Kiel Institute for World Economics
Duesternbrooker Weg 120
24105 Kiel (Germany)

Kiel Working Paper No. 1215

Urban Specialization in the Internet Age – Empirical Findings for Germany

by

Franz-Josef Bade,

Claus-Friedrich Laaser and

Rüdiger Soltwedel

August 2004

Urban Specialization in the Internet Age – Empirical Findings for Germany

Abstract

Declining spatial transaction costs will affect patterns of urban specialization. The underlying hypothesis is that production locations of goods and services which require face-to-face contacts will continue to be concentrated in core cities of large agglomerations even in the Internet age while locations of standardized production activities with a high codified information content will spread to more peripheral locations. The paper provides empirical evidence on changes in employment specialization patterns of nine different types of German districts (ranging from core cities of agglomerations to low density rural districts) for the period 1976 to 2002. Obviously there is an increasing concentration of "white collar" employees relative to "blue collar" workers in core cities which even gains momentum in particular in the second half of the 1990s.

Keywords: E-commerce, Spatial Division of Labor

JEL Classification: O18, O33, R11

Prof. Dr. Franz-Josef Bade
Dean, Faculty of Spatial Planning, University of Dortmund
Department of Economics
D-44221 Dortmund, Germany
Phone (+49) 231 755-4810 or -6440
Fax (+49) 231 755-6439
e-mail:franz-josef.bade@uni-dortmund.de

Dr. Claus-Friedrich Laaser
Kiel Institute for World Economics
D-24100 Kiel, Germany
Phone: (+49) 431 8814-463
Fax: (+49) 431 85853
e-mail: cflaaser@ifw.uni-kiel.de

Prof. Dr. Rüdiger Soltwedel
Kiel Institute for World Economics
D-24100 Kiel, Germany
Phone: (+49) 431 8814-339
Fax: (+49) 431 85853
e-mail: soltwedel@ifw.uni-kiel.de

Table of Contents

List of Tables

1. Introduction: In search for spatial effects of the New Economy[1]

The New Economy has attracted substantial attention since the Internet entered on stage. Economists as well as politicians expect the New Economy to raise the level of economic development on a higher development path with higher growth rates due to higher knowledge and information content as well as options to economize on spatial transaction costs (cf. OECD 2000).

The Internet appears to be a powerful (and irresistible) driver of a new general-purpose technology that will further reduce spatial transaction costs. The deployment of the Internet as a medium for making and performing transactions via information and communication (ICT)-networks may affect the interregional division of labor in business-to-business (B2B) transactions and of retail trade in business to consumer (B2C) with potentially far-reaching consequences for the relative competitiveness of locations and changes in urban hierarchies. On the one hand, some authors heralded the "death of distance" and the "end of geography" (Cairncross 1997) or regarded cities as the "leftover baggage from the industrial era" (Gilder 1996). On the other hand, it is held that this line of thinking, both as to the demise of the city and to the removal of regional development constraints, "is profoundly flawed" (Gillespie et al. 2000: 13); the proportion of world GDP that can "operate as though geography has no meaning … is likely to be small" (Venables 2001: 24).

Empirical evidence on the spatial implication of the Internet is scarce, however. So far, empirical research on the regional impact of E-commerce

---

[1] This paper presents selected empirical results of the research project „The Spatial Impact of the New Economy" which has been conducted in the Kiel Institute for World Economics on behalf of the Wüstenrot Foundation, Ludwigsburg. The calculations have been carried out in cooperation between the Faculty of Spatial Planning of the University of Dortmund and the Kiel Institute for World Economics. The entire results of the project are to be found in Dohse et al. (2004).

mainly focuses on locational patterns of New Economy firms proper.[2] Therefore, this paper aims at (i) discussing conceptual issues of the Internet-driven spatial structural change and (ii) at providing preliminary empirical evidence for Germany. Yet, a caveat is warranted: what we are looking at, is very much a moving target instead of a concise research topic. The fully-fledged impact of E-commerce is still an issue looming around the corner instead of being already in the pipeline because the systemic properties are not yet in place to really wire up the whole economy effectively. Hence, our evidence is not even a pattern prediction but a plausibility-based speculation about the future course of our events.

The structure of the paper is as follows: Section 2 looks at basic considerations on potential Internet-driven spatial differentiation processes. Section 3 develops a proxy indicator for spatial structural change caused by the Internet. In section 4, empirical evidence for recent spatial structural change in Germany that possibly could be related to the advent of communications technologies in production and marketing will be presented. Section 5 summarizes the results.

2. Basic conceptual considerations

Both the technological characteristics of the Internet as a means to bridge distances and the issue of explaining changing locational activity patterns have had their forerunners. On the technological side, several distance-relevant general-purpose technologies, such as the steam engine and the railways in the 19th century and the telephone in the 20th, have opened up new vistas of a more intense interregional division of labor:

- The analysis by Rosenberg and Trajtenberg (2001) on the spatial effects of the increasing deployment of a specific innovative vintage of the

[2] Cf., e.g., Bade and Nerlinger (2000), Gillespie et al. (2000; 2001), Koski et al. (2001), Winther (2001), Krafft (2000-2002), Dohse (2002), Matuschewski (2002).

steam engine in 19th century US suggests two-sided spatial effects: The increasing application of the new technology permitted a relocation and reorganization of economic activity which had so far suffered from severe locational restrictions of water-power supply. In this sense, it opened up additional locational options. On the other hand, the new technology "served as a catalyst for the massive relocation of industry away from rural areas and into large urban centers, thus fueling agglomeration economies, attracting further population, and fostering economic growth" (ibid.: 44).

- The advent of the railways entailed – just as the New Economy did – an initial stock exchange hype with subsequent bankruptcies of the majority of players, as well as a decline in transaction costs which permitted the opening-up of "new frontiers" at the periphery, thus causing a "death of distance". The spatial diffusion of the new rail technology lead to agglomerative and deglomerative tendencies at the same time. The agglomerative impact of railways was their support for urban development because central locations now could rely on fast and reliable supply of all vital commodities being delivered from the rural periphery. The deglomerative impact was the synchronization of time zones along their tracks which is a prerequisite of spatial division of labor over greater distances and which opened distant locations the access to interregional competition (Coyle 2000).

- Similarly, the development of telephone and related networks gave rise to both agglomerative and deglomerative tendencies. As seen from the perspective of technological diffusion, telephone networks and service utilization spread out from business applications in agglomerative centers both to private applications and to less central locations. This functional and spatial diffusion pattern clearly supported agglomerations

until applications became ubiquitous. At the same time, increasing applications of telephone and related ICT-technologies have offered a widely unexhausted potential for decentralization of economic activities, in particular physical production, because information and control functions could be centralized due to declining telecommunications costs.[3]

The *telematics debate of the 1980s* paved the road towards understanding the spatial impact of distance-relevant general-purpose technologies. The telematics debate centered on the question of potential spatial impacts of innovative combinations of telecommunications applications and computerization.[4] It came up with the following stylized patterns which appears to be relevant for the Internet era (Fritsch and Ewers 1985: 50):

- a decentralization of *standard production activities* due to a decreasing significance of the transaction-hampering power of distance,
- at the same time a centralization of *management tasks* which require face-to-face contacts, and
- possibly a *polarization of economic activities* between agglomerations and periphery with unclear consequences for the locations in-between.

The spatial impact of the advance of ICT applications and, in particular, B2B will depend upon how the balance of centrifugal and centripetal forces shaping the incumbent economic landscape will be influenced. Among the various spatial transaction costs categories relevant for the balance of centrifugal and centripetal forces, ICT-applications will primarily *reduce information costs*, although a couple of other cost categories will be involved, too (Maignan et al. 2003: 9-10; Venables 2001). Therefore, it is

---

3 Cf. Fritsch and Ewers (1985: 34); Henckel et al. (1984: 64).

4 Cf., e.g., Goddard et al. (1983); Marti and Mauch (1984); Fritsch and Ewers (1985); Picot (1985).

key to the understanding of the spatial processes of agglomeration and deglomeration of economic activities due to ICT-networks and services what the specificities of the information are that contract partners exchange alongside the value chain.

