CROSS-BORDER TECHNOLOGY NETWORKS IN BORDER REGIONS? THE CASE OF THE EUREGION MAAS-RHINE

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ABSTRACT

This paper describes the results of a study investigating cross-border networking by enterprises in the border region of the Netherlands, Belgium and Germany, the so-called Euregion Maas-Rhine. Special attention is given to knowledge transfer and sourcing of technology across borders. The study was undertaken in view of the completion of the European internal market in 1993, which was widely expected to induce enterprises to make more effective use of available opportunities to improve their innovative and hence competitive potential. It was found that the majority of enterprises is still oriented towards a purely national environment. Enterprises that are engaged in cross-border networking, however, seem to be doing better than the ones that maintain a national orientation. Experiences of enterprises in cross-border networking form the basis for policy recommendations to promote economic and technological co-operation in the Euregion Maas-Rhine.

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1. INTRODUCTION

Firms located in border regions are traditionally confronted with an incomplete market since half of their hinterland is on the other side of the national border. This incompleteness does not only refer to the firm's sales potential (its customers), but also to the labour market (its employees), the suppliers of its capital goods, its raw materials or semi-manufactured articles and the supply of technological knowledge by commercial, non-commercial, intermediary organisations, higher education institutes and public research establishments. At the same time this incompleteness means that half of the firm's potential competitors are also on the other side of the border. Obviously, if the borders disappear enterprises in border regions are confronted with a completely new set of opportunities as well as threats. In times of peace, borders seldom disappear. The recent completion of the internal European market, however, can be considered as a case in point.

Of course, West-European borders were not insurmountable barriers over the past 50 years. The European Community (now: the European Union) and the European Free Trade Association have encouraged trade and economic and technological co-operation. In that respect, the completion of the internal European market in 1993 was only a minor step compared to what had happened in the preceding decades. Nevertheless, the completion of the internal market was expected to give a new and important impulse to enterprises, promoting a more European orientation, with important advantages of scale and scope. And indeed, the announcement of the disappearance of borders by itself already led to a wave of national and European mergers anticipating intensified competition on a European scale.

Enterprises in border regions could be expected to be particularly challenged by intensified competition as well as by larger opportunities. It was not at all clear, however, that the opportunities would be greater than the threats, nor that the enterprises in border regions were willing and able to grasp the opportunities. The completion of the internal market has therefore stimulated a renewed interest in the economic potential and dynamics of border regions among policy makers as much as among researchers. Bigger sales potential, a larger supply of labour, cheaper purchasing possibilities and a larger number of knowledge suppliers were mentioned as obvious chances for those firms being no longer confronted with an incomplete hinterland. The study reported here has concentrated on the potential of hitherto unused sources of knowledge across the border.[1]

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[1] This paper presents some results of the research project "New Chances for Enterprises in Border Regions" (see also Corvers *et al*, 1994a and 1994b; Reger *et al*, 1994). This project has been commissioned to MERIT by the COB/SER (Commission for the Development of Firms of the Social-Economic Council of the Netherlands), which consists of representatives of employers' associations and trade unions. In conducting the research, MERIT has cooperated with the Fraunhofer-Institut für Systemtechnik und Innovationsforschung (ISI) in Karlsruhe, Germany, and the Facultés Universitaires Notre-Dame de la Paix, Faculté des Sciences Économiques et Sociales, Departement Gestion de l'Entreprise, Namur, Belgium.

The debate about regional development along the internal borders of the European Union has also been inspired by the more general debate about regional development. Since the early 1980s new insights into the dynamics of regional development have appeared. Based on the analysis of various dynamic regions in Europe and North America, these insights focused on the importance of interactions between enterprises in a regional context. Networking between enterprises is seen as an important source of technological and economic development in a region. In the context of border regions the question then arises, if and under what conditions cross-border networking between firms can contribute to regional economic development. The study reported here has investigated the extent of cross-border networking in a specific region in Europe. Furthermore, it has tried to identify the differentiating characteristics of firms that are engaged in cross-border networking compared to those who are not. The region involved is the south-east border region of the Netherlands, the so-called Euregion Maas-Rhine, stretching from Aachen in Germany over Maastricht and Heerlen in the Netherlands to Hasselt, Genk and Liège in Belgium (see Map 1).

Map 1: The Euregion Maas-Rhine and its location in Europe

This paper will first elaborate on regional economic development and the relationship between regional economic theory and policy. The next section will deal with the impact of the European integration on border regions in the EU, the so-called Euregions. Section 4 will present a profile of the Euregion Maas-Rhine. The following section will present an analysis of survey data on cross-border co-operation between firms for the acquisition of technological knowledge in the Euregion Maas-Rhine. Special attention is given to sources of technological knowledge and their geographical location, the characteristics of firms engaged in cross-border technology co-operation and the relationship between cross-border technology co-operation and economic performance. Finally, we will present some policy recommendations in order to attune regional policy more to the economic practice of business located in border regions.

2. REGIONAL ECONOMIC DEVELOPMENT: THEORY AND POLICY

The role of networking and technology as important factors to enhance regional economic growth has been discussed in several theories. Traditional theories on this theme, such as the growth pole theory of Perroux, focus particularly on the positive external effects of large firms in a region (Hartgers *et al*, 1990); parts of these concepts were used as a basis for regional policy in the 1960s and 1970s. By providing grants to large firms that wanted to locate branch plants in economically weak regions, central governments hoped that these firms could stimulate the regional economies by multiplier effects.

The new theoretical approach around flexible specialisation places economic networking in a different perspective (Scott, 1988; Scott & Storper, 1987; Piore & Sabel, 1984). Both internal and external flexibility have to enable firms to react to changes in their environment (Läpple, 1989). External flexibility or outsourcing is increased in order to react faster to market changes, to save development costs, to spread risks and to learn from other firms and research centres. By using concepts such as subcontracting or co-makership (long-term, intensive co-operation between customer and supplier) large firms are hiving off more and more activities in order to reduce their own manufacturing depth (the part of the final product manufactured by the firm itself). For instance, in 1975 47.9% of Philips' turnover consisted of external supply, whereas in 1990 it had increased to 60% (Van Gelder, 1992). These hived off activities will be partly integrated in networks. In comparison to traditional theories which focus on branch plants networks, the flexible specialisation approach stresses inter-firm relations between small and medium-sized enterprises (SMEs). Regional economic success stories in the Third Italy and Baden-Württemberg are explained by the existence of bottom-up developed networks between SMEs and their attached institutions, such as research centres and training facilities.

Porter (1990) also stresses economic networking in his study on the competitive advantage of nations. Among his strongest empirical findings is the association between vigorous domestic or even regional rivalry (in technology rather than prices) and the creation and persistence of competitive advantage in an industry. Geographical concentration of rivals and the attached supplier networks even enlarge

the benefits caused by strong competition. They stimulate a fast diffusion of new technologies and help upgrading suppliers by competition and intensive research and development co-operation with customers.

These two modern theoretical approaches, stressing economic networking as an important factor behind regional economic growth, have caused substantial criticism, which may be viewed in terms of two major areas. Firstly, criticism is related to the (over-emphasised) positive effects of economic networking on regional economic development, whereas the relationship between economic networking and regional economic decline is disregarded. Paradoxically, economic networking is also one of the decisive factors explaining the stagnation of old industrial areas. In these cases, however, the network is a top-down emerged industrial complex dominated by large enterprises, as the example of the Ruhr Area, Germany, shows. Here, large companies were forced to internalise many functions because of the lack of a supplier base (Grabher, 1990). The domination of large firms in a region appears to have suffocating effects on the flexibility and sectoral substitution, which should occur at the end of a product life cycle (Butzin, 1991). Self-sustaining coalitions and a lack of entrepreneurship are the regional heritage, caused by the domination of the industrial complex for decades.

