The determinants of strategic partnerships in research and development (R&D) - A regional comparison among the German federal states -

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1. Introduction

The growth and prosperity of economies depend to a high degree on private investments in production capability. For many companies the production factor knowledge plays a key role in their efforts to strengthen competitive capacity. Enterprises invest in research and development (R&D) to maintain and to improve their ability to compete. With growing global competition and shorter product lifecycles many companies are searching for new ways to organize their innovation processes. One approach to intensify the efficiency of the innovation work is to form a co-operation with other organisations in R&D. In such partnerships all participants work freely and mutually together without loosing their economic independence. The aim of this paper is to identify determinants for companies to participate in R&D co-operations. Particular emphasis will be put on regional aspects of R&D co-operations.

In Germany the R&D co-operation is becoming increasingly popular (SV 2001, p. 17). The first question we study is whether this form of joint R&D is used in all parts of the country and where opportunities for small and medium sized enterprises (SMEs) can be explicitly assumed. We also study the determinants of the participation of companies in such partnerships and we discuss how these efforts are reflected in the economic success of these companies. Special emphasis is being put on the possible contribution of R&D co-operations to diminish present location disadvantages in Eastern Germany.

The investigation starts with a comparison between the R&D activities of companies in the Eastern and Western part of Germany – the two regions of the country where, even more than ten years after the unification, the biggest differences in economical progress and welfare can be observed. Then emphasis will be put on the use of R&D co-operations and its appearances. To examine the circumstances in which companies are likely to join R&D co-operations, a logistical regression will be estimated. The paper ends with a discussion about the role of the R&D co-operation in the innovation system in the German economy.

2. Data

The data are from a study by the Institut für Mittelstandsforschung Bonn (IfM Bonn) by order of the Bundesverband der Deutschen Industrie e.V. (BDI) and ERNST & YOUNG in summer 2001. The study was limited to companies in the manufacturing industry (with the exception of the mining industry, energy in-

dustry and water engineering) and industry-related services such as the credit and insurance business and transport-, communication and advisory services (without trade, catering and health services). The questionnaire was sent by mail to companies of all sizes and located all over the country. 957 out of 10.000 companies which were asked to participate answered the questionnaire. 886 of the firms provided information about their attitude towards inter-firm co-operation. They form the sample now being analysed.

3. Characteristics of the German innovation system with special regards to the innovation performance of East German companies

Before we take a closer look at regional patterns of R&D co-operation activities and analyse the strategic function of such partnerships, the circumstances in which they take place will be briefly described. The following issues will be discussed:

- Do companies in Eastern and Western Germany differ in their R&D capacity?
- How can the competitive position of companies in Eastern Germany be determined in comparison to their counterparts in Western Germany?

In order to gain insight into the innovative potential of companies in the Eastern and Western part of Germany their R&D capacities can be analysed. Comparing the companies according to their R&D facilities regional differences can be observed: On average, the share of R&D personnel as a percentage of the total number of employees is higher within the observed companies in Eastern Germany (5.8 %) than within their counterparts in Western Germany (3.2 %). This result conforms with the findings recently presented by the STIFTERVERBAND (2002, p. 23). It can be assumed that the R&D capacities built up in Eastern Germany come about to a certain extent as a result of governmental subsidies (BMBF/BMWi 2001).

Eastern German companies are not only better equipped with regard to their R&D personnel - they are also more willing to spend a higher share of their annual return on sales in R&D (table 1). While almost one third of the companies in Eastern Germany covered by the inquiry spent more then ten percent of their return on sales in 2000 on R&D, only approximately one out of seven companies in Western Germany did likewise. This indicates that the companies in Eastern Germany are aware that they have to create new products and services in order to catch up with their competitors in Western Germany.

