Cooperative Strategies of Small, Medium and Large Firms in the Commercialisation of Nanotechnology

Marina Fiedler
Ludwig-Maximilians-University
Ludwigstraße 28 VG II
80539 Munich, Germany
Tel.: +49 (0)89 2180 2777
Fax: +49 (0)89 2180 99 2777
E-Mail: fiedler@lmu.de

Isabell Welpe
Ludwig-Maximilians-University
Ludwigstraße 28 VG II
80539 Munich, Germany
Tel.: +49 (0)89 2023 8774
Fax: +49 (0)89 2023 8775
E-Mail: welpe@lmu.de

We examine the antecedents for cooperative behaviour in the commercialisation of nanotechnology for small/medium and large firms. For small and medium firms (SMEs) our results confirm the influence of complementary assets and transaction costs, but surprisingly do not support any influence of intellectual property rights protection on cooperative behaviour. For large firms the results show a negative relationship for both intellectual property rights protection and ownership of complementary resources with cooperative behaviour. Overall, collaboration-based commercialisation in nanotechnology for both small/medium as well as large firms seems to follow antecedents previously identified in earlier studies. In addition, we find that in the current stage of the nanotechnology commercialisation environment, intellectual property rights protection for small/medium sized enterprises is associated with the acquisition of other firms.

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*The authors would like to thank colleagues and students at the Ludwig-Maximilians-University for their helpful comments and suggestions.

1. Introduction

Understanding how scientific knowledge translates into commercially viable products in the marketplace is an important research issue (Arora, Fosfuri, and Gambardella, 2001; Arrow, 1962; Gans and Stern, 2003; Goldfarb and Henrekson, 2003; Sobrero and Roberts, 2002; Teece, 1986) and it is a common mistake for inventors to underestimate the difficulty in commercialising science and technology (Hung and Chu, 2004; Waitz and Bokhari, 2003). Nanotechnology is emerging from recent scientific advances to which marketers and investors attribute enormous commercial potential, for example estimates about the total worldwide market size add up to over US$ 1 trillion in 10 to 15 years (National Science Foundation, 2001). Already today, articles on topics related to nanotechnology account for 2.5% of scientific articles and 0.7% of patents, which can be seen as an indication that the commercial potential of nanotechnology will have at least the same magnitude as biotechnology (Wonglimpiyarat, 2005; Zucker and Darby, 2005).

Despite the fact that the relevance of nanotechnology commercialisation is widely acknowledged by researchers and industry experts alike, previous studies to our knowledge have not yet examined the commercialisation strategies of nanotechnology firms. Prior studies show that the commercialisation of an invention can be pursued by either following a competitive product market strategy, which requires that the innovator offers an integrated value proposition and avoids detection and a competitive reaction from established market players, or by cooperating with others (Gans and Stern, 2003; Gans, Hsu, and Stern, 2002; Wilson and Appiah-Kubi, 2002). Gans, Hsu, and Stern (2002) show that cooperation is more efficient than an independent entry on the market when the supplier of ideas has strong intellectual property rights (IPR), the search and bargaining costs for finding a cooperation partner are low, and the potential partner owns important complementary resources. In order to understand the commercialisation dynamics in the emerging nanotechnology context, we examine the antecedents of cooperation.

Consequently, we pose the following research question: To what extent do intellectual property rights, low search and bargaining costs, and the importance of complementary assets have an influence on the decision to pursue a cooperative as opposed to a stand-alone commercialisation strategy of nanotechnology inventions?

We derive hypotheses that link intellectual property rights, search and bargaining costs for finding a cooperation partner, the ownership and importance of complementary resources to cooperative commercialisation strategies. We test our hypotheses using samples of both small/medium and large nanotechnology firms since previous studies show that in the nanotechnology context small and large firms innovate and commercialize (Bhat, 2005).

Two of our four hypotheses are confirmed for small/medium as well as large firms. With regard to commercialisation preferences, firms in both samples prefer competitive market entry over cooperative strategies. Furthermore, contrary to the assumption that intellectual property protection fosters cooperative strategies and licensing, we find strong evidence, that intellectual property rights holders prefer acquisition of other firms over a commercialisation strategy.