Secondly, doubts are thrown upon the role of the region. It is not quite clear what the spatial repercussions of increasing techno-economic networking will be. Will it lead to regional clustering or declustering? Flexible specialisation advocates think that the increase in outsourcing could lead to new regional production clusters (Scott, 1988). They base their arguments mainly on quick delivery demands of new logistic concepts, such as just-in-time, and on the need of informal contacts in flexible networks. Authors who doubt the clustering hypothesis, stress the fact that assemblers are increasingly demanding for high quality co-makers, which may be situated at a greater distance (Gaebe, 1991) and operate on an international market.

One can say that regional co-makership (especially with regard to research and development) and global-sourcing strategies (mainly low-value production) generate at the same time a re-agglomeration as well as an internationalisation of modern economies (Rehfeld, 1991). It is also generally assumed that bottom-up developed networks between SMEs can positively affect regional economic development. Top-down hierarchical networks between large firms and regional suppliers, on the other hand, can hinder regional economic restructuring. Research done by the Fraunhofer-Institut für Systemtechnik und Innovationsforschung (FhG-ISI) in Karlsruhe, Germany, confirm that innovative and economically well developing firms tend to have many external relations with research centres and other firms (Gemünden *et al*, 1991).

Policy-makers have recognised the increasing importance of techno-economic networking for regional economic development. Regional policy has increasingly shifted its focus from attracting branch plants to the region to developing the region's endogenous potential (Vanhove & Klaassen, 1987). Supporting the innovative potential of SMEs is considered to be crucial in order to increase their competitive strengths. Measures are taken to strengthen networking between firms and between

firms and regional knowledge centres (regional technology transfer) (Hassink, 1992). This new type of SMEs is assumed to be able to act as qualitative suppliers for larger firms in the region which are looking for possibilities to hive off parts of their production. Potentials for stimulating techno-economic networks can be particularly large in border regions, since the frontier has been hindering networking possibilities since a long time.

3. BORDER REGIONS AFTER 1992: 'EUREGIONS'

This section gives attention to the expected impact of the European integration on European business and European border regions. The Dutch border regions situated along the Dutch-German and Dutch-Belgian border are highlighted.

Border regions and Euregions

After the White Paper of 1985 and the ratification of the European Act of 1987, the nearing of the Internal Market had became a reality. During that time the European Commission realised that the disappearing of the European internal borders on January first, 1993, also meant the disappearing of the European border regions. Border related problems however, would not disappear automatically, but could very well hinder the European integration becoming a success. Border regions are usually situated in the corners of the country, facing a backward regional economic development. Historically, border regions have never played an important role in the industrial development of a country. The few times they were integrated in the process of industrialisation occurred because of their natural resources, for example coal. In most cases border regions are economically underdeveloped because of the danger of a military conflict, the agglomeration tendency of industry and the impossibility of market expansion (Mikus, 1986). To this can be added their peripheral location, the lopsided production structure and the shortage of (cross-border) infrastructure (Corvers, 1992).

The Internal Market initiative has placed border regions in the middle of the attention, since the European Commission is convinced that the border is the ultimate place where the success of the European integration shall be proved. Large differences in production structure and production environment between areas on either side of the border is considered to hinder that success. The European Community has therefore put a lot of (financial) effort in promoting cross-border co-operation between these regions in order to solve border related problems. The INTERREG-initiative that was launched in 1990 stimulates cross-border co-operation in seven areas, namely: networking, information exchange and communication (1), traffic, transport and infrastructure (2), recreation and tourism (3), education and labour market (4), environment (5), technology transfer and innovation (6), research and project management (7). The initiative is based on projects and finances up to 50% of the project costs. For the first INTERREG-period (1991-1993) 800 million Ecu was made available for all European border regions for a period of three years. Although the negotiations between the European Commission and the Member States are still in progress, it is estimated that the budget for the second INTERREG-period

(1994-1999) will be around 3 billion Ecu for a period of six years.

The launching of this initiative led to the emergence of a new phenomenon, the 'Euregion'. Euregion is an abbreviation of European region and indicates some form of cross-border co-operation, mainly between (semi-)public organisations. The European Commission was willing to finance cross-border co-operation on condition that border regions had some kind of organisation (ranging from gentlemen's agreement to civil and public law) in view of the accountability. An Euregion therefore can be viewed as an organised border region.

Dutch border regions and the Euregion Maas-Rhine

In the Netherlands seven Euregions can be distinguished: four along the Dutch-German border and two along the Dutch-Belgian border and one Euregion overlapping both, namely the Euregion Maas-Rhine (Table 1).

Table 1: Dutch 'Euregions'

Ems Dollard-Region (Groningen (NL), Emden, Leer (D))
Euregion Rhine-Ems-IJssel (Enschede, Hengelo (NL), Nordhorn, Rheine (D))
Euregion Rhine-Waal (Arnhem, Nijmegen (NL), Kleve, Duisburg (D))
Euregion Rhine-Maas-North (Venlo (NL), Mönchengladbach (D))
Euregion Maas-Rhine (Maastricht, Heerlen (NL), Aachen (D), Hasselt, Genk, Liège (B))
Euregion Benelux-Middengebied (Eindhoven (NL), Antwerpen (B))
Euregion Scheldemond (Vlissingen, Middelburg (NL), Gent, Brugge (B))

NL = the Netherlands D = Germany B = Belgium

Although the European Community refers to border regions as homogeneous areas, they can be quite diverse in terms of their geographical size, population density, economic characteristics and degree of development (Martinos & Caspari, 1990). Moreover, there are also significant differences in the bodies that have been set up to initiate, plan or implement cross-border co-operation and the degree of formal co-operation that has been established (Martinos & Caspari, 1990). Differences in level of co-operation (local or regional), in administrative structure (de facto or according to civil or public law), in goals to be achieved as well as ways to finance cross-border co-operation make this diversity even more diverse (Kessen, 1992). Research conducted by present writers on the regional-economic profiles of Dutch Euregions showed the reality of this diversity even in a small country as the Netherlands (Corvers *et al*, 1994a). This research showed that presenting border regions requires more shade than the simple stereotype picture of structurally weak regions, remotely located, characterised by either industrial decline or farming activities, scarcely populated, lacking basic infrastructure, having high unemployment rates and contributing very little to the GNP.

4. THE EUREGION MAAS-RHINE: A PROFILE

The Euregion Maas-Rhine has a more complex setting compared to the other Dutch Euregions, because it consists of:

- *five regions*: South Limburg (NL), Limburg (B), Liège (B), the German speaking Community in Belgium and the Aachen Region (D);
- *five cities*: Maastricht (NL), Heerlen (NL), Hasselt / Genk (B), Liège (B) and Aachen (D);
- *four regional authorities*: Province of Limburg (NL), Province of Limburg (B), Province of Liège (B) and Regierungsbezirk Köln (D),
- *four cultures*: Dutch, Flemish, Walloon and German;
- *three countries*: the Netherlands, Belgium and Germany;
- *three languages*: Dutch / Flemish, French and German.

The organisation of the Euregion Maas-Rhine is also more complex than in any other Dutch Euregion, because of the different levels of cross-border co-operation that are involved.

Organisation

The Euregion Maas-Rhine was established in 1976. In this area (see Map 1) it was agreed that cross-border co-operation would take place on a regional level between the Dutch Province Limburg, the Belgian Provinces Limburg and Liège and the German Region Aachen (which is located in the Regierungsbezirk Köln and consists of the Stadt Aachen, Kreis Aachen, Kreis Düren, Kreis Euskirchen and Kreis Heinsberg). The goal was to improve the social-economic development of the region by strengthening its advantages and solving its cross-border related problems.