Table 1: Share spent on R&D expenses as a percentage of total sales return in companies in Eastern and Western Germany

Companies that are practising R&D and spend on average ... of their total return on sales on R&D	Share of companies (%)		
	Eastern Germany[1]	Western Germany[2]	Germany
up to 5%	47.1	62.9	60.4
more than 5% up to 10%	21.6	24.0	23.6
more than 10%	31.4	13.1	16.0
n = 326			© IfM Bonn

1 (2) including (excluding) West-Berlin

It can be seen that the investment in R&D bears fruits. 32.1 % of all companies that are committed to R&D compete predominantly with products and services that they introduced less then three years ago to their assortment. Among companies that are not involved in R&D one can observe that the share of those with such a modern assortment is significantly lower (18.6 %). Regional differences can also be emphasised: The share of companies involved in R&D with mainly new products and services is in Eastern Germany (46.2 %) significantly higher than in Western Germany (30.5 %). These results indicate that research activities have enabled these companies, in particular those in Eastern Germany, to introduce new products on a successful commercial basis.

Despite these positive signs of innovation performance the Fraunhofer Institut et al. still sees a `technologic gap´ in the Eastern German economy in comparison to that of the Western federal states (BMBF 2002, p. 47). One should not underestimate the fact that companies in Eastern Germany on average have not yet attained the competitive level reached in Western Germany. As the Federal Statistics Office pointed out for the year 1999, the so-called `new federal states´ in the Eastern part of Germany are still lagging behind and show a productivity that hardly comes up to 65 % of the Western German level (STATISTISCHES BUNDESAMT 1999). Estimations on the basis of our inquiry suggest a similar difference for 2000 and for the first half of 2001. The statements given by the companies confirm this. Only 38.9% of those located in Eastern Germany saw themselves in an average competitive position or in an even better position compared to other companies of the same branch. Among the companies in Western Germany this share comes to 50.8 %. This indicates that the Eastern German economy is still on its way to recovery from the transformation process that started with the collapse of the communist regime and the establishment of a free-market economy. But it has to be pointed out that

major improvements in innovation have to take place to equalise these regional differences in efficiency.

As far as the use of new technology is concerned, significant differences between the companies in Eastern and Western Germany can not be found. Also POHL states that the capital fund has been largely replenished (2002, p. 4). Confining the discussion only to those companies that have managed to survive the enormous transformation process in the past and to those companies which have been founded subsequently is not sufficient. POHL emphasises a `gap of enterprises´ in Eastern Germany taking Western Germany as a benchmark (2002, p. 3). A higher number of knowledge intensive firms is needed in Eastern Germany in order to reach a level of innovation activities as a whole that can be compared to that in Western Germany.

Even if the existing companies are on their way to improvement in competitiveness - and their commitment to R&D is a good sign of this - the founding of new enterprises is necessary in order to strengthen the economy in Eastern Germany. Whether or not the R&D co-operation can be an appropriate instrument to solve these problems will now be discussed.

4. The role of R&D co-operations in the German innovation system

The government puts a lot of effort into the support of the involvement and the creation of R&D facilities in Germany. Thereby governmental subsidies are also provided for those companies that want to join a R&D co-operation. Pro-Inno is a nationwide programme and InnoRegio a programme explicitly created for Eastern German states (BMBF/BMWI 2001, p. 31). For the further analyses the following questions will be answered:

- How eminent is the R&D co-operation among companies?
- Can differences be stated between companies in Eastern and Western Germany?
- Who are the potential partners for companies?
- How is the success of these companies to be rated and does that give us an indication as to how to evaluate the political programmes?

Little more than a quarter of all companies included in the examination participate in R&D co-operations (28.7 %). The use of this external knowledge resource has become an important instrument in innovation management. These sorts of co-operations range from periodical interactions to sharing knowledge

and exchanging R&D personnel for conjoint projects up to founding R&D joint ventures. According to the findings of CUMMINGS the informal exchange of knowledge is the most often observed form of R&D co-operation in the private business sector (1992, p. 215).

Among those who have filled in the questionnaire the companies in Western Germany are slightly more often involved in R&D co-operations (29.2 %) than the Eastern German counterparts (26.5 %). But it must be stressed that these observed differences are not significant according to a chi-square test which means that general disparities between these two regions can not be proved. Being asked about their future plans, the share of companies in Eastern Germany which are preparing to form an R&D co-operation and are willing to start it within the next two years is even higher (16.2 %) than among the companies in Western Germany (13.7 %). The KfW also stated that companies in Eastern Germany are catching up in being committed to R&D co-operations with their Western German counterparts (2002, p. 27). This institute even sees companies from Eastern Germany being already in the lead since 2001. This leads us to conclude that the R&D co-operation is an instrument of innovation management that is increasingly becoming popular especially in Eastern Germany.