2. Theory and Hypotheses

We examine whether a cooperative commercialisation strategy used by nanotechnology innovators is associated with intellectual property rights protection, the cost of searching for and bargaining with a cooperation partner and the ownership of complementary assets. The appropriability regime refers to the institutional factors that govern an innovator's ability to capture the profits generated by an innovation (e.g. Katz and Shapiro, 1985; Teece, 1986). According to Teece (1986) the most important specifications of such a regime are the nature of the technology and the efficacy of legal mechanisms of protection. Intellectual property protection has been discussed many times as being crucial to nanotech companies (Harris, Hermann, Bawa, Cleveland, and O'Neill, 2004; Luther, Bachmann, Holtmannspötter, Heimer, Werner, and Köhler, 2004). Gans, Hsu and Stern (2002) found evidence that innovators who control intellectual property rights are more likely to pursue a cooperative strategy for commercialising their invention than a competitive market entry. Gans and Stern (2002) developed their model from the perspective of start-up innovators. We argue that for large firms the relationship between intellectual property protection and cooperation can actually be reversed. Large firms usually have expertise and own complementary assets necessary for commercialization. Thus, for them there might be no need to cooperate since they can commercialize their innovation with their own resources.

Hence,

> **H1a.** There is a positive relationship between intellectual property rights protection of SMEs and a cooperative commercialisation strategy.
>
> **H1b.** There is a negative relationship between intellectual property rights protection of large firms and a cooperative commercialisation strategy.

A key argument in transaction cost economics is that transactions should be aligned with governance structures in an efficient way (Oxley, 1997, Williamson, 1991). According to transaction cost theory, firms as integrated constructs only have a right to exist if they are able to solve the coordination and motivation problems more efficiently internally than through interaction with external partners on the market. According to Williamson, particularly heavy transaction problems arise when economic subjects, endowed with bounded rationality and acting in an opportunistic way, enter transaction relations with a high degree of uncertainty, and when information and knowledge is asymmetrically distributed among the transaction partners (Williamson, 1991). In these cases, pure market forms of exchange, coordinated over the price mechanism, have too many transaction costs. Consequently, there is a large variety of arrangements for the exchange of technologies or technological services, ranging from joint ventures, partnerships, or strategic alliances to licensing and cross-licensing agreements (Arora et al., 2001; Sobrero and Roberts, 2002).

However, even if intellectual property rights are well defined, there may still be uncertainty and ambiguity about potential cooperation partners as well as the value or the characteristics of the new technology. This uncertainty may induce search costs and necessitate detailed bargaining between the parties about royalty rates and other contingent contracting provisions (Gans et al., 2002). Thus, the lower the level of search and bargaining costs associated with following a cooperation strategy are, the more probable is it to follow this strategy for commercialising an innovation. This applies equally to small, medium and large firms.

> **H2.** There is a negative relationship between the search and bargaining costs and establishing a cooperative commercialisation strategy.

Successful commercialisation of an innovation generally requires that the know-how in question be utilized in conjunction with other capabilities or assets (Greis, Dibner, and Bean, 1995; Luukkonen, 2005; Teece, 1986), such as marketing, competitive manufacturing, and after-sales support (Teece, 1986). Cooperation allows innovators to exploit complementary assets controlled by other firms (Autio and Yli-Renko, 1997; Gans et al., 2002; Gans and Stern, 2003). Both large and small firms might differ in their assessment of necessary complementary assets but will both have incentives to cooperate if they perceive that the cooperation partner owns valuable resources.

While avoiding duplication of sunk assets is important in some environments, complementary assets confer minimal value in settings where innovation makes the existing complementary assets obsolete (Gans et al., 2002; Henderson, 1993). As the sunk costs of a competitive product market entry increase, the gains from trade between innovators and complementary asset holders increase and so innovators will be more likely to forego a competitive product-market entry (Gans et al., 2002). However, if the innovator is already owner of the complementary assets necessary for commercialising their innovation, the probability for choosing a cooperation strategy decreases. Thus,

H3a. There is a positive relationship between the importance of complementary assets for the commercialisation of a given innovation and a cooperative commercialisation strategy.