In December 1988 the Dutch government presented the Fourth Paper on Spatial Planning ('Vierde Nota over de Ruimtelijke Ordening') forecasting the changes in society and their spatial effects to expect in the next thirty years. One project that is launched in this paper is the MHAL-project. This project is meant to improve the cross-border infrastructure in the area around the cities **M**aastricht / Heerlen, **H**asselt / Genk, **A**achen and **L**iège. The actors who participate in this cross-border co-operation are: the Dutch Ministry of Spatial Planning, the Dutch Ministry of Economic Affairs, the Province of Dutch Limburg and the cities Maastricht and Heerlen. Succeeding in the improvement of cross-border infrastructure cannot be accomplished by the Dutch Ministry of Spatial Planning alone. Therefore, in December 1989 the ministers of Spatial Planning of the Netherlands, Flanders, Wallonia and North Rhine-Westphalia signed a declaration of intent to co-operate together in this pilot-project and develop the cross-border infrastructure in the Euregion Maas-Rhine jointly.

In 1989 a third form of cross-border co-operation in the Euregion Maas-Rhine was established by the five major cities, the MHAL-cities. These are Maastricht and Heerlen in the Netherlands, Aachen in Germany and Hasselt / Genk and Liège in Belgium. This local level of co-operation can be considered a spin-off of the national MHAL-project and a reaction on the meagre results of the provincial co-operation of the Euregion Maas-Rhine since 1976. The MHAL-city co-operation concentrates on specific topics such as knowledge infrastructure, tourism, environment, transport, in order to develop the potentials of this (in their view) coherent urban area.

Population

Almost 3.6 million people live in the Euregion Maas-Rhine on an area of 10,745 km². The population density of the region is 335 inhabitants per km². The Dutch part of the Euregion Maas-Rhine is the most highly populated area per km², 787 inhabitants per km², as Table 2 below shows. The Aachen Region has the largest number of inhabitants, over 1 million.

Table 2: Population figures of the Euregion Maas-Rhine (1989)

	population	area in km²	population per km²
South Limburg (NL)	727,887	925	787
Province of Limburg (B)	740,974	2,422	306
Province of Liège (B)	991,843	3,862	257
Aachen Region (D)	1,135,490	3,530	322
Euregion Maas-Rhine	3,596,194	10,745	335

Source: EMR, 1991, p. 4

The Euregion Maas-Rhine is an urban area of three and a half million people; half of the population lives in the urban agglomerations. The following five cities form the core of these urban agglomerations (Table 3):

Table 3: Urban population figures of the Euregion Maas-Rhine (1993)		
City	Population in Core	Population in Agglomeration
Maastricht (NL)	117,000	150,000
Heerlen (NL)	95,000	250,000
Hasselt / Genk (B)	128,000	150,000
Liège (B)	200,000	660,000
Aachen (D)	245,000	500,000
Total urban area	785,000	1,710,000

Source: MHAL, 1993, p. 4

Economic history

Although the Euregion Maas-Rhine is now divided by three national borders, it has shared a similar economic history based on a long tradition of industrialisation on the basis of coal and iron, which goes back to the middle of the 19th century. Early industrialisation is still visible in the presence of a large number of traditional industries (metal, paper, ceramics, glass and chemical industry). Coal-mining has been an
important activity in this region until very recently. Despite the similarity in production structures, cross-border economic links between the Dutch part for example and the other regions of the Euregion Maas-Rhine have been at a surprisingly low level (Breuer, 1984, p. 50). South Limburg increasingly became economically and also culturally linked with the Netherlands, as the extracted coal from the region was mainly sold in the Netherlands and only a small number of suppliers and 'follow-up industries' were established in South Limburg (Breuer, 1984; see also Soeters, 1992). The administrative borders with German and Belgian regions became increasingly economic borders as well.

The mines in the Dutch part of the Euregion were the first to close, starting twenty-five years ago. Before the end of this century the mines in the Aachen area will be closed, whereas the last coal mines in Belgian Limburg were closed in 1992. Since the 1970s, there are no mines in Liège any more and the metal and mechanical industries can no longer insure sufficient economic growth in this region. The whole Euregion is therefore struggling with problems of economic conversion, looking for chances of modernisation, new technologies and new firms. In the Dutch part of the Euregion, conversion has largely been completed by transforming the Dutch State Mines into one of the largest chemical enterprises in the world (DSM, 1991; net sales in 1991 *f* 9.347 billion). Aachen is undoubtedly building its conversion on the presence of the largest European technical university in that city, which has already led to the establishment of hundreds of small engineering and consultancy firms (Fromhold-Eisebith, 1992). The prominent position of manufacturing in the Belgian parts of the Euregion has lost considerable ground to services in the past decade. The growth in

services can be seen as a result of economic conversion policies and has led to a major shift in sectoral division in Liège and to a lesser extent in Belgian Limburg.

Economic indicators

All parts of the Euregion followed a different restructuring policy which is mainly devised at national government level. Despite differences in policies and hence differences in the restructuring stage in the Euregion, economic indicators such as unemployment rate and gross regional product per inhabitant, show that most sub-regions still lag slightly behind average figures of the national state or 'Land' (Table 4).

Table 4: Economic indicators per sub-region in the Euregion Maas-Rhine.

Area	Unemployment rate 1993	Gross regional product per inhabitant 1991 (ECU)
South Limburg	9.2%	13.911
THE NETHERLANDS	8.2%	15.733
Limburg	9.0%	15.789
Liège	11.9%	14.672
BELGIUM	8.8%	15.974
Aachen Region	6.7%	15.432
NORTH RHINE-WESTPHALIA	6.6%	18.924

Source: Eurostat 1994.

Production structure

The whole Euregion Maas-Rhine can be regarded as a manufacturing area (see Knapp *et al*, 1988), although employment in the service sector has been rapidly growing during the 1980s. In all sub-regions, except for the western part of South Limburg, relatively many people work in manufacturing industry compared with national or 'Land' figures. The Belgian parts of the Euregion are more characterised by a concentration of manufacturing industry in a few branches than the Dutch and German parts of the Euregion. In Liège 44% of the manufacturing employees work in the metal industry, in Belgian Limburg the metal and car industry are by far most important (49.9% of manufacturing employment) (Allaert, 1992, p. 69). In the Aachen region, 45% of the employees in the ten largest manufacturing industries work in mechanical engineering, electrical engineering and coal-mining (Fromhold-Eisebith, 1992, p. 95). The three largest industries in the manufacturing sector in South Limburg are chemicals, wood & paper and stone, ceramics & glass, employing 43% of the manufacturing workers. Chemical industry is much more important in South Limburg than in the Netherlands as a whole (28.5% of the total manufacturing work-force in South Limburg compared with 10% of the total Dutch work-force in

manufacturing industry) (Dassen *et al*, 1992, p. 12).

Firms in the Euregion Maas-Rhine tend to employ a relatively large number of employees compared with national figures. Apart from the Aachen region, where firms have an average size (Fromhold-Eisebith, 1992, p. 94), in all other sub-regions in the Belgian and Dutch part of the Euregion the number of large firms (500 and more employees) are over-represented (Knapp *et al*, 1988, p. 40).

Manufacturing industry in South Limburg is little dependent on decisions from outside the region compared with national figures and foreign neighbouring regions, such as Belgian Limburg. 85.7% of manufacturing firms in South Limburg is independent (in the Netherlands 73.0%), 9.4% is branch of a Dutch company (in the Netherlands 17.7%) and 4.9% branch of a foreign company (in the Netherlands 9.3%) (Kleinknecht & Poot, 1990, p. 74). In contrast with the other parts of the Euregion, Belgian Limburg has attracted many foreign 'branch plants' in order to compensate for the job losses in coal-mining (Swyngedouw, 1990). More than 50% of the manufacturing employment in Belgian Limburg belongs to foreign companies (such as Ford, Philips, Volvo Car, KNP and Siemens), whereas in Dutch Limburg 20% of the employment belongs to foreign companies, in the Aachen Region 25-30% and in the Province of Liège 25-30% (BCI, 1990).