Table 2 provides information about the constellations of R&D co-operations in which companies participate:

Table 2: The choice of partners of companies to form a R&D co-operation in East and West Germany (multiple answers possible)

R&D co-operations with ...	Share among companies, who participate in R&D co-operations (in %)		
	Eastern Germany[1]	Western Germany[2]	Germany
enterprises	88.4	96.2	94.9 ?
among them: suppliers	*69.8*	*66.2*	*66.8*
firms on the same production level	*53.5*	*61.0*	*59.7*
clients	*58.1*	*49.5*	*51.0*
universities / science institutes	76.7	52.9	56.9 **
n = 253			© IfM Bonn

** significant at the 1 % level
? chi-square test could not be calculated
1 (2) including (excluding) West-Berlin

Almost every company involved in such a co-operation works together with other firms. While doing so, both vertical and horizontal connections within the production system can be observed, and this in Eastern and Western Germany

to a similar extent. Among these mainly suppliers are chosen as partners, but partners on the same production level are chosen nearly as often. Slightly more than half of the companies have joined a R&D co-operation with clients.

More than half of the companies covered by the study maintain contact with universities or other research institutes for the purpose of exchanging information and conjoint projects. Nevertheless there are significant differences between companies in Eastern and Western Germany which need to be pointed out: R&D co-operations between firms and scientific organisations can be observed more often among companies in the Eastern than in the Western part of the country.

The distinction between various sizes of companies reveals differences in their R&D co-operation behaviour. As mentioned in table 3, small enterprises in Eastern Germany with a maximum of 19 employees are more often participating in R&D co-operations than those in Western Germany. This is also due to the fact that companies of this size have a high share in the structure of firms in Eastern Germany. On the other hand, the share of medium-sized enterprises in Western Germany participating in R&D turns out to be higher than in the Eastern part of Germany.

Table 3: Partners of companies with differing size, that join R&D co-operations in Eastern and Western Germany

Companies with ... employees	Share of companies participating with ... in a R&D co-operation (%)					
	other companies		research institutes		all organisations	
	Eastern Germany[1]	Western Germany[2]	Eastern Germany[1]	Western Germany[2]	Eastern Germany[1]	Western Germany[2]
up to 19	42.1	20.0	36.4	7.5	41.9	19.2
20 to 99	34.2	46.2	30.3	47.7	32.5	16.3
100 to 499	18.4	26.6	27.2	33.6	20.9	27.1
500 and more	5.3	7.2	6.1	11.2	4.7	7.4
Altogether	100.0	100.0	100.0	100.0	100.0	100.0
n = 233						© IfM Bonn

1 (2) including (excluding) West-Berlin

In order to estimate the status of R&D co-operations, the companies covered by the study were asked to evaluate the role of their partnership for their competitiveness. Most of these firms (85.4 %) assured that their R&D co-operation is of importance for their future ability to compete. The majority of the companies (54.7 %) even considered their commitment to be of crucial importance for

their market position. In most of the cases the R&D co-operation is considered to be of high importance to the well-being of the firm and has a strategic function in the innovation competition. In Eastern Germany even 66.7 % of the firms shared this belief while the share among companies in Western Germany was significantly lower (52.2 %).

The high esteem of this instrument is also reflected in the perspective of innovation. Almost three out of four companies (72.5 %) that are involved in R&D co-operations are planning to introduce new products and services within the next two years. Thereby, the share of firms with such expansion plans is significantly higher within companies which participate in R&D co-operations than in those who do not use this instrument (39.5 %). This shows that conjoint R&D provides advantages for companies in their attempts to remain competitive. This optimism is shared equally by companies in Eastern and Western Germany.

In addition to that more than a third of all companies participating in R&D co-operations are planning to expand their staff within the year 2002 (38.4 %). Here too, a higher share of companies with expansion plans can be observed within the group of firms which are involved in R&D co-operations than within the rest of the firms of the sample (23.7 %). This shows that the success of R&D co-operations contributes to the growth of the firm. This is true for companies in Eastern and Western Germany to nearly the same extent.

