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## Industrial clusters and economic integration: Theoretic concepts and an application to the European Metropolitan Region Nuremberg

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# IAB-Discussion Paper

22/2009

Articles on labour market issues

## Industrial clusters and economic integration

Theoretic concepts and an application to the  
European Metropolitan Region Nuremberg

Nicole Litzel  
Joachim Möller

# Industrial Clusters and Economic Integration

Theoretic Concepts and an Application to the European Metropolitan Region Nuremberg

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Joachim Möller (IAB)

Mit der Reihe „IAB-Discussion Paper“ will das Forschungsinstitut der Bundesagentur für Arbeit den Dialog mit der externen Wissenschaft intensivieren. Durch die rasche Verbreitung von Forschungsergebnissen über das Internet soll noch vor Drucklegung Kritik angeregt und Qualität gesichert werden.

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## Abstract

Economic integration typically goes along with disintegration of production through outsourcing and offshoring (Feenstra 1998). As horizontal and vertical links between firms become more and more pronounced, value chains within regions are increasingly organized by production and innovation clusters. On the basis of a literature overview, we argue that in a world of economic integration clusters can be expected to play a prominent role. Therefore clusters can also be seen as a key element in the European Metropolitan Region concept. Within such an economic space, localisation economies according to the 'Marshallian trinity' (knowledge spillovers, input sharing and labour market pooling (Rosenthal/Strange 2003)) can be realized.

The paper builds on a comprehensive company survey for the core of the European Metropolitan Region Nuremberg that includes customer-supplier relationships and various forms of cooperation. As indicated by numerous empirical studies, the characteristics of clusters differ substantially. In order to overcome the fuzziness of the concept we suggest a bottom-up methodology of cluster identification using a set of qualitative and quantitative indicators.

Given that many kinds of barriers to interregional and international trade are becoming less and less important and transport cost are falling, modern production clusters tend to have a higher geographical extension than traditional ones. We therefore raise the question of whether clustering is relevant for economic integration on the regional, national and supra-national level.

## Zusammenfassung

Wirtschaftliche Integration geht typischerweise einher mit einer Desintegration des Produktionsprozesses durch Outsourcing und Offshoring (Feenstra 1998). Horizontale und vertikale Verbindungen zwischen Unternehmen werden stärker, so dass die regionalen Wertschöpfungsketten zunehmend als Produktions- oder Innovationscluster organisiert sind. Basierend auf einem Literaturüberblick legen wir dar, dass Cluster im Zuge der wirtschaftlichen Integration eine wichtige Rolle spielen können. Aus diesem Grund bilden Cluster auch den Schlüssel für das Konzept der Europäischen Metropolregion. In einem derartigen Wirtschaftsraum können sich Lokalisierungseffekte entsprechend von „Marshalls Dreifaltigkeit“ ergeben (Weitergabe von Wissen, Herausbilden einer spezialisierten Arbeitnehmerschaft und Verfügbarkeit spezieller Vor- und Zwischenprodukte (Rosenthal/Strange 2003)).

Das Papier baut auf einer umfassenden Unternehmensbefragung im Kern der Europäischen Metropolregion Nürnberg auf, die auch Kunden-Lieferanten-Beziehungen und verschiedene Arten von Kooperationen umfasst. Zahlreiche empirische Studien zeigen, dass sich Charakteristika von Clustern stark unterscheiden. Um dieser Unschärfe entgegenzuwirken schlagen wir eine Bottom-Up-Methode zur Clusteridentifikation vor, die auf verschiedenen qualitative und quantitative Indikatoren aufbaut.

Nachdem verschiedenste Schranken für interregionalen und internationalen Handel abgebaut werden und Transportkosten fallen, haben moderne produktionsgeprägte Cluster oftmals eine größere geographische Ausdehnung als traditionelle. Vor diesem Hintergrund stellen wir die Frage, ob Cluster für regionale, nationale und internationale Integration relevant sind.

**JEL classification:** R11, R12

**Keywords:** Economic Integration, Industrial Clusters, Outsourcing, Offshoring, Border Regions, Cluster Identification, Proximity, Concept of European Metropolitan Region, Border Situation, Cooperation

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# 1 Introduction

Economic integration typically goes along with disintegration of production through outsourcing and offshoring (Feenstra 1998). As horizontal and vertical links between companies become more and more pronounced, companies' value chains within regions and regional value systems are increasingly organized by production and innovation clusters, i.e. "(...) geographically proximate group(s) of interconnected companies, suppliers, service providers and associated institutions in a particular field, linked by externalities of various types" (Porter 2003: 562). Firm clusters are a widespread empirical phenomenon and cluster promotion has become a cornerstone of regional economic policy. Clusters are strongly linked to the realisation of localisation economies according to the 'Marshallian trinity', i.e. knowledge spillovers, input sharing and labour market pooling (Marshall 1890; Rosenthal/Strange 2003). Also in New Economic Geography industrial clustering is an important issue (Fujita et al. 1999, ch. 16). Moreover, cluster policies might play a key role in the concept of the European Metropolitan Region.

It can be assumed that production clusters today tend to have a higher geographical extension than clusters in former times that were often based on raw material and resource availability or infrastructure, for example. Given favourable transport facilities and a situation of declining border impediments, production clusters might increasingly cross borders. Such supra-national forms for the division of labour can be seen as a specific form of how economic integration is proceeding.

In this paper we argue that in a world of economic integration clusters can be expected to play a prominent role. A higher division of labour, the ample use of outsourcing and offshoring possibilities and declining vertical integration as expressed by Krugman's (1995) famous *slicing the value chain* requires more active horizontal and vertical interlinkages between firms. In addition, diagonal links for example to research institutions and service partners gain importance for successful innovation. Along with this comes a growing need for getting in touch with more and new business partners. We consider clusters and the analysis of their internal structures to be helpful for a better understanding of regional structures and potentials and to support their exploitation. In order to put the concept on a firmer footing we try to find objective criteria for cluster identification and measurement.

The paper is organised as follows. Section 2 provides an overview. We then give a critical appraisal of the cluster concept in Section 3. Section 4 provides a case study using Nuremberg Metropolitan Region as an example for a highly integrated economic space. We raise the question of whether clustering is relevant for economic integration on the regional, national and supra-national level. Section 5 concludes.

## 2 Economic integration, agglomeration and clustering

### 2.1 Background

International economic integration “(...) is a process and a means by which a group of countries strives to increase its level of welfare.”<sup>1</sup> Although in recent times there has been growing scepticism among economists vis-à-vis the implications of pure neoclassical trade theory, this process of economic integration in general is expected to generate a win-win situation with positive influences on the development of all participating countries – at least in the long run, as costs in the short term can be quite high.<sup>2</sup>

Economic integration can remove market distortions and eases the exploitation of economies of scale, creates new incentives for product and process innovations, allows better factor allocation, and leads to enhanced competition and thus to efficiency gains. The effects become more pronounced with the entering of different stages or overlapping types of integration: from lower tariffs for partners in a preferential trading area to a partial customs union to a free trade area with the abolition of all internal tariffs and quotas. Advanced stages of integration are a customs union, a common market introducing free mobility of factors, an economic and monetary union boosting financial integration and finally the complete economic integration including a supranational government.

Baldwin (2008) paints a picture of the developments of the European Union from the devastations of World War II – leading to “(...) very uneven attitudes towards the supranationality that is at the heart of the uniqueness of European integration” (Baldwin 2008: 7) – to the Treaty of Rome (1957). It already went far beyond a customs union, aiming at a full economic union and establishing the European Commission to supervise its implementation independently: “(...) the idea of using economics as a Trojan horse for political integration worked like a charm” (Baldwin 2008: 12). The positive sides of the Internal Market exert a strong attraction to outside countries. As the last accession rounds show, many – but not all – European countries accept the rules of supra-nationality. Baldwin (2008) states that this far-reaching interference makes it hard for other regions to learn from the European process.

However, different stages of economic integration are brought forward on a worldwide scale. The establishment of the Free Trade Agreement between the USA and Canada in 1988, the creation of the North American Free Trade Agreement (NAFTA) six years later with the elimination of all tariff barriers between the three

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<sup>1</sup> Jovanović (1998: 9), being today’s use of the notion. In the introductory chapter (p. 5 ff.) he gives an overview of the development of definitions: “Integration means different things in different countries and at different times” (p. 8), with the term arising in the 1940s.

<sup>2</sup> For the discussion of costs, benefits and compensations see Jovanović (1998: 100 ff.; 113 f.).



nations in 2008, for example, made trade triple between 1993 and 2007. In the European context a major step towards fully integrated markets was made in 1992. The *Single Market Programme* abolished non-tariff trade barriers between the member states. The *Internal Market* with its integrated goods markets, service markets, labour markets and capital markets led to dynamic positive developments in the participating countries.

## 2.2 Integration of markets and disintegration of production

One consequence of the integration of markets is the increasing international division of labour. Companies widely use the opportunities offered to exploit advantages of re-organising their internal production processes and to concentrate on their core competencies. Some specialise in certain activities in the value chain that turns fragmented or sliced (Krugman 1995). As for the country level, economic activity becomes less and less vertically integrated, but vertically specialised. The focus is on the products and processes in which they have a comparative advantage. As Feenstra (1998: 41) puts it: "By a variety of measures, the increased use of imported inputs, and narrowing of production activities within each country, is a characteristic feature of many OECD countries over the past two decades." Hummels et al. (2001) try to quantify these developments. They shed some light on one feature of vertical specialisation: the sequential production within an international value chain. For ten OECD countries the share of imported goods that are used to produce export goods is 0.2; for the smaller countries it mounts to 0.4. Between 1970 and 1990 this share increased by about 30 percent for ten OECD and four emerging market countries. Along with vertical specialisation comes a higher variety of both preliminary and intermediate goods, leading to lower costs and better matching in the production process (Ethier 1982; Feenstra 1998; Jabbour 2007a).

Another aspect of vertical specialisation is vertical foreign direct investment,<sup>3</sup> growing at a much higher rate than international GDP. Coeurdacier et al. (2009) analyse the development of the most important share in FDI, being cross-border mergers and acquisitions. Their results indicate that such activities in manufacturing were boosted by the European Internal Market and the European Monetary Union, whereas mergers and acquisitions in services have no significant effect. Neary (2009) sheds light on the conflict between the theoretical predictions that falling trade costs should hamper FDI and the empirical observations of the boom of vertical, horizontal and export platform FDI as well as mergers and acquisitions. He observes that a clear distinction of these forms of cross-border activities is not very useful, as most companies pursue complex operations that mix different approaches.

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<sup>3</sup> FDI is a major factor in development because of the inflow of capital, but also of knowledge coming into the target country through the channels of management and production processes.

Behrens et al. (2009) employ a new trade theory framework with exports and FDI between technologically heterogeneous countries. The model distinguishes peripheral and central locations and includes heterogeneous firms as well as multinationals. The study shows that an "(...) increasing liberalization of FDI yields larger gains than increasing trade liberalization" (Behrens et al. (2009: 4)). As for the effects of trade liberalisation on companies and countries the authors draw the general conclusion that it raises productivity and welfare of them all, but it attracts resources to more productive firms, to countries with a larger market, a more central and accessible location and better technological possibilities as well as to countries with lower costs. Concerning the introduction of bilateral trade agreements, Behrens et al. (2009) show that in all of their model settings insiders gain and outsiders lose.