Finally, some indicators show that firms in the sub-regions of the Euregion use less R&D-input than their counterparts in the Netherlands, North Rhine-Westphalia and Belgium. The share of manufacturing firms in South Limburg which carry out innovation activities is slightly higher than the average in the Netherlands. Kleinknecht & Poot (1990, p. 14) define these innovation activities as R&D work that is either carried out by the firm itself (not necessarily in a separate R&D-department) or subcontracted to other firms. The share of manufacturing firms in South Limburg with their own R&D-department (8.2%), however, is much lower than the national figure (16.2%) (Kleinknecht & Poot, 1990, p. 14). As some large firms have in-house R&D functions, the above data could point at the fact that SMEs have limited R&D capacities (see also Dassen *et al*, 1992, p. 14). In the Aachen Region the number of R&D employees of the 1,000 employees in the private sector was 6.6 in 1989, which was below the figure for the state of North Rhine-Westphalia (10.4) (BfLR, 1994). Also some figures on expenditure on R&D of a firm as a percentage of its gross value added in the Belgian provinces point to a weak presentation of R&D-intensive firms in the Belgian part of the Euregion. These figures were 0.77% in Liège and 0.96% in Limburg, against 1.50% for Belgium (CEC, 1987). Also the number of science and technology graduates in firms per 1,000 employees is relatively low in Liège and Limburg, 2.86 and 3.03 against 4.26 in Belgium.

Public research establishments

Public research establishments consist of those public or semi-public organisations that either carry out research to exclusively serve government or that partly carry out market-oriented research (Charles & Howells, 1992). Examples are the Fraunhofer Institutes or Max Planck Institutes in Germany, the labs of the Centre National de la

Recherche Scientifique (CNRS) in France and TNO in the Netherlands. There is a large diversity in the availability of those public research establishments that could be used by firms in order to expand their technical innovativeness. Although South Limburg has many higher education institutes, there are nearly no public research establishments that could be used by firms to solve technological problems (Ter Haar & Vermeulen, 1991). Technical subjects are not represented at the University of Limburg in Maastricht (7,000 students). The polytechnic at Heerlen (1,700 students) offers technical subjects, but has no research facilities. Public research establishments which could be used by firms in South Limburg are located just at the other side of the border in the Aachen region. This region is extremely well equipped with higher education institutes (the largest technical university of Europe; the Technical University RWTH (37,000 students) and Polytechnic Aachen (10,600 students)) and public research establishments (Federal Research Centre Jülich and Fraunhofer Institutes for Laser Technology and Production Technology in Aachen). Belgian Limburg has only a small university in Diepenbeek (LUC 1,400 students) and lacks important public research establishments. Liège has a full university (UdL 12,000 students), and several specialised research centres. Although the variety in public research supply in the Euregion is large, cross-border technology transfer is at a low level in general (Fromhold-Eisebith, 1992; Beerts, 1988).

Policies to stimulate technology transfer

In all parts of the Euregion Maas-Rhine initiatives have been set up to foster technology transfer. This can be seen in the framework of the shift from traditional regional policy (the attraction of inward investment) to the development of regional endogenous potential in which technology transfer and support for SMEs play an important role (Hassink, 1992). In the Aachen region, the Aachener Gesellschaft für Innovation und Technologietransfer (AGIT) is a powerful regional body which is responsible for all activities in the field of stimulating business start-ups and spin-offs, regional technology transfer and consultancy and marketing of the Aachen Region (inward investment). In South Limburg there is more overlap. Two nationally initiated organisations, the Innovation Centre and the Industriebank LIOF, are the two main organisations engaged in technology transfer and consultancy. In Belgian Limburg, the Gewestelijke Ontwikkelings Maatschappij (GOM) is the main regional development body. The GOM focuses mainly on attracting inward investment, although it has some technology-related consultancy tasks for endogenous firms as well. The regional development organisation in Liège, the Société Provinciale d'Industrialisation (SPI), fully concentrates on real estate management in order to offer inward investors a proper site. The technology transfer agency at the University of Liège, Interface, can be considered as the main technology transfer body in this sub-region. Unlike the transfer agencies at the other universities in the Euregion, Interface has a pro-active attitude towards SMEs, as it visits some 200 enterprises each year.

The above mentioned organisations differ considerably with regard to their tasks, their financial sources and their organisation. Cross-border co-operation between these bodies in order to foster Euregional technology transfer and networking has proven to be rather difficult. Unlike the technology transfer organisation in the

Aachen Region, the Dutch and Belgian regional development organisations are not regionally initiated, but are installed by national policy to induce regional economic growth. Therefore, they are confined to national tasks and less interested in cross-border co-operation. The technology transfer agencies at the universities in the Euregion, however, are in the middle of a co-operation process, as they established the Euregional TRansfer Agency (ETRA).

5. CROSS-BORDER NETWORKING BETWEEN ENTERPRISES

This section analyses cross-border co-operation between firms, located in the Euregion Maas-Rhine, for the acquisition of technological knowledge. This analysis is based on the results of a questionnaire that was sent to all manufacturing firms in the Euregion Maas-Rhine with ten or more employees. After some remarks about the response rate and general results of the survey, special attention is given to business partners that firms consider to be important sources of technological knowledge and their geographical location. This section also examines the characteristics of firms engaged in cross-border technology co-operation and the relationship between cross-border technology co-operation and the firm's economic performance.

Analysis of response

Between September 1992 and April 1993 almost 2,200 questionnaires were sent to manufacturing firms with ten or more employees in the Euregion Maas-Rhine. The response rate is 22.3% (483 firms out of 2,163 have filled in and returned the questionnaire). South Limburg has the highest response rate (30.0%) whereas the Aachen Region has the lowest (19,7%) (Table 5).

In all sub-regions the response rate of SMEs is below average. The response rate per sector of industry corresponds in all the sub-regions more or less with the total population of sectors. Those sectors with a response rate (far) above average consist mainly of large firms in traditional industries such as paper and paper processing industry (62.5%), rubber and chemical industry (64.3%), optical industry and other industry (71.4%) in the Dutch part of the Euregion Maas-Rhine. Since the questionnaire was sent out in the framework of the project 'New Chances for Enterprises in Border Regions', the response might be slightly biased towards firms that already undertake cross-border activities.

Table 5: Analysis of response in the Euregion Maas-Rhine

	number of contacted firms	number of received questionnaires	response rate (%)
South Limburg	483	145	30.0
Belgian part Euregion	866	178	20.5
Aachen Region	814	160	19.7
Euregion Maas-Rhine	2,163	483	22.3

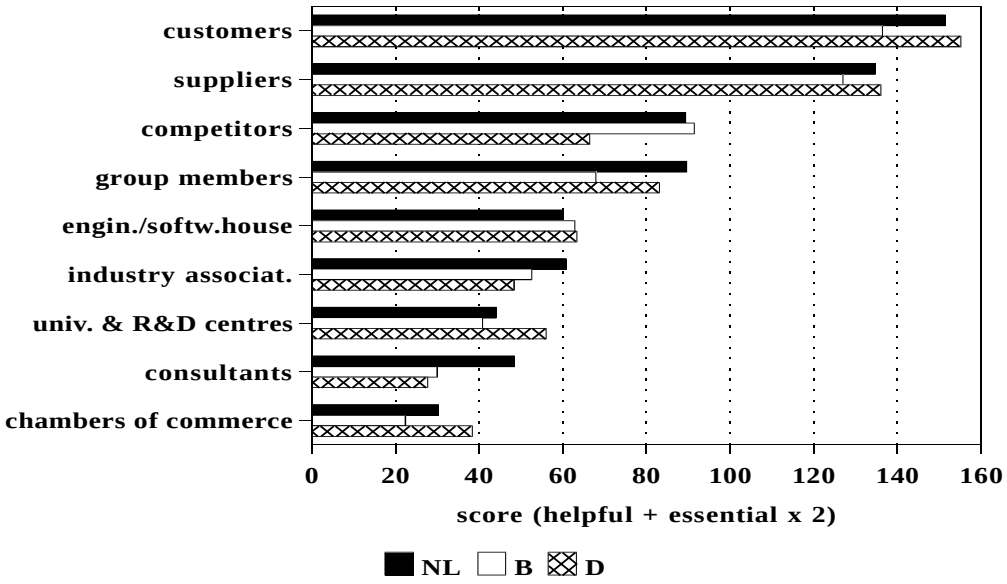
Source: MERIT, ISI, Namur

General results

Section 2 has demonstrated that it is not so much the branch plant attracted to the region that is the engine of regional economic growth, but the existing trade and industry, and SMEs in particular. The existence of bottom-up developed networks between SMEs as well as between SMEs and institutions attached to SMEs, such as research centres and training facilities, is an important factor in enhancing regional economic growth. These networks can perform as an ideal mechanism for the absorption and diffusion of new technologies because they link up all the activities that are important in one specific industry in one region.