5. Model estimation: Likelihood for enterprises to join an R&D co-operation

To examine the circumstances in which companies are likely to form or join an R&D co-operation, a logistic regression can be estimated. Companies of all observed branches and sizes were included in the model. The test results specify the relative importance of the determinants and their influence on the likelihood that companies join an R&D co-operation (table 4). The model is able to explain the likelihood of participation in R&D co-operations of companies on the highest level of significance (0.01%). The distinction of whether a company is participating in such a strategic partnership or not could be anticipated in 81.2 % of all included cases.

Table 4: Logistic regression: Co-operation activities in R&D

marks	regression coefficient `β´	expected `β´	significance	
residence of the enterprise (reference category: Bavaria)				
· Baden-Wurttemberg	0.590	1.805	0.229	
· North Rhine-Westphalia	0.367	1.443	0.433	
· Berlin and Brandenburg	0.296	1.344	0.676	
· Saarland and Rhineland-Palatinate	0.072	1.075	0.937	
· Hesse	0.051	1.052	0.940	
· Bremen and Lower Saxony	-0.042	0.959	0.947	
· Hamburg and Schleswig-Holstein	-0.224	0.800	0.798	
· Saxony	-0.488	0.614	0.534	
· Thuringia	-0.613	0.542	0.527	
· Mecklenburg-Western Pomerania and Saxony-Anhalt	-1.424	0.241	0.270	
industry (reference category: industry related services)				
· producer good industry	-0.588	0,556	0.332	
· investment good industry	-0.999	0.368	0.066	
· consumer good industry	-1.075	0.341	0.061	
· building industry	-2.026	0.132	0.018	*
structural marks / market performance				
· number of employees in 2000 (logarithm)	0.610	1.841	0.000	***
· growth rate of employees 1999 till 2000	0.001	1.000	0.889	
· high percentage of return on sales (above 5%)	-0.104	0.901	0.755	
· company is lead by owner	-1.024	0.359	0.008	**
background / access to financial resources				
· experiences in co-operation with suppliers	1.024	2.784	0.002	**
· experiences in co-operation with customers	0.848	2.336	0.011	*
· experiences in co-operation with other producers	0.642	1.901	0.049	*
· employee participation is practised	0.576	1.779	0.094	
· financial margin for investments above average	-0.223	0.800	0.515	
· teamwork is practised	-0.391	0.676	0.251	
R&D capacities / technological level of performance				
· share of R&D personnel on all employees	2.812	16.637	0.049	*
· use of new technology above branch average	0.817	2.263	0.014	*
· no own R&D personnel	-0.965	0.381	0.022	*
competitive situation				
· market share of primary product above average	-0.123	0.884	0.713	
· highly innovative in past	-0.455	0.634	0.382	
· innovative in past	-0.570	0.566	0.176	
· residence of main competitors in Germany	-0.659	0.517	0.046	*

Table 4

marks	regression coefficient `β´	expected `β´	significance
strategic aims of management			
· intensifying R&D-activities	1.926	6.859	0.007 **
· rising the technical level of production	1.291	3.638	0.067
· introducing new products	0.735	2.086	0.041 *
· improvement in knowledge management	-0.146	0.864	0.801
· improvement in quality of own products	-0.245	0.783	0.663
· strengthen the own core competence	-0.652	0.521	0.342
· develop new markets	-1.047	0.351	0.244
· increasing usage of outsourcing	-1.646	0.193	0.001 ***
constant factor	-1.872	----	0.187

Significant at the 5% (*) , 1% (**) or 0.1% (***) level
Cox & Snell-R^2 = 0.393
Number of observations = 383
Log-Likelihood = 501.793

