
Test of Joint Significance of Founding Cohorts, $\chi 2$ (3)	7.42*	7.82**	5.61
Test on Heteroscedasticity, $\chi 2$ (14)	32.33***	24.27**	35.96***
Log-Likelihood	-14797.71	-8305.53	-12914.03
Observations	5986	5986	5986

Notes: Clustered standard errors in parentheses; *** (**, *) indicate a significance level of 1% (5%, 10%). The heteroscedasticity term includes the three size class dummies based on the ventures' employment and the industry dummies.

Table 5: Heteroscedastic tobit regressions on the effect of ownership concentration and different owner types (subsample of CVs)

Endogenous Variables	INNO	NOVEL	INCRE
	Model 10	*Model 11*	*Model 12*
Ownership Concentration	-27.56***	-25.79***	-13.26
	(8.81)	(7.75)	(9.73)
Number of Owners	-1.63**	-1.81	-0.59
	(0.81)	(1.14)	(1.07)
log(Size)	7.47***	6.17***	7.03***
	(1.31)	(1.48)	(1.38)
log(Age)	0.21	1.61	-2.14
	(7.85)	(5.40)	(7.26)
R&D Intensity	3.82***	2.67***	2.73***
	(0.33)	(0.38)	(0.40)
R&D Intensity^2	-0.04***	-0.02***	-0.03***
	(0.00)	(0.00)	(0.01)
East	-3.19	-7.85**	2.90
	(3.81)	(3.23)	(3.94)
Financial Owner	0.78	-6.01**	5.54
	(3.71)	(2.86)	(3.77)
Foreign Owner	2.36	1.24	2.91
	(3.90)	(3.62)	(3.99)
Service Owner	-5.64	-6.65	-1.10
	(6.82)	(5.34)	(6.09)
Unknown Owner	-2.51	-2.26	0.33
	(4.91)	(4.75)	(6.19)
Intercept	6.98	11.10	-32.31*
	(14.13)	(13.59)	(17.38)
Test of Joint Significance of Industry Dummies, $\chi 2$ (11)	42.73***	8.86	42.73***
Test of Joint Significance of Year Dummies, $\chi 2$ (13)	37.71***	20.19	47.88***
Test of Joint Significance of Founding Cohorts, $\chi 2$ (3)	4.25	11.80***	2.56
Test on Heteroscedasticity, $\chi 2$ (14)	42.59***	18.95	29.06**
Log-Likelihood	-4142.87	-2503.86	-3596.86
Observations	1421	1421	1421

Notes: Clustered standard errors in parentheses; *** (**, *) indicate a significance level of 1% (5%, 10%). The heteroscedasticity term includes the three size class dummies based on the ventures' employment and the industry dummies.

Table 6: Structure of the unbalanced panel (1993-2007)

Number of yearly observations	Number of observations per Venture	Percentage
1	1,150	46.92
2	542	22.11
3	273	11.14
4	168	6.85
5	99	4.04
6	72	2.94
7	37	1.51
8	30	1.22
9	24	0.98
10	24	0.98
11	14	0.57
12	12	0.49
13	3	0.12
14	3	0.12
15	0	0
Total	2451	100

Table 7: Industry classification

Industry	Description
1	Food and Beverages
2	Textiles, clothes and leather goods
3	Wood, paper, publishing and printing
4	Fuels and chemicals
5	Rubber and plastic products
6	Non–metallic mineral products
7	Basic and fabricated metals
8	Machinery and equipment
9	Office and communication equipment, electrical machinery and components
10	Medical and optical instruments
11	Motor vehicles and other transport equipment
12	Furniture products and n.e.c.

Table 8: The matching protocol

Step 1	Specify and estimate a probit model to obtain propensity scores $\hat{P}(X)$.
Step 2	Restrict the sample to common support: delete all observations on treated firms (corporate ventures) with probabilities larger than the maximum and smaller than the minimum in the potential control group.
Step 3	Choose one observation from the subsample of CVs and delete it from that pool.
Step 4	Calculate the Mahalanobis distance between this firm and all independent ventures in order to find the most similar control observation. $MD_{ij} = \left(Z_j - Z_i\right)' \Omega^{-1} \left(Z_j - Z_i\right)$ In our case, Z contains the estimated propensity score. Ω is the empirical covariance matrix of the matching arguments based on the sample of potential controls.
Step 5	Select the observation with the minimum distance from the remaining sample. (Do not remove the selected controls from the pool of potential controls, so that it can be used again.)
Step 6	Repeat steps 3 to 5 for all observations in the sample of CVs.
Step 7	Using the matched comparison group, the average effect of having a corporate investor can simply be calculated as the mean difference of the matched samples: $\hat{\alpha}_{TT} = \frac{1}{n^T}\left(\sum_i Y_i^T - \sum_i \hat{Y}_i^C\right)$ with $\hat{Y}_i^C$ being the counterfactual for *i* and n^T is the sample size (of treated firms). Note that the same observation may appear more than once in the selected control group.
Step 8	As we perform sampling with replacement to estimate the counterfactual situation, an ordinary t-statistic on mean differences is biased, because it does not take the appearance of repeated observations into account. Therefore, we have to correct the standard errors in order to draw conclusions on statistical inference. We follow Lechner (2001) and calculate his estimator for an asymptotic approximation of the standard errors.