H3b. There is a negative relationship between the degree of ownership of complementary assets for a given innovation and a cooperative commercialisation strategy.

3. Data and Method

Sample, Survey Design and Data Collection

We obtained data through two pre-tested surveys of small/medium and large nanotechnology firms in Germany from November 2005 through January 2006. In our empirical investigation, we surveyed 96 large and 336 small and medium-sized firms in nanotechnology, thereby addressing the total population of such companies at the time of the survey in Germany. We made an effort to identify *all* relevant nanotechnology firms in the aforementioned countries. Our survey of the existing nanotechnology firms is based on the European nanotechnology gateway “nanoforum.org”, which includes a comprehensive database of all firms in Europe. Several sources recommend the nanoforum database as reliable source for identifying firms active in nanotechnology, among them the Federal Ministry for Education and Research (www.bmbf.de/en/index.php) and the VDI - The Association of German Engineers (www.vdi.de/vdi/english/index.php). For the mailing process, we used the total design method as it was suggested by Dillman (1978). The final number of completed surveys for the large firms was 36, which constitutes a response rate of 38%, and the final number of completed surveys for the small and medium sized firms was 98, translating into a response rate of 29%.

Small and Medium Sized Firms

Variables

Table 1 reports the summary statistics for the variables that we used in the SME study.

Insert Table 1 about here

Dependent Variable

Cooperation measure.

We asked respondents to rate, on a 7-point Likert scale, the extent to which they pursue an alliance or joint venture with another firm in order to commercialize their innovation.

Independent Variables

Intellectual property protection

Intellectual property rights protection is composed of the answers of respondents regarding the number of patents, petty patents and trademarks, which they own.[1]

Search and bargaining costs

We used a more direct measure than Gans et al. (2002) for the costs and effort associated with finding and bargaining with a cooperation partner to commercialise the innovation by asking respondents to indicate them on a 7-point Likert scale.

Complementary assets: importance

We asked respondents on a 7-point Likert scale to indicate how important access to a number of complementary assets has been for their commercial success.

Complementary assets: ownership

The second dimension of complementary assets is the degree of ownership over complementary assets the firms in our sample had at the beginning of the commercialisation of their innovation.

[1] In previous studies intellectual property rights protection has been measured both as number of patents and overall intellectual property rights protection including trade marks, petty patents, and copyrights. We obtain the same results with both overall intellectual property rights protection and patent protection.

Large Firms

Variables

Table 3 reports the summary statistics for the variables that we used in study 3.

Insert Table 3 about here

Dependent Variable

Cooperation measure

Cooperation in the large firm sample is a dummy variable consisting of two distinct measures, cooperation (e.g. strategic alliance, joint venture) and capital investment.

Independent Variables

Intellectual property protection

Respondents indicated the degree to which their intellectual property was protected through legal protection mechanisms (number of patens, petty patents and trademarks).

Search and bargaining costs

Respondents indicated the overall costs they had in order to find a cooperation partner on a 7-point Likert scale.

Complementary assets: importance

We asked respondents to indicate on a 7-point Likert scale how important access to complementary assets has been for the commercial success of their firms.

Complementary assets: ownership

Respondents indicated the degree of ownership of ownership of complementary assets which they had at the beginning of the commercialisation of the innovation on a 7-point Likert scale.

4. Results

Descriptive Results for Small, Medium and Large Firms

Interestingly, we found only small differences between large and small/medium firms in the reported levels of importance of a successful commercialisation of their nanotechnology invention for their economic survival (Ø 5.51 for SMEs and Ø 5.21 for large firms), which indicates a generalized high importance of the economic success of the nanotechnology-based innovations. On average, SMEs reported a time of four years for developing nanotechnology inventions, of which the majority were product innovations (57.1%).

In retrospect, SMEs also reported that the most important resources for the commercial success of their nanotechnology innovation were production facilities, know how, capital and marketing/sales. Large firms on the other hand considered know-how, qualified personnel and production facilities as the most important

complementary resources for commercialising nanotechnology successfully. With regard to ownership of complementary resources SMEs reported the least ownership of marketing, after-sales and capital whereas large companies mostly lacked know how.