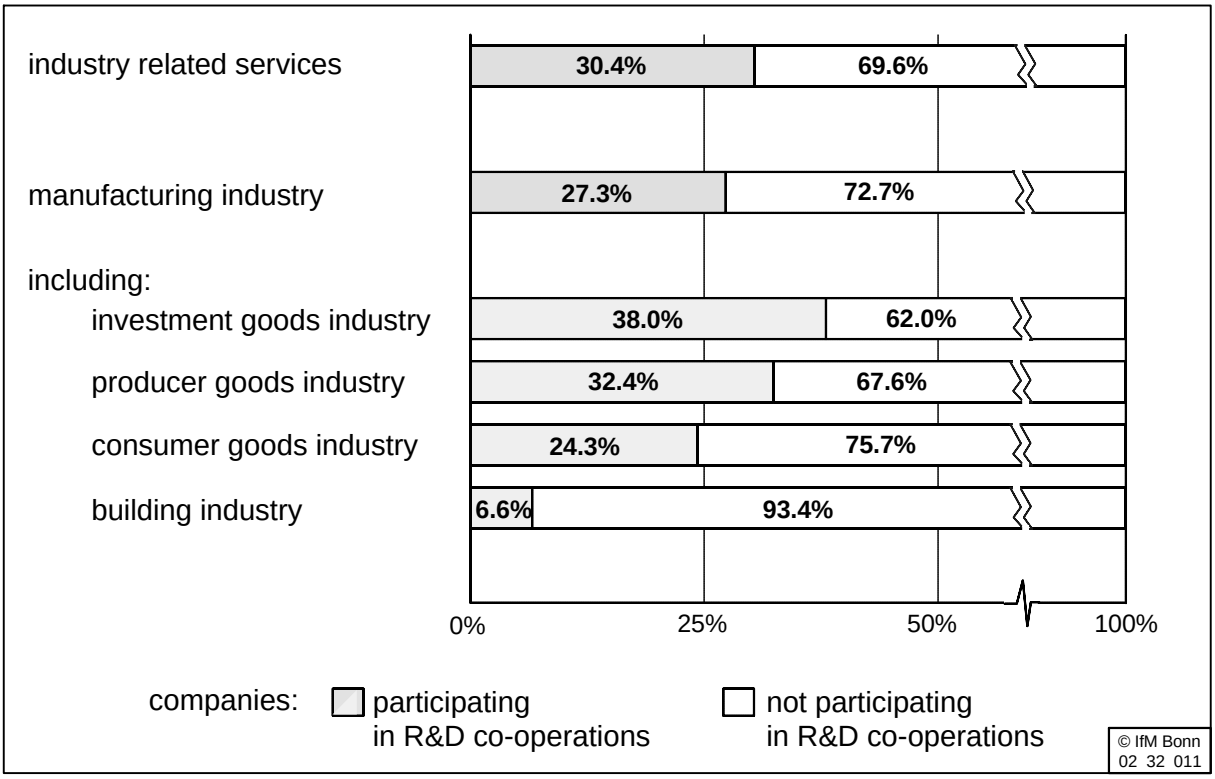
Regional aspects

As the model suggests, regional factors do not contribute significantly to explain the probability of the observed companies to participate in an R&D co-operation. Comparing the German federal states with Bavaria - the region in which the share of firms participating in R&D co-operations almost resembles the share that has been observed nationwide - only marginal differences in the commitment to such partnerships can be observed. While the results of the bivariate analyses have highlighted, at least to some extent, differences between co-operation activities in Eastern and Western Germany, the multivariate analysis makes clear that other determinants apart from location specific factors have to be held responsible for the use of this instrument. Neither regional barriers nor accumulations in the spread of this instrument can be observed.

Industry

Unlike the firm`s place of residence the branch determines the willingness to co-operate in R&D. As picture 1 shows, in the building industry the demand for conjoint R&D is significantly lower than in the reference category, the industry related services. This is indicated in the negative premise of the regression coefficient in table 4.

Figure 1: Companies that joined R&D co-operations divided according their branch of industry

