Functional polycentricity in the Mega-City Region of Munich

Viktor Goebel, Alain Thierstein, Stefan Lüthi
Chair for Spatial and Territorial Development
Technical University of Munich,
email: goebel@raumentwicklung.ar.tum.de, thierstein@raumentwicklung.ar.tum.de, luethi@raumentwicklung.ar.tum.de
Phone-number +49-89-289-22489
Fax-number: +49-89-289-22576

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Abstract

Mega-City Regions are nodes in the network of information flows and therefore important locations of the knowledge based economy (KBE). This new spatial scale is recognized by planners and politicians as being crucial to develop competitive national economies.
In this paper we want to examine the spatial patterns and firm connectivities of the KBE in the Mega-City Region of Munich. We test the hypothesis whether (1) High-Tech-Branches and Advanced-Producer Services (APS) have different location strategies and (2) whether the firm connectivities and the role of the surrounding functional urban areas are different from those of the core city of Munich. In order to deal with both hypotheses we combine a quantitative value-chain approach with the method of the Global and World City Study Group (GaWC) to analyse inter-firm as well as intra-firm networks. We hypothesise that APS branches follow a different location strategy to ensure proximity with their customers then high-tech branches. The latter are more capital-intensive and their location patterns and strategies are in general more path-dependent. Our study shows indications for a division of labour among functional urban areas within the Mega-City Region of Munich. It seems that Munich plays the role of the international knowledge hub whereas the other functional urban areas are contributing in various ways to the distinctive character of the Mega-City Region of Munich.

1. Introduction

Innovation, modern transport and telecommunication infrastructure enabled the development of increased division of labour, increasing linkages between cities and enterprises and thus wider catchment areas of metropolises. A new spatial scale appeared in academic and political discussions. This scale can be expressed by the term Metropolitan Area, Metropolitan Region, Metropolitan agglomeration or other terms. We like to use the term Mega-City Region (MCR) to describe the phenomenon of Metropolises, cities and towns physically separate but functionally networked, clustered around one ore more metropolises of global importance, "drawing enormous strength from a new functional division of labour" (Hall & Pain, 2006: p.3). Typically these areas can be approximated by a circumference from the centre of a metropolis which can be reached within a car travel time of 60 to 90 Minutes (e.g. Thierstein et al., 2003). However, the resulting borders should never be regarded as an absolute delimitation; it is more like the influence of the metropolis is fading with the distance and depends on other factors too. The main criterion is always functional cohesion.

In most Mega-City Regions a distinct primate centre can be found, but there is nevertheless always a certain degree of polycentric spatial structures existent. Mega-City Regions are of increasing importance in spatial sciences. They are the nodes in the network of the global economy, location of creation of new knowledge and

also engines of the cultural development. Blotevogel (2007) defines four functions and a set of indicators to describe the nature of metropolitan areas:

Table I: Functions of a Mega-City Region – Source: Blotevogel 2007

Metropolitan Functions	examples for indicators
Regulation Function	headquarters of big firms, powerhouses of political decisions (parliament, ministries)
Innovation Function	universities, research units of firms
Gateway Function	airports, congress centres
Symbol Function	landmarks, images, architecture, brands

Beside this important approach describing and distinguishing Mega-City-Regions there is another important aspect to get a comprehensive picture: The functional relations between the Mega-City Regions should be considered. Sassen (2001) and Castells (1996) emphasise the relevance of flows between the nodes of the network drawn by the global economy. The expression "flow" means the exchange of goods, capital, persons and information. Castells appreciation is as follows:

> "Our societies are constructed around flows: flows of capital, flows of information, flows of technology, flows of organizational interactions, flows of images, sounds and symbols]…[They are the expression of the process dominating our economic, political and symbolic life. Thus, I propose the idea that there is a new spatial form characteristic of social practices that dominate and shape the network society: the space of flows."
> (Castells 1996: p.412)

Why is it so important to regard the flows between the cities? The percentage and relevance of the knowledge based economy (KBE) has grown continuously over the last decade in nearly all countries with a powerful economy. We will prove that for the MCR of Munich in this paper too. The KBE-Sector is defined by a high proportion of research and development activities, the dependency on qualified workers and the branches are linked to innovative processes and products. Central resources for these branches are information, knowledge and highly skilled people. Several qualities to be found especially in Mega-City Regions promote an innovative milieu which enhances the creation of innovation:

- Face-to-face contacts are probable or easy to realize. These contacts remain important in order to get use of tacit knowledge (Jones, 2007; Schmidt, 2005).
- Infrastrucure (e.g. airports, fairs) advances the exchange of information. This is essential to create new information or knowledge (Kujath, 2005).
- A high degree of division of labour is going along with the abundance of different specialists. These people form a potential when they recombine their knowledge and thus create innovation.