A synoptic view on the predictions of the telematics debate of the 1980s[5] and on recent reasoning on the spatial impact of the Internet[6] leads to the conclusion that the distinction between *tacit knowledge* and *ordinary information* provides a guideline for assessing potential spatial structural change as a consequence of B2B-applications. Hence, in order to gain empirical evidence on spatial implications of E-commerce, it is necessary to look at the characteristics of the knowledge versus information content of economic transactions. Spatial clusters of economic activity will persevere or even increase where there is a strong need for the exchange of complex information. Very often this is the case with research activities clustering around research and education institutions to benefit from positive externalities. But face-to face contacts are equally important for management tasks, e.g., in planning, consultancy or in order to build up confidence. If the complexity of information should extend into the backward (B2B) and/or forward linkages (B2C) proximity is also required to suppliers and customers, respectively. More generally: agglomeration effects will arise at that point of the value chain where complex information is most crucial for the economic success of the transaction. The more information can be subjected to codification and digitization, the more dispersed the pattern of location will be. Accordingly, Maignan et al. (2003: 8-9) derive dominating centrifugal forces in cases of a mere

---

5 Cf., e.g., Goddard et al. (1983); Marti and Mauch (1984); Fritsch and Ewers (1985); Picot (1985).

6 Cf. Leamer and Storper (2001), Audretch and Thurik (2000), and Storper and Venables (2002)

exchange of codified information, whereas an increase in the share of tacit knowledge may lead to additional centripetal forces. Bellini et al. (2003) find evidence for a greater dispersion of industrial locations on the one hand, and a counterbalancing development due to a structural shift towards knowledge- and skill-intensive activities on the other. Therefore, the ambiguity of potential spatial effects as a result of the digital economy suggests a parallelism of both centrifugal and centripetal (or –reinforcing) relocations.[7] If the increasing penetration of ICT-applications will mainly foster the centrifugal forces, the death of distance may entail a decline of cities – telecommunications and cities will then turn out to be substitutes.

The Internet's feature as a general-purpose technology first of all provides ample opportunity for *firms* and *whole branches* to re-organize internal firm structures, external delivery, sales and co-operation networks as well as whole value-added chains. These opportunities were previously not available because of prohibitive communications, time and control costs (Porter 2001).

The Internet may create new business models, but primarily it provides options for improving "front end" productivity by virtue of process innovations. Internet solutions will be incorporated into normal business of more or less all firms. Spatial differentiation effects at the firm level due to B2B may incorporate

- complete or partial firm-site relocations, in particular of those entrepreneurial functions which can be performed by remote control,
- an outsourcing of functions which, in a process of concentrating on core competencies, can more favorably be performed by external suppliers or buyers,

---

[7] See also Moriset (2003) on the potential heterogeniety of the spatial effects of ICT.

- new commercial exchange relations via electronic marketplaces with more distant partners and
- new co-operation agreements with other firms, including strategic alliances or even take-overs, leading to new patterns of the regional division of labor in a functional sense.

As a result, a new geography of firm site locations may emerge. The research task is therefore to link relocations or new patterns of suppliers/customers to the knowledge content or digitization potential of a transaction.

3. ICT and spatial structural change of employment patterns – towards an empirical analysis

So far, existing studies on the impact of the Internet on the economy – at least for Germany – primarily are either *case studies* dealing with single firms or conglomerates, or they are based on *interviews* of potentially affected firms.[8] Although these studies differ in their methodology and scope, there is a common conclusion: ICT has forced headquarters to concentrate – both with regard to core competencies and spatially in the agglomeration centers –, whereas complementary functions (e.g., business services) as well as the production activities are going to be outsourced – however, not towards the extreme periphery but rather to the medium neighborhood. Apparently, a mild decentralization is occurring as a consequence of ICT which at the same time strengthens the relative importance of cities.

---

[8] A pertinent case study is the analysis of Grentzer (1999) who asked for the locational consequences of increasing ICT-applications for the *geography of domestic and foreign firm sites of a large corporate network*. A cross-firm survey based on field research, but confined to the Rhein-Main area, has been undertaken by Caspar et al. (2000; 2002).

To capture the impact of New Economy applications on B2B, one would need data both on Internet-driven decentralization processes of firm sites (similar to Caspar et al. 2000; 2002) and on changing patterns of transactions partners of firms (in their supplier-customer relations and co-operation partners) caused by B2B on a larger scale, preferably for an entire country. However, publicly available data of that kind are not available in Germany. Moreover, firms may perceive of these information as business secrets, i.e., it is hard to impossible to get reliable data for a broad-based analysis. Hence, proxies have to be developed to grasp the potential process of diffusion of standardized activities on the one hand and of clustering of knowledge-intensive activities on the other.

If activities with a high content of codified information either in the product itself or as input in the course of the value chain could become footloose whereas activities with a high content of tacit knowledge would tend to cluster in central agglomerations, these relocations should leave their traces in regional employment patterns. Therefore, it seems promising to look for spatial changes *in job qualifications and functional employment patterns*. The change in the relative importance of different levels of skilled labor force either at central or at peripheral locations would then serve as a proxy for the knowledge/codified information ratio of a transaction. Decreasing spatial transactions costs suggest a separation of management and production functions beyond certain thresholds. Management functions depend on face-to-face-communication, exhibit a higher level of urbanization economies beyond branch borders, such as in contacts to firm-related services, and will cluster in central cities. Manufacturing functions, on the other hand, are less prone to urbanization economies but subject to factor cost considerations and will be dispersed to a greater variety of more distant and smaller cities. This process may result in the change of a

location's sectoral to a functional specialization pattern (cf. Duranton and Puga 2001: 17-20; 2003: 17-19).

We take guidance from two avenues of research: (i) an analysis of regional specialization of different locations which is confronted with functional specialization with respect to specific types of employees as in Duranton and Puga (2001; 2003) for the USA and (ii) the analysis of the changes in the regional structure of different job qualifications that reflect the human capital of employees as in Bade and Schönert (1997), Bade and Niebuhr (1999), Bade, Niebuhr, and Schönert (2000) and Bade (2001).

Duranton and Puga (2001; 2003) found evidence for the *USA* that the degree of sectoral specialization of cities of various sizes has decreased throughout the last forty years (the period of the increasing use of telecommunications) whereas the functional specialization (measured by the deviation of the ratio of white collar to blue collar employees from the national average) has increased (cf. Table 1).

For *Germany*, the empirical picture seems to contradict Duranton/Puga. The various analyses by Bade et al. (1997-2001) present relative growth paths of different occupational qualifications for various classes of locations (agglomeration centers, urban fringes, semi-concentrated regions and the absolute periphery) for longer time-series. They suggest that (i) there is an ongoing deconcentration process of employment from agglomerations to more remote areas, (ii) this process is not confined to production activities but encompasses all kinds of highly skilled labor including R&D, (iii) the process does not peter off at the border of the urban fringe but extends into the periphery, and (iv) disparities between agglomerations and the periphery are still declining (see Bade, Niebuhr and Schönert 2000: 21-22).

Table 1 – The Diminishing Sectoral Specialization and Increasing Functional Specialization of US Cities According to Duranton and Puga (2001; 2003)

Local population[a]	Sectoral specialization			Functional specialization in management against production[c]			
	1977	1987	1997	1950	1970	1980	1990
5,000,000 – 19,397,717	.375	.369	.348	+10.2%	+22.4%	+30.8%	+39.0%
1,500,000 – 4,999,999	.287	.275	.257	+ 0.3%	+16.7%	+21.7%	+25.7%
500,000 – 1,499,999	.352	.338	.324	–10.9%	–10.0%	– 5.0%	– 2.1%
250,000 – 499,999	.450	.409	.381	– 9.7%	– 9.7%	–10.9%	–14.2%
75,000 – 249,999	.499	.467	.432	– 2.1%	– 6.6%	–12,7%	–20.7%
67 – 75,000	.708	.692	.661	– 4.0%	–33.7%	–40.4%	–40.5%

[a]Population by Metropolitan Statistical Area/Consolidated Metropolitan Statistical Area (New England County Metropolitan Area in New England), or Non-metro Area. The same areas are included in each population class throughout the table, on the basis of area definitions and population data from the Decennial Census of 2000. [b]Median value for each population class of a Gini index comparing the local and national distributions of employment shares across 2-digit sic manufacturing sectors. If s_h and $\bar{s}_h$ are respectively the local and national shares of employment in sector *h* the Gini specialization index is $\frac{1}{2}\sum_h \left| s_h - \bar{s}_h \right|$. Its value is close to one if a city is fully specialized in a sector that is very small at the national level and is equal to zero if local employment is dispersed across sectors in the same way as national employment. [c]Percentage difference from the national average in the number of executives and managers per production worker (occupied in precision, production, fabrication, or assembly).

Source: Duranton and Puga (2001: 2; 2003: 2).

At a second glace, however, the seeming contradiction to the findings of Duranton and Puga (2001; 2003) for the USA withers away. The *number* of high-skilled and R&D workers is still increasing in agglomerations, albeit at less than proportional rates, and due to the still existing steep slope in the share of high-skilled labor from agglomerations of the periphery, the pertinent *share* in agglomerations might even grow slightly faster than at the periphery (Bade and Schönert 1997: 78; Bade, Niebuhr and Schönert (2000: 22). Moreover, Bade (2001: 357) has found different results for another occupational qualification which can be described by "strategic planning services for enterprises" (management consultancy, accountancy, and legal advisory services). For this group the decentralization process in Germany is much less distinct and dispensed employees from the centers are more or less absorbed by the urban fringe. Both observations taken together might well be in line with the findings of Duranton and Puga (2001; 2003) who concentrated on the *ratio* between white collar and blue collar workers.