Our questionnaire was therefore interested in the role of business partners for the development or introduction of technically improved or new products or production methods. From the nine categories of business partners, customers and suppliers were considered most important by all enterprises in the Euregion Maas-Rhine. Among the business partners regarded as least important for generating new technological ideas were the universities, Chambers of Commerce, industry associations and other intermediary organisations (Figure 1).

Figure 1: Role of business partners for development of products and processes

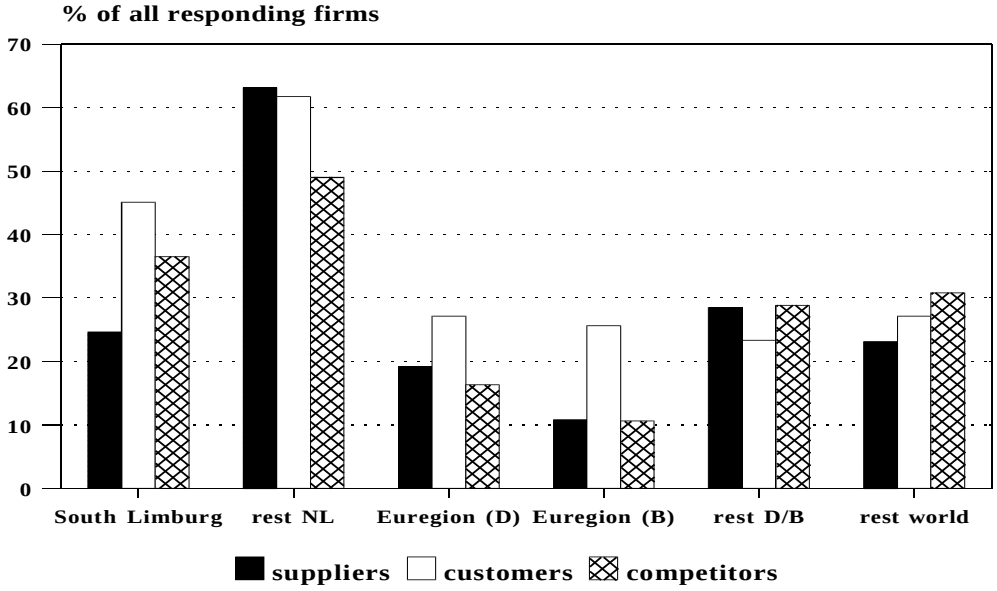


Source: MERIT, ISI, Namur

The geographical location of the most important business partners -mostly in the region or further away in their own country - confirms the national orientation of firms. Although there may be cheaper purchasing possibilities just across the border or markets to be discovered, the orientation of firms in all three parts of the Euregion

Maas-Rhine is firstly national. However, we have found some differences between the three sub-regions. Enterprises in South Limburg have more customers, suppliers and competitors they consider an important business partner in the foreign parts of the Euregion than enterprises in the Belgian and German parts (compare Figure 2 with Figures 3 and 4).

Figure 2: Location of important business partners of Dutch firms in the Euregion Maas-Rhine



Source: MERIT, ISI, Namur

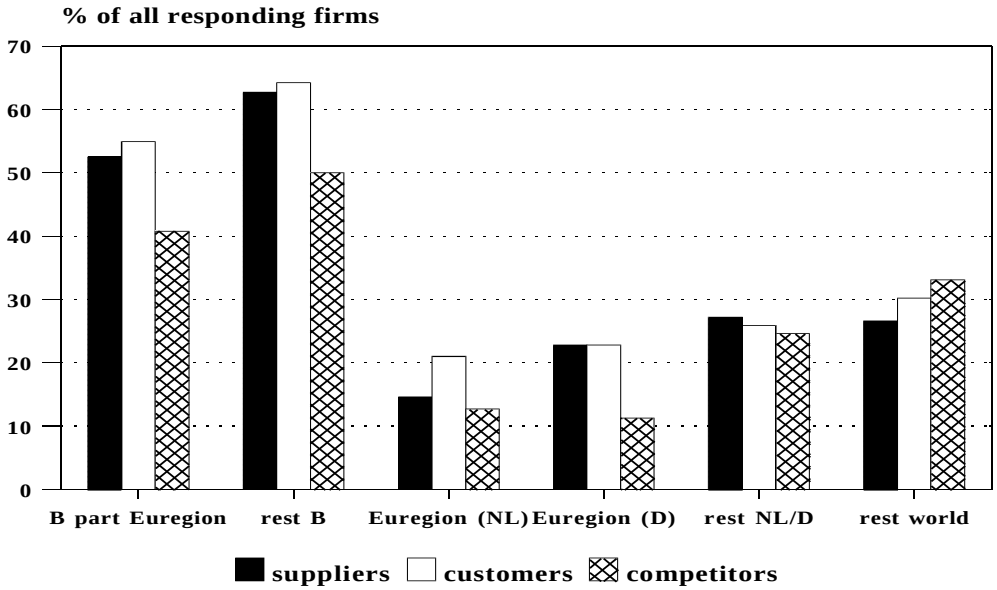
Belgian enterprises take up a middle position: important customers and suppliers are located in the region and in the rest of the country, but they also have some of these business partners in the foreign parts of the Euregion (Figure 3).

German enterprises strike the eye because they have the lowest orientation on the Euregion in terms of customers, suppliers and competitors (Figure 4).

Besides differences between sub-regions, the geographical location of important business partners is also related to the size of firms in the Euregion Maas-Rhine. SMEs are more regionally oriented whereas large enterprises have more suppliers from outside the Netherlands, Belgium and Germany. The same applies to the customers and competitors of large enterprises: they operate on a global market. About 50% of the SMEs indicated that an important source of technological knowledge could be found among their customers and competitors in the region.

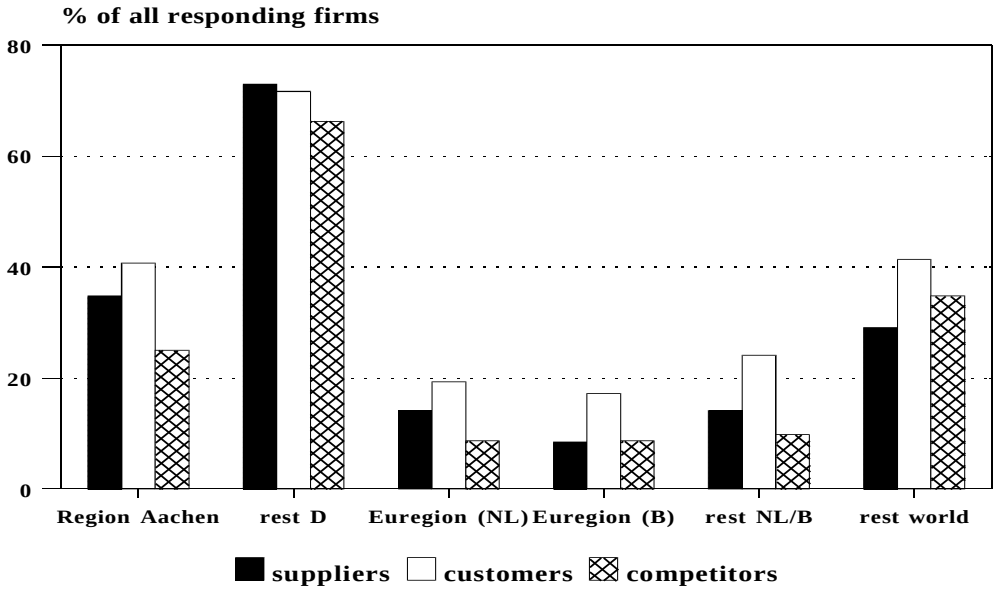
Not only networking between firms, SMEs in particular, is seen as an important factor in enhancing regional economic growth, but also networking between SMEs

Figure 3: Location of important business partners of Belgian firms in the Euregion Maas-Rhine



Source: MERIT, ISI, Namur

Figure 4: Location of important business partners of German Firms in the Euregion Maas-Rhine



Source: MERIT, ISI, Namur

and universities and research institutes. Although enterprises in all parts of the Euregion Maas-Rhine consider universities and research institutes less important in generating new technological ideas, there are some differences between the firms in the sub-regions.