Table 9: Matching results

	CVs		Matched Control Group		p-value of two-sided
	N1= 1416		*N0*= 1416		t test on mean equality
	Mean	Std. Dev.	Mean	Std. Dev.	
Number of Owners	2.26	2.05	2.25	2.04	0.92
log(Size)	3.84	1.25	3.83	1.17	0.90
log(Age)	2.27	0.47	2.27	0.44	0.98
R&D Intensity	3.86	9.83	3.32	8.79	0.31
R&D Intensity^2	111.53	597.22	88.28	556.90	0.48
East	0.64	0.48	0.66	0.47	0.58
INNO	21.45	29.99	18.18	28.59	0.053*
NOVEL	6.75	16.78	4.23	12.14	0.001***
INCRE	14.69	24.03	13.95	24.86	0.61

Notes:industry dummies, year dummies and founding cohorts are not reported. t-statistics are based on Lechner's (2001) asymptotic approximation of the standard errors that account for sampling with replacement in the selected control group.

Table 10: Heteroskedastic IV tobit regressions on the effect of corporate venturing

Endogenous Variables	INNO	NOVEL	INCRE
	Model 13	*Model 14*	*Model 15*
CV	25.42**	26.88***	22.44*
	(12.02)	(10.43)	(11.46)
Number of Owners	1.07*	0.86*	0.77
	(0.56)	(0.50)	(0.59)
log(Size)	4.75***	1.74	4.88***
	(1.49)	(1.30)	(1.44)
log(Age)	7.13	3.82	4.42
	(4.37)	(3.89)	(4.19)
R&D Intensity	4.42***	2.80***	3.77***
	(0.26)	(0.23)	(0.30)
R&D Intensity^2	-0.04***	-0.02***	-0.05***
	(0.01)	(0.00)	(0.01)
East	-3.11	-9.62***	1.85
	(2.10)	(1.87)	(2.05)
Intercept	-47.94***	-37.21***	-61.42***
	(8.84)	(7.61)	(8.26)
Test of Joint Significance of Industry Dummies, $\chi 2$ (11)	66.49***	30.28***	66.64***
Test of Joint Significance of Year Dummies, $\chi 2$ (14)	132.18***	53.29***	146.52***
Test of Joint Significance of Founding Cohorts, $\chi 2$ (3)	7.64*	7.27**	6.57*
Log-Likelihood	-17416.78	-10933.47	-15535.55
Observations	5986	5986	5986

Notes: Clustered standard errors in parentheses; *** (**, *) indicate a significance level of 1% (5%, 10%).

FIGURE

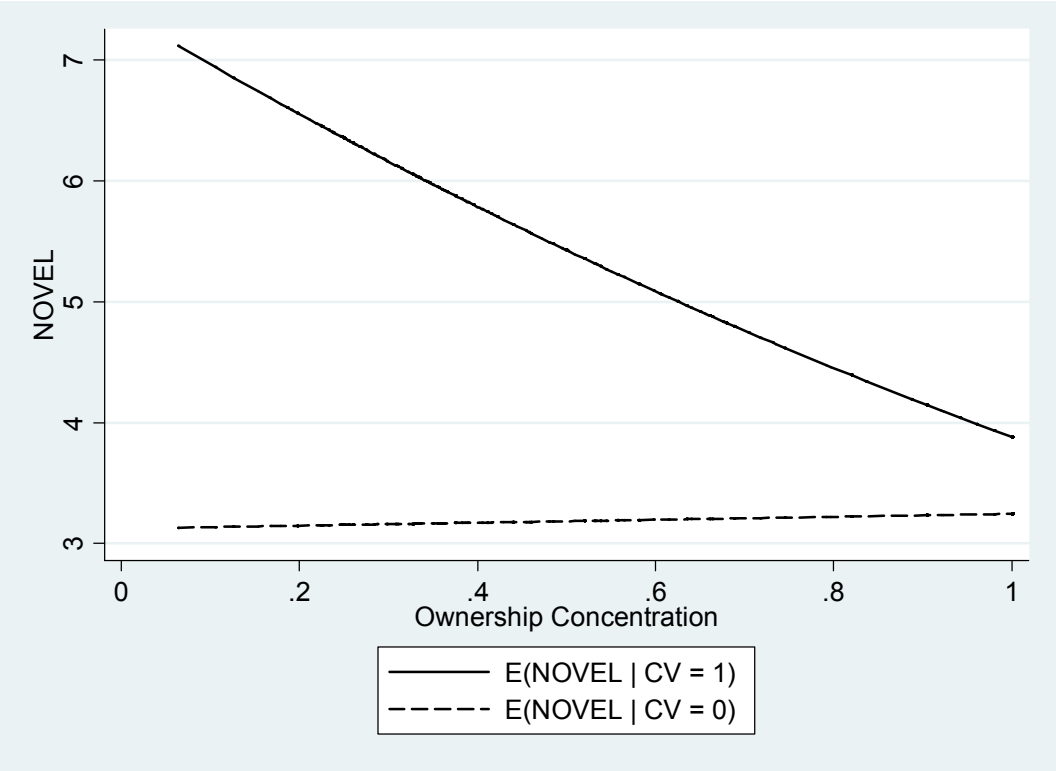

Figure 1: Predicted values of radical innovations for CVs and IVs