However, it should be clear from the outset that there is reason to be cautious to linking potentially observable spatial trends to the increasing use of the Internet or ICT applications in general. It would mean to overstate the ICT-impact to attribute to it any concentration or de-concentration of qualified jobs in the last decades. Therefore, only the period after 1990 when the technical progress accelerated due to the looming liberalization of communications has been considered. But even for this period any correlation remains week due to alternative explanatory variables, such as the consequences of German re-unification on agglomeration processes in West Germany. However, given the scarcity of available information on the impact of ICT on (re-) locations of firm sites this approach may render at least some tentative evidence and conclusions.

4. Empirical evidence for Germany

4.1 Data source and key characteristics of calculations

For our empirical analysis, we use the Bade data to repeat the Duranton/Puga-approach for Germany, and to look for changes in the functional specialization of cities in Germany with respect to occupational qualifications. Following-up on Duranton/Puga, we have calculated for West Germany the deviation of the ratio of white collar workers to blue collar workers (*W/B-ratio)* in every district (Kreis) from the national average of this ratio for the period 1976-2002 from the Bade (2003) database on regional employment statistics; a second set of calculations including East Germany covers the period 1993-2002.[9] Table 2 informs

[9] As data for single districts were available for Germany we have run the calculations at this lowest layer of regional disaggregation. In doing so, we have chosen a somewhat different regional perspective than Duranton and Puga (2001; 2003). They have looked at *consolidated* metropolitan regions (covering the central business district as well as the outer suburbs) of different size of population figures. We, instead, have separated the cores from the outer Thünen-rings and looked at the averages of the dissaggregated classes of districts. This has the advantage that general relocation trends between cores and outer rings (as a

about the various occupational functions which have been allocated to "white collar" and "blue collar" workers.

Table 2 – Occupational Functions of German "White Collar" and "Blue Collar" Employees

Broad category of occupational functions (No. of function)	No. of occupational group[a]	Description of occupational group[a]
White Collar:		
Managerial and administrative functions, (27):	751	Entrepreneurs, Managers, CEOs, Business division heads
	76	Representatives, Employees with administrative or decision-making authority
	881	Economists and Social Scientists, Statisticians
Other business-oriented services, Management consultants (30):	752	Management consultants, Analysts
	753	Accountants, Tax consultants
	81	Lawyers, Legal advisors
Marketing (32):	703	Advertising
	82	Publicists, Translators, Librarians
	83	Artists and related occupations
R&D occupations (for comparison):		
Technical services, R&D (20):	032	Agricultural engineers and consultants
	60	Engineers
	61	Chemists, Physicists, Mathematicians
	883	Other natural scientists
Blue Collar:		
Manufacturing occupations (2-14)	07 to 43	Diverse manufacturing occupations in all industries
For comparison: total number of employees		

[a]According to the nomenclature of occupations, compiled by the Federal Statistical Office in 1975.

Source: Bode (1998: Table A3); Statistisches Bundesamt (1993); ZUMA (without publ. date); own compilation.

A similar ratio has been calculated for the group of natural scientists and engineers representing R&D activities relative to "blue collar" workers (*R&D/B-ratio)*. The research by Bade et al. indicated that more and more R&D employees are following the manufacturing employees on their road

---

kind of "urban sprawl") can be mapped. On the other hand, the disadvantage of a less clear differentiation between the development in the largest and the smallest consolodated agglomerations has to be borne, but these differences seem to be less pronounced in Germany compared to the US.

towards the German periphery, although R&D remains heavily concentrated in core cities. The respective occupations of this control group can be found in Table 2 as well.

Since the employees identified as "white collars" are not only working in manufacturing industries but also in the service sector and even in the public sector,[10] calculations have been run both for the entire local economy covering all white collars (regardless of their sector of employment) relative to blue collar manufacturing workers, and, separately, for manufacturing industries only.

Both ratios, the *W/B* and the *R&D/B*, have been calculated in the first instance (a) for all 326 districts of West Germany for 1976, 1980, and all years from 1984 onwards until 2002, and (b) for the total of 440 districts of Germany as a whole, i.e. including the *New Laender* in East Germany for the period of 1993-2002. In a second step, the results of the district ratios have been grouped according to a classification scheme for districts with respect to their size and degree of agglomeration which has been provided by the German Federal Office for Building and Regional Planning (BBR).[11]

Thirdly, for all nine groups of districts according to this classification scheme the deviations of the district type average, the median, the quasi-minimum (5-percentile), and the quasi-maximum (95-percentile) from the West German average have been computed.

---

[10] As far as public employees with executive functions are concerned, these are included in the occupations in Table 2 as far as they are subjet to social security contribution. In Germany, this is the case for salaried employees with contracts similar to the private sector, but not for civil servants in a narrower sense whose pensions are paid directly from public budgets and not from the budget of the social insurance system. The inclusion of a part of the public sector into our calculations can be justified by the contribution of this sector to the centrality of the core cities.

[11] The nine types of districts of the BBR-scheme (DT) are: (1) Core cities, (2) high density districts, (3) medium density districts and (4) rural districts, each being part of agglomerations; (5) core cities, (6) medium density districts and (7) rural districts, each being part of urbanized regions; (8) rural districts of major density and (9) rural districts of minor density, each being part of rural and peripheral regions.

4.2 Results for West Germany, 1976-2002

The results of the calculations for West Germany for the period 1976-2002 are presented in Tables 3 to 6.[12] Looking first at deviations of district type averages of the *W/B-ratio* from the West German average (Table 3, first four columns), it becomes clear that only core cities of central agglomerations, i.e. primary core cities, district-types (DT) 1, and core cities of urbanized regions, i.e. secondary ones, DT 5, are highly specialized in management, headquarter, and administrative functions relative to manufacturing occupations.

Table 3 – The Change in Functional Specialization of West German Cities and Districts 1976-2002 – Deviations of Averages of District Size Classes from the West German Average

Size and agglomerative type of German districts[a]	Functional specialization in management against production (W/B-ratio) – average of districts of each class[b]				Functional specialization in R&D against production (R&D/B-ratio) – average of districts of each class[b]			
	1976	1990	1995	2002	1976	1990	1995	2002
1) Core cities of agglomerations	50.1	66.6	75.0	95.9	79.8	89.4	98.9	107.3
2) High density districts of agglomerations	-13.7	-10.4	-5.9	2.5	-9.1	-3.8	-4.5	1.7
3) Medium density districts of agglomerations	-23.3	-22.8	-21.9	-24.9	-35.8	-25.3	-22.0	-12.7
4) Rural districts of agglomerations	-25.0	-29.1	-31.6	-37.3	-43.9	-41.5	-41.0	-43.1
5) Core cities of urbanized regions	42.5	44.9	46.1	53.6	41.6	45.8	54.5	57.1
6) Medium density districts of urbanized regions	-35.5	-38.7	-39.6	-43.2	-46.6	-43.2	-42.1	-42.4
7) Rural districts of urbanized regions	-45.1	-48.7	-50.7	-57.4	-62.7	-62.9	-61.4	-61.0
8) Rural districts of major density of rural and peripheral regions	-30.8	-34.9	-36.3	-40.1	-50.7	-50.1	-48.8	-47.8
9) Rural districts of minor density of rural and peripheral regions	-41.3	-40.4	-49.0	-54.8	-65.4	-66.9	-67.7	-71.6

[a]Size of districts according to the BBR classification scheme. [b]Percentage difference from the West German average in the number of executives and managers per production worker.

Source: Bade (2003) database on regional functional employment; applied method following Duranton and Puga (2001; 2003); own calculations.

Thus, the West German regional pattern with respect to employees' occupations and functions exhibits the expected division of labor between

[12] Although calculations have been made for 1976, 1980, 1984 and all subsequent years until 2002, the tables only report the results for 1976, 1990, 1995, and 2002.

core cities, the adjacent Thünen rings, and the more remote periphery. Both types of core cities always have been specialized in this way – with a *W/B-ratio* of 40 to 50 per cent above the West German average in 1976. Furthermore, a certain increase of about DT 1: 16½ percent (DT 5: 2½ percent) is already reported for the first half of the observation period, i.e., the pre-Internet period from 1976 to 1990.

But, interestingly, the deviation from the West German average has gained significant momentum after 1990 and, in particular, after 1995. For DT 1, the increase over time of the deviation from the West German average reaches nearly 30 percentage points from 1990 to 2002, with more than 20 percentage points from 1995 to 2002. For DT 5 an increase of 1990-2002: 10 and 1995-2002: 6½ percentage points is reported. For all other district types, with the exception of the first Thünen ring of high density districts in agglomerations (DT 2) from 2000 on, the *W/B-ratio* lies far below the West German average.