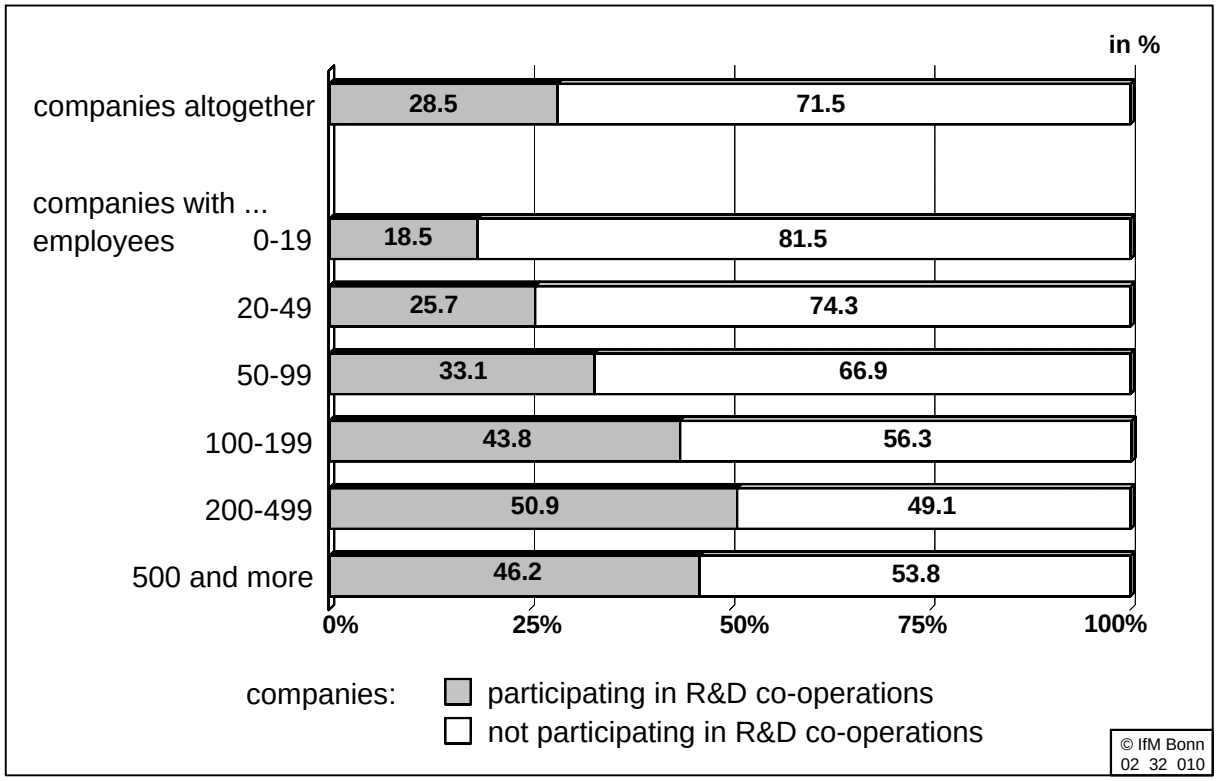


For companies of other branches in the manufacturing industry a significant deviation in the share of R&D co-operations compared to those of the service sector cannot be verified. It can be noted that companies that belong to research-intensive branches - the investment goods industry and the producer goods industry - do have high shares of R&D co-operations compared to other branches within the producing sector. But a specific branch in which R&D co-operations are especially common cannot be identified.

Plant size

Another factor that seems to influence the willingness to co-operate in R&D is the size of the enterprise. The higher the number of employees the more likely it is that a company takes part on an R&D co-operation. The positive premise of the regression coefficient indicates this. As figure 2 shows, among companies the propensity to attend an R&D co-operation inclines constantly with a rising number of employees. In the group of firms with 200 to 499 employees the highest share of co-operating companies can be observed. In comparison large enterprises do not participate as often in R&D co-operations.

Figure 2: Companies joining R&D co-operations distinguished according to their size



Market performance

Two variables were chosen to be added to the model representing the present economic performance of the companies on the market: the growth rate of employees as an indicator for prosperity and the percentage of return on sales as a mark of the success according to the expenses. The often assumed hypothesis that mainly troubled companies are seeking help by joining co-operations while those with a good market performance do not require such subsidy cannot be confirmed. It turns out that both variables do not have a significant influence on the willingness to join R&D co-operations. This indicates that R&D co-operations are set up by growing companies nearly as often as by companies with stagnating or even diminishing numbers of employees. In addition to that, companies with temporary negative return on sales do participate in such partnerships nearly as often as those in a prosperous market environment. Both indicators show that R&D co-operations are undertaken regardless of the short-term market performance. This also leads to the conclusion that R&D co-operations are planned for the long term. A pro cyclical behaviour can not be assumed.