Enterprises in the Aachen Region have more contacts with universities and research institutes (36.6%) in order to attract technological knowledge than the Belgian (22.6%) and Dutch enterprises (21.0%). Although there is a traditional difference between SMEs and large enterprises in the extent to which they attract technological knowledge from universities and research institutes, this difference is less obvious in the Aachen Region compared with the foreign parts of the Euregion. A reason for this could be the vast supply of knowledge institutes in the Aachen Region and the more intense relationships between firms, including SMEs, and universities and research institutes via former students and former supervisors. The existence of these personal technology transfer relationships could clarify the reasons why firms in the Aachen Region have a higher level of innovativeness than firms in the other sub-regions of the Euregion Maas-Rhine, as other results of our questionnaire indicate.

Of all the enterprises in the Euregion, firms located in South Limburg have the most Euregional contacts with universities across the border, whereas German firms have no Euregional university orientation at all. This is less surprising when you know that the university located in the Aachen Region, the RWTH (Rheinisch-Westfälische Technische Hochschule), is Europe's largest technical university. Again, Belgian enterprises take up a middle position: they have some contacts with Euregional universities, but most of the mentioned international contacts are with the Technical University Eindhoven which is located just outside the Euregion Maas-Rhine.

Strategy and characteristics

Our research investigates technology co-operation across the border and is therefore interested in three types of firms:

1. Firms that undertake cross-border activities, in terms of market sales, supply, labour market, contacts with competitors, co-operation with universities and research institutes in the Euregion Maas-Rhine (in the following abridged as 'strategy BC').
2. Firms that can be qualified as technology intensive, because of their R&D activities, participation in (inter)national technology programmes, co-operation with universities and research institutes, (further) development of new products or new processes in the past five years, percentage of R&D costs in total turnover ≥3.5%, percentage of R&D personnel in total personnel ≥5% (in the following abridged as 'strategy TI').
3. Firms that do not only have cross-border activities, but are also technology intensive (in the following abridged as 'strategy BC/TI').

Thereupon, the research is interested in two relationships:

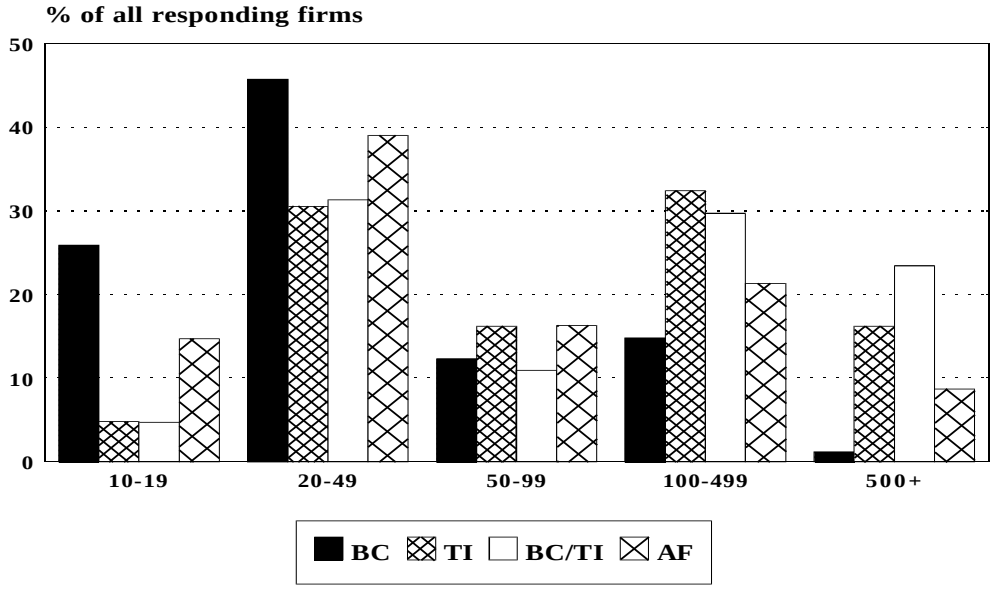
1. between strategy (BC, TI or BC/TI) and characteristics of these firms in terms of size, sector and (in)dependent status;
2. between strategy (BC, TI or BC/TI) and economic performance of these firms in terms of development of net turnover and employment over the past three years.

The differences between the characteristics of firms with a specific strategy (BC, TI, BC/TI) is rather small in the Belgian part of the Euregion Maas-Rhine compared with the Dutch and German firms.

Size

Statistical analysis showed that the strategy of a firm corresponds strongly with its size. Firms with strategy BC are over-represented in the small size group of 10-19 and 20-49 employees (Figure 5). Firms with strategy TI and BC/TC are over-represented in the large size group of 100-499 and 500 and more employees. The only sub-region where this relation does not apply is the Belgian part of the Euregion Maas-Rhine.

Figure 5: Size distribution of firms (number of employees) with different strategies in the Euregion Maas-Rhine (%)



Source: MERIT, ISI, Namur

Sector

Because of the national differences in definitions, the sectoral grouping defined for this research had to be rather broad in order to be able to compare the sub-regions. Three sectors are defined: basic products (such as chemical industry, paper industry, metal and non-ferro), capital goods (such as machine-building, car industry, electrotechnical industry) and consumer goods (such as printing, textile industry, ceramics industry).

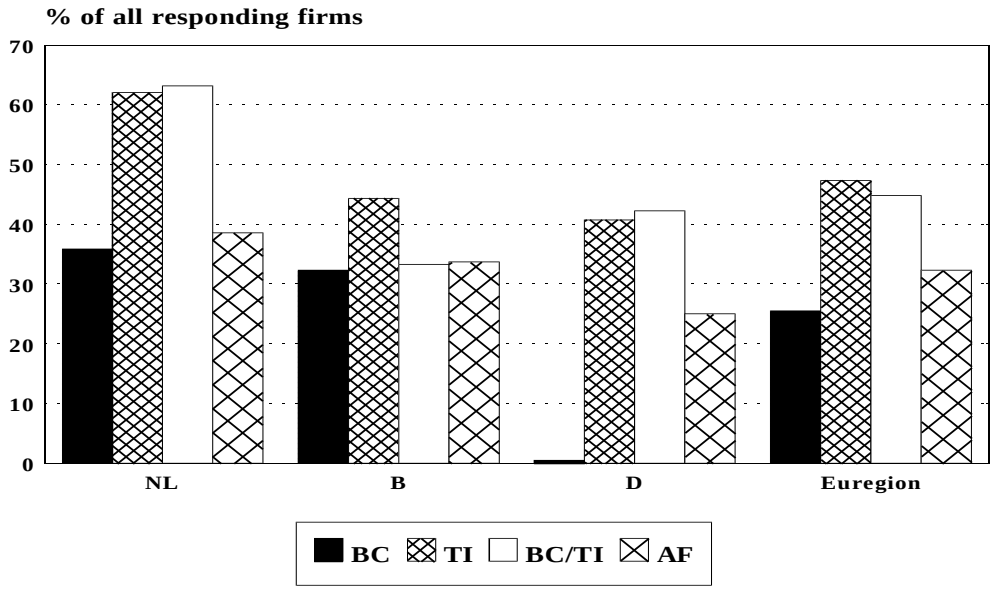
Although statistically not significant, many firms in South Limburg with strategy BC can be find in the capital goods sector. Firms with strategy BC/TI are mainly represented in the basic goods sector. In the Aachen Region firms with strategy BC, on the contrary, are under-represented in the capital goods sector. In this sector many firms with strategy BC/TI can be find and to a lesser extent firms with strategy TI.