With the beginning of the Internet age, core cities seem to have, on average, more and more specialized on management, administrative and headquarter functions, i.e. activities which are not subject to ICT transmission but instead continue to require close face-to-face contacts and the productive milieu of spill-over-effects in cities. In contrast to core cities, the other district types exhibit a different specialization pattern, notably on production and assembly functions, which increases with the distance from the centers.

This picture is reinforced by a comparison with the *R&D/B-ratio* (last four columns of Table 3). The deviation of this ratio in core cities (DT 1 and 5) from its West German average indeed is traditionally even higher than it is the case with the *W/B-ratio*, and it has also increased over time. Remarkably, however, is the fact that the increase of the *R&D/B-ratio* is

much less pronounced in general, and since 1990 in particular, than that of the *W/B-ratio*. The results suggest that although core cities are even more specialized on R&D than on management activities this pattern has only slightly changed in the Internet era in contrast to the rapidly increasing management specialization. This observation would coincide with the above mentioned hypothesis that engineers have to follow the assemblers towards more remote firm sites while managers and headquarter services remain in the core cities.

Both trends discussed above are reinforced in the calculation for the *manufacturing sector*: The specialization of core cities on management functions of manufacturing industry firms (*W/B-ratio*) increases over time a little bit slower in the fist half of the 1990s, but again accelerates markedly at the end of the observation period (first four columns of Table 4).

In addition, for manufacturing the high density districts adjacent to core cities (DT 2) participate to a greater extent in the management specialization pattern than for the entire local economy. The increase in the deviation of the *W/B-ratio* from the West German average is again more pronounced than that of the (still slightly higher) *R&D/B-ratio* (last four columns of Table 4). Looking at the results for manufacturing even leaves us with the impression that core cities, having traditionally been highly specialized on R&D, now nearly have caught-up with respect to the management specialization pattern.

In order to get more insights into the distribution of cases, we have computed the median as well as the 95- and the 5-percentile (as quasi-maximum and –minimum).

Table 4 – The Change in Functional Specialization of Manufacturing Industries in West German Cities and Districts 1976-2002 – Deviations of Averages of District Size Classes from the West German Average

Size and agglomerative type of German districts[a]	Functional specialization in management against production (W/B-ratio) – average of districts of each class[b]				Functional specialization in R&D against production (R&D/B-ratio) – average of districts of each class[b]			
	1976	1990	1995	2002	1976	1990	1995	2002
1) Core cities of agglomerations	44.4	62.1	67.9	93.1	95.9	94.8	104.5	105.5
2) High density districts of agglomerations	2.2	-0.8	8.1	6.1	1.5	2.5	3.7	3.7
3) Medium density districts of agglomerations	-11.8	-8.2	-5.7	-7.8	-42.9	-34.0	-29.7	-14.5
4) Rural districts of agglomerations	-29.0	-30.7	-25.7	-30.1	-63.2	-50.7	-47.3	-49.5
5) Core cities of urbanized regions	10.2	21.8	33.9	44.9	25.1	38.9	49.7	59.4
6) Medium density districts of urbanized regions	-23.7	-27.4	-24.6	-28.0	-45.4	-42.3	-39.1	-38.1
7) Rural districts of urbanized regions	-36.6	-41.3	-41.8	-44.2	-69.7	-66.5	-62.6	-60.7
8) Rural districts of major density of rural and peripheral regions	-30.6	-35.0	-34.8	-34.7	-56.9	-53.2	-50.0	-47.2
9) Rural districts of minor density of rural and peripheral regions	-44.3	-50.5	-50.7	-54.6	-74.1	-72.8	-71.5	-73.3

[a]Size of districts according to the BBR classification scheme. [b]Percentage difference from the West German average in the number of executives and managers in manufacturing industries per production worker.

Source: Bade (2003) database on regional functional employment; applied method following Duranton and Puga (2001; 2003); own calculations.

Comparing the deviations of the district size class *medians* from the West German average (Table 5) with the averages (Table 3) – now again for the entire local economy – provides evidence that the specialization of DT 1 and DT 5 core cities on management functions apparently is a phenomenon of just a few highly specialized cities: Both the level and the increase over time in the deviation from the West German average is by far much less pronounced for the core cities midway in the sample than for the arithmetic mean which, accordingly, must be dominated by a few cases of extraordinary high values in the *W/B-ratio* relative to the West German average. In other words: High concentrations of management jobs can be found only in a few, probably metropolitan, core cities, while in the majority of these the specialization is only moderate.

Table 5 – The Change in Functional Specialization of West German Cities and Districts 1976-2002 – Deviations of Median of District Size Classes from the West German Average

Size and agglomerative type of German districts[a]	Functional specialization in management against production (W/B-ratio) – median of districts of each class[b]			
	1976	1990	1995	2002
1) Core cities of agglomerations	17.6	18.3	28.2	38.1
2) High density districts of agglomerations	-34.5	-35.8	-31.8	-27.6
3) Medium density districts of agglomerations	-27.0	-29.1	-28.5	-34.1
4) Rural districts of agglomerations	-26.0	-24.4	-26.8	-30.1
5) Core cities of urbanized regions	22.6	29.4	34.4	38.0
6) Medium density districts of urbanized regions	-38.1	-43.6	-44.3	-49.4
7) Rural districts of urbanized regions	-50.4	-53.1	-53.7	-60.6
8) Rural districts of major density of rural and peripheral regions	-32.1	-41.4	-45.5	-52.0
9) Rural districts of minor density of rural and peripheral regions	-52.4	-53.8	-55.5	-61.2

[a]Size of districts according to the BBR classification scheme. [b]Percentage difference from the West German average in the number of executives and managers per production worker.

Source: Bade (2003) database on regional functional employment; applied method following Duranton and Puga (2001; 2003); own calculations.

This pattern is replicated in the 95-percentile (Table 6): Near the maximum the specialization on management jobs is extraordinarily high both in DT 1 and DT 5 core cities – the level of the deviation from the West German average is 4-5 times as high as on average for these district types (compare respective columns in Table 6 with Table 3). The increase over time in this deviation for the 95-percentile of DT 1 and DT 5 core cities is impressive but more stable over time throughout the whole observation period; in contrast to this, the deviation of class averages from the West German average accelerated particularly from 1995 onwards (Table 3). This leaves us with the impression that the club of cities specialized on management activities was joined by more members in the 1995-2002 period.

Returning to the interregional comparison of the results for the 95-percentile, also the first Thünen ring adjacent to the core cities (DT 2) exhibits the same increase in the specialization pattern and even outperforms the secondary core cities of DT 5. On the other side of the sample, at the 5-percentile, we find only core cities which are far below the average specialization on management functions (Table A1 in Appendix 1).

A rather similar pattern is found, if we look at the median, the 95- and the 5-percentile in manufacturing alone (see Tables A2-A4 in Appendix 2).

Table 6 – The Change in Functional Specialization of West German Cities and Districts 1976-2002 – Deviations of 95-Percentile of District Size Classes from the West German Average

Size and agglomerative type of German districts[a]	Functional specialization in management against production (W/B-ratio) – 95-percentile of districts of each class[b]			
	1976	1990	1995	2002
1) Core cities of agglomerations	228.9	352.2	374.6	464.5
2) High density districts of agglomerations	106.2	171.1	206.6	283.4
3) Medium density districts of agglomerations	30.3	24.3	32.2	35.2
4) Rural districts of agglomerations	7.4	-12.6	-17.8	-18.2
5) Core cities of urbanized regions	173.3	198.3	186.5	213.1
6) Medium density districts of urbanized regions	15.7	7.7	1.5	4.2
7) Rural districts of urbanized regions	-0.7	-16.5	-19.5	-32.4
8) Rural districts of major density of rural and peripheral regions	19.9	15.0	12.7	4.8
9) Rural districts of minor density of rural and peripheral regions	53.6	49.8	0.1	-6.0

[a]Size of districts according to the BBR classification scheme. [b]Percentage difference from the national average in the number of executives and managers per production worker.

Source: Bade (2003) database on regional functional employment; applied method following Duranton and Puga (2001: 2003); own calculations.

In general, these findings for Germany correspond with those of Duranton and Puga (2001; 2003) who found management activities in the US increasingly to be concentrated in the largest metropolitan regions in particular in the era of more intense ICT applications (cf. Table 1).

4.3 Results for Germany as a whole, 1993-2002

The results for Germany as a whole, i.e., including the *New Laender* in Eastern Germany for the period from 1993 onwards, should be considered with more caution. The reasons are: (a) the initial regional structural patterns in Eastern Germany were quite different due to path dependencies from the former GDR; (b) part of the adjustments in the course of time must be attributed to the severe disequilibrium after unification and the necessary structural change in the *New Laender* from totally incompetitive socialist production patterns towards more normal conditions nowadays.