In the context of the paper, two other aspects of vertical specialisation are of paramount importance: outsourcing and offshoring. Blinder (2007: 1) distinguishes the two phenomena as follows: "(...) a job is *outsourced* when it is contracted *out of the company* – presumably to another company. The *country* in which the job is now being done is irrelevant. (...) *Offshoring*, by contrast, means moving jobs *out of the country*, whether or not they leave the company."

Outsourcing is possible with both tradeable and non-tradeable goods and services. By their very nature the latter are not subject to offshoring. Typically they require face-to-face contact. In his paper offering reflections about the changing scope of international division of labour, Blinder (2005) uses the label 'personal services' for the corresponding tasks. Over time, the weight of personal services in total production is not invariant. Considering the developments in information and communication technologies, more and more services are becoming tradeable and thus turn into 'impersonal services' that are possible to provide abroad. The author especially emphasizes the necessary change in looking at skill levels. The traditional idea is that highly qualified workers are providing personal services and are winners of proceeding globalisation, whereas less qualified workers are associated with impersonal services and are therefore considered losers. However, the exposure of jobs to offshoring is not necessarily linked to the skill level. For instance, software development can be classified as impersonal services that can be transferred abroad, whereas hairdressing is a personal service that has to stay local.

Blinder (2005) sees the offshoring activities that are just starting as the early stages of a *Third Industrial Revolution*<sup>4</sup>, the *Information Age*. In order to allay the related fears he writes: "Just as with the first two industrial revolutions, massive offshoring will not produce massive unemployment. Nor should we view it as a long-run threat to our standard of living. The world gained enormously from the first two industrial revolutions, and we are likely to do so from the third as well" (Blinder 2005: 9). But

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<sup>4</sup> Blinder (2005: 7) with the First Industrial Revolution being the shift from farm to factory (mainly taking place in the 19th century) and the Second Industrial Revolution the shift from manufacturing to services (20th century and still ongoing).

this will be accompanied by social and economic frictions. A heavy burden of adjustment lies on the educational system. Just to provide more education might turn out not to be sufficient. The question is also for which professions or tasks workers should be prepared. Blinder concludes that maybe the job alienation as a frequently observed outcome of the First Industrial Revolution might well be a fading phenomenon.

The requirements for the international and interregional division of labour in the Information Age might have further consequences. On the basis of a trade model that treats the cost-reducing effect of offshoring like technological progress, Robert-Nicoud (2008: 518) discovers that "(...) offshoring triggers a specialisation by function rather than by sector." Grossman/Rossi-Hansberg (2006) also finds effects of trading and offshoring on the character of tasks needed to produce final goods. In their view, "(...) international trade is less today a matter of countries' specialization in particular industries and more about their specialization in particular occupations and tasks." Grossman/Rossi-Hansberg (2008: 1). The authors develop a model that breaks down the wage effects of new developments in information and communication technologies into three parts: a productivity effect, a relative-price effect and a labour-supply effect. They show that the productivity effect of transferring tasks abroad – that can be seen as factor-augmenting technological progress – can dominate the other two effects. This possibly entails an *increase* in domestic demand of the type of workers whose jobs are exposed to offshoring. Therefore, their wages might rise as well.

Jabbour (2007b) takes into account the transaction costs involved in internationalisation and analyses the effects on the productivity of companies. She finds positive effects of both outsourcing and offshoring on productivity. But taking a closer look at the latter reveals that only offshoring to other companies leads to significant profits, whereas intra-company offshoring even reduces profits, especially when high-tech inputs are imported. The author also compares different theoretical models explaining offshoring and tests the hypotheses again with French data (Jabbour 2007a). She checks which internationalisation strategy is followed by companies and finds "(...) that most productive and large firms engage in partnerships, low productive and low scale ones vertically integrate while firms with intermediate levels of productivity and scale outsource from independent suppliers" (Jabbour 2007a: 38 f.).

### **2.3 Economic integration and highly asymmetric border regions**

The European Union included some of the Central and Eastern European countries in its *Generalised System of Preferences* (GSP) as early as the fall of the Iron Curtain in 1989. One reason was to extend the positive micro-economic effects and dynamics of economic integration. For former 'border countries' this meant a deep change in economic relationships. Eight of the ten new member states of the 2004 enlargement are Central and Eastern European post-socialist countries. With regard to Germany, for instance, two of them are direct neighbours and all of the eight countries have Germany as a geographically proximate 'old' member state. After

May 2004 this led to dynamic developments of foreign trade that markedly exceeded the growth rates of exchange with former trading partners inside and outside the EU.<sup>5</sup>

For studies in general, special attention has to be devoted to border regions: “Borders affect economic activity in border regions since they generate barriers that raise the costs of cross-border interaction and reduce the transfer of information and knowledge” (Niebuhr/Stiller 2006: 60). As far-reaching economic integration not only abolishes trade barriers but also reduces the impact of national borders, the effect on border regions can be expected to be even larger than on the rest of the country, especially in interfaces with high discrepancy in GDP per capita.

Krätke (2001) provides empirical evidence that the German-Polish border region hardly profits of the possibilities of economic integration. The author speaks of a ‘leapfrogging effect’, i.e. cross-border activities like offshoring and FDI mainly happen transnationally between economically strong regions in both countries – consequently the border region suffers of increasing traffic, but has no welfare gains. From a theoretical point of view, Forslid (2009) demonstrates with a New Economic Geography footloose model – it includes three regions differing in size – that in certain parameter constellations economic integration without accompanying regional policies leads to a total deindustrialisation of the peripheral region. However, welfare is growing in all three types of region.

In the context of NAFTA, the impacts of trade along the US-Mexican border are investigated by Feenstra/Hanson (1997). The authors develop a theoretical model with trade of intermediate goods. They find that US firms are outsourcing activities with – by American standards – relatively low skill requirements, but need relatively highly skilled workers from a Mexican perspective. As a consequence of the relative labour demand shifts due to integration, the skill premium increases on both sides of the border.

Enright et al. (1997) study the relationship between Hong Kong and the Chinese Mainland. They also argue for positive economic effects on both sides when exchange is started in a border land situation with extraordinary wage differentials. Not only do wages and employment in the low-wage region increase but the high-wage region also gains. “In Hong Kong’s case, decentralization of the vast majority of its manufacturing has resulted in an eight to tenfold increase in production controlled by Hong Kong firms in the last two decades” (Enright 2003: 110)<sup>6</sup>.

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<sup>5</sup> Untiedt et al. (2007) give a broad, concise analysis and description of the effects of EU enlargement on Germany. In several aspects, the country seems to have benefited more than expected from the new situation.

<sup>6</sup> Referring to Enright et al. (1997).

As the EU enlargement process transforms some former peripheral external borders of the EU into centrally located internal borders, the integration effects should be even stronger than in other regions, especially on the goods and the labour markets. Due to geographical proximity, outsourcing of different economic activities is possible with comparatively low transaction costs and enhanced possibilities for offshoring emerge.

For labour market integration, Niebuhr/Stiller (2006) give an overview of theories that touch the topic of effects specific to border regions: traditional location theory, New Economic Geography, trade theory and migration theory. The empirical analysis of spatial structures and their cross-border interdependencies in internal border regions versus external and non-border regions reveals that the "(...) spatial dependence between neighbouring labour markets in Europe is relatively low along national borders" – concerning not only the new internal borders of the 27 EU member states after enlargement, but the borders of the 15 already highly integrated "old" member states.

Moritz/Gröger (2007) focus on the labour market situation along the border between the Czech districts of Western Bohemia and the German districts of Eastern Bavaria. This border region was characterised by one of the world's largest spatial wage differentials. Analysing the development from 1980 to 2001, they capture the labour market effects of the fall of the Iron Curtain in 1989 that had already changed the pre-accession border situation massively. They expect structural shifts in the labour market due to extensive offshoring possibilities. However, changes in the skill structure in Eastern Bavaria follow the same pattern as in comparable rural regions and in the entire federal state of Bavaria – a trend towards higher qualifications and a convergence towards the national average. As for wage differentials, they also find a catching-up effect of wages for skilled and highly-skilled workers and a non-significant change for low-skilled workers. There is no evidence for either a significant positive or negative special effects for the Bavarian-Bohemian border region after the fall of the Iron Curtain.

Marin (2004) addresses fears in Austria and Germany concerning possible job transfer due to Eastern Enlargement. She uses a survey data set that covers all of the German and 80 percent of the Austrian direct investment projects from 1990 to 2001 in the (future) new member states with the two countries being the most important investors. Her results show that outsourcing activities both in manufacturing and services are considerable, but that the job losses are much lower than expected. Marin (2004) gives two explanations for this. First, the horizontal foreign direct investment dominates which often serves as a strategy of market entry. Second, in the case of vertical foreign direct investment there is no net substitution of jobs in the source country to the target country. As a consequence: "German and Austrian firms increase their production and employment demand in Germany and Austria when workers in their affiliates in the accession countries become less costly" (Marin 2004: 22). This is due to the general increase in profitability when companies

use the advantages of international division of labour. Companies with advantageous cost structure can survive easier in a competitive world. In contrast to the results of Feenstra/Hanson (1997), the author also finds that – down to the good endowment of skills in the accession countries and the low percentage of skilled workforce at home – both Austria and Germany transfer high-skill and R&D activities on unexpected large scale to their Eastern affiliates (Marin 2004: 28 ff.).<sup>7</sup>

## 2.4 Functional specialisation

Outsourcing and offshoring can occur simultaneously. As for outsourcing, Rossi-Hansberg et al. (2009) develop a theory concerning firms that can split up their internal production processes into headquarters and production plants. Both can locate either in the centre of a city or on its edge. Their work is based on the empirical observation that the internal structure of cities in the US has changed hugely over the last few decades. Data of the 50 largest Metropolitan Statistical Areas in the USA between 1980 and 1990 (and partially available data extensions for 1970 to 2000) reveal that population in the cities grew considerably, both in the centre counties and the edge counties. This was coupled with employment growth and an increasing number of establishments, whereas the size of plants and establishments declined in all city areas. Relatively speaking, the shares of population and employment on the edge of the cities increased.

Rossi-Hansberg et al. (2009) observe that this movement in economic activity to the periphery is mainly down to non-management and not to management occupations. However, they find no evidence that this shift is driven by any specific industry or sector. “One interpretation of the theory we present, and the empirical evidence more broadly, is that with firms sending their larger and more routine operations to the periphery, city centers are steadily becoming management or administrative hubs.” (Rossi-Hansberg et al. 2009: 145). Their theory helps explain these transformations in urban structure by showing that population growth is the driving force behind changes in firms’ internal organisational structure. They shift from integrated operations to a structure with headquarters and management in the centres and production plants on the outskirts.

Duranton/Puga (2005: 345) observe similar developments in the division of labour between cities of different sizes: “By 1980 differences across cities had increased substantially and a clear ranking by size had emerged: larger cities had become specialised in management functions whereas smaller cities had become specialised in production. This pattern became even more marked over the following decade.”

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<sup>7</sup> Lorentowicz et al. (2005) in their study on the international division of labour ascertain the same pattern for Austria and Poland – high-skilled jobs go to the low-wage country, low-skilled jobs stay in the high-wage country.