Management aspects

Furthermore it can be pointed out that the way a company is managed has an impact on the likelihood of participating in R&D co-operations. In companies led by management the decision to join such a partnership is significantly more likely to be made than in independent firms led by their owner. In all probability, this can be attributed to the specific culture of owner-led companies. Owners in general prefer to stay independent in their decision-making. They seem to be less willing to co-operate and share their management power with partners. For managers the threshold to open parts of the company for a joint working project seems to be much lower. This might be due to the experiences of these decision-makers working together with the parent company.

This finding can explain the differences in co-operation between the companies in Eastern and Western Germany discussed in chapter 4.The share of small companies in Eastern Germany, which are led by management, is relatively high compared to those in Western Germany. This might be the reason why small companies in Eastern Germany are more often willing to join R&D co-operations than their counterparts in the Western part of the country.

Experiences with other forms of co-operations

The results of the logistic regression provide evidence that there is a connection between experiences with other forms of co-operations and the willingness to join an R&D co-operation. The management of companies that have experienced the regulatory mechanisms of co-operations in recent years, find significantly better access to R&D partnerships than others with no such background. This result is supported by the findings of WOLFF et al.: They suggest that dealing with an R&D co-operation can be learned (1994, p.18). Companies that have had these experiences know better what to consider when choosing a partner. It seems that these experiences are not imperative when entering such alliances, but at least if one has had success with such experiences the inhibitions to form future partnerships will be reduced.

This finding also has another possible background: It can be assumed that chances to co-operate in R&D occur even more often when companies know partners from earlier co-operative relationships. Being part of such a network provides the necessary contacts and seems to open doors for new partnerships. Knowing each other personally offers security and makes it easier to win a partner for a new project. Opportunities for conjoint R&D might even develop out of existing co-operations.

Participatory management style

Complimenting the arguments associated with co-operation experiences another variable is added to the model representing a participative style of management. The question is if the encouraging effect of inter-firm co-operations can be transferred to intra-firm relationships. But as the empirical results suggest, such a link can not be observed. Companies that organize parts of their production in teamwork and/or let their employees participate in the management's decision-making do not tend to open themselves more often to external co-operations than others.

Access to investment capital

Another common belief is that only those companies co-operate which do not have the financial resources to do without support. The model does not provide a reason to assume that this is a common scenario. Companies that see themselves at a disadvantage when it comes to the question of running sufficient funding according to their competitors, do not join R&D co-operations significantly more often than others. It can be assumed that other qualities such as creativity and knowledge, even more than financial advantages, are important incentives for conjoint R&D.

The role of R&D facilities

Furthermore, the model suggests that the availability of R&D capacities within a company is, in most cases, a prerequisite to joining such a co-operation. Companies that do not have their own R&D personnel rarely participate in these partnerships. R&D co-operations are not a common strategy to building up R&D facilities. Companies usually depend on R&D capacities and skills in order to be able to win a partner to form an R&D co-operation. Only those who can offer interesting knowledge to others can assume to find a partner from whom they can benefit. But it can be stressed that a relatively high share of employees in R&D, compared to the total working staff, goes hand in hand with a high likelihood of wanting to join a co-operation and wanting to benefit from others competence. This indicates that research-intensive companies are more inclined to take advantage of external R&D capacities than others.

Technological abilities

The technological level of production determines the capability of firms to enter an R&D co-operation. Companies that participate in such partnerships see themselves better equipped with new technologies than others. Again this un-

derlines the finding that special knowledge is an important condition to be able to join R&D co-operations. Especially in such a milieu a win-win situation can be created. In addition to that, WOLFF et al. found out that partners need similar qualifications and, at least, a joint understanding of the problems that should be solved within the co-operation (1994, p.8).

Competitive position

Additionally the model suggests that companies with a market share above average are not more inclined to join an R&D co-operation than those with a relatively low share. Even small firms operating in a market niche are participating in such partnerships. Also, the hypothesis that firms which were highly innovative in the past are more often inclined to join R&D co-operations can not be confirmed.

An interesting aspect can be highlighted by taking a closer look at the residence of the main competitors of co-operating companies. It can be found that companies which compete mainly with others not located in Germany are more likely to join R&D co-operations than others who compete nationally. This finding might indicate the existence of regional patterns of R&D co-operations. Supposing that most of the R&D co-operations take place within companies or organisations located in Germany, this leads to the hypothesis that the scenario of `competing on international scale and co-operating on regional scale´ might be a common strategy. Unfortunately we can not provide information about the residency of the partners of those in the sample who co-operate. Therefore this assumption is only of hypothetical nature.