By and large, results for unified Germany as a whole corroborate the findings from the analysis for West Germany.[13] Core cities of agglomerations as well as of urbanized regions (DT 1 and 5) exhibit a high and rapidly over time increasing *W/B-ratio* compared to the German average, both in the entire local economy (Table 7) and in manufacturing (Table 8). The increase is particularly pronounced at the end of the observation period: The specialization on management tasks in core cities apparently gained momentum in the early years of the Internet.

Again, also in this sample the specialization on R&D is still higher than that on management, at least for DT 1, and the *R&D/B-ratio* has increased less. Core cities, traditionally having been the home of the knowledge-based industry, now are catching-up with respect to management tasks. The next Thünen ring of DT 2 is more or less following DT 1 and DT 5 concerning a further concentration on management activities but gains more than proportionally only for the manufacturing sub sample, not for the entire economy including services.

While the additional information in the sample including East Germany does not contradict the overall picture that emerged for West Germany, some new features can be discerned. The most striking of these is the more than proportional management-production-ratio for rural districts at the outer fringe of agglomerations (DT 4, see Table 7) in 1993 which did not exist in West Germany. Only at the end of the observation period the deviation of the ratio from the German average turned negative.

---

[13] We only report on the district type arithmetic means of deviations in the *W/B-* and the *R&D/B-ratio* from the German average in Tables 7 (for the entire local economy) and 8 (for manufacturing industries only).

Table 7 – The Change in Functional Specialization of German Cities and Districts 1993-2002 – Deviations of Averages of District Size Classes from the German Average

Size and agglomerative type of German districts[a]	Functional specialization in management against production (W/B-ratio) – average of districts of each class[b]				Functional specialization in R&D against production (R&D/B-ratio) – average of districts of each class[b]			
	1993	1996	1999	2002	1993	1996	1999	2002
1) Core cities of agglomerations	73.2	79.2	92.2	106.3	91.5	101.1	110.9	115.4
2) High density districts of agglomerations	-18.0	-13.6	-6.9	-2.8	-12.0	-10.1	-2.6	-0.6
3) Medium density districts of agglomerations	-20.7	-22.2	-24.8	-27.0	-22.7	-20.7	-19.6	-18.1
4) Rural districts of agglomerations	17.9	8.4	2.1	-4.6	0.7	-4.5	-11.6	-15.2
5) Core cities of urbanized regions	63.9	71.9	71.2	73.0	65.0	74.0	70.5	69.6
6) Medium density districts of urbanized regions	-30.4	-33.5	-35.8	-38.8	-37.3	-39.1	-38.8	-40.6
7) Rural districts of urbanized regions	-33.1	-37.3	-42.5	-47.4	-48.5	-48.7	-51.4	-52.5
8) Rural districts of major density of rural and peripheral regions	-24.3	-26.1	-30.3	-33.9	-38.4	-39.1	-41.5	-43.6
9) Rural districts of minor density of rural and peripheral regions	-4.1	-10.8	-20.8	-27.3	-33.4	-36.0	-41.2	-45.1

[a]Size of districts according to the BBR classification scheme. [b]Percentage difference from the national average in the number of executives and managers per production worker.

Source: Bade (2003) database on regional functional employment; applied method following Duranton and Puga (2001; 2003); own calculations.

One would be tempted to attribute this unexpected positive deviation of the *W/B-ratio* to the still heavily oversized public sector in East Germany (which is included in the "white collar"-numerator as long as public services are not provided by civil servants).

However, the picture clarifies by looking at the corresponding figures for the manufacturing sector in Table 8: It is in fact manufacturing which is responsible for this "white collar concentration" at the urban fringe in DT 4. A similar pattern can be observed in 1993 for DT 3, the less dense and moderately remote districts of agglomerations. Again, this effect thins out towards the end of the observation period, i.e. in the course of structural adjustment in East Germany.

Table 8 – The Change in Functional Specialization of Manufacturing Industries in German Cities and Districts 1993-2002 – Deviations of Averages of District Size Classes from the German Average

Size and agglomerative type of German districts[a]	Functional specialization in management against production (W/B-ratio) – average of districts of each class[b]				Functional specialization in R&D against production (R&D/B-ratio) – average of districts of each class[b]			
	1993	1996	1999	2002	1993	1996	1999	2002
1) Core cities of agglomerations	59.8	65.3	74.7	90.7	92.3	101.3	111.6	107.6
2) High density districts of agglomerations	-5.2	-0.1	7.2	5.2	-0.4	1.5	6.9	5.6
3) Medium density districts of agglomerations	5.7	-1.6	-5.8	-8.3	-21.7	-23.4	-22.8	-17.0
4) Rural districts of agglomerations	28.5	18.5	10.5	4.3	-4.2	-7.3	-21.3	-27.2
5) Core cities of urbanized regions	51.0	58.6	54.4	50.2	54.2	63.0	58.0	59.3
6) Medium density districts of urbanized regions	-13.0	-17.4	-21.0	-23.5	-34.6	-35.6	-36.6	-37.6
7) Rural districts of urbanized regions	-17.3	-23.2	-29.1	-32.6	-47.9	-51.0	-53.7	-54.3
8) Rural districts of major density of rural and peripheral regions	-12.6	-23.8	-26.9	-29.4	-38.9	-40.0	-43.5	-45.2
9) Rural districts of minor density of rural and peripheral regions	-6.2	-19.6	-29.4	-33.9	-43.2	-49.5	-50.4	-55.0

[a]Size of districts according to the BBR classification scheme. [b]Percentage difference from the national average in the number of executives and managers in manufacturing industries per production worker.

Source: Bade (2003) database on regional functional employment; applied method following Duranton and Puga (2001; 2003); own calculations.

Apparently, the explicitly different firm structure in East Germany – with by far less large firms and a more atomistic firm structure in East German manufacturing (Cf. Ragnitz et al. 2002; DIW et al. 2002) – is mirrored in our results. In West Germany the headquarter location decisions of large firms dominate the concentration patterns on management in core cities. In contrast to this, smaller manufacturing firms in East Germany, often still with integrated management and production firm sites in the sense which Duranton/Puga characterized as typical for the pre-ICT era, somewhat dilute the clear picture derived for West Germany at least at the beginning of the observation period. In general, however, the concentration of management jobs particularly on core cities is still quite high.

4.4 Specialization and decentralization

Our empirical results suggest that core cities in Germany increasingly specialize on those entrepreneurial tasks which can be qualified as “white collar” work and which require a lot of face-to-face contacts in an urban milieu. Other tasks, such as mere production, assembly or secondary services, which are apt for ICT-control and do not need that amount of face-to-face contacts are outsourced or relocated to more remote sites at the periphery. Under such a specialization pattern, urban centers apparently play their traditional role as dense and highly productive locations providing spillover effects and other Marshallian externalities. Although the analysis presented above cannot render any strict causality, it provides the noteworthy parallelism of a rapidly increasing specialization of German core cities just in the phase of increasing Internet application being the newest vintage of ICT networks and services. Hence, the question arises: Do these results suggest a survival, and may be even revival, of core cities in the Internet age?

Certainly, the distinct and reinforced specialization pattern offers German core cities the option to play a decisive roll also in the Internet age. But on the other hand we have to note the ongoing general decentralization process of economic activity in Germany in the 1990s (Table 9 for West Germany 1976 to 2002 and Table 10 for entire Germany 1993-2002 reporting the share of jobs in the 9 district types).[14]

In particular for West Germany, the shares of the various district classes in the employment total exhibit the ongoing decentralization process from 1976 towards at least 1999: Primary core cities of DT 1 have lost more than 5 percentage points in their employment share since 1976 and still nearly 2

---

[14] See also Bade et al. (1997-2001).

percentage points since 1990 until the millennium; afterwards the share stagnates. For secondary core cities of DT 5 the era of stagnation already commenced in 1995. In absolute terms, the total number of jobs in DT 1 core cities, however, has increased from 7.322 million jobs in 1998 to 7.652 in 2001, but in accordance with the business cycle the figure again decreased to 7.591 in 2002. A parallel development is recorded for DT 5 with 1.635 million in 1998 to 1.709 in 2001 and 1.707 in 2002 (Bade 2003).