The descriptive results of the commercialisation strategies of the SMEs (measured on a 1-7 Likert scale) chosen by nanotechnology innovators show that the SMEs in our sample most intensely pursue a competitive entry into the market (Ø 6.0) followed by cooperation in the form of strategic alliances and joint venture (Ø 4.6). To a lesser extent, they also license out their IPR (Ø 2.7), sell their company to another firm (Ø 2.7), acquire other firms themselves (Ø 2.7) and sell their IPR to another firm (Ø 2.1).

A big difference between large and small firms can be noticed in the degree to which a cooperation strategy is followed. Whereas only about one third of all SMEs follows a cooperative strategy for commercialising nanotechnology, almost 80 percent of the large companies pursue a cooperative strategy for commercialising their inventions. However, both SMEs and large firms evaluate the economic success of their most important cooperation as moderately high (SME: Ø 4.7; large firms: Ø 5.3). Asked about the intensity of their cooperation with small, medium and large firms, SMEs reported the highest cooperation intensity with small companies (i.e. up to 50 employees). SMEs also reported a significantly lower absolute number of employees working in cooperation than large firms (Ø 20 versus Ø 67). Also cooperation with universities is considered very important by both SMEs and large firms.

Multivariate Results for Small and Medium Firms

Insert Table 2 about here

Table 2 presents the results of the tests of Hypotheses 1-3b for the SME sample. Column 1 of Table 2 shows the results with only the control variables included and cooperation as the dependent variable. None of the control variables are significantly related to cooperation indicating a heterogeneous sample. Column 2 indicates that when the predictor variables are added to the equation, an additional 20% of the variance is explained (R^2 change = .20, $p < .001$). Contrary to our prediction, the regression results show that the intellectual property rights protection is not significantly related to cooperation, thus Hypothesis 1 is rejected. The regression results further show that search and bargaining costs are significantly ($p < .05$) and negatively related to cooperation, thus confirming Hypothesis 2. The importance of access to complementary resources is also positively and significantly ($p < .05$) related to cooperation. Thus Hypothesis 3a is supported. Finally, the ownership of complementary assets at the beginning of the commercialisation is not significantly related to cooperation, rejecting Hypothesis 3b.

Multivariate Results of Large Firms

Insert Table 4 about here

Table 4 presents the results of the tests of Hypotheses 1-3b for the large firm sample. A logistic regression analysis yielded a significant negative relationship between intellectual property rights protection and cooperative commercialisation strategy, thus confirming Hypothesis 1b, which had predicted a negative relationship. Contrary to our prediction in Hypothesis 2, search and bargaining costs are not related to cooperation, rejecting Hypothesis 2. Similarly, the importance of access to complementary resources is not significantly related to cooperation. Thus Hypothesis 3a is rejected. Finally, there is a significant negative relationship between ownership of complementary assets at the beginning of the commercialisation and cooperation, confirming Hypothesis 3b.

Post Hoc Analysis

A well-established result in the literature is the positive relationship between intellectual property rights protection of SMEs and licensing (Gans and Stern, 2000; Harris et al., 2004; Kollmer and Dowling, 2004) and other forms of cooperation (Goldfarb and Henrekson, 2003; Rodgers, Catton, and Duncan, 2002). Since previous research strongly supports the relationship between intellectual property protection and cooperative commercialization, we were surprised to find no such relationship in our SME sample.

We therefore conducted a „post-hoc-analysis“ investigating the relationship between intellectual property protection and commercialisation strategies, such as competitive market entry, being acquired, selling intellectual property rights of the innovation, acquisition of another firm, and licensing in. An examination of correlations in Table 5 indicates a relatively high level of zero-correlation between intellectual property rights and the acquisition of another company. On a bivariate level, the relationship between intellectual property rights and all other commercialisation strategies are non-significant.

Insert Table 5 about here

To test the strength of this unexpected result, we also ran a hierarchical regression analysis with acquisition as dependent variable and all of the independent and control variables we used in the Hypotheses tests in the sample of SMEs (see Table 1 for the independent variables) and IPR are the only significant predictor variable ($p < 0.001$).