All these factors can be found in metropolises or are at least easier to realise there than in peripheral areas. However the exchange of information and knowledge does not only occur within metropolises and their hinterland but at a global dimension. The better connected a city is the more economic activities are probable and virulent. The nodes and their accessibility are very important in the global economy and form a global "world city network" (Taylor, 2004). The fast growing city of Dubai in the desert of the Arabian Emirates is an illustration how real and morphological growth is enhanced by the gateway and decision function of this location. This growth can hardly be explained from national economic power alone.

Two categories of flows can be identified: Physical (people, goods…) and non-physical (information, decisions…) flows (Thierstein et al. 2006). While the first category can be captured by the collection of commuter data, travel surveys etc. the second category remains difficult for an accurate scientific approach. Halbert (2004) succeeded in monitoring the spatial pattern of telephone calls in France but up to now we don´t know any approach to meet the challenge depicting the flows of information comprehensively and directly.

Aware of this situation the Global and World City Study Group (GaWC) at Loughborough University introduced a quite interesting and convincing methodology to get a relative estimate of the flows. The group regards the flows created through intra-firm networks. The central assumption of this method is that the office locations of firms are always communicating within their firm-network. Therefore it is possible to evaluate the flows

between the nodes by adding and weighting all the locations of firms in a certain city or region (Taylor 2004: p.67).

This paper will introduce the study project "Flows in the Mega-City Region of Munich", carried out at our chair. The project is funded mainly by the City Council of Munich and the Airport society. It aims to analyse intra-firm and inter-firm relationships along the value chain and deals with the patterns of the knowledge based economy. The Project is related to the INTERREG III B study project POLYNET "Sustainable Management of European polycentric Mega-City Regions", completed in 2005. We apply the same methodology for the Mega-City Region of Munich, however some additions and modifications have been made. First, the High-Tech Sector is included and the location pattern will be compared to the branches of the Advanced Producer Service (APS) Sector. Second, the inter-firm relationship along the value chain will be subject of the study. Furthermore the relevance of the KBE in the Mega-City Region of Munich will be considered.

The paper will describe the study and the methodology used (section 2) and show interim findings from the intra-firm network analysis (section 3). Preliminary conclusions are drawn (section 4).

The whole project is dealing basically with the following questions:

- Which flows and inter-relationships within the KBE exist in the MCR of Munich? How is the MCR and how are the single functional urban areas (FUA) within the MCR linked with the rest of the world?
- What kind of functional polycentricity can be derived from the office location strategies of firms in the KBE sector?

The following hypotheses are tested:

1. There are functional relations around Munich which constitute a Mega-City Region of Munich
2. High-Tech-Branches and APS (Advanced Producer Services)-Branches have different location patterns and their integration and connectivity in the network of the global economy is different too.
3. Munich is the knowledge hub in the monocentric Mega-City Region.
4. The degree of integration of a FUA within the Mega-City Region in the network of the global economy does not correspond necessarily to the sum of inhabitants and jobs in the FUA.

2. Study Project: Flows in the Mega-City Region of Munich

2.1 Study design

In the entire study project we want to examine the structure and nature of economic linkages along the value chain. The project is structured basically in two modules:

- Module 1 uses the GaWC-methodology to analyse intra-firm networks constituted by the numerous office locations of KBE-firms in the MCR of Munich. The methodology will be described briefly in section 2.3. Before we could run the analyses we had to define a study area (→section 2.2). Additionally we had to define the KBE-branches, as no common international definition exists. The objective of module 1 is to create a database covering as much office locations as possible within the frame of the project. With that database we map the intra-regional flows between the FUAs in the MCR and set up a ranking of the most connected locations for each single FUA within the MCR. Furthermore we compare the calculated values describing the amount of flows with values to be estimated by the size of population and workplaces. All this analysis is done separately for high-tech and APS-Branches, enabling us to test the differences. Moreover, the spatial distribution of workers in the KBE sector was analysed in the MCR and compared.

- In Module 2 we do an analysis of the inter-firm relations to other firms in the same or other branches. The questions address the value chain as well. Data was successfully collected by a web-based survey, but is still processed. Additionally some 20 personal interviews with entrepreneurs will be held in order to deepen knowledge and get information which is not accessible by the quantitative approach. Module 2 is not yet included in this paper. Results are expected in autumn 2007.