They call this the shift from ‘sectoral specialisation’ to ‘functional specialisation’ – i.e. to production of final and intermediate goods versus headquarters and business services. The integration decision of firms in the model of Duranton/Puga (2005) is determined by the trade-off between the benefits of having production and management facilities located in their specialised environments and the benefits of having a single location, respectively. The cost advantage of the latter declined rapidly in the decades under consideration thanks to technological progress in management methods and communication technologies.

## 2.5 Market integration and industrial clusters

The integration of markets lowers transaction costs for companies to locate in favourable business environments – worldwide. Companies can more easily exploit the advantages of vertical integration, offshoring and outsourcing. For regions this results in fierce competition over companies and highly skilled or creative workers. It is no longer predominantly the traditional factors like infrastructure, resource endowment and geographical location that attract investment, but dynamic factors like availability of personnel with the necessary qualifications and existence of universities and research institutions – in other words an environment favourable for innovation and knowledge spillovers. Companies locate where they find this advantageous atmosphere. It can be observed „(...) that even as competition and economic activity globalize, (...) competitive advantage can be localized” (Enright 2003: 100). Porter (1990) calls this the ‘location paradox’. To make their economic strengths, advantages and distinctive features visible, regions strongly focus on promoting regional clusters.

## 2.6 Agglomeration economies and industrial clusters

The correlation between economic growth and agglomeration is well known. Looking at traditional explanations, regional economics differentiates between two major types of agglomeration advantages: *localisation economies* as the benefits resulting from concentration of companies in a specific industry on a given location<sup>8</sup>, and *urbanisation economies* as positive external effects between spatially concentrated different industries. Both benefits are typically restricted to companies and individuals in the same economic space. The interaction of these factors leads to agglomeration advantages that can also be measured empirically: Ciccone/Hall (1996) estimate a productivity growth of four to six percent for the USA with the doubling of population density; for Europe a similar effect is shown (Ciccone/Cingano 2003; Baptista 2003; Möller/Haas 2003)<sup>9</sup>. And Lehmer/Möller (2009) – controlling for

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<sup>8</sup> Marshall (1890) describes localisation economies as externalities of knowledge spillovers, input sharing and labour market pooling (see also Rosenthal/Strange 2003).

<sup>9</sup> Agglomeration also has disadvantages, for example congestion, higher costs of living and bad environmental conditions like pollution.

urban-rural skill bias, individual characteristics, regional industries and firm-size effects<sup>10</sup> – find an urban wage premium of 8.6 percent in Germany.

In addition, a range of dynamic local externalities contribute to the growth and success of regional clusters. An important milestone in New Economic Geography – which discusses models based on monopolistic competition (Dixit/Stiglitz 1977; Ethier 1982) in a world with transport costs in the widest sense, scale economies and externalities of market size (e.g. Krugman 1991; Ottaviano/Puga 1998; Fujita et al. 1999; Fujita/Thisse 2002; Head/Mayer 2003) – is Krugman’s core-periphery model that has been extended and modified several times (e.g. Krugman/Venables 1995; Helpman 1998; Puga 1999; Forslid/Ottaviano 2003). The interplay of production, consumption and localisation decisions in certain constellations can develop centripetal forces that lead to a centralisation of production. The characteristic feature of value chains or supply chains is vertical integration with its forward and backward linkages, externalities that affect a company because of changes in either suppliers’ or customers’ actions (Hirschman 1958).

These local interactions of companies and consumers are one prerequisite for clustering. The analysis of horizontal links between companies – including mutual learning effects and therefore fostering innovation – provides another approach to looking at clusters. The three factors Feldman/Audretsch (1999) stress to make the step towards successful innovation clusters refer to these horizontal interconnections. First, complementary activities should be diverse to a certain extent and, if possible, share a thematic platform. This recurs concerning empirical results for example by Glaeser et al. (1992) and Jacobs (1969), showing that diversity proves to be more conducive to innovation than specialisation. Second, they conclude that the endowment with technological potential in the past only partly explains the development of innovation clusters. For successful progress it seems to be far more important to efficiently organise the existing structures and business contacts: “The underlying economic and institutional structure matters, as do the microeconomic linkages across agents and firms” (Audretsch 2003: 19). Third, they state that competition spurs innovation more than a monopoly (Glaeser et al. 1992; Audretsch/Feldman 1996). It is not just the fact of competition stimulating technological developments, but also the cooperation among competitors. For this constellation, Brandenburger/Nalebuff (1996) coins the notion ‘co-opetition’. According to Jonas (2005), from the sociological point of view competition and confrontation play crucial roles in clusters, but this interplay is hardly included in the analysis.

Along with cooperation and the efforts of establishing contacts and staying in touch – be it between horizontally or vertically interlinked companies or diagonally linked research institutions – comes the exchange of information and knowledge, as already observed by Marshall (1890). “‘Knowledge’ differs from ‘information’ in that it

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<sup>10</sup> The “raw” premium is about 15.5 percent.



is creative and informed by meaning and understanding, whereas information is passive and, without the application of knowledge, meaningless” (Cooke 2007, footnote 3). Information can also be termed ‘explicit knowledge’, in contrast to ‘tacit knowledge’ introduced by Polanyi’s seminal work (1966). The latter is hard or even impossible to codify, it is bound to individuals and therefore to locations and regions which causes its character to be ‘sticky’.<sup>11</sup> Both specifications of knowledge are mutual complements (Polanyi 1966; Nonaka 1991).

Local knowledge spillovers, also termed ‘spatially bound knowledge externalities’ or ‘non-market based knowledge flows’, are strongly connected to sticky or tacit knowledge. They can be considered a local pool of knowledge that is nurtured through social interaction that typically happens more frequently in geographical proximity. Knowledge spillovers are seen as an important part of economic growth, but still the process as such as well as the possibly selective transmission of tacit knowledge is conceptually unclear and has not been sufficiently modelled or measured – according to Breschi/Lissoni (2001) it is still a black box.<sup>12</sup> Consequently, Howells (2002: 876) argues that „(...) most of the metrics imply the imparting of knowledge, but do not actually measure it.“

However, there is a strand of literature on the possibilities of pinning down the ‘invisible’ effects of knowledge transfer. In this context, Jaffe et al. (1993) try to localise and quantify these effects by analysing the ‘paper trail’ left by patent citations.<sup>13</sup> They find that spillovers not only occur in technologically close fields, but that important knowledge externalities also come from other industries. Ten years earlier Scherer (1982) had already used this methodology to point out the importance of inter-industrial spillovers on a company’s productivity growth. Also the pioneer work of Jacobs (1969) stresses the positive influence of diversity on knowledge externalities and therefore on innovation.

Almeida/Kogut (1997) show evidence of clear localisation effects in the US semiconductor industry also by looking on citations in new patents as an indication of knowledge flows. According to Bottazzi/Peri (2003), knowledge externalities can be measured by observing the effects of spending in research & development in one region on R&D productivity in neighbouring regions. Estimating the effects of doubling R&D expenditures, they find an 80 to 90 percent increase in innovation in the region of origin, two to three percent in a 300 km radius and no effect further away. 50 percent of new patents in the EU-15 countries as well as 50 percent of R&D

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<sup>11</sup> Von Hippel (1994) introduces the notion ‘sticky’, Audretsch (2003) adapts it to ‘sticky knowledge’.

<sup>12</sup> See Breschi/Lissoni (2001) for a critical assessment of the concept of localised knowledge spillovers, the abuse of the notion and implications for further research.

<sup>13</sup> A reference to Krugman’s often quoted lines (1991: 53 f.): „(...) knowledge flows, by contrast, are invisible; they leave no paper trail by which they may be measured and tracked, and there is nothing to prevent the theorist from assuming anything about them that she likes.“

spending are allotted in five out of 86 regions. Several authors<sup>14</sup> introduce spatial aspects in the knowledge production function. Using this method, Audretsch/Feldman (1996) show that the innovative output of all companies in a region increases with the overall R&D inputs.

However, Breschi/Lissoni (2009) divide localised knowledge flows into pure externalities being non-market based social interactions and market-based knowledge exchange pinned down in formal cooperation. In the framework of the patent citation method by Jaffe et al. (1993), the latter is observed with a geographical analysis of inventors' mobility across companies in selected industries in the US. To employ a mobile inventor and thus to profit of the knowledge (tacit and explicit) he gathered in former contracts is connected with a price. Thus, the authors include social network analysis and also look at co-invention networks with short social chains. Their results reveal that a high share of localised knowledge flows are down to the market transactions of mobile inventors, and as they rarely move out of their co-invention network the geographical aspect is strong. They conclude that informal interactions are by far overrated for the explanation of the diffusion of tacit knowledge.

A further important feature of clusters are diagonal interlinkages between companies and research institutions. They become important particularly in regard of innovation. As for the local knowledge spillovers from universities, Jaffe (1989) and Varga (1998, 2000) show positive effects of university research on the number of new patents of local companies, Anselin et al. (1997) on high-tech innovations. And Acs et al. (2002) carry on the approach to show their positive impact on local employment in high-tech industries.

Literature distinguishes three forms of knowledge externalities: both Marshall-Arrow-Romer (MAR) and Porter externalities see localisation economies as a source for local knowledge spillovers and regional growth, but they differ in their view on the role of competition. MAR puts emphasis on the 'threatening' character of knowledge spillovers as through espionage and poaching. They argue that local monopolies allow firms to get the maximum return out of their investments in research & development and human capital. Porter however stresses the quality of local competition to spur innovation and diffuse knowledge.<sup>15</sup> Jacobs (1969) follows his view on competition, but Jacobs externalities emphasize the role of diversity and inter-industry spillovers, i.e. urbanisation economies.

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<sup>14</sup> Jaffe (1989), Feldman (1994) and Audretsch/Feldman (1996), see Audretsch (2003: 17).

<sup>15</sup> However, there is mixed evidence. In their study of the determinants of spatial concentration in German high-tech industry, Alecke et al. (2006) do measure the localisation economies introduced by Marshall (1890) – being input sharing, labour market pooling and knowledge spillovers. They regress the Ellison/Glaeser index of geographical concentration on different industry characteristics and find only weak effects for labour market pooling, for input sharing strong effects on agglomeration. Their results show no evidence for knowledge spillovers between high-tech companies and conclude that for the geographical range used, knowledge spillovers do not contribute to agglomeration.

In addition, sociological literature also challenges the 'automatism' that regular personal contact and direct interaction create trust and reciprocity within clusters (Shrum/Wuthnow 1988). Questions that arise are, for instance, which formal and informal rules enable the cohesion of clusters, whether a certain collective behaviour can be observed in a cluster context and how collective identity is created and sustained within clusters. Cluster structures can be seen as specialised networks with power and control playing a central role (Hakanson/Johanson 1993; Uzzi 1997; Abraham 2001; Blumberg 2001). Network analysis can contribute to the discussion with statements on cohesion, the density of relation and connectivity or the degree of centralisation, e.g. whether certain clusters are dominated by one agent or 'leading company' (Jansen 1999, 2002).<sup>16</sup> Sociological aspects help explain – beyond economic reasons – why companies cooperate with others, which framework they prefer, what their expectations are or how strong the cluster awareness within a region is. The common scenario of 'self-fulfilling harmony' in regional clusters will gain some additional twists.