Since these results were rather surprising to us, we randomly picked 6 of the interviewed firms and contacted them again with open questions about their impression of the connection between intellectual property rights and commercialisation strategies (especially the seemingly missing link between the intellectual property rights protection and cooperation as well as licensing fees as commercialisation strategy). Most of the interviewees confirmed our results and explained them with the emerging nature of nanotechnology, which does not allow for adequate licensing fees in the current stage of development as well as the favourable conditions for acquiring other firms in the current market situation in Germany. In

particular, they said that in the current development state of nanotechnology, it is rather difficult to find adequate cooperation partners and licensees due to the largely unknown market players, application potential and commercial markets. Furthermore, in the present German nanotechnology market SMEs with solid financial resources and the intention to strengthen their bargaining position for future nanotechnology stages meet other SMEs on the verge of bankruptcy. This situation creates a wide choice of potential acquisition candidates for potential buyers.

5. Discussion and Conclusion

We set out to understand collaboration-based commercialisation of small, medium and large firms in the context of an emerging technology. In accordance with Gans, Hsu and Stern (2002) we find that for SMEs low search and bargaining costs as well as a high importance of complementary assets increase the intensity of cooperative cooperation. For large firms, both strong intellectual property rights protection and ownership of complementary resources are negatively associated with a cooperative strategy.

However, even though there is a vivid discussion about the influence of intellectual property protection on choosing a cooperation strategy for commercialising inventions, we find that for SMEs i) there is no significant relationship between intellectual property protection and the pursuit of cooperation as exploitation strategy and, ii) the actual dominant strategy for intellectual property rights holders is not cooperation but product market entry either by building up own resources or by acquiring other companies.

The results for SMEs are in contrast to the prediction of Gans, Hsu and Stern (2002) and support the traditional model of organizing innovation, where R&D and the complementary assets required for innovation are integrated inside the firm (Arora et al., 2001). We can think of several possible explanations for this result. First, the emerging nature of nanotechnology which still has undefined markets, unspecified applications and unknown players makes it difficult to find cooperation partners or licensees willing to pay appropriately.

Second, despite the fact that by and large nanotechnology innovation can be fairly well protected by formal intellectual property mechanisms, the lack of expertise of patent offices with the interdisciplinary nature of nanotechnology has led to many patents with overlapping claims (Harris et al., 2004). Thus, firms in our sample may find it difficult to generate license fees at the present time because of the ambiguity of the current state of the market for nanotechnologies. This interpretation is also consistent with Teece (1986) who argued that if a firm cannot obtain appropriate rents from innovation through licensing in order to profit from the technology, the firm should acquire assets that are co-specialized with the innovation (Pisano, 1990; Teece, 1986).

Third, innovating firms may wish to strengthen their bargaining position instead of generating license fees or selling itself under value in the current phase, and thus try to build up a solid patent portfolio and necessary complementary assets, instead of licensing and thus sharing the profits with the licensee.

Fourth, favourable acquisition conditions may be present in the German nanotechnology market as indicated by the post hoc analysis, e.g. such as low prices and a wide choice of acquisition partners makes it attractive for firms to pursue commercialisation via the acquisition of complementary resources. Furthermore, firms which have a strong intellectual property rights position have usually heavily invested in R&D, which also enhances their ability to identify complementary assets within the market and absorb this

information, making it rational for them, given financial power, to acquire other firms (Cohen and Levinthal, 1989).

Finally, the firms in our sample could have a preference for buying instead of cooperating because of the high amount of chemical firms in the area of nanotechnology. German chemical companies have pioneered the institutionalisation of in-house R&D early in the 20th century (Arora et al., 2001) and it might just be a case of path-dependency that firms seek integration instead of using the "market for technology".

Our non-result regarding complementary asset ownership in the SME sample might be explained by the fact that complementary assets are either closely held or freely available, depending on the industry in which the nanotechnology is commercialized. One possible explanation for our non-result regarding search and bargaining costs and cooperative commercialisation in the large firm sample could be the fact that the overall level of search and bargaining costs was low with little variance as can be seen in Table 3.