(In)dependent status

In all three parts of the Euregion Maas-Rhine firms with strategy BC are more likely

to be independent than firms with strategy TI or BC/TI (Figure 6). The latter are more likely to be part of a larger concern. The Aachen Region is the most striking example of this finding: not one firm with strategy BC forms part of a larger corporation. Firms with strategy TI and BC/TI on the other hand are more likely to be part of a larger concern in the Aachen Region and particularly in South Limburg compared with BC/TI firms in the Belgian part of the Euregion. The Belgian firms with strategy TI on the other hand are more likely to be part of a larger concern than the other firms in Belgian Limburg and Liège.

Figure 6: Distribution of firms that are part of a larger concern with different strategies (%)



Source: MERIT, ISI, Namur

Strategy and economic performance

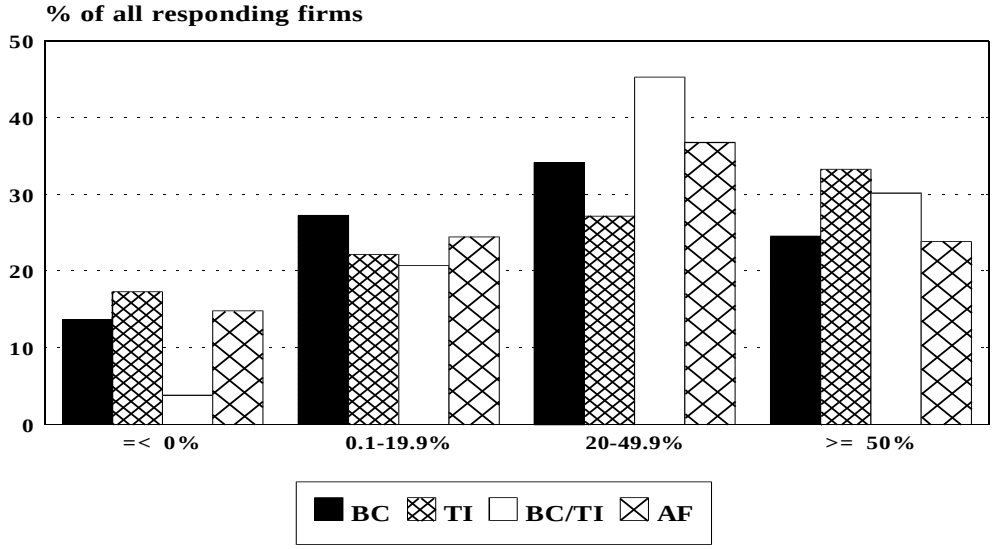
Besides the relationship between the firm's strategy (BC, TI or BC/TI) and the firm's characteristics in terms of size, sector and (in)dependent status, our research is interested in the relationship between the firm's strategy (BC, TI or BC/TI) and the firm's economic performance in terms of development of net turnover and employment over the past three years.

Development of net turnover

No statistical significance could be found between BC, TI and BC/TI firms and their development of turnover (Figure 7). In other words, firms with either above average cross-border activities or above average technology capacity or both do not have an above average development of turnover. Given the fact that there are too many missing observations, it is not possible to conduct a reliable statistical analysis. Figure 7 however, shows that firms with a BC/TI strategy perform better than all other firms

and were able to realise an increase of 20-49.9% in net turnover between 1988 and 1991.

Figure 7: Distribution of the development of turnover of firms between 1988 and 1991 with different strategies in the Euregion Maas-Rhine (%) (*)



(*) = Please notice that a relatively large number of firms did not respond to this question: the percentage missing values is 27.3%
Source: MERIT, ISI, Namur

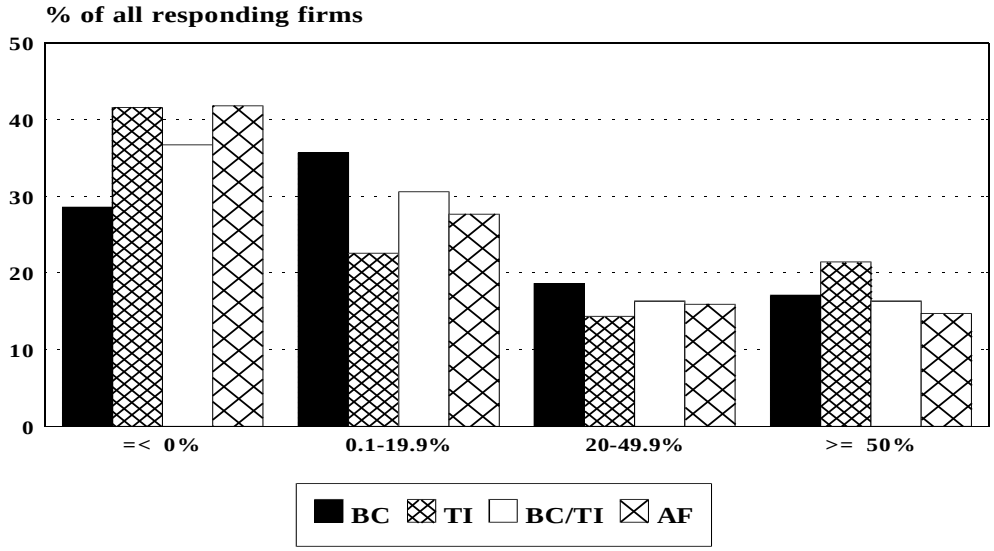
Development of employment

No statistical significance could either be found between BC, TI and BC/TI firms and their development of employment (Figure 8). This means that neither of these firms are characterised by a development of employment above average. Unfortunately, the table has too many missing observations and it is therefore not possible to conduct a reliable statistical analysis. Figure 8, however, shows that firms with strategy BC in all three parts of the Euregion Maas-Rhine experienced an increase in employment up till 19.9% between 1988 and 1991.

6. SUMMARY AND CONCLUSIONS

While large firms, mainly branch plants, were regarded as major engine of regional economic growth in more traditional regional policy, this insight had changed by the end of the 1970s in favour of SMEs. The importance of networking between SMEs for regional economic growth as well as the diffusion of new technologies via these networks was demonstrated by regions with very few branch plants like Baden-Württemberg and Emilia Romagna. During the 1980s policy-makers started to recognise the importance of techno-economic networking for regional economic growth and regional policy increasingly shifted from attracting branch plants to

Figure 8: Distribution of the development of employment of firms between 1988 and 1991 with different strategies in the Euregion Maas-Rhine (%) (*)



(*) = Please notice that a relatively large number of firms did not respond to this question: the percentage missing values is 28.2%
Source: MERIT, ISI, Namur

regions to developing the endogenous potential of regions. This new idea of regional policy considers the innovative potential of SMEs to be crucial. Measures are taken to strengthen this potential by encouraging networking between firms and between firms and regional knowledge centres (regional technology transfer). Potentials for stimulating techno-economic networks can be particularly large in border regions, since the frontier has been hindering networking possibilities for a long time.

Besides the national governments, the European Community has implemented its own regional policy since the mid-1970s in order to diminish the economic differences between the regions in the EU. While border regions formed a blind spot in the regional policy of the national governments, the European Commission placed them in the middle of the attention with the launching of the European Internal Market initiative. The European Commission has launched a Community Initiative in 1990, INTERREG, which promotes cross-border co-operation between public, semi-public and private parties. This INTERREG-initiative did not only place border regions in the middle of (political) attention, but created a new phenomenon as well, the Euregion. An Euregion is a border region with some kind of organisation in view of the accountability to the European Commission. After three years of INTERREG-programme (1991-1993), one has the impression that cross-border co-operation is taking mainly place between public and semi-public organisations and has a more social-cultural than social-economic content; business is hardly involved in cross-border projects.