2.2 Study Area

The Mega-City Region of Munich is one of the most competitive metropolitan regions of Germany. Several companies operating at the global scale like Siemens, BMW, Allianz Insurance etc. have their headquarters or

major offices here. Munich and its suburbs are the location of excellent universities and important research units of firms. Additionally famous research institutions (e.g. Max-Planck-Society, Fraunhofer-Society) and the European Patent Office is located in Munich. There are numerous start-ups of several innovative branches.

The MCR of Munich has doubtless a monocentric structure with Munich as the primary city (approximately 1.3 Million residents. In a perimeter of about 80 km from the city centre several other (sub-)centres can be found, Augsburg with nearly 270 000 residents the second biggest city. In the sub-centres there are important firm-locations as well and we can assume strong relations between the centres.

There is no common scientific understanding which perimeter is applicable for a MCR. However, analysing flows in a region implicates the question of its extent (Thierstein 2003). Our method to set up the study area derives from the POLYNET-Project and the European Metropolitan Areas Comparative Analysis (GEMACA):

The first step is to define a Functional Urban Area (FUA) with the following criteria:

- Cores: using the NUTS 5 – spatial units used by the EU – defining cores on the criteria seven or more workers per hectare and minimum 20,000 workers in either single or in contiguous NUTS-Units.
- Rings: defined on the basis of 10% or more of the residentially based workforce commuting daily to the core. Overlapping rings: The municipality with the bigger share to a centre is assigned there.

The second step is to define the MCR. The main criterion is the contiguity of FUAs connected to the MCR (Hall et al. 2006: 20). As no other real MCR is nearby and most of the neighbouring FUAs are clearly connected to Munich we decided to include all FUAs identified by the ESPON 1.1.1 final report (ESPON, 2004) in a circumference accessible by a 60 minutes car trip. from the city centre of Munich. This criterion is already used in several approaches (e.g. Thierstein et al., 2003; BBR, 2005). We appended the FUA of Regensburg to our study area because of its high relevance. The circumference of 60 minutes travel time corresponds approximately to a circle of 70 km radius. The delimitation between the FUAs is in most cases congruent with borders of the German counties (“Landkreise”). Some checks in parts of the study area show that the result does not differ substantially from the original GEMACA method. The spatial extent of the Study area can be seen in Figure 1 to 3.

2.3 Methodology

The first task was to define the branches of the knowledge based economy. For the APS-Branches we adopted basically the definition of the POLYNET study, as comparisons shall be undertaken. Some minor modifications have been made as e.g. media services are of relevance in Munich and have not been included in POLYNET.

For the high-tech-branches we adopted the understanding of the Oslo-Manual from the OECD (2005). There a differentiation between “high-tech” branches and medium to high-tech branches is made. Manufacturing of cars and machine construction is listed as medium to high-tech. We decided to include both branches in our study because we identified a high share of innovative products and a high proportion of high-skilled people and within the firms of the MCR. These attributes are indicator to identify the KBE-Branches.

Table II: Considered branches of the KBE, NACE-Codes in brackets

Advanced-Producer-Services (APS) branches	High-Tech branches
Finance (65, 671)	Chemistry (partly), Manufacture of pharmaceuticals and bio-technology (24, 73104 and others)
Management Consulting (72, 7413, 7414, 7415)	Manufacture of machinery (29, partly)
Accountancy (7412)	Manufacture of electrical and optical equipment (30)
Insurance (66, 672)	Manufacture of electrical machinery and apparatus (31)
Law (7411)	Manufacture of radio, television and communication equipment and apparatus (32)
Logistics (6024, 611, 612, 621, 622, 632, 634, 641)	Manufacture of medical, precision and optical instruments, watches and clocks (33)
Advertising & Media (744, 221,922,924)	Manufacture of cars and car components (34)
Design (742)	Manufacture of aircraft and spacecraft (353)

The analysis of intra-firm networks is based on the methodology of the Globalisation and World Cities Study Group (GaWC). The assumption underlying this methodology is that firms of the knowledge-intensive economy

create a network with their locations of offices which reproduces the economy (Taylor 2004). The accumulated flows of information and goods in this network are a good indicator to measure the importance of the nodes – the cities. The methodology is described in detail by Hall & Pain (2006) and Taylor (2004).