Table 9 – The Share of West German Cities and Districts in the Total West German Workforce 1976-2002

Size and agglomerative type of German districts[a]	Share of a District Type in the Total West German Workforce[b]							
	1976	1990	1995	1998	1999	2000	2001	2002
1) Core cities of agglomerations	38.6	35.0	33.7	33.2	33.1	33.2	33.2	33.1
2) High density districts of agglomerations	15.2	16.4	16.4	16.7	16.7	16.7	16.7	16.8
3) Medium density districts of agglomerations	5.6	6.1	6.5	6.6	6.5	6.6	6.6	6.6
4) Rural districts of agglomerations	1.4	1.5	1.6	1.6	1.7	1.7	1.6	1.7
5) Core cities of urbanized regions	7.8	7.6	7.4	7.4	7.4	7.4	7.4	7.5
6) Medium density districts of urbanized regions	16.2	16.9	17.2	17.3	17.3	17.3	17.3	17.3
7) Rural districts of urbanized regions	6.4	7.1	7.5	7.5	7.5	7.4	7.4	7.4
8) Rural districts of major density of rural and peripheral regions	6.3	6.8	7.0	7.0	7.0	7.0	6.9	6.9
9) Rural districts of minor density of rural and peripheral regions	2.5	2.7	2.8	2.8	2.8	2.8	2.7	2.7
Total West German Workforce *[1000 Jobs]*	100.0 *19,921*	100.0 *22,366*	100.0 *22,597*	100.0 *22,074*	100.0 *22,390*	100.0 *22,846*	100.0 *23,017*	100.0 *22,912*

[a]Size of districts according to the BBR classification scheme. [b]Employees Subject to Social Security Contributions per District Class in Per Cent of West German Total.

Source: Bade (2003) database on regional functional employment; own calculations.

Hence, for West Germany the specialization pattern on management activities found in paragraph 4.2 occurs in parallel to a further decentralization in the 1990s which, at the turn of the millennium, appears to have somewhat decelerated. Whether this can be interpreted already as a turning point in the trend or not, remains an open question. Geppert and Gornig (2003) who perform a job study for a number of West German core

cities which still lost jobs in the course of the 1990s, interpret the job increase which they found for these cities since 1998 as a hopeful symbol for a revival of German metropolitan areas. Thus, in future research, we may ask the Glaeser and Shapiro (2001) question: "Is city life back?"

For Germany as a total, i.e. including the *New Laender*, the decentralization process is observable from 1993 until 1998 as well, then, however, slightly turns towards centralization (Table 10). In general, the decentralization appears to be less clear than for West Germany alone.

Table 10 – The Share of Cities and Districts in the Workforce of Germany as a Whole 1993-2002

Size and agglomerative type of German districts[a]	Share of a District Type in the Total German Workforce[b]							
	1993	1995	1997	1998	1999	2000	2001	2002
1) Core cities of agglomerations	32.1	31.1	30.9	30.7	30.7	30.9	31.1	31.1
2) High density districts of agglomerations	13.3	13.3	13.5	13.7	13.8	13.8	14.0	14.0
3) Medium density districts of agglomerations	6.4	6.6	6.7	6.7	6.7	6.7	6.6	6.7
4) Rural districts of agglomerations	3.3	3.5	3.5	3.5	3.5	3.4	3.3	3.3
5) Core cities of urbanized regions	8.6	8.4	8.3	8.3	8.3	8.3	8.3	8.3
6) Medium density districts of urbanized regions	16.3	16.5	16.6	16.6	16.7	16.7	16.7	16.6
7) Rural districts of urbanized regions	8.1	8.5	8.5	8.5	8.4	8.3	8.2	8.3
8) Rural districts of major density of rural and peripheral regions	7.3	7.5	7.4	7.4	7.4	7.4	7.3	7.4
9) Rural districts of minor density of rural and peripheral regions	4.5	4.7	4.7	4.7	4.6	4.5	4.4	4.4
Total German Workforce *[1000 Jobs]*	100.0 *28,520*	100.0 *28,040*	100.0 *27,204*	100.0 *27,132*	100.0 *27,406*	100.0 *27,750*	100.0 *27,744*	100.0 *27,499*

[a]Size of districts according to the BBR classification scheme. [b]Employees Subject to Social Security Contributions per District Class in Per Cent of West and East German Total.

Source: Bade (2003) database on regional functional employment; own calculations.

What do these ambiguous changes in the spatial structure mean for economic activity in the sense of value added? Table 11 provides evidence on the development of local GDP of the 9 district classes and of GDP per capita for Western Germany (up to 2000 only due to data limitations).

Table 11 – The Change in Local GDP and GDP per Capita of West German Cities and Districts 1992-2000 by District Type

Size and agglomerative type of German districts[a]	Cumulated Percentage Change of GDP[b]		Cumulated Percentage Change of GDP per Capita[c]	
	1992-2000	1998-2000	1992-2000	1998-2000
1) Core cities of agglomerations	19,3	5,5	19,3	6,1
2) High density districts of agglomerations	27,0	6,9	21,4	5,8
3) Medium density districts of agglomerations	23,2	4,6	18,6	3,7
4) Rural districts of agglomerations	23,2	4,7	13,1	3,3
5) Core cities of urbanized regions	20,7	5,5	22,8	6,6
6) Medium density districts of urbanized regions	22,1	5,8	15,9	4,5
7) Rural districts of urbanized regions	23,9	4,6	17,0	3,8
8) Rural districts of major density of rural and peripheral regions	22,5	5,0	15,8	4,2
9) Rural districts of minor density of rural and peripheral regions	21,3	2,4	15,9	2,2
West Germany on average	*22,1*	*5,5*	*18,1*	*5,0*

[a]Size of districts according to the BBR classification scheme. [b]In nominal terms, average by district type. [c]Inhabitants.

Source: Statistische Landesämter (2002); own calculations.

The data exhibit that West German core cities both of DT 1 and DT 5 have on average grown less between 1992 and 2000 in terms of GDP than West Germany as a whole and as all other adjacent and more distant Thünen rings (first column of Table 11): DT 1 by nearly 3 percentage points compared with the average, and DT 5 still by more than 1½. However, with respect to GDP per capita (third column), DT 1 and DT 5 indeed perform far better than the average over the whole period: DT 1 with 1¼ percentage points and DT 5 even with 4¾, although DT 1 core cites are yet outperformed by their adjacent Thünen ring of DT 2 with 3¼. In addition, if we look only at the 1998 to 2000 sub period, the relative performance of core cities improves to an average level for total GDP (column 2) and a distinctly more than proportional figure for GDP per capita (column 4).

A common denominator of these somewhat ambiguous results can presumably be found in the interpretation that indeed the hopeful perspective of the core cities' intensifying specialization patterns on white collar activities as genuine urban tasks is still overshadowed by the general decentralization trend in Germany. It is unclear whether some hints on a slight retardation of this trend from the millennium onwards prove to be

stable and will set a still more advantageous perspectives of core cities in the Internet age.

5. Conclusions

Declining spatial transaction costs will affect patterns of urban specialization. The underlying hypothesis is that production locations of goods and services which require face-to-face contacts will continue to be concentrated in core cities of large agglomerations even in the Internet age while locations of standardized production activities with a high codified information content will spread to more peripheral locations. The paper provides empirical evidence on changes in employment specialization patterns of nine different types of German districts (ranging from core cities of agglomerations to low density rural districts) for the period 1976 to 2002. Obviously there is an increasing concentration of “white collar” employees relative to “blue collar” workers in core cities which even gains momentum in particular in the second half of the 1990s.

In Germany a similar pattern of increasing functional specialization is evolving as it has been described by Duranton and Puga (2001; 2003) for the USA. Core cities, in particular of large agglomerations, but also of urbanized regions increasingly exhibit a clearly increasing white collar/blue collar ratio, and they have done so with increasing intensity in recent years when new vintages of ICT transmission techniques, among them the Internet, have spread out in business relations. Results in this direction are more pronounced for West Germany in isolated perspective, but can be found also with East German districts being incorporated into the sample.

Apparently, core cities actually gain in importance just in the Internet age, at least in relative terms, and cannot not be seen to be the losers of this new general purpose technology, i.e. does not seem to be a general “decline of the cities” due to the Internet. However, the ongoing deconcentration of

economic activity in Germany is not (yet) reverted. Thus, a somewhat mixed and ambiguous picture arises from our analysis. Of course, the mere parallelism between the white/blue collar ratio increase and spreading Internet use is far from proving a strict causality, and further research is needed in this respect. Nevertheless, the analysis may shed some light on core cities' perspectives in the ongoing Internet age:

- German core cities are indeed increasingly specializing on face-to-face-prone management activities which are less apt for ICT transmission, while the spreading use of Internet applications in all areas of business would suggest the majority of other standardized activities to be outsourced to "somewhere", so that the urban milieu and its basic Marshallian positive externalities are largely left untouched by ICT and particularly the Internet,
- at the same time core cities have to cope with long lasting trends of (manufacturing) jobs losses being transferred to more remote regions, and of a less than proportional increasing GDP – a trend which has been rather stable at least until the millennium,
- as recently as after the turn of the century, the decentralization is somewhat less clearly visible with respect to job losses and GDP growth,
- notwithstanding the decentralization trends, core cities and their adjacent Thünen ring clearly have gained in terms of GDP per capita growth.