The Euregion Maas-Rhine is a border region along the Dutch-Belgian-German border with almost 3.6 million inhabitants. Cross-border co-operation has existed in the Euregion Maas-Rhine since 1976 on provincial level. The sub-regions of this Euregion

share a similar economic history, based on traditional industries, such as coal-mining and steel industry. In fact, the manufacturing sector in the Euregion is still formed by a large number of traditional industries, such as coal-mining, steel, chemical industry, wood & paper, stone, ceramics & glass, mechanical engineering, electrical engineering and automotive industry. The size of the enterprises that make up these industries is large (500 and more employees) compared with the average size of firms in the respective countries.

In terms of higher education institutes and public research establishments the Euregion Maas-Rhine is well endowed, particularly compared to other border regions. The Aachen Region is extremely well equipped with both a technical university (the RWTH), a polytechnic and several public research establishments. However, cross-border technology transfer between the RWTH in Aachen and firms in other parts of the Euregion is at a low level. Technology transfer in the sense of solving technical problems of firms with the help of higher education institutes and public research institutes, is often started by the relationships between (alumni) staff in research and development and professors (often former supervisors) at higher education institutes. Since a large majority of students in the sub-regions tend to study at national universities, one can expect that they are more likely to search for technical support at their former national universities than just across the border.

A questionnaire was sent to all manufacturing firms with ten or more employees in the Euregion Maas-Rhine. The results show that customers and suppliers are considered to be the most important business partners by firms for the development or introduction of technically improved or new products or production methods. Universities, Chambers of Commerce, industry associations and other intermediary organisations are considered far less important for generating new ideas. Most important business partners are located in the firm's region or in the rest of the country; this holds for firms in all three parts of the Euregion. The German manufacturing firms have the lowest orientation on the Euregion Maas-Rhine in terms of contacts with customers, suppliers, competitors and universities. They are more focused on the Aachen Region and the rest of Germany. Belgian firms take up a middle position, whereas Dutch firms have most Euregional contacts, partly because of the geographical location of South Limburg. Even in that region, however, the majority of enterprises has a national orientation. SMEs in all parts of the Euregion are more regionally oriented, whereas large enterprises are more likely to operate on a global market, beyond the nation-state.

In our analysis we have differentiated between firms that do engage in cross-border networking and firms that do not. Furthermore, we have distinguished between firms with high and low technological capacity. Statistical analysis could not demonstrate that firms with either cross-border relations or a high technology capacity performed better in terms of growth in turnover and in employment than firms without these characteristics. However, there was a tendency showing that firms which combined a high technological capacity with cross-border activities, performed better than other firms. One could conclude from this that investing in technology pays off if the firm ventures cross-border activities. And vice versa, tapping new, foreign markets has to be carried by investments in technological knowledge. It is the combination of

technology and market growth that can lead the firm to better economic performance.

The governments (local, regional and national) in the Euregion Maas-Rhine hold the view that co-operation in regional policy making is a prerequisite for economic growth in the region. Since 1976 cross-border co-operation has emerged in several policy areas; cross-border infrastructure is the most elaborated (at least in terms of reports, committees, conferences). However, if governments really want to 'use' the instrument of cross-border co-operation to stimulate economic growth in the region, regular or (even better) institutionalised contacts between governments on either side of the border are useful, but not sufficient. Since economic growth is produced by business and since the competitive potential of a firm depends increasingly on its technological knowledge and practical application, cross-border co-operation should focus more on firms and facilitate technology transfer across the border. Cross-border co-operation between firms can be a means to increase the firm's technological knowledge and contribute to economic development in the region. Many sources of technological know-how in border regions are still untapped, whether it concerns customers, suppliers of capital goods, raw materials or semi-manufactured articles, competitors, employees or universities and research institutions. The question is how to facilitate this potential cross-border networking.

Firstly, the quality of the information supply has to be improved. Firms are interested in receiving information on aspects such as export opportunities in the Euregion Maas-Rhine, potential suppliers, useful research institutions and the possibilities of co-operation with complementing firms.

Improving the quality of information supply is necessary, but not sufficient to get SMEs involved in cross-border technology networking. A more active mode of intervention can be added to this action. SMEs regard their customers and suppliers as the two most important sources for technological ideas (for the development or introduction of technically improved or new products or production methods). Intermediary organisations such as Chambers of Commerce, Regional Development Corporations and employers organisations could try to take these relationships as starting-point for transfer of knowledge, instead of trying to create networks with themselves in the center. There are several ways intermediary organisations can take up this new role. Indeed some have already started to do so by organising industrial fora, trade & industry 'contact days', partner match conferences, workshops and information gatherings (for example on specific technologies).

Another activity in this line, which is on micro-level, is to bring together entrepreneurs from different sectors and from different parts of the Euregion Maas-Rhine and let them narrate their experiences on the common theme of that session (for example the starting up of a specific innovation process, the problems that emerged and the way they were solved).

A fourth possibility to enhance cross-border technology transfer is to concentrate on sectors where opportunities for networking are likely to exist because firms in these sectors can complement each other (in terms of supply, sales, R&D co-operation). Possibilities for cross-border networking in the Euregion Maas-Rhine exist in the

automotive industry and the chemical industry. A project bringing together suppliers in the automotive sector located in the Dutch and Belgian part of the Euregion Maas-Rhine have been set up by the respective Regional Development Corporations.

Also governments have to carry through some changes if they want 'their' cross-border co-operation to be taken seriously by entrepreneurs as an instrument contributing to the economic growth of the region (as they proclaim). Firstly, at present three levels of government in each part of the Euregion Maas-Rhine are involved in cross-border co-operation. Although they all pursue the same goal, one sometimes has the impression they regard each other more as competitors than as partners. Instead of holding back information from the other, they should co-operate more together to truly achieve clearly stated goals. Secondly, one has the impression that the governments participating in cross-border co-operation emphasize the advantages of closer co-operation in the Euregion Maas-Rhine (e.g. a market of almost 3.6 million consumers opening up), but avoid addressing the problems that can only solved by closer co-operation (e.g. differences in drug policies causing a lot of nuisance in the Dutch part of the Euregion Maas-Rhine).

Thirdly, recent years have showed a luxuriant growth of subsidies and organisations that are engaged in handing them out. All these scattered funds would create more spin-off if they would be put together in one fund with unambiguous criteria. If this is politically not attainable, at least an overview of subsidy possibilities as well as statistical information about the use of these subsidies should be made available publicly.

One of the assets of the Euregion Maas-Rhine is its well endowed knowledge infrastructure. Governments, enterprises, but also the universities should make more use of this advantage of the location. On the analogy of the 'Research Triangle Park' in North Carolina, a similar technopolis could be developed in the Euregion. This technopolis could stimulate cross-border co-operation between high-tech enterprises and between these enterprises and the knowledge institutions. The physical infrastructure of the Euregion Maas-Rhine is well endowed with one of the largest inland ports of Europe in Liège and with Liège and Aachen becoming a high-speed train (TGV) stopping-place before 2000. The conditions for the establishment of a 'Euregional Research Quadrangle' are therefore promising.

Our research revealed that cross-border co-operation between firms and higher education institutes and public research establishments is at a low level. More co-operation between technology transfer agencies in the three parts of the Euregion could help here and is in fact, after the Euregional TRansfer Agency has been established, under way. On the other hand, many contacts between SMEs and higher education institutes emerge out of personal contacts between graduates and their former supervisors. Cross-border technology transfer can therefore very effectively be supported by stimulating the exchange of students and cross-border apprenticeships. Other activities include exchanges among schools (secondary level), cross-border vocational training, profession oriented language courses for employees and stimulating students to take courses at the other universities in the Euregion Maas-Rhine (and certifying them).

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