The GaWC-Method is only an approximation to get to grips with the complex interrelationships and connectivity of intra-firm networks and decisions on office locations. But it's results in previous studies are quite impressing and convincing (e.g. Taylor 2004, Hall & Pain 2006). The process implies subjective decisions while evaluating the locations. However this work is done by the same person for all the branches in order to secure similar assessment.

The list of the firms to be under examination in our study was basically derived from the Hoppenstedt database, a commercial data provider. Additionally the list was improved by checking websites of associations for the several economic sectors and information from the Chamber of Commerce of Upper Bavaria. The information about the office locations and their relevance within the firm-network was obtained mainly through the websites of the firms. The database query and additional research gave some 4000 APS-locations with more than 20 employees and some 1000 locations in the high-tech sector. The majority of these hits are firms with only a single location, therefore not applicable for the GaWC-Method.

A sample with 164 APS-Firms and 155 high-tech-firms was carefully chosen in a top-down approach. We arranged all firms by their size in terms of employees and took the top positions in each FUA and each branch. All 100 firms from the GaWC-list (Taylor et al., 2002) have been considered as long as they have a location in the MCR of Munich. We are pretty sure that our sample contains the relevant information about location patterns because we did a test analysis after reaching some 100 firm networks. The additional 60 firms did not lead to any severe changes in the results in the end.
Additionally to this functional approach we did a quantitative analysis of the spatial distribution and the development of employees in the KBE.

3. First findings

3.1 Growing relevance of the KBE-Sector within the economy

The number of workers in a certain sector and their proportion referring to the whole economy is beside other figures (e.g. turnover) an admitted indicator for the relevance of that sector. We calculated the values of employees subject to social insurance contribution, which covers about 80% of the whole labour force for three prints of time (1999, 2002 and 2006, Figure 1). Several spatial units as the entire State of Bavaria, the MCR and the (core-) of Munich have been considered in order to evaluate the assumed concentration of KBE-employees in the MCR. The relevance of the KBE-Sector has grown significantly in all spatial units over that period as it has done for the MCR of Munich. In the latter circumference we observe clearly higher proportions for each date, and for the City of Munich the growth is disproportionate. These results indicate clearly a concentration of KBE-activities in the MCR.

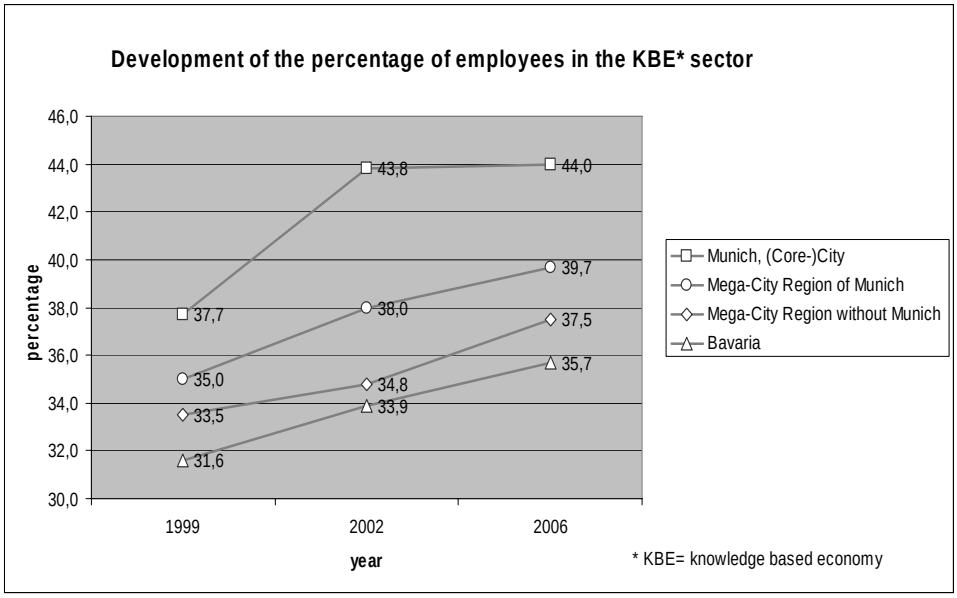

Figure 1: Development of the share of employees in the knowledge based economy.
Source of Data: German Federal Agency of Employment, own calculations