In sum, we believe that our study makes a number of contributions. First, we show that the influence of intellectual property protection in an emerging, cross-sectional technology with uncertainty and ambiguity about markets and players differs from the results of previous studies. Second, we contribute to the discussion in the management of innovation literature, by testing whether established findings apply in the context of an emerging technology and by showing that the antecedents of cooperative commercialisation differ between small and large firms. Third, our result regarding the influence of intellectual property rights on acquisitions answers the call for research on identifying which firms are responsible for acquisition in high technology industries (Bloningen and Taylor, 2000).

Furthermore, our study is one of the first to empirically examine the commercialisation strategies of firms in Germany, which is one of the major players in nanotechnology. Finally, we added another dimension of complementary assets (namely their importance) to the original model of Gans et al. (2002) for which we find a significant positive relationship with cooperation.

Overall, our results raise further questions about the dynamics of commercialisation in the context of an emerging technology. More research with similar samples is needed to assess the representativeness of the current findings. It might also be of interest to re-examine our results regarding the influence of intellectual property protection on acquisitions, for example, by gathering comparative data in another emerging cross-sectional technology. Another area that would merit further investigation would be to examine the antecedents of alternative commercialisation strategies (e.g. licensing, acquisition, competitive market entry, etc.) pursued by nanotechnology inventors.

In conclusion, our study has raised a number of interesting questions regarding the commercialisation process of small and large firms. It has taken a first step to help both individuals and organisations to better understand the dynamics of nanotechnology commercialisation strategies. Right now, it seems important for nanotechnology innovators to carve out their claims by strengthening their patent portfolio as well as following a competitive product market strategy by building up own resources as well as acquiring other firms.

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Variables		Mean	σ[#]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Cooperation		4.56	(1.89)	-0.03	-0.29**	0.27**	0.12	0.04	-0.07	0.02	-0.15	-0.19†	-0.03	-0.05	-0.00	-0.06	0.01	0.10
Intellectual Property Rights	1	8.27	(10.79)	X	0.04	0.08	-0.06	0.23*	0.19	0.00	-0.13	0.08	-0.01	0.01	-0.07	-0.03	-0.05	0.07
Search and Bargaining Costs	2	4.43	(1.93)		X	0.18†	-0.07	0.08	0.23*	-0.28**	0.21*	0.21*	0.07	-0.11	0.13	-0.08	-0.16	-0.06
Complementary Assets: Importance	3	30.29	(6.63)			X	0.30**	0.09	0.11	-0.15	0.12	0.03	0.17†	-0.03	0.02	-0.10	-0.01	-0.03
Complementary Assets: Ownership	4	29.84	(7.27)				X	-0.17†	0.09	-0.16	0.38***	0.04	0.14	0.16	0.11	-0.07	-0.12	-0.08
VC-Funded	5	1.24	(0.43)					X	-0.03	-0.01	-0.20†	-0.20†	-0.15	0.02	-0.10	0.03	0.08	0.24*
Product Innovation	6	0.57	(0.50)						X	-0.16	0.04	0.15	0.14	-0.03	-0.08	0.24*	-0.12	0.06
University Spin-Off	7	0.26	(0.44)							X	-0.14	-0.05	-0.05	0.01	-0.19†	-0.11	0.11	0.03
Company Age	8	19.87	(24.95)								X	0.21*	-0.06	-0.08	-0.07	-0.05	0.07	-0.14
Nanotechnology Experience	9	7.79	(6.41)									X	-0.09	-0.01	0.16	0.16	-0.08	-0.07
Industry Segment: Automotive	10	0.06	(0.24)										X	-0.11	-0.08	-0.07	-0.20*	-0.10
Industry Segment: Chemicals/Materials	11	0.15	(0.36)											X	-0.14	-0.12	0.53***	-0.17†
Industry Segment: Electronics/IT	12	0.09	(0.29)												X	-0.09	-0.25*	-0.13
Industry Segment: Energy/Env. Tech.	13	0.07	(0.26)													X	-0.22*	-0.11
Industry Segment: Optics/Analytics/Fine Mechanics	14	0.39	(0.49)														X	-0.33***
Industry Segment: Medicine/Life Science	15	0.14	(0.35)															X

[1]**Note:** The numbers on the first column are of means. [#]Standard deviations of each variable. The number of responses used in the analyses is 98; † ≤ .1, * p ≤ .05, ** p ≤ .01, *** p ≤ .001.