Pervading all these aspects is the notion of geographical proximity. Torre (2008a) questions the need for co-location and the frequency of face-to-face contact necessary for knowledge spillovers and innovation. He does not go as far as Cairncross (1997) to proclaim the 'death of distance' due to new information and communication technologies. Neither does he follow the literature on epistemic communities (like the network of Linux developers) and communities of practice to the end, claiming that geographical proximity is not at all necessary and all knowledge transfer can happen entirely in cyberspace. Based on empirical observations, e.g. that even in epistemic communities project leaders have to meet personally, that (professional) mobility concerning both distance and time away from home increases and that new developments in information and communication technologies leads to "(...) actor's ubiquity" (Torre 2008a: 876), he states that temporary geographical proximity with meetings in certain stages of an innovation project is adequate for knowledge exchange.<sup>17</sup>

The possible negative effects of being located close to suppliers, customers and cooperation partners are scarcely noted. Torre (2008b: 37) lists three major sources of possible problems. First, he states that the local diffusion of knowledge cannot only spur innovation, but can also mean "(...) knowledge leaks, industrial espionage, and poaching of specialist employees". This happens especially in clusters in which activities of different economic actors are technologically closely linked and with participating innovation and technology leaders. Second, Torre (2008b: 37) names the negative aspects of lock-in, such as the possibility that a cluster is "(...) plagued by excessive specialization or trapped in mono-activity (...)" or exclusivity. His last

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<sup>16</sup> Examples of applied network analysis in the cluster context can be found in Cantner/Graf (2006) and Wrobel (2004).

<sup>17</sup> However, permanent geographical proximity is especially sought after by SMEs, as big companies can more easily send their employees on longer business trips abroad.

point is the nature of communication between cluster members: it is possible that in a comfortable situation of co-location interactions are reduced to routines, but that exchange does not lead to any new impulse.

## 2.7 The concept of European Metropolitan Regions

By nature, the cores of metropolitan regions are densely populated urban areas. The correlation between economic growth and agglomeration in Europe can already be observed during the Industrial Revolution. High economic growth goes along with urbanisation, the emergence of industrial regions and deepening regional disparities (for instance Martin/Ottaviano 2001; Duranton 1999). Consequently Fujita/Thisse (2002) argue that agglomeration can be seen as the spatial counterpart of industrial growth.

An ambitious central objective of the Lisbon Strategy for the European Union – as discussed at the EU Summit 2000 – is the creation of “(...) the most competitive and dynamic knowledge-based economy in the world, capable of sustained economic growth providing more and better jobs and greater social cohesion” by 2010 (Lisbon European Council 2000). One means to achieve this aim is the creation of European Metropolitan Regions, considered to be “(...) the motors of societal, economic, social and cultural development. They are taken for spatial and functional locations whose outstanding functions on an international scale also radiate across the national borders” (Adam et al. 2005: 417).<sup>18</sup> Thus, European Metropolitan Regions are designed to put agglomerations on an international stage.

And in the European Spatial Development Perspective 1999 it is pinned down that a polycentric approach should improve spatial balance in Europe: “The creation of several dynamic zones of global economic integration, well distributed throughout the EU territory and comprising a network of internationally accessible metropolitan regions and their linked hinterland (towns, cities and rural areas of varying sizes), will play a key role” (European Communities 1999: 20). I.e., being based on the idea of Functional Urban Areas in the EU, they comprise not only an urban agglomeration, but also extensive surrounding rural areas – the concept takes into account the space influenced by a city. This radius does not necessarily coincide with political or administrative boundaries, but is characterised by commuter flows, for example, indicating a common labour market.

Within the economic space of a European Metropolitan Region, economic development typically varies considerably. In a long-term study, Bade (2007) shows that from 1960 to 2006 employment in the West German metropolitan core cities fell by roughly ten percent, whereas it increased in the surrounding urbanised districts by nearly 60 percent. Interestingly, it is not the core cities but the peripheral regions which are the winners in structural change. This is true not only for changes in

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<sup>18</sup> translation by the authors

employment but also for GDP growth. Moreover, Bade (2007) presents some evidence that the phenomenon cannot be explained by the well-known suburbanisation process alone. Hence the concept of strengthening metropolitan regions is questionable if it is meant as a highly dynamic core giving momentum to the periphery. It is reasonable only if the whole economic space is considered in order to revitalise its interlinkages in a comprehensive and symmetric manner.

Despite the sceptical view of past development as expressed by Bade (2007), metropolitan regions can be seen as focal points in an upcoming knowledge and information society. A wide range of studies shows that the share of research and development as well as the share of highly skilled workers is substantially higher in densely populated regions than in rural areas. Glaeser/Saiz (2004) argue for the causality of high urban productivity and high urban growth rates leading to high skill levels both in cities and metropolitan statistical areas.<sup>19</sup> This triggers a dynamic process since skilled people attract more skilled people. Berry/Glaeser (2005) and Moretti (2004) report an increasing divergence in skill levels for US cities – in their findings ‘smart’ cities experience a far higher growth in the share of highly skilled workers than agglomerations with a lower initial level of education. According to Südekum (2008), for West Germany these concentration forces are less strong. In contrast to results from the US, he even shows a convergence of skill levels across regions as well as within industries. However, the data from 1977 to 2002 also indicate that regions with a higher initial level of education experience a higher increase of total employment.

Against this economic background stands the creation of European Metropolitan Regions with their objective to “(...) maintain the productive capacity and competitiveness of Germany and Europe and help accelerate European integration” (COMMIN). Taking a look at some features of European Metropolitan Regions, some analogies to the cluster concept are eye-catching.

### **3 The analysis of industrial clusters**

#### **3.1 Pros and cons of clustering**

An extensive debate about the critical aspects of the cluster concept has been sparked by the publications of Porter, and especially by his diamond model of competitiveness (1990 and ensuing papers, reviving the importance of localisation economies in times of proceeding globalisation). This focus is mainly down to the popularity of the policy-oriented part of his work that has served as the basis for the implementation of regional cluster policies worldwide, from industrialised to developing countries. “Porter’s work met with even greater response than Krugman’s, since its implications are not confined to economics. Rather they directly apply to the work of policy makers at the local as well as at the national level” (Torre 2008b: 32). This

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<sup>19</sup> They show that double the number of colleges per capita in 1940 leads to four percent higher urban growth in the decades between 1970 and 2000.

is also observed by Martin/Sunley (2003) – their critical appraisal of Porter’s diamond model of competitiveness found many recipients. They state that a major reason for the success of the concept is the creation of a brand called ‘cluster’. It is picking up various ideas of economic geography approaches like industrial districts, innovative milieux, learning regions, regional innovation systems and networks,<sup>20</sup> but applies strongly to practitioners with the aim of enhancing competitiveness and a well-written business strategy.

Martin/Sunley (2003) give a critical survey of the theoretical and analytical base of the cluster concept, the empirical grounds it rests on and the way it is implemented on the practical side. An argument for the popularity of Porter’s work is the flexibility of the construct which makes it feasible for a wide spectrum of applications. The authors warn against careless use, as “(...) the mere popularity of a construct is by no means a guarantee of its profundity” (Martin/Sunley 2003: 7). However, the “(...) successive refashioning of an already soft concept furthermore allows it to keep up with changing trends and thereby remain ‘marketable’” (Torre 2008b: 34).

In this critical context Feser (2008: 196) remarks “(...) that devising recipes for building clusters according to ideal-types (...) has become a multi-million dollar consulting business.”<sup>21</sup> The confinement to the ideal-type of clusters – “(...) leading export-oriented industries in selected industrialized countries” (Feser 2008: 196) and the neglect of declining or dying industries – is one aspect in his critical appraisal. And Feldman/Braunerhjelm observe: “Lists of attributes of successful clusters tell us little about how these clusters get started and what differentiates successful clusters from places where investments yield no significant benefits for the local economy” (Feldman/Braunerhjelm 2006: 1 f.).

Not much is known yet about the evolution of clusters. Their life cycle cannot be compared with the developments of the industry they are associated with (Menzel/Fornahl 2007) and especially their first step and emergence is distinct and often only visible in hindsight. Feldman/Braunerhjelm argue that “(...) while mature clusters may look similar, what really matters is the process by which clusters come into existence” (Feldman/Braunerhjelm 2006: 2) and “(...) some triggering events coupled with an entrepreneurial spark seem necessary in order for industry clusters to emerge and enter a sustainable growth trajectory” (Feldman/Braunerhjelm 2006: 3).

Feser (2008) therefore suggests that not ‘building clusters’ should be the policy focus but ‘leveraging synergies’: “(...) innovation policies should aim to nurture and exploit innovative synergies between interdependent firms and institutions, regard-

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<sup>20</sup> See for instance Barjak and Meyer (2004) for a detailed discussion about the differences of these concepts.

<sup>21</sup> For the scope of Porter’s work see also the websites of the “Institute for Strategy and Competitiveness” ([www.isc.hbs.edu](http://www.isc.hbs.edu)) and “TCI – The Competitiveness Institute” ([www.competitiveness.org](http://www.competitiveness.org)), on the website described as “(...) the global practitioners network for competitiveness, clusters and innovation”.

less of whether a discrete spatial cluster emerges as a result” (Feser 2008: 198). The point is not to create clusters for the sake of it, but to try and prepare rich soil for cluster prerequisites to grow.

Duranton (2008) argues in the same direction. He asks whether the aim of Porter’s diamond – to create and enhance regional competitiveness – is enough motivation for the implementation of an often quite costly policy.<sup>22</sup> His look at the mechanics of clusters unearths major inefficiencies and leads him to conclude that the proposed policies can hardly deal with “(...) solving a very difficult co-ordination problem and correcting for a number of market failures, which we know very little about” (Duranton 2008: 42). Looking at a catalogue of expected benefits of clusters and their methods of estimation shows that even the ‘very modest’ effects are probably over-rated. Both Duranton (2008) and Martin/Sunley (2003) point out that the question of causality between regional growth and geographic concentration has not really been answered yet.

An additional critical aspect concerns the long-run development of regional specialisation. As empirical studies show, the specialisation of regions tends to decline (Kim (1995) for USA, Möller/Tassinopoulos (2000) and Haas/Südekum (2005) for Germany). The measurement concept in these studies is based on conventional industry classifications. However, looking at specialisation not only along intra- but also along intersectoral regional value chains the picture may change. In an automotive cluster, for instance, there are producers from the metal, plastics and electronics industries, among others. Standing for many examples, Porter (1998) identifies a medical technology cluster in Massachusetts (USA) with over 400 companies that was hidden in the statistics due to their highly diverse industry affiliation.<sup>23</sup>

Sölvell (2008: 91) defends Porter’s diamond cluster concept and brings to mind the evolution of his groundbreaking publication as being “(...) offered as tool for scholarly analysis, it became much more used as a tool by policymakers. And policymakers have in many cases, while referring to Professor Porter, used the tool for many other purposes than what was originally thought.” He also clearly distinguishes between the proposed ‘evolutionary view of the world’ and the widely criticised ‘constructive view of the world’. The latter really is prevalent in practical implementation as a survey of cluster and network managers in Germany underpins (Wrobel/Kiese 2009).

Despite all the critical aspects. it is a matter of fact that cluster development has become a cornerstone of regional economic policy in the last two decades. Empiri-

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<sup>22</sup> Duranton (2008) gives an overview of the complexity of the model, the difficulties resulting from this specification, inefficiencies arising and what is missing.