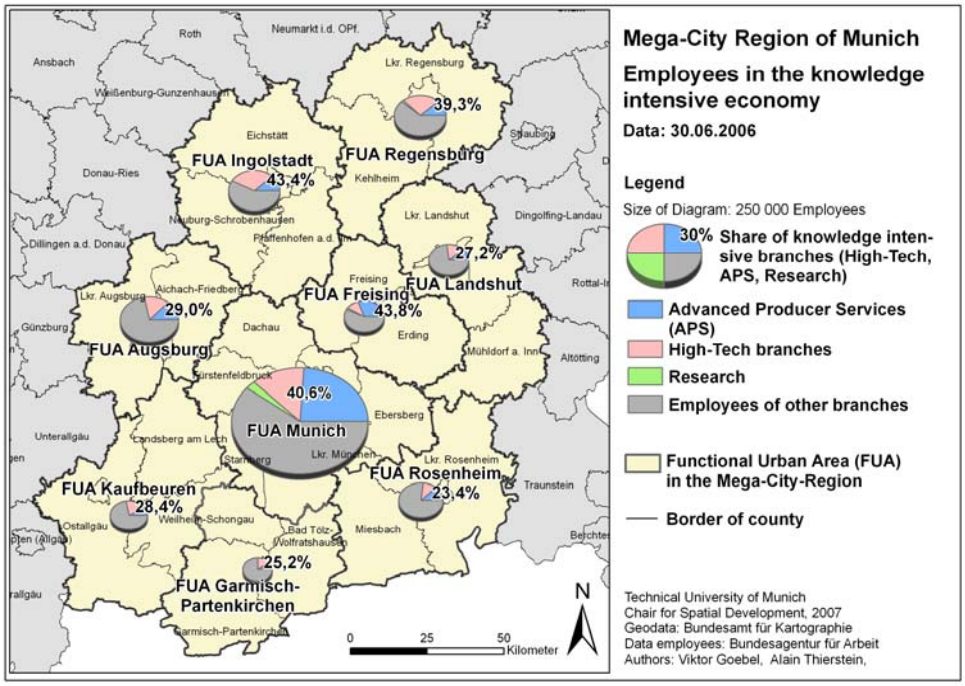

Figure 2: Employees of the knowledge based economy in the Mega-City Region of Munich of Munich
Source of Data: German Federal Agency of Employment, own draft

The spatial distribution of the employees in the KBE can be seen in Figure 2. The dominance of the FUA of Munich is obvious. The APS-Sector is quite strong in Munich (23,1%) and Freising (31 %), while the minimum percentage occurs in Landshut (10 %). High-tech branches have a relative high proportion in Ingolstadt (31%), Regensburg (26%) and Augsburg (21%), not so much in Munich (14%) or Freising (11%). This distribution acts as an indicator for division of labour in the MCR which will be analysed by the functional approach too.

3.2 Functional relations within the MCR of Munich

Hypothesis 1: *"There are functional relations around Munich which constitute a Mega-City Region of Munich."* is supported by our findings referring to calculations from the APS-networks. We found considerable high values of connectivity within the FUA of Munich for both Meta-sectors. For example the value of connectivity is bigger for the relation Regensburg-Munich (124) than to town situated closer to Regensburg like Nuremberg (91). This is true for all other FUAs in the APS-networks as well. The area is bound together by interactions and the flows within the Mega-City Region (Figure 3). For this figure we calculated all intra-regional connectivity values and compared them to the strongest link Munich-Regensburg.
For the high-tech branches the situation is different. Their locations and linkages do not show such a clear predominance within the entire MCR. Comparatively strong relations exist between Munich-Regensburg, Munich-Augsburg and Munich-Ingolstadt. However, this fact does not reject the hypothesis. So far we did examine only intrafirm-relations. But there might be other flows like inter-firm relations, physical flows and exchange of information which cannot be gathered by intra-firm networks. These relations contribute to the constitution of a functionally linked region for the High-Tech-Branches too.