Thus, it would be exaggerated to contend that "white collars" more and more remain among themselves in German core cities and at last are going to turn off the lights. But nevertheless the concentration of core cities on "white collar" activities is clearly detectable in the employment data, and

the value added statistics suggest that these are indeed the highly paid activities. It appears as if the spreading of the Internet would actually sharpen the profile of cities as locations of spillovers and positive externalities. The Internet can thus be expected not to provoke a decline but rather an accentuation of urban texture.

References

Audretsch, D.B., and A.R. Thurik (2000). What's new about the new economy? Sources of growth in the managed and entrepreneurial economies. ERIM report series research in management: Strategy and entrepreneurship, 2000-45. Erasmus Research Institute of Management, Erasmus Universiteit Rotterdam.

Bade, F.-J. (2003). Database on Regional Functional Employment.

Bade, F.-J. (2001). Regionale Entwicklungstendenzen und Unterschiede des Humankapitals. In H.-F. Eckey et al. (Hrsg.), *Ordnungspolitik als konstruktive Antwort auf wirtschaftspolitische Herausforderungen*. Festschrift zum 65. Geburtstag von Paul Klemmer. Stuttgart: Lucius & Lucius, 337-361.

Bade, F.-J., E.A. Nerlinger (2000). The Spatial Distribution of New Technology-based Firms: Empirical Results for West-Germany. *Papers in Regional Science*, 79 (2): 155-176.

Bade, F.-J., A. Niebuhr (1999). Zur Stabilität des räumlichen Strukturwandels. *Jahrbuch für Regionalwissenschaften*, 19: 131-156.

Bade, F.-J., M. Schönert (1997). Regionale Unterschiede und Entwicklungstendenzen in der Qualität der Arbeitsplätze. *Geographische Zeitschrift*, 85 (2+3): 67-80.

Bade, F.-J., A. Niebuhr, M. Schönert (2000). Spatial Structural Change – Evidence and Prospects. HWWA Discussion Paper, 87. Hamburg: Hamburgisches Welt-Wirtschafts-Archiv (HWWA).

Bellini, E., G.I.P. Ottaviano, and D. Pinelli (2003). The ICT Revolution: Opportunities and Risks for the Mezzogiorno. The Fondazione Eni Enrico Mattei Note di Lavoro Series, 86.2003. Milano. Downloaded from Internet-site http://www.feem.it/web/activ/_wp.html.

Bode, E. (1998). *Lokale Wissensdiffusion und regionale Divergenz in Deutschland*. Kieler Studien, 293. Tübingen: Mohr.

Cairncross, F. (1997). *The Death of Distance: How the Communications Revolution Will Change Our Lives*. Boston, Mass.: Harvard Business School Publications.

Caspar, J., C. Heinrich, N. Köck, S. Krömmelbein, A. Schmid (2000). Unternehmensvernetzung und regionale Beschäftigung am Beispiel der Region Rhein-Main. In S. Krömmelbein, A. Schmid (Hrsg.), *Globalisierung, Vernetzung und Erwerbsarbeit. Theoretische Zugänge und empirische Entwicklungen*. Wiesbaden: Deutscher Universitätsverlag, 73-128.

Caspar, J., S. Krömmelbein und A. Schmid (2002). Regionale Beschäftigungseffekte der neuen Informations- und Kommunikationstechnologien in der Rhein-Main-Region. In J. Fischer, S. Gensior (Hrsg.), *Sprungbrett Region? Strukturen und Voraussetzungen vernetzter Geschäftsbeziehungen*. Berlin. Edition Sigma. 329-352.

Coyle, D. (2000). Radio Talk on the New Economy. Essay on BBC Radio Four's „The World Tonight" on Friday 11 February 2000. Downloaded from Internet-site http://dialspace.dial.pipex.com/diane. coyle/worldtonight.htm.

Dohse, D. (2002). The Spatial Structure of the New Economy in Germany. Paper presented at the 42nd Congress of the European Regional Science Association (ERSA) "From Industry to Advanced Services – Perspectives of European Metropolitan Regions" in Dortmund 27-31 August 2002. University of Dortmund: Congress CD-ROM.

Dohse, D., C.-F. Laaser, J.-V. Schrader und R. Soltwedel (2004). Räumlicher Strukturwandel im Zeitalter des Internets – Eine Untersuchung der raumwirtschaftlichen Folgen des Vordringens des Internets als Transaktionsmedium. In Wüstenrot Stiftung (Hrsg.), *Räumlicher Strukturwandel im Zeitalter des Internets – Neue Herausforderungen für Raumordnung und Stadtentwicklung*. Wiesbaden: VS Verlag für Spzialwissenschaften, S. 11-144.

Duranton, G., and D. Puga (2001). From Sectoral to Functional Urban Specialisation. CEPR Discussion Paper, 2971. London: Centre for Economic Policy Research (CEPR). Downloaded from Internet-site http://www.cepr.org/pubs/new-dps/dplist.asp?dpno=2971.

Duranton, G., and D. Puga (2003). From Sectoral to Functional Urban Specialisation. CEPR Discussion Paper, 2971, revised version June 2003. London: Centre for Economic Policy Research (CEPR). Downloaded from Internet-site http://dpuga.economics.utoronto.ca/papers/sec2func.pdf.

Fritsch, M., and H.-J. Ewers (1985). *Telematik und Raumentwicklung – Mögliche Auswirkungen neuer Telekommunikationstechniken auf die Raumstruktur und Schlußfolgerungen für die raumbezogene Politik*. Kleine Schriften der Gesellschaft für Regionale Strukturentwicklung. Bonn: Gesellschaft für Regionale Strukturentwicklung.

Geppert, K., and M. Gornig (2003). Die Renaissance der großen Städte – und die Chancen Berlins. *DIW-Wochenbericht*, 70 (26 vom 26. Juni): 411-417.

Gilder, G. (1996). Forbes ASAP, February 27th: 56.

Gillespie, A.E., R. Richardson, and J. Cornford (2000). Regional Development and the New Economy. Centre for Urban and Regional Development Studies (CURDS), University of Newcastle upon Tyne: Draft Paper. Downloaded from Internet-site http://www.ncl.ac.uk/curds.

Gillespie, A., R. Richardson, and J. Cornford (2001). Regional Development and the new economy. *EIB Papers* 6 (1): 109-139.

Glaeser, E.L., and J. Shapiro (2001). Is There a New Urbanism? The Growth of U.S. Cities in the 1990s. NBER Working Paper w8357. Cambridge, MA: National Bureau of Economic Research.

Goddard, J.B., A.E. Gillespie, A.T. Thwaites, and J.F. Robinson (1983). Study of the Effects of New Information Technology on the Less Favoured Regions of the Community. Final Report for the Directorate General for Regional Policy of the Commission of the European Communities. Centre for Urban and Regional Development Studies (CURDS), University of Newcastle upon Tyne.

Grentzer, M. (1999). *Räumlich-strukturelle Auswirkungen von IuK-Technologien in transnationalen Unternehmen*. Geographie der Kommunikation, 2. Münster: LIT.

Henckel, D., E. Nopper, and N. Rauch (1984). *Informationstechnologie und Stadtentwicklung*. Schriften des Deutschen Instituts für Urbanistik, 71. Stuttgart u.a.: W. Kohlhammer/Deutscher Gemeindeverlag.

Koski, H., P. Rouvinen and P. Ylä-Anttila (2001). ICT Clusters in Europe. The Great Central Banana and the Small Nordic Potato. UNU/WIDER Discussion Paper, 2001/6. Helsinki: United Nations University World Institute for Development Economics Research.

Krafft, L. (2000-2002). Ergebnisse des Forschungsprojekts „E-startup.org“, durchgeführt an der European Business School, Schloß Reichartshausen, Oestrich-Winkel. Downloaded from Internet-Site http://www.e-startup.org/ergebnis.htm.

Leamer, E.E. and M. Storper (2001). The economic geography of the Internet age. NBER working paper series, 8450. National Bureau of Economic Research, Cambridge, Mass.

Maignan, C., D. Pinelli, and G.I.P. Ottaviano (2003). ICT, Clusters and Regional Cohesion: A Summary of Theoretical and Empirical Research. Fondatione Eni Enrico Mattei and CEPR, Nota di Lavoro 58.2003. Milano. Downloaded from Internet-site http://www.feem.it/Feem/Pub/Publications/ WPapers/ Default.html.

Marti, P., and S. Mauch (1984). Wirtschaftlich-räumliche Auswirkungen neuer Kommunikationsmittel, Schlußbericht. Nationales Forschungsprogramm „Zentren-Peripherie“, Projekt 4.507. Arbeitsberichte des nationalen Forschungsprogramms „Regionalproblem in der Schweiz“, 46. Bern und Zürich: Infras.