<sup>23</sup> See Möller/Litzel (2008) for applying cluster data from the Eastern Bavarian research project CORIS (cluster-oriented regional information system, [www.coris.eu](http://www.coris.eu)) to established measurements of regional specialisation and spatial concentration of economic activities. Included are horizontal, vertical and diagonal interlinkages.

cal studies present overwhelming evidence for the existence of clusters. The practical relevance of the phenomenon cannot be denied. Clusters are dealt with in a wide spectrum ranging from highly formalised models of regional economic theory to practical training units for business development institutions.

One reason for the popularity of clusters might lie in the fuzziness<sup>24</sup> of the concept. Porter's definition given in the introduction leaves open how to exactly interpret 'geographical proximity', 'particular field' or 'various types of externalities'. One could imagine a black box with no sharp outlines, unknown size and unspecific complexity. And this blurry picture is what many definitions have in common.

There is another important caveat with respect to the definition problem. Several authors emphasise the considerable differences between the structures of clusters, be it the variety between countries, regions, technological fields or hierarchical structures (Guinet 1999). As (Enright 2003: 101) puts it: "Similar terminology is used for clusters with widely different characteristics. 'Cluster' terminology seems so embedded that one despairs of redefining or sharply defining the term." This variety should not be neglected in data collection and analysis and hampers the operationalisation of clustering as a workable empirical concept. It seems that a passe-partout is illusionary.

Sound empirical analysis of the concept therefore requires a proper identification strategy. On taking a closer look, the definitions offer a range of possible topics and approaches. Kiese (2008) denotes clusters as eclectic concept, combining parts of theories with different perspectives from economics, economic geography, sociology and political science. However, the practical developments worldwide – with cluster policies implemented by cities, counties, districts, regions, nations – are far ahead of their analytical pervasion.

### **3.2 Cluster identification methods**

An approach for identifying clusters can be based on a characteristic ingredient of the concept, the regional concentration of certain economic activities. In the vast literature on the exploration of the distribution of economic activity in space<sup>25</sup>, certain measurement concepts get close to the nature of clusters, both from a top-down and a bottom-up point of view.

As an important example of a top-down approach, the index of geographical concentration as developed by Ellison/Glaeser (1997) must be mentioned. Based on a 'dartboard method', where companies choose their locations randomly, the authors differentiate between various forms of geographical concentration of employment. Geographical concentration may result from single companies running big plants

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<sup>24</sup> Also noted by Martin/Sunley (2003).

<sup>25</sup> Combes/Overman (2004: 2857ff.) provide a range of criteria for identifying good measures for spatial location of economic activities.



that dominate the regional industry structure, or the (co-)location decision of different companies. The Ellison/Glaeser index allows one to “compare with more confidence, for example, the concentration of American and European industries, the concentration of high- and low-tech industries, and the changes in levels of concentration over time” (Ellison/Glaeser 1997: 890 f.).<sup>26</sup>

Alecke et al. (2006) apply the Ellison/Glaeser index to German high-tech manufacturing industries in order to examine “(...) the existence and strength of *localization* economies as opposed to *urbanization* economies which occur *across* industries” (Alecke et al. 2006: 22). In this context, they use the notion of ‘clusters’ for agglomeration patterns of a three-digit industry.

Another top-down method is suggested by Sternberg/Litzenberger (2006) – the ‘cluster index’. It avoids problems of arbitrariness coming with the bottom-up approaches and also allows comparability between regions and industries focused on in different studies. The authors combine measures of spatial concentration and spatial specialisation that can be calculated with easily available regional data. When a region exhibits above-average concentration and specialisation in a certain industry, this is not, in their eyes, a sufficient indicator for the existence of a regional cluster. The authors therefore also control for firm size. However, they conclude that the ‘cluster index’ can capture what is defined as a ‘regional cluster’ by the European Commission, being the first hierarchical step in cluster identification. To include the linkages between companies and between companies and institutions and therefore identify ‘regional innovation systems’ or ‘regional innovation networks’<sup>27</sup>, the index has to be complemented with bottom-up methods also focusing on cross-industry structures of value chains.

Because of these characteristics, Enright (2003) develops a different approach. He suggests a range of criteria (termed ‘cluster dimensions’) to provide a useful and applicable classification for various types of clusters. These dimensions cover aspects like geographic scope, density, breadth, depth and stage of development of the clusters. Moreover, characteristics of firms forming the clusters like geographic span of sales, technological activity and innovative capacity as well as ownership structure play a role for classification. The data he uses stem from a survey carried out with cluster experts worldwide, generating 160 detailed descriptions of working clusters. It turns out that they vary widely with respect to all of the dimensions. Nevertheless Enright (2003: 102) argues that the characterisation “(...) along these dimensions allows one to understand their potentials and problems in ways that can inform policy and strategy.”

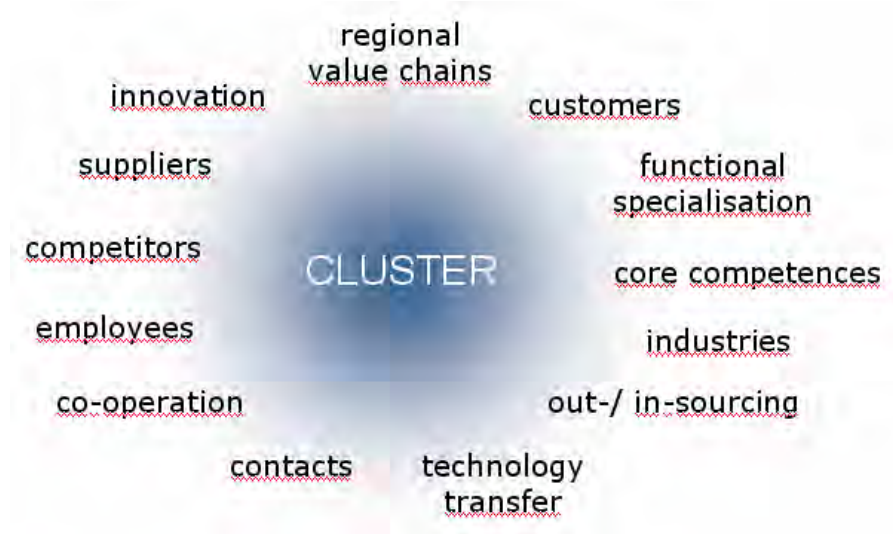
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<sup>26</sup> An even more general concept for measuring spatial concentration has been developed by Duranton/Overman (2002). Since the data requirement for calculation of the proposed index is high, the concept has rarely been applied in practice yet.

<sup>27</sup> The authors use the definition by the European Commission.

Unfortunately, most of Enright's cluster dimensions remain fuzzy as well (Möller/Litzel 2008). The underlying problem is that economic space is the result of a process of formation of business, growth and decline. It reflects economic and political history, regional circumstances like accessibility and market potential, availability of natural resources, artisan traditions, impacts of economic policy etc. Additionally, value chains, in which regions are typically specialised, are extremely different in their complexity, and their requirements of technology, skills and logistics. As a result, the structure of every economic space as a conglomerate of all these forces is as idiosyncratic as any organic structure. Figure 1 tries to capture the most important aspects of clustering. Again, it becomes clear that the concept with its different approaches is blurry and encircles company-oriented questions.

**Figure 1**  
**The complexity of cluster-related aspects**



source: own illustration

### 3.3 A methodology for cluster identification

To identify a region's clusters and to encompass different approaches offered by the literature, we develop a methodology<sup>28</sup> to register the value-chain-oriented structures and functional specialisation systematically in an economic space. Cluster-relevant individual firm data are collected and backed by geographical information.

The survey is conducted along the core competencies of individual companies and institutions and their interactions that can be observed on the micro-level. The methodology involves several interconnected elements. To gain a first insight into the economic structures and to identify the leading companies in the region, in-depth interviews with experts from different institutions are conducted. In the following, members of the managing boards of the leading companies are interviewed as well, leading among others to information about further relevant firms and institutions in

<sup>28</sup> This section is based largely on section 8.3.1 in Möller/Litzel (2008).

the region that are also considered for further interviews. As many different fields of interest have to be taken into account, a detailed manual for each type of interview is developed.<sup>29</sup> After this stage, a rough outline of the region's economic system is visible, including first indications about the segments covered by regional competencies as well as about relevant companies and institutions. The extent of cluster-specific geographical space also becomes clearer. Typically it turns out that cluster regions do not correspond to the areas drawn by administrative borders. If possible, they should therefore be defined by functional considerations.<sup>30</sup>

The interviews give initial information about potential regional clusters, main vertical and horizontal links between companies and diagonal links between firms and institutions as well as some strengths and weaknesses of the location. On this basis we conducted a survey of manufacturing and service companies. The questionnaire aims at deepening the cluster-specific information. It contains sections inquiring about customer-supplier relationships and cooperations with partners from within or outside the region, for instance joint projects in human resource development or research and development. Additionally we asked for products and services offered, core competencies, important innovations, firm size, company structure etc.

For the identification of cluster potential in a region we used a set of five criteria in order to check whether fields of functional specialisation can be considered working clusters or, alternatively, supply chains with potential for clustering. These criteria are concentration in space, labour market pooling, existence of 'leading companies' (technology leaders, market leaders, image carriers) and the presence of supporting institutions and network activities.<sup>31</sup>

## **4 Clusters in a European Metropolitan Region: the case of Nuremberg**

Our case study builds on a comprehensive enterprise survey for the European Metropolitan Region Nuremberg. In this section we first introduce our area of investigation and its geographical position in Central Europe. Second, we describe the data-

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<sup>29</sup> Both our different interview guidelines and the questionnaire are designed to approach and encircle the topic from business aspects familiar to management staff. Company representatives are able to answer detailed questions concerning cluster-related topics as depicted in Figure 1. The term 'cluster' is introduced only at the very end with a question concerning cluster awareness. Major practical problems arising from being unacquainted with the fuzzy 'cluster' notion can thus be avoided.

<sup>30</sup> Feser et al. (2001) also work on the conceptual problem of clusters neglecting administrative borders. As a basis for further quantitative and qualitative analyses they developed a methodology that combines a non-spatial technique revealing inter-industry links with an analysis of employment patterns in economic space.

<sup>31</sup> First, this methodology was implemented in Eastern Bavaria in 2000 and 2001 with an extension along the river Danube between Regensburg and the Austrian border in 2006. In 2006 we then adapted the methodology to the specific needs of the survey in the core of the European Metropolitan Region Nuremberg. For this paper, we use data of the latter project (see data description in section 4.2.3).

base used for analysis. Section 4.3 presents some evidence on economic integration in the Nuremberg region. It is indicated by findings on the strength of backward and forward linkages as well as on cooperation behaviour of regional companies within and outside clusters. We then raise the question of whether clustering within a European Metropolitan Region is relevant for economic integration on the regional, national and supra-national level.