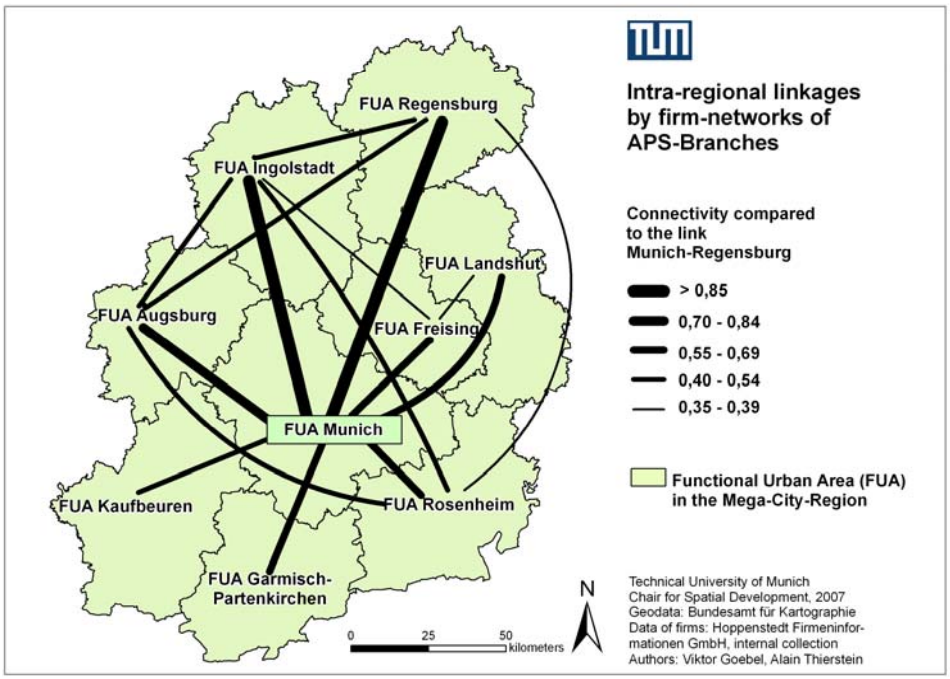

Figure 3: Inter-regional linkages within the Mega-City Region of Munich by firm-networks of the APS-Branches. The strength of the linkages are related to the strongest link Munich-Regensburg

3.3 Differences between High-Tech and APS-Branches

The study is supporting hypothesis (2): *High-Tech Branches and APS Branches have different location patterns.* The results of the GaWC-Analysis show significant differences between the two main dimensions of the knowledge based economy: High-Tech and APS.
There are links between the locations of the High-Tech-Branches in the Mega-City Region of Munich, mainly between Munich and Regensburg, Ingolstadt, Augsburg, whereas APS-locations can be found more widespread in the regional and national scale.

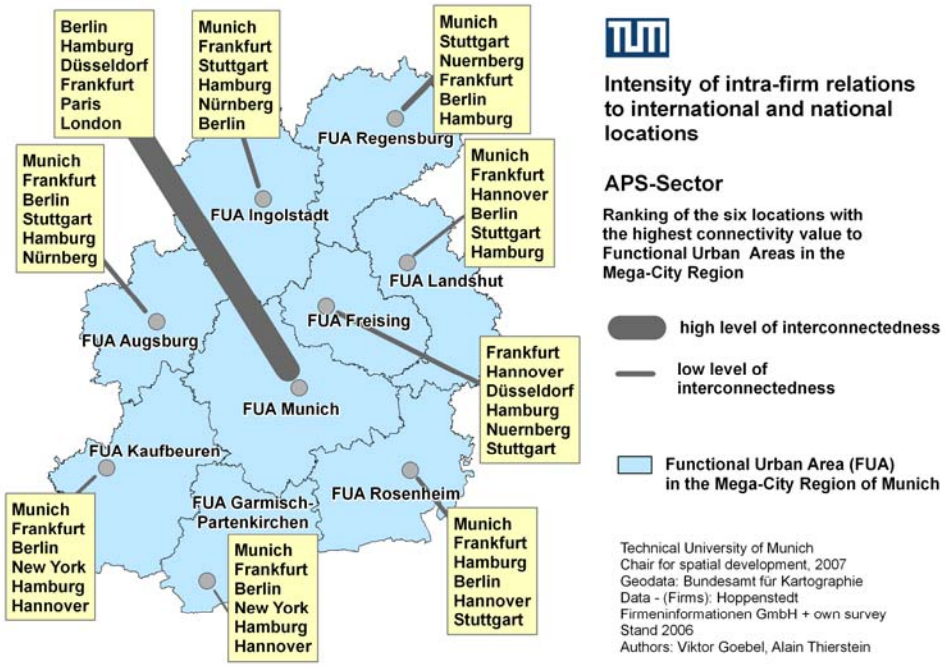

Figure 4: Intensity and ranking of connectivity values created by intra-firm networks of APS-companies. Berlin at No. 1 for the FUA of Munich means that Berlin is the most connected location in the sense of the GaWC-methodology.