Matuschewski, A. (2002). Regional Embeddedness of Information Economy Enterprises in Germany. Paper presented at the 42nd Congress of the European Regional Science Association (ERSA) “From

Industry to Advanced Services – Perspectives of European Metropolitan Regions" in Dortmund 27-31 August 2002. University of Dortmund: Congress CD-ROM.

Moriset, B. (2003). The New Economy in the City: Emergence and Location Factors of Internet-based Companies in the Metropolitan Area of Lyon, France. Urban Studies, 40, 2165-2186.

Organisation for Economic Co-operation and Development (OECD) (2000). *ICTs, E-commerce and the Information Economy. OECD Information Technology Outlook 5*. Paris: OECD.

Picot, A. (1985). Integrierte Telekommunikation und Dezentralisierung in der Wirtschaft. In W. Kaiser (Hrsg.), *Integrierte Telekommunikation*. Vorträge des vom 5.-7.11.1984 in München abgehaltenen Kongresses. Telecommunications, Veröffentlichungen des Münchner Kreis, Übernationale Vereinigung für Kommunikationsforschung, 11. Berlin u.a.: Springer, 484-498.

Porter, M.E. (2001). Strategy and the Internet. Harvard Business Review, March: 63-78.

Rosenberg, N., and M. Trajtenberg (2001). A General Purpose Technology at Work: The Corliss Steam Engine in the Late 19th Century US. NBER Working Paper 8485. Cambridge, MA: National Bureau Of Economic Research. Downloaded from Internet-site http://www.nber.org/papers/w8485.

Statistische Landesämter (2002). Bruttoinlandsprodukt, Bruttowertschöpfung in den kreisfreien Städten und Landkreisen Deutschlands 1992 und 1994 bis 2000. Volkswirtschaftliche Gesamtrechnungen der Länder, Kreisergebnisse, Reihe 2, Band 1. Stuttgart: Statistisches Landesamt Baden-Württemberg (electronic version).

Statistisches Bundesamt (1993). Bevölkerung und Erwerbstätigkeit. Fachserie 1. Reihe 4.1.2 Beruf, Ausbildung und Arbeitsbedingungen der Erwerbstätigen 1991 (Ergebnisse des Mikrozensus). Wiesbaden.

Storper. M., A.J. Venables (2002). Buzz : The Economic Force of the City. Downloaded from Internet-site http://www.druid.dk/conferences/summer2002/Papers/STORPER.pdf.

Venables, A.J. (2001). Geography and International Inequalities: the Impact of New Technologies. LSE Centre for Economic Performance Discussion Paper, 507. London: London School of Economics and Political Science. Downloaded from Internet-site http://cep.lse.ac.uk/pubs/download/dp0507.pdf.

Winther, L. (2001). The Spatial Structure of the New Economy in the Nordic Countries. Nordregio Working Paper 2001:10. Stockholm: Nordregio.

Zentrum für Umfrage, Methoden und Analysen (ZUMA) (without publ. date). Klassifizierung der Berufe, Ausgabe 1975 (KldB 75), Fassung für den Mikrozensus bis 1991, Mannheim. Downloaded from Internet-Site http://www.gesis.org/Dauerbeobachtung/Mikrodaten/Daten/Abteilungsdaten/Mikrozensen/mz_1991/kldb75_91.htm.

Appendix 1: Table A1 for the 5 percentile of the white/blue collar ratio in West Germany

Table A1 – The Change in Functional Specialization of West German Cities and Districts 1976-2002 – 5-Percentile for District Size Classes

Size and agglomerative type of German districts[a]	Functional specialization in management against production – 5-percentile of districts of each class[b]			
	1976	1990	1995	2002
1) Core cities of agglomerations	-42.4	-46.2	-48.9	-54.0
2) High density districts of agglomerations	-55.6	-58.9	-56.9	-64.1
3) Medium density districts of agglomerations	-64.1	-62.6	-65.3	-62.5
4) Rural districts of agglomerations	-53.6	-56.7	-59.4	-67.3
5) Core cities of urbanized regions	-47.4	-36.8	-27.5	-30.0
6) Medium density districts of urbanized regions	-69.5	-70.6	-69.6	-72.7
7) Rural districts of urbanized regions	-64.5	-65.9	-69.5	-72.5
8) Rural districts of major density of rural and peripheral regions	-70.2	-69.4	-69.8	-72.5
9) Rural districts of minor density of rural and peripheral regions	-74.8	-75.8	-76.2	-80.2

[a]Size of districts according to the BBR classification scheme. [b]Percentage difference from the national average in the number of executives and managers per production worker (occupied in precision, production, fabrication, or assembly).

Source: Bade (2003) database on regional functional employment; applied method following Duranton and Puga (2001; 2003); own calculations.

Appendix 2: Tables A2-A4 for the additional calculation of median, 95- and 5-percentile of the white/blue collar ratio in West German manufacturing sector

Table A2 – The Change in Functional Specialization of Manufacturing Industries in West German Cities and Districts 1976-2002 – Median for District Size Classes

Size and agglomerative type of German districts[a]	Functional specialization in management against production – median of districts of each class[b]			
	1976	1990	1995	2002
1) Core cities of agglomerations	15.5	17.5	29.2	24.2
2) High density districts of agglomerations	-6.8	-21.8	-14.0	-12.5
3) Medium density districts of agglomerations	-13.1	-18.1	-19.2	-23.1
4) Rural districts of agglomerations	-30.7	-32.2	-30.2	-36.9
5) Core cities of urbanized regions	5.7	1.0	9.6	23.6
6) Medium density districts of urbanized regions	-25.8	-29.6	-27.1	-31.3
7) Rural districts of urbanized regions	-42.0	-44.5	-41.3	-48.2
8) Rural districts of major density of rural and peripheral regions	-31.0	-38.8	-37.0	-39.8
9) Rural districts of minor density of rural and peripheral regions	-50.2	-47.2	-51.8	-57.0

[a]Size of districts according to the BBR classification scheme. [b]Percentage difference from the national average in the number of executives and managers per production worker (occupied in precision, production, fabrication, or assembly).

Source: Bade (2003) database on regional functional employment; applied method following Duranton and Puga (2001; 2003); own calculations.

Table A3 – The Change in Functional Specialization of Manufacturing Industries in West German Cities and Districts 1976-2002 – 95-Percentile for District Size Classes

Size and agglomerative type of German districts[a]	Functional specialization in management against production – 95-percentile of districts of each class[b]			
	1976	1990	1995	2002
1) Core cities of agglomerations	219.7	380.8	380.3	487.4
2) High density districts of agglomerations	120.6	81.7	129.0	149.5
3) Medium density districts of agglomerations	43.1	43.1	64.2	54.7
4) Rural districts of agglomerations	-7.3	-6.4	4.8	18.4
5) Core cities of urbanized regions	80.9	133.6	101.9	159.3
6) Medium density districts of urbanized regions	23.2	14.8	16.4	20.2
7) Rural districts of urbanized regions	6.1	-3.2	-10.8	-19.6
8) Rural districts of major density of rural and peripheral regions	5.2	4.4	6.5	-1.3
9) Rural districts of minor density of rural and peripheral regions	-14.8	-33.7	-37.8	-36.1

[a]Size of districts according to the BBR classification scheme. [b]Percentage difference from the national average in the number of executives and managers per production worker (occupied in precision, production, fabrication, or assembly).

Source: Bade (2003) database on regional functional employment; applied method following Duranton and Puga (2001; 2003); own calculations.

Table A4 – The Change in Functional Specialization of Manufacturing Industries in West German Cities and Districts 1976-2002 – 5-Percentile for District Size Classes

Size and agglomerative type of German districts[a]	Functional specialization in management against production – 5-percentile of districts of each class[b]			
	1976	1990	1995	2002
1) Core cities of agglomerations	-32.9	-39.7	-36.8	-44.9
2) High density districts of agglomerations	-41.8	-48.4	-44.3	-59.2
3) Medium density districts of agglomerations	-54.0	-60.8	-51.7	-53.3
4) Rural districts of agglomerations	-46.8	-45.3	-37.3	-47.8
5) Core cities of urbanized regions	-45.9	-49.1	-45.9	-33.6
6) Medium density districts of urbanized regions	-56.5	-59.0	-53.0	-56.9
7) Rural districts of urbanized regions	-63.8	-65.0	-63.1	-64.4
8) Rural districts of major density of rural and peripheral regions	-64.0	-61.0	-62.7	-66.4
9) Rural districts of minor density of rural and peripheral regions	-67.5	-65.7	-64.7	-71.5

[a]Size of districts according to the BBR classification scheme. [b]Percentage difference from the national average in the number of executives and managers per production worker (occupied in precision, production, fabrication, or assembly).

Source: Bade (2003) database on regional functional employment; applied method following Duranton and Puga (2001; 2003); own calculations.