Table 1: Summary Statistics[1] for Small and Medium Firms

Dependent Variable		**Cooperation**		
		1	2	
Intellectual Property Rights	**H1:**		0.01	n.s.
Search and Barg. Costs	**H2:**		-0.35	**
Complementary Assets: Importance	**H3a:**		0.30	**
Complementary Assets: Ownership	**H3b:**		0.10	n.s.
VC-Funded		-0.03	-0.04	
Product Innovation		-0.03	0.05	
University Spin-Off		0.00	-0.11	
Company Age		-0.10	-0.13	
Nanotechnology Experience		-0.17	-0.13	
Industry Segment: Automotive		-0.04	-0.08	
Industry Segment: Chemicals/Materials		0.06	-0.00	
Industry Segment: Electronics/IT		0.20	-0.03	
Industry Segment: Energy/Env. Tech.		-0.04	0.01	
Industry Segment: Optics/Analytics/Fine Mechanics		-0.02	-0.02	
Industry Segment: Medicine/Life Science		0.08	0.07	
F-value		0.50	1.89	*
Change in R^2		0.06	0.20	
R^2		0.06	0.26	
Adjusted R^2		-0.06	0.12	

[1]**Note:** Standardized regression coefficients are shown. N=98; † ≤ .1, * p ≤ .05, ** p ≤ .01, *** p ≤ .001.

Table 2: Hypotheses Tests for Small and Medium Firms[1]

Variables		Mean[1]	σ[#]	1	2	3	4	5	6
Cooperation		0.25	(0.44)	-0.18	0.12	0.26	-0.50*	-0.17	-0.11
Intellectual Property Rights	1	5.58	(1.50)	X	0.28	0.26	0.05	0.51*	0.05
Search and Bargaining Costs	2	2.89	(1.12)		X	0.14	-0.05	0.30	-0.04*
Complementary Assets: Importance comp2	3	11.00	(6.16)			X	-0.28	0.01	-0.23
Complementary Assets: Ownership comp 1	4	15.52	(4.44)				X	0.07	-0.10
Hightech	5	0.74	(0.47)					X	-0.09
Duration of Cooperation	6	5.00	(4.61)						X

[1]**Note:** The numbers on the first column are of means. [#]Standard deviations of each variable. The number of responses used in the analyses is 36. [†] ≤ .1, * p ≤ .05, ** p ≤ .01, *** p ≤ .001.

Table 3: Summary Statistics for the Large Firms

Dependent Variable		**Cooperation**		
		1	2	
Intellectual Property Rights	**H1:**		-1.80	*
Search and Barg. Costs	**H2:**		1.13	n.s.
Complementary Assets: Importance	**H3a:**		0.11	n.s.
Complementary Assets: Ownership	**H3b:**		-0.59	*
Hightech		-0.74	0.50	
Duration of Cooperation		0.06	0.25	
Nagelkerkes R-Square		0.05	0.71	
LL		30.40	13.77	*

[1]**Note:** Regression coefficients are shown. N=36; * p ≤ .05. The coefficients can be interpreted such that a one-unit change in the independent variable results in a one-unit change in the log-likelihood of a favoured outcome.

Table 4: Hypotheses Tests for the Large Firms[1]

		Competitive Market Entry	Being Acquired	Selling IPR of Innovation	Acquisition	Licensing-in
IPR	r	.021	-.083	-.049	.409	-.065
	sig.	.835	.419	.633	.000	.525

Note: Pearson correlation coefficients are shown. N=98; † ≤ .1, * p ≤ .05, ** p ≤ .01, *** p ≤ .001.

Table 5: Commercialisation Strategies pursued by Small and Medium Enterprises