Strategic aims

Finally, the model allows statements about typical strategic aims of companies which join R&D co-operations. These firms have announced significantly more often than others the aim to intensify their own R&D activities. This leads to the conclusion that R&D co-operations are mainly used to enlarge the basis of research capacities by a conjoint action. The main reason to form such partnerships lies in the chance to create synergies. Among small companies with a limited capacity, co-operations can help to diminish size specific disadvantages in R&D. In addition to this, companies that intend to reduce their own production programme by outsourcing are not likely to participate in R&D co-operations. This might indicate that R&D co-operations are unlikely to be used to substitute R&D activities by taking another organisation `in the boat´.

There are also other aims mentioned by the companies that joined R&D co-operations. Creating new products and services, securing the own quality standard, improving the own knowledge and entering new markets are aims that are being pursued also by other companies that are involved in R&D but do not co-operate in this field.

5. Summary and Conclusions

The R&D co-operation has become a popular strategic instrument of innovation management that is especially used by big and medium sized enterprises, but meanwhile it is also established among small firms. R&D co-operations are being formed in every German state in nearly the same extent; neither regional entrance barriers nor regional clusters can be observed. Conjoint activities in R&D take place between companies on every level in the production system. In addition to that, universities and other scientific institutes are often included.

Through R&D co-operations companies take advantage of the specific knowledge of their partners and create synergies. This enables them to work in fields where they would otherwise not have access to. This strategy has been chosen not in order to substitute own R&D in favour of a conjoint work, but rather to pool resources. Among a variety of aims these companies are typically trying to intensify their innovative capability and to create new products and services. In general, companies that are involved in R&D co-operations appear to be more innovative than others. This means that these partnerships help the participants to improve their competitive position and to renew and enlarge production skills.

The results of the empirical analyses indicate that experiences made in other co-operations of a different kind along with a technological excellence enable companies to form R&D co-operations. Besides that, the ability to join an R&D co-operation relies on owing R&D facilities. Other determinants that have an impact on the probability to join such partnerships can be noticed in branch specific marks and in the way the company is managed.

The majority of those who are involved in R&D partnerships does acknowledge the strategic advantage of R&D co-operations and sees the chance to preserve and even improve their abilities for market performance. Most of them see a key role in their strategy to stay competitive. The success that can be expected by joining an R&D co-operation is in most cases already reflected in the ability

to innovate: Those who participate in an R&D co-operation are usually characterised by a relatively modern range of products and services.

Special emphasis of the analysis was put on the innovation process in Eastern Germany. The share of companies that participate in R&D co-operations in Eastern Germany is only slightly lower than in Western Germany. Meanwhile, the quantity of R&D personnel became higher in Eastern Germany than in Western Germany. In addition to that, companies in Eastern Germany are more willing to spend a high share of their return on sales to invest in R&D then those in Western Germany. This already effects the innovation performance of these companies. Companies in Eastern Germany use modern technological equipment and compete on the market with a young assortment of products. These circumstances provide the basis not only for improving their competitiveness but also to attract potential partners for future R&D co-operations. The R&D co-operation can be expected to become even more popular especially among the companies in Eastern Germany.

This expected development does not only indicate that companies in Eastern Germany are on their way to catch up with those in Western Germany in terms of competitiveness, it is also a sign that the potential of R&D co-operations is not exhausted yet. But in this context it should not be overlooked that to a certain extent the innovation success of companies in Eastern Germany is based on governmental subsidies. The success of companies who profit from these subsidies shows that the programmes have indeed led to the intended effects.

A special emphasis has to be put on the role of universities and research organisations for the innovation system in Eastern Germany. R&D co-operations with scientific institutions turned out to be especially favoured by companies in Eastern Germany. The access to knowledge is owed to a good part to the willingness of these institutes to co-operate with companies. Their attitude should be an example also for other regions in the country.

From a macro-economic perspective it can be stressed that R&D co-operations contribute to a more efficient use of the R&D resources. Such partnerships also help to accelerate the spread of knowledge. That is why R&D co-operations play an important role in the innovation process especially in the Eastern part of Germany to close the technological gap.

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