#### 4.1 The European Metropolitan Region Nuremberg

In the European Spatial Development Perspective (ESDP), the European Commission puts focus on the relevance of 'gateway cities' for regional development. The concept encompasses regions "(...) which provide access to the territory of the EU (large sea ports, intercontinental airports, trade fair and exhibition cities, cultural centres)" (European Commission 1999: 22) – as for Nuremberg, three Trans-European Networks intersect, two Pan-European Corridors start<sup>32</sup> and the region provides several infrastructure facilities like an international airport, a cargo transport centre and one of the world's 15 largest exhibition centres<sup>33</sup>. In addition, the concept applies to "(...) metropolitan regions located on the periphery, which can use specific advantages, such as low labour costs or special links with economic centres outside Europe or neighbouring non-Member States." (European Commission 1999: 22) – Nuremberg region is about 100 kilometres away from the border to the Czech Republic and has strong historic links especially to its capital Prague. Against this background, Nuremberg was designated as 'Gateway to Eastern Europe' by the European Union in 1997.<sup>34</sup> Figure 2a depicts the geographic position of the Nuremberg region in Central Europe

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<sup>32</sup> Railway axis TEN 1, inland water axis TEN 18, railway axis TEN 22, corridors IV and VII (see e.g. IHK 2007).

<sup>33</sup> see <http://www.nuernbergmesse.de/en/company/>

<sup>34</sup> The second German 'Gateway to Eastern Europe' is Dresden. In 2007 a workgroup of the German Federal Ministry of Transport, Building and Urban Affairs proposed a new guideline for further development of the Czech-German border region. The underlying idea is that the existing Euregiones in the sparsely populated border region are of too small scale to initiate efficient cross-border cooperation. Thus they introduce the so-called 'Central European Crystal', a planning region spanning between the European Metropolitan Regions Prague (CZ), Munich (D), Nuremberg (D), Saxon Triangle (D) and Wrocław (PL).

**Figure 2a**  
**Geographical position of the Nuremberg region in Europe**



source: IHK (2007: 41)

For the Nuremberg region, this proved to be an important step in becoming a European Metropolitan Region. In the 1990s a joint regional steering committee<sup>35</sup> developed a long-term strategic concept in a discursive and mutual collective learning process. The aim was to shape the national and international profile of the agglomeration explicitly – being one of 30 top economic regions in Europe and among the ten strongest technology regions in Germany<sup>36</sup> – in the competition between economic locations.

For two decades a massive structural change took place in and around Nuremberg. Traditional industries like metal and electrical industry switched importance with services. “The proportion of industrial employees fell from 61 percent to 39 percent, whilst the proportion of service employees rose from 38 percent to 61 percent” (Heidenreich 2005: 746).<sup>37</sup> In a certain sense the economic space of Nuremberg had to reinvent itself after deindustrialisation with tertiarisation. According to Glaeser/Saiz

<sup>35</sup> Partners on the long run are the regional Chamber of Commerce and Industry, the regional Chamber of Trade, unions, universities and universities of applied sciences, the district government of Central Franconia, and all cities and counties in Central Franconia plus adjacent counties. Financial support for projects in this framework is provided by the Federal State of Bavaria, the Federal Republic of Germany and the European Union.

<sup>36</sup> See for instance IHK (2007), where a benchmark of all eleven European Metropolitan Regions (EMRs) and 16 agglomerations in Germany is provided. Egelin et al. compare the potential for endogenous growth of 15 European Metropolitan Regions. The choice of EMRs to benchmark the EMR Rhine-Neckar represents poly- and monocentric regions in Germany and other member states and includes EMR Nuremberg.

<sup>37</sup> Also see IHK (2005) and Stadt Nürnberg (2003) (both in German language).

(2004), adjusting the skill level is an important factor for regions that experienced negative external shocks. To face the challenges of structural change, to support the regional labour market and to strengthen existing potentials with global growth potential the joint strategy referring to cluster concepts was implemented.

A central feature in the development of a strategic concept is the Master Concept of Development (*Entwicklungsleitbild*) that was first passed in 1998 and then updated in 2005.<sup>38</sup> Taking into account existing network partners and interested companies it identified regional so-called ‘fields of competence’, i.e. clusters. These were to be organised in ‘competence initiatives’ – different kinds of organisations managing cluster activities to an individual extent.<sup>39</sup> The strategies pinned down in the Master Concept of Development are designed for the long run and are thoroughly implemented. In addition, it helped to focus the region’s governance structure and also to set up a joint regional marketing association.

To start with, cluster management activities were realised in five fields of competence.<sup>40</sup> Consequently, the performance of the Nuremberg region in international rankings climbed up several positions and resulted in its admission as a European Metropolitan Region in April 2005 – the eleventh in Germany. Figure 2b indicates the both the area under investigation as the “core” of the European Metropolitan Region Nuremberg and its size in 2008.

Nuremberg is the dominant city, where roughly one quarter of the population is living, but where 37 percent of employees subject to social security are working and where about 37 percent of the region’s GDP is also generated. In addition, 37 percent of the unemployed are registered in the city of Nuremberg.<sup>41</sup>

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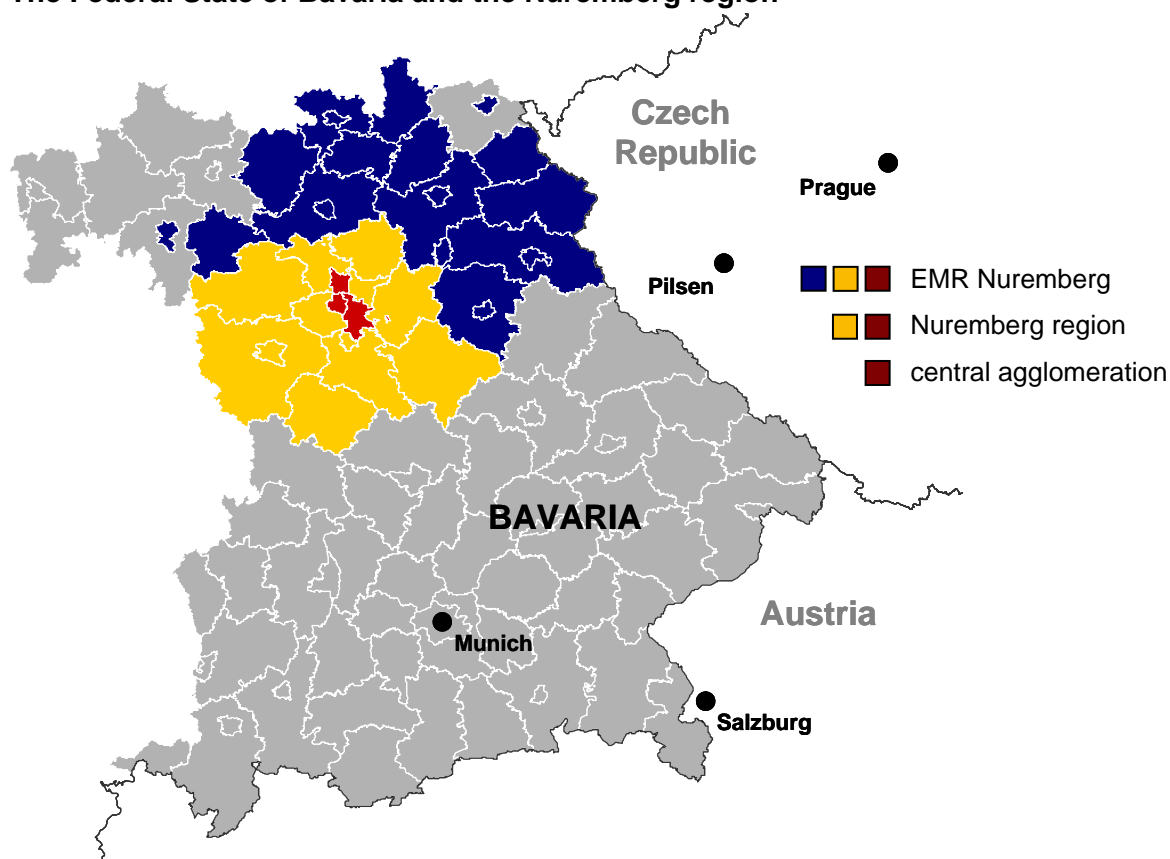
<sup>38</sup> The Master Concept was developed under the lead of the Nuremberg Chamber of Commerce and Industry and the city of Nuremberg with scientific cooperation by Prognos AG.

<sup>39</sup> See Neumann (1996); Stadt Nürnberg (2003); *Entwicklungsleitbild der Wirtschaftsregion Nürnberg* (2005) for information on the development and implementation of the process (in German language).

<sup>40</sup> These five fields of competence are Transport and Logistics, Information and Communication, Medicine and Health, Energy and Environment and New Materials. In 2005, the sixth field, Automation and Production Technology, was started. A range of subclusters focuses, on certain aspects of the individual competence initiatives. To take account of the dominant production-related service industry with national and international importance the field of Innovative Services was also named as a regional core competence with strong potential for future growth.

<sup>41</sup> Data source for this section: Bavarian State Office for Statistics and Data Processing and the statistical information offered by the Federal Employment Agency (BA).

**Figure 2b**  
**The Federal State of Bavaria and the Nuremberg region**



*Notes:* The graph depicts the Federal State of Bavaria (grey), the entire European Metropolitan Region (EMR) Nuremberg in 2008 (blue, yellow and red – 21 counties, 12 cities, roughly 3.5 million inhabitants) and the area in the focus of the study, the Nuremberg region coloured in yellow and red. This corresponds to the former “core of the EMR Nuremberg” as the Bavarian district of Central Franconia and the two adjacent counties Forchheim (in Upper Franconia) and Neumarkt (part of Upper Palatinate). The region with its nearly two million inhabitants is characterised by the triangle of the cities Nuremberg-Fuerth-Erlangen (coloured dark red). This agglomeration is surrounded by counties with high population and industry density, the counties further away are rural areas.

source: own illustration

Concerning skill structure, the region under consideration roughly follows the West German pattern, e.g. the national share of highly skilled graduated employees is 8.7 percent, compared to 9 percent in the core of the European Metropolitan Region Nuremberg. Outstanding is the city of Erlangen with 25 percent of employees holding a degree. The reason for this lies in the concentration of employers like the University Erlangen-Nuremberg<sup>42</sup>, several headquarter facilities of a world-renowned multinational company and a wide range of high-tech firms grouped around them. On the other hand, the region’s share of workers without vocational qualification (14.2 percent) is also considerably higher than in the national average (12.9 percent).

<sup>42</sup> The University Erlangen-Nuremberg in 2008/2009 has around 26,000 students and 12,000 employees (45 percent of which are affiliated with the clinical centre) ([www.uni-erlangen.de](http://www.uni-erlangen.de)).

Within the Nuremberg Metropolitan Region the cultural interconnections and economic integration are strong, as can be seen, for example, by the intra- and inter-regional commuting patterns focused on the agglomeration, by the double-location of the University Erlangen-Nuremberg and the distribution of headquarters in the cities and related production sites in the outskirts. Some of the biggest industrial employers with headquarters in the Nuremberg Metropolitan Region have more employees outside than in the region, indicating a strong international economic integration.

As for the impact of European integration on the Nuremberg Metropolitan Region, Heidenreich (2005: 743), referring to the massive deindustrialisation and tertiarisation process after 1970, states: “The economic difficulties of the Nuremberg region, however, were the result of the economic liberalisation in Europe after the creation of the Common Market and the economic integration of eastern and western Europe. Many of the traditional electro-technical and mechanical engineering companies of the region either closed down or outsourced a considerable part of their production tasks abroad.”