The data was used to set up a ranking. The first six national or international locations with the strongest connectivity are shown in Figure 4 referring to the APS-Branches and in Figure 5 for the High-Tech-Branches. Fundamental differences can be seen: For the high-tech sector linkages with international locations rank generally high while mostly national locations occur in the ranking of the APS-locations. This is an interesting finding because we assumed that in a globalised world the international linkages are very important for the APS-Sector. This may still be true but does not occur in the intra-firm ranking. An explanation could be that APS-firms try to ensure proximity to there customers and act thus more area-wide, at least on the national scale. So a lot of national locations cover or overrule abundant international flows. By contrast high-tech companies basically pick up resources and customers at certain points in the world; we can derive that very likely from the collected location data and aim to confirm it in the proceeding study. High-tech-companies are basically more path-dependant in their development and bound to made investments in production-infrastructure.

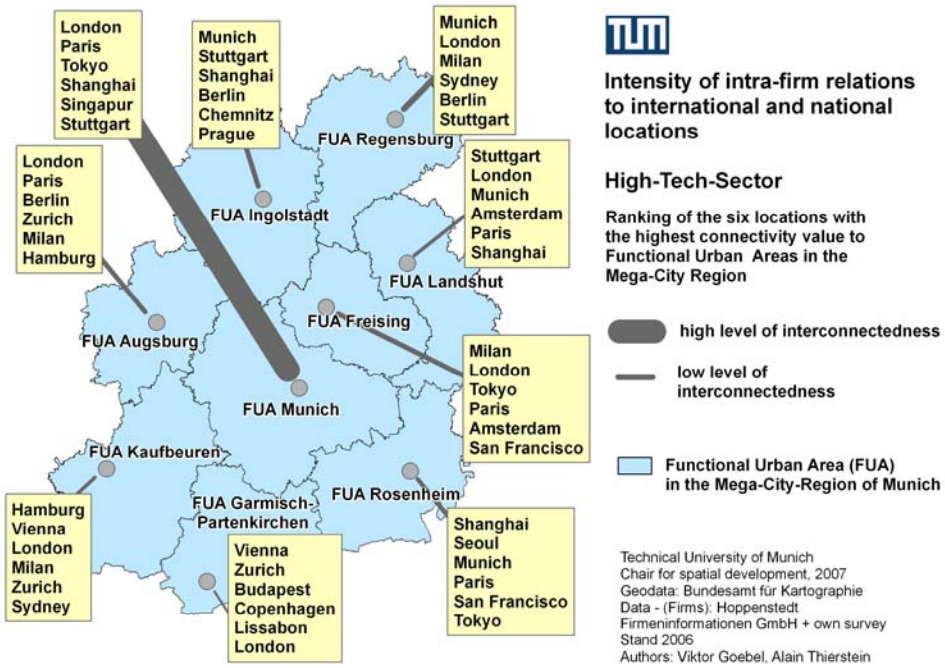

Figure 5: Intensity and ranking of connectivity values created by intra-firm networks of High-Tech-Companies.

3.4 Munich as the international Hub for the MCR

Munich assumes the role as the hub city of the entire Mega-City Region. This can already be assumed from the sheer size but can also be seen in the already described rankings which are defined by listing all the linkages by their abundance (Figure 4) relating the FUAs in the Mega-City Region. Munich is ranking at the top position one for all other FUAs except Freising. This means that the majority of economic relation is influenced by Munich. A further possible method to describe the hub-function of Munich is comparing the values of connectivity to the sum of population and workplaces (Figure 6). For this comparison we calculated the value of connectivity to be expected of the spatial distribution of population and workplaces. If the violet circle exceeds the black ring we can regard this FUA as disproportionate important for the knowledge based economy. For the European and global scale this is true especially for Munich and Freising. With other words: Internationally oriented firms prefer Munich and Freising as location because they benefit here from a good integration in the global network and the corresponding advantages like easier exchange of information. However this does not mean that the other locations are not important. They are just basically stronger linked to national networks.
The hub function of Munich has a connection to morphological developments like growing gateway infrastructures - e.g. international airports and the construction of high-speed train lines.

The results of the Munich case are partially similar to findings in the MCRs examined by the POLYNET study. In most regions the primate FUA has a surplus of significance compared to inhabitants on international scale. This is not true for the MCRs of South-East-England and Ile-de-France (Thierstein 2006). In these large regions the primate FUAs London and Paris cannot attract internationally connected firms proportionally; probably due to disadvantages of density like traffic congestion. FUAs like Cambridge and Rouen are here more internationally integrated by intra-firm networks in comparison to their size.

The inhomogeneous distribution of absolute and relative connectivity is a potential to enhance functional division of economic activities in the Mega-City Region. In conclusion of this paragraph we state that hypothesis 3: "*Munich is the knowledge hub in the monocentric Mega-City Region.*" is supported by our study. Moreover we could show that the connectivity values and thus the integration by intra-firm networks do not directly correspond to the sum of inhabitants and jobs. So hypothesis 4 is supported too.

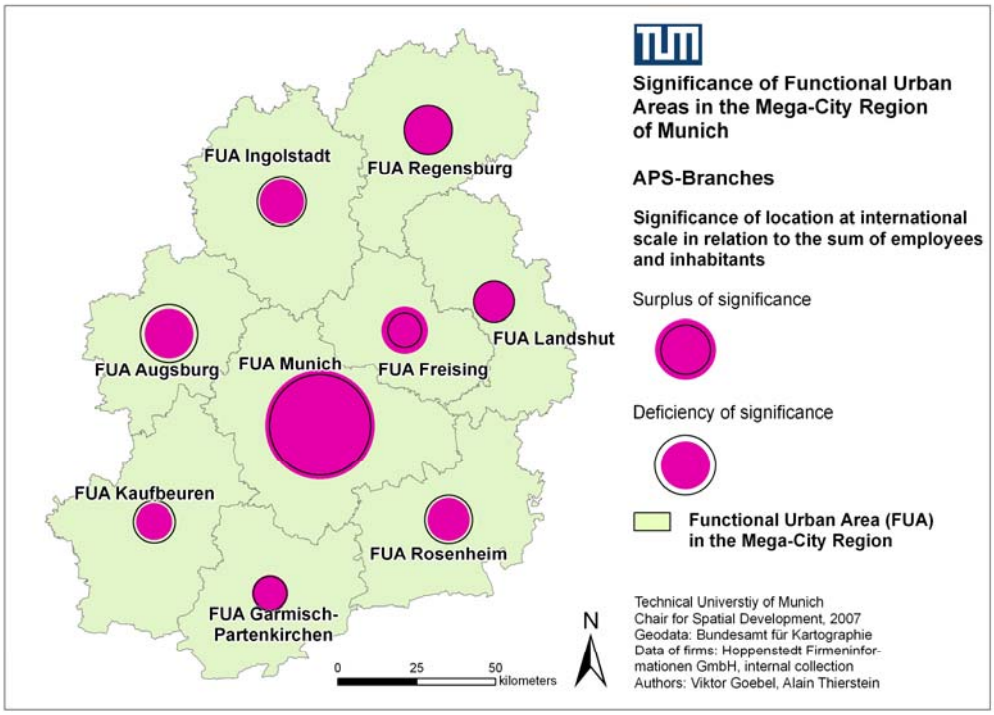

Figure 6: Relevance of functional urban areas in the Mega-City Region of Munich in relation to the sum of employees and inhabitants. An exceeding violet circle indicates a stronger connectedness in the international network as expected by its size in terms of residents and employees.

4. Conclusions

A main result of our study was the identification of significant differences between the high-tech- and APS-branhes. Moreover we found relevant indications that Munich has an important role for all other FUAs in the MCR. We found at least two dimensions of polycentricity in the basically monocentric MCR of Munich: The knowledge hub FUA Munich has a qualitative and a quantitative dimension. The density of APS-firms and the number of employees in the KBE is corresponding to the above-average amount of international flows connecting Munich to the rest of the world. However the international relevance of Munich is supported by the high-tech activities in all other FUAs and functional relation from intra-firm networks.

From the first findings of the study we see some indications for a functional division of labour in the MCR and thus functional polycentricity. However, this statement remains as a hypothesis unless more research is done. The quantitative analysis of employee figures showed that high-tech branches locate above-average in the ring of FUAs around Munich, especially in the North. They are linked directly to many different global nodes and they can benefit from the knowledge and gateway infrastructure of Munich. This situation can be regarded as strength of the entire MCR which is thus broadly based on its economic structure.

Functional flows related to the economy can basically be differentiated in

- intra-firm flows
- inter-firm flows and
- transfer of knowledge.

The intra-firm flows are now mapped by our study. To draw a comprehensive picture the remaining task is to analyse the inter-firm flows and the transfer of knowledge. Recently we could successfully gather relevant data by a web survey, asking for interrelations and cooperation between the branches of the KBE in the MCR of Munich. In our analysis of the data we will regard separate parts of the value chain. Moreover our study is

supplemented by personal interviews to get information not accessible by the quantitative approach. Important themes here are methods of communication and the evaluation of location factors.

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