However, according to a survey of export-oriented companies in Central Franconia<sup>43</sup>, in 2005 10 percent plan investment or production in the new member states, roughly 40 percent have intense contact and only 13 percent of them feared negative effects of the 2004 EU-enlargement. It seems that after the process of deep structural change, the Nuremberg region has found its new position in the highly integrated economic space in Central Europe. This might be due to favourable conditions of the location including human resources and soft factors, combined with a concise regional cluster strategy.

To analyse whether clustering is relevant for economic integration on the regional, national and supra-national level, we refer to a detailed regional establishment survey.

## 4.2 Database

In the following we use data collected in the research project at the Institute for Employment Research (IAB) “Clusters and Inter-Firm Networks in the Nuremberg Region”. In late 2005 and early 2006 in-depth expert interviews have been conducted with experts of regional economic structures and with company representatives. The information obtained formed the basis for a company survey in the second half of 2006 and a follow-up survey in early 2007. See Figure 2b for a depiction of the area under investigation – the district of Central Franconia plus the two adjacent counties. The detailed questionnaire covered the range of topics illustrated in Figure 1 and thus the survey contains detailed information not only about the companies and

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<sup>43</sup> The quoted survey was conducted by the Nuremberg Chamber of Commerce and Industry (IHK), the feedback was 204 questionnaires.



institutions forming the clusters and their products, services, size, age etc., but also about customer-supplier-relationships and cooperation projects.<sup>44</sup>

For the survey, all firms without employees subject to social security and companies in a non-active status were excluded. In addition, a selection was made according to the affiliation of firms to NACE industries and methods of stratified random sampling were applied. Some sectors that are not of interest in the cluster context were excluded entirely, e.g. antique shops and private child care facilities. The questionnaire was sent to about 8,700 companies in the region and was returned by 888 (10.2 percent). The sample represents roughly 88,000 employees, or again a little more than 10 percent of all dependent workers.<sup>45</sup>

### **4.3 Evidence on the Nuremberg region's economic integration**

One central aim of the creation of Metropolitan Regions is to foster intra-regional integration to strengthen its economic performance – but this does not imply that a Metropolitan Region's economy is encapsulating itself. The same accounts for regional clusters where outside linkages and contacts are of vital importance. In this context, we take a closer look on the backward and forward linkages as well as on cooperation behaviour of regional companies within and outside clusters.

For the background it is important to be informed about the companies' awareness of being part of a cluster.<sup>46</sup> In our survey, 14.9 percent state to be active members of at least one cluster in the Nuremberg region and 8.6 percent of a supra-regional cluster. In addition, 24.1 percent of the companies classify themselves as potential members of a regional and 20.2 percent of a supra-regional cluster. In the following, we add the active and potential members to form the group of 'cluster affiliates' and contrast them with non-cluster companies.

As for the forward linkages, we asked the companies in the survey where their three most important customers are located (Figure 3). With 54.4 percent for cluster affili-

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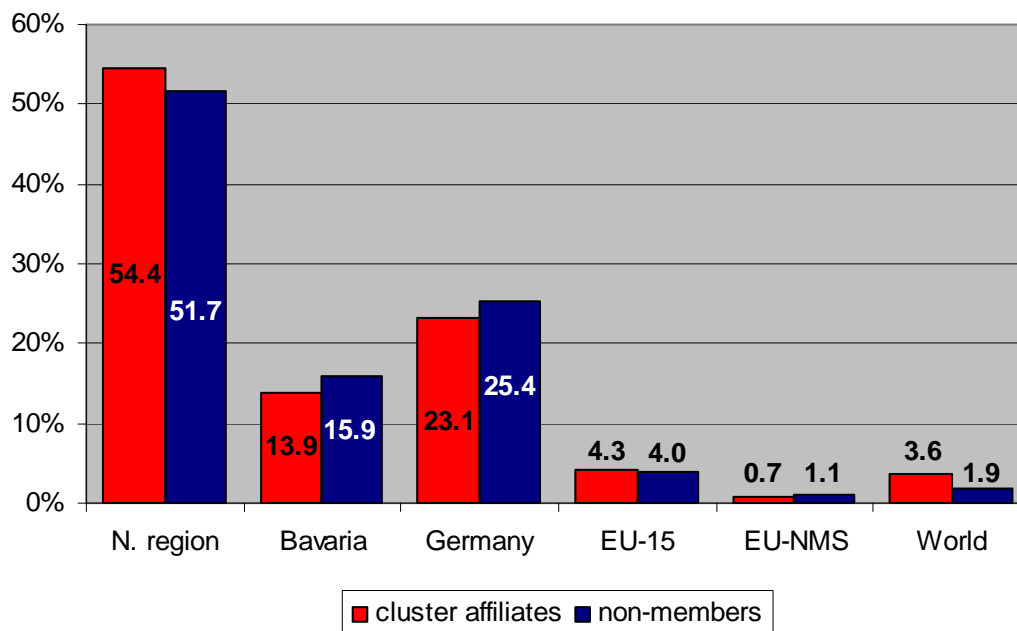
<sup>44</sup> Information was also collected to build the web-based cluster-oriented regional information system CORIS, available under <http://www.coris.eu> (in German language).

<sup>45</sup> We apply the data described above to a set of five criteria. It is used to check whether fields of specialisation can be considered working clusters or, alternatively, value systems with potential for clustering. These criteria are concentration in space, labour market pooling, existence of "leading companies" (technology leaders, market leaders, image carriers), of supporting institutions and network activities (see Möller/Litzel (2008, Section 8.3.1) for a description of the application of the methodology to data from Eastern Bavaria.) For the Nuremberg region, the eight value chains we identified as clusters operate in medical technology & health, automotive, logistics & transport technology, information technology & communication services, plastics industry, specialised automation, electronics and environmental technology & energy. Clearly our results back the fields of competence in which network organisations in Central Franconia are active. To some extent, our research leads to different and additional subclusters and we also identify two more potential clusters.

<sup>46</sup> In the questionnaire we gave a brief definition of a cluster as a localised network of companies and supporting institutions in a specialised field of production or services, possibly spreading to several industries.

ated companies and 51.7 percent for non-members stating to have their three most important customers located here, both groups indicate that for them the Nuremberg region is a major market.<sup>47</sup> By contrast, the rest of Bavaria appears less important with 13.9 and 15.9 percent respectively and the share of companies where the most important customers are located outside Germany is around 4 percent. Interestingly, the respective share of the new EU member states is more or less negligible. Taken together, the strongest forward linkages are found within the Nuremberg region in more than 50 percent of the cases, in nearly 70 percent within Bavaria (excluding the region under consideration) and in more than 90 percent within Germany (excluding Bavaria).

**Figure 3**  
**Cumulated answers to the question: “Please name the location of your three most important customers” by affiliation with regional clusters**



Notes: The results for the most important, second and third most important customers were added.  
 N (cluster affiliates)=886, N (non-members)=1177.  
 The differences between cluster affiliates and non-members are significant at the 10 percent level according to a  $\chi^2$ -test.

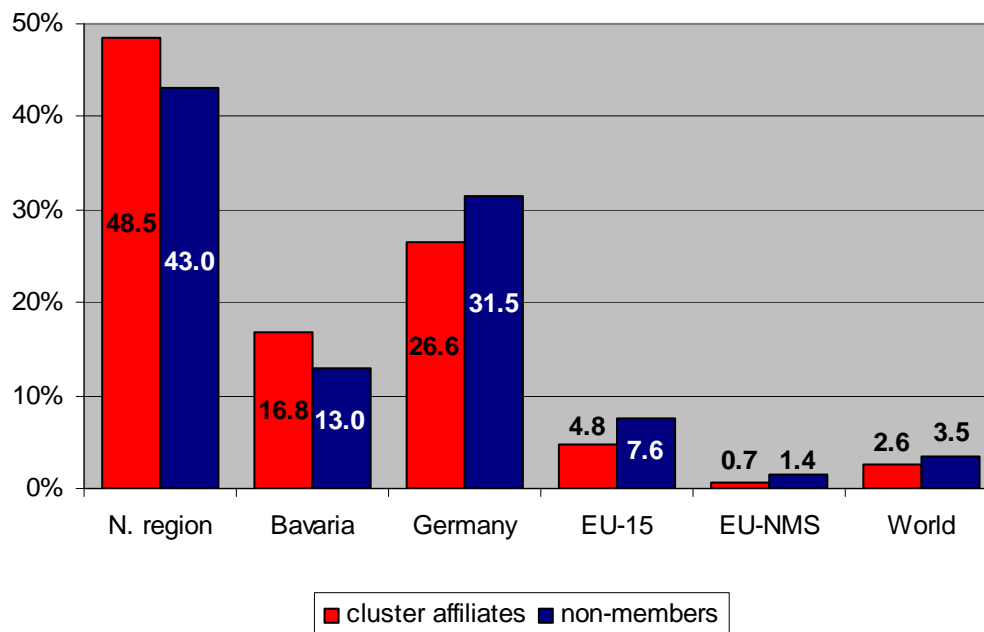
source: IAB & UR company survey 2006/ 2007, Nuremberg region

Figure 4 gives an impression of the strength of the backward linkages. It turns out that the geographical scope of the most important suppliers is a little higher than that of the most important customers. Nevertheless, nearly 50 percent of the cluster affiliates state that the most important suppliers are located within the Nuremberg region, whereas this is the case for 43 percent of the non-cluster members only. For both groups, Germany (excluding Bavaria) is on the second most important position.

<sup>47</sup> Not depicted here are the results for the most important customer only, the result being 63.6 percent for cluster members and 57.3 for non-members.

Again there is no evidence that cross-border linkages to the new EU member states are of paramount importance.

**Figure 4**  
**Cumulated answers to the question: “Please name the location of your three most important suppliers” by affiliation with regional clusters**



*Notes:* The results for the most important, second and third most important suppliers were added. N (cluster affiliates)=730, N (non-members)=993. The differences between cluster affiliates and non-members are significant at the 1 percent level according to a  $\chi^2$ -test.

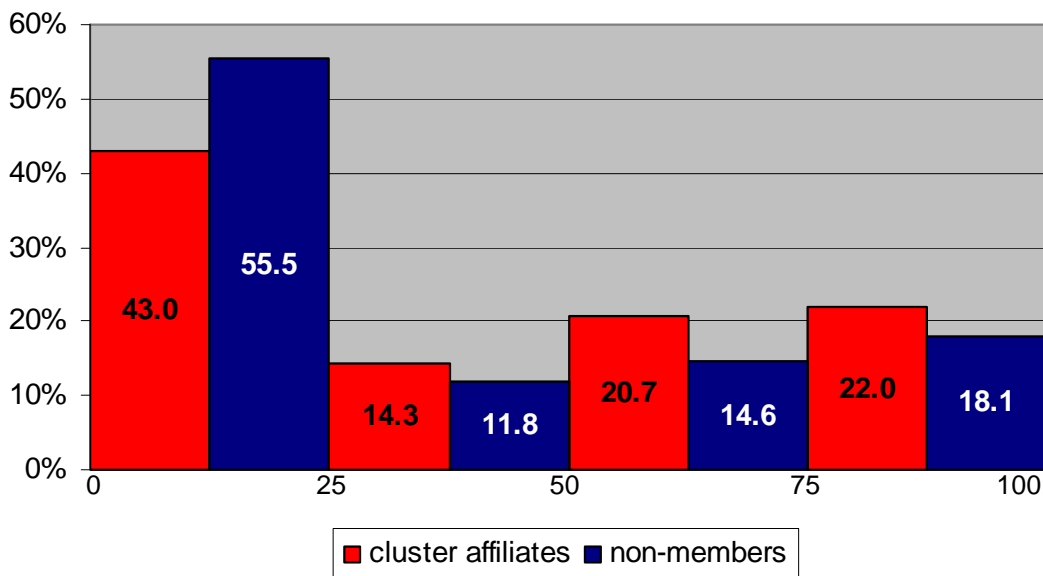
source: IAB & UR company survey 2006/ 2007, Nuremberg region

The importance of local suppliers and customers is remarkable. Checking for the quantitative side of forward and backward linkages, we first look at the total share of inputs from the local market and second on the share of turnover respectively.

The histogram in Figure 5 shows that cluster affiliates are more regionally oriented than non-members. 22 percent of all regional cluster affiliates buy between 75 and 100 percent of their inputs in the Nuremberg region, whereas roughly 18 percent of non-members are sourcing regionally. In the lowest quartile, indicating a share of less than a quarter of all inputs, the difference is more striking: for 55.5 percent of non-members of regional clusters the local market is of minor importance, the corresponding value for cluster affiliates is 43 percent.<sup>48</sup>

<sup>48</sup> As for the number of firms weighted with the number of employees the picture changes markedly. 12.5 percent of all cluster affiliates and 8.4 percent of non-members get their inputs mainly from the Nuremberg region (4<sup>th</sup> quartile), still indicating a stronger local focus of cluster affiliates, but both values are smaller than in the unweighted case. However, the weighted share of companies that use less than 25 percent of regional inputs is 68 and 66.8 percent respectively. These differences make visible the sourcing strategies of big companies versus small and medium-sized firms. For the latter, international supply is less important.

**Figure 5**  
**Distribution of shares of inputs from the Nuremberg region by cluster affiliation**



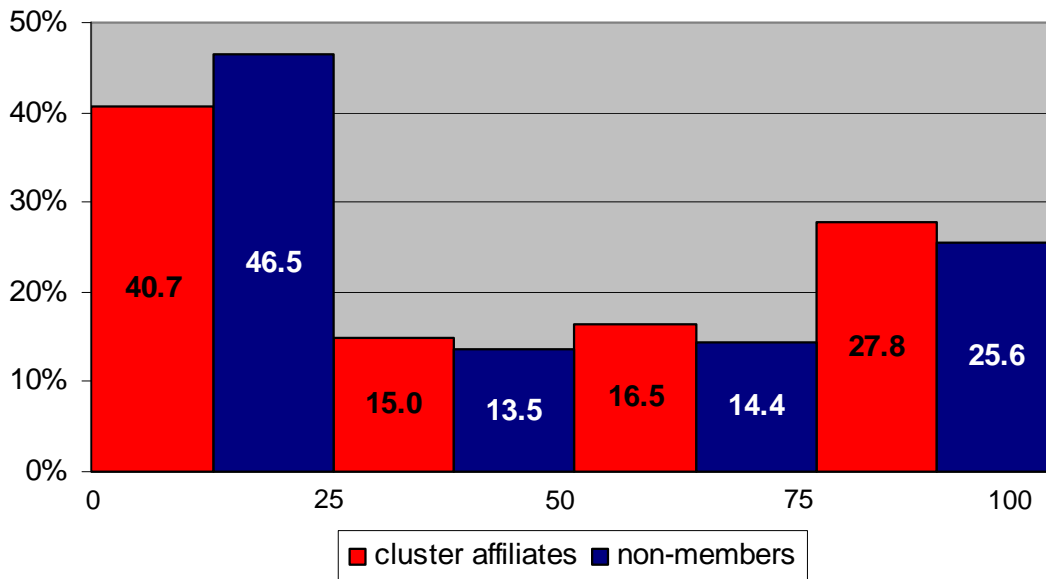
Notes: N (cluster affiliates)=314, N (non-members)=431.  
 Means of cluster affiliates and non-members are equal (significant at the 1 percent level according to a two-sample t-test allowing for unequal variances).  
 source: IAB & UR company survey 2006/ 2007, Nuremberg region

Figure 6 shows again that cluster affiliates are more regionally oriented than non-members, now referring to the demand side. However, turnover shares are more evenly distributed than inputs. 27.8 percent of cluster affiliates generate more than three quarters of their turnover in the Nuremberg region and 40.7 percent less than a quarter. For non-members the corresponding shares are 25.6 and 46.5 percent.<sup>49</sup>

Together with backward and forward linkages, cooperation activities are another vital aspect of regional economic integration. As is to be expected, the cooperation behaviour of cluster affiliates is more developed than in other companies. This is clearly visible in Figure 7 – contacts to all different groups of cooperation partners are more developed for cluster affiliates.

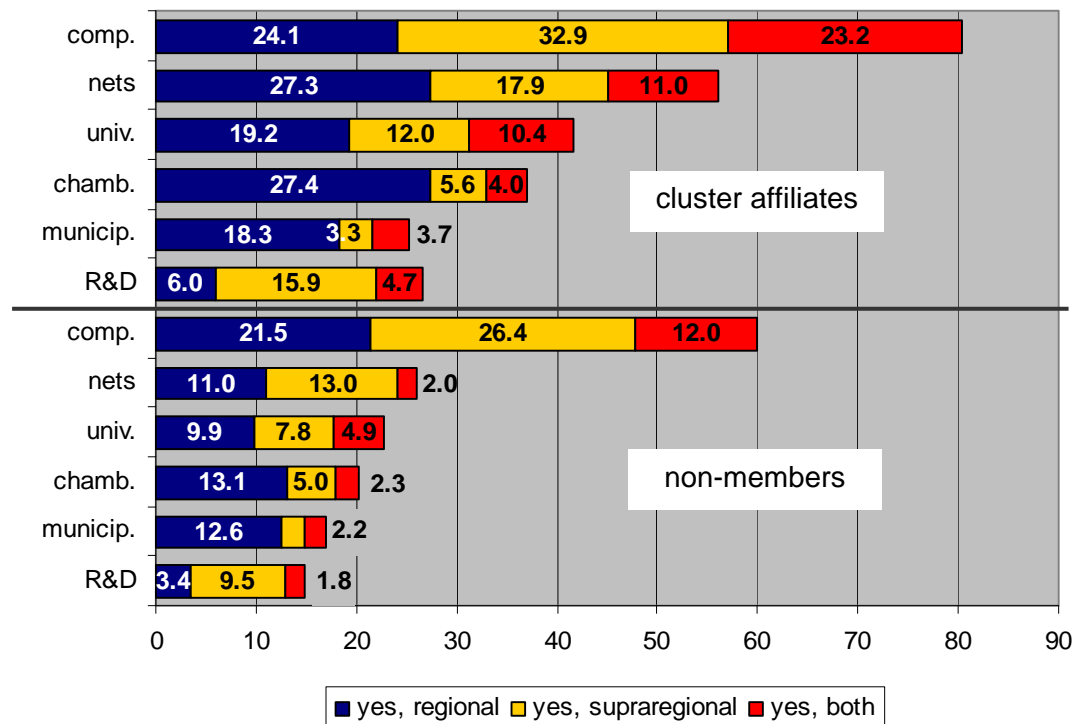
<sup>49</sup> The weighted results are again different: 13.2 percent of cluster affiliates and 9.7 percent of non-members have more than three quarters of their sales in the Nuremberg region (4<sup>th</sup> quartile). As for the weighted share of companies that generate less than 25 percent of their turnover regionally is 77.2 and 69 percent respectively. Also for the demand side the sales strategies of big companies indicate a much stronger supra-regional focus.

**Figure 6**  
**Distribution of shares of turnover generated in the Nuremberg region by cluster affiliation**



Notes: N (cluster affiliates)=334, N (non-members)=473.  
Means of cluster affiliates and non-members are equal (significant at the 10 percent level according to a two-sample t-test allowing for unequal variances).  
source: IAB & UR company survey 2006/ 2007, Nuremberg region

**Figure 7**  
**Answers to the question: "Has your company already cooperated with the following partners?"**



Notes: The differences between cluster affiliates and non-members are significant at the 1 percent level for all items, apart from item "municipalities" that is significant at the 10 percent level according to a  $\chi^2$ -test.  
source: IAB & UR company survey 2006/ 2007, Nuremberg region

The literature suggests that in cluster regions companies cooperate more frequently on the regional level than with partners from outside the region. Our data shows that for cooperation with other companies 24.1 percent of cluster affiliates rely on regional partners only, whereas 32.9 percent choose partners from outside the region. 23.2 percent cooperate both intra- and inter-regionally. Also non-members have a stronger focus on cooperation partners from outside. For cluster affiliates, just 6 percent find their research and development partners within the Nuremberg region only, the share of firms with only outside cooperations is 2.5 times as high. However, taking a look at cooperation with universities renders a different picture: local bonds are dominant here. Concerning joint activities with locally oriented partners like Chambers of Commerce and Industry, Chambers of Trade and municipalities, the regional shares are certainly higher than the supra-regional one. Only few address both regional and supra-regional institutions.

To summarize our empirical results we find that both backward and forward linkages within the selected region are remarkably strong. In general this holds for all firms irrespective whether they classify themselves as affiliated to a cluster or not. However, cluster affiliates rely even more on partner firms located within the Nuremberg Region. The difference is statistically highly significant for suppliers, but less so for customers.

A striking fact is the important role that regional cooperation activities play for the firms in our sample. This holds not only for inter-company relationships, but also for various forms of exchange with other partner like universities, research institutes or other business supporting institutions. Again, the extent to which firms interact is significantly more developed for those who report a high degree of cluster awareness.

## **5 Résumé and perspectives**

Our survey highlights the fact that economic integration should not be restricted to the aspect of cross-border integration but should also consider the higher intensity of intra-regional relationship between business partners as well as between firms and supporting institutions. In so far, developing regional and local ties can be seen as a means to increase economic fitness of local firms. Industrial clusters play an important role in this context.

Our case study covers the Nuremberg region, the core of the European Metropolitan Region Nuremberg. The concept of metropolitan regions is intended to foster intra-regional cooperation of various forms by introducing suitable governance structures. In addition, investment in the local transport infrastructure extends the relevant local economic area. At the same time the awareness of a common economic space can be developed.

Despite the strong ties to regional partners, cluster activities should not be understood as encapsulation of the economic space. Typically intra-regional cooperation

is complemented with business relations and contacts to external partners. Being strongly involved in regional activities does by no means exclude intensive contacts to outside partners. In so far as clustering strengthens the affiliated firms, they can be expected to be better prepared for inter-regional competition. Although our example region is neighboured by low-wage areas, it seems that fears concerning possible job transfers are groundless. In our survey the trading partners in the new EU member states do not play a major role neither for sales nor for supply. Geographical proximity, fruitful cooperation and knowledge spillovers might outweigh possible cost savings through offshoring.

Our general conclusion is that localisation as a form of intra-regional integration does not contradict a more intensive supra-regional or international integration. To the contrary, both can be seen as being complementary to each other.

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