

# On the relationship between centres and small towns in a city-regional context: knowledge-intensive concentration and specialisation in Germany

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## Abstract

Small towns have become increasingly important to research in recent years. However, researchers have largely ignored both the reciprocal economic-functional linkages between large cities and small towns in agglomerations and the spatial patterns of concentration and specialisation of knowledge-economy activities. This article aims to respond to this gap in several ways. First, it analyses spatial concentration processes in the 50 largest city regions of Germany, differentiated by knowledge bases (analytical, synthetic, symbolic). Second, it analyses and compares functional specialisation effects in both the large cities and the small towns within city regions. Here, the focus is on identifying the same directional tendency of specialisation and distribution in both types of settlements, without presuming the large cities to be the trend-setting constant. The analysis uses labour market data from the Federal Employment Agency. Consequently, decentralised concentration processes can be observed, especially in city regions in southern Germany, where a focus on a particular knowledge base cannot be ascertained. The analysis shows the same specialisation or distribution patterns for half of all city regions for both core cities and small towns, when all three knowledge bases are considered together. The paper concludes with an argument concerning possible further theoretical implications based on the notion that the interlinkages between small towns and large cities are reciprocal.

## Keywords

city-regional comparison, Germany, knowledge bases, knowledge intensive business services (KIBS), city regions, small towns

## Introduction

To date, urban systems research has considered large cities to be concentration points of important economic activities and innovation dynamics, especially internationally networked and important World Cities and Global Cities (e.g. Glaeser, 2011). In recent years, this urban bias has been increasingly softened in favour of peripheral spaces (Eder & Trippel, 2019; Glückler et al., 2023) and the hitherto neglected settlement type of small towns (Mayer 2021). In general, the last decade has seen small towns increasingly become the focus of research in different disciplines and from multiple perspectives (Wagner & Growe, 2021). In particular,

various working groups have emerged in the German-speaking countries emphasising the importance of this type of settlement as a place to both live and work (Gribat et al., 2022; Steinführer et al., 2021; Porsche et al., 2019). Nonetheless, considerable research gaps remain (Schumacher & Born, 2022).

However, only a few studies in the European context have considered small towns as an equal part of metropolitan or city regions, thus largely neglecting the mutual functional relationships between large cities and small towns (Atkinson, 2019; Grossmann & Mallach, 2021). Furthermore, the lack of systematic-quantitative studies concerned with the development and analysis of special spatial patterns or comparative research at the regional or national level (Mayer & Lazzeroni, 2022) is particularly surprising. As a matter of fact, it has already been comprehensively demonstrated that small towns experience different growth dynamics in terms of both population and economic activity depending on their location, including in relation to large cities (Mayer & Motoyama, 2020). However, studies focusing on small towns have mostly concentrated on rural areas and regions that are experiencing shrinkage, meaning they face completely different challenges to small towns in agglomeration areas (Westlund, 2008; Naldi et al., 2020). By contrast, there is a large body of literature that demonstrates the positive effect and significance of (exchange) relationships between cities for different functional areas, mostly measured in terms of relationships between large cities or international global cities or the integration of individual cities into regional city networks (Van Oort et al., 2010; Burger & Meijers, 2016).

Concepts that specifically refer to the relationships between large cities and their smaller neighbours, such as the much discussed and applied approaches of *borrowing size* and *agglomeration shadow* (Burger & Meijers, 2017), have mostly argued with a unidirectional perspective, from large cities to small towns. These concepts suggest that smaller towns in the metropolitan environment may benefit from the functional relationships and regional/international linkages of large cities and, thus, borrow functional endowments (*borrowing size*). Alternatively, they may suffer from the negative influence of the superiority of the large cities, thus falling under the *agglomeration shadow* and, referring back to central place theory, providing only basic functions and services of general interest. However, recent reflections indicate a re-thinking with regard to the mutual consideration of the relationships between cities of different sizes: “Perhaps the question should not primarily be how SMSTs [small and medium-sized towns] can gain from large neighbour cities, but instead, what those large cities can borrow from nearby SMSTs in this regard” (Meijers & Burger, 2022: 33). However, this still refers to functions that are considered the specific potential of smaller towns (e.g., Mayer & Knox, 2010) and cannot be ostensibly equated with metropolitan or large city functions. Therefore, this article focuses on knowledge-intensive services, which, due to agglomeration advantages such as the high availability of human capital and infrastructure endowments, are spatially described as having a great affinity to large cities (Elche et al., 2021).

In the field of knowledge-intensive work, studies in recent years have especially focused on the relationship between large cities and peripheral areas (Bürgin et al. 2021, 2022), arguing that this sector, in particular, has seen the flexibilisation of working practices. Besides, the increasingly ubiquitous availability of information and communication technologies makes the choice of workplace less location-dependent (Ojala & Pyöriä, 2019; Hislop, 2013). Nonetheless, studies also have demonstrated that the catchment areas of large cities are considered attractive places to live (Volgmann et al., 2022) and work, including in the field of knowledge-intensive business activities (De Ávila Serrano, 2019; Solis et al., 2022; Wagner & Growe, 2023b). In this context, small towns represent poles of reliability for the often already congested large cities (Wagner & Growe, 2019). In the context of the city region, this is also accompanied by upgrading processes in the surrounding areas, which can positively impact the narrower and wider catchment areas of large cities (Wagner & Growe, 2023b). However, the importance of small towns, especially in relation to knowledge-economy activities, remains only marginally investigated, with limited systematic research. Nonetheless, initial studies provide indications of small-town centres of knowledge economies (Meili & Mayer 2017).

To fill these research gaps, the present study considers the (a) concentration and (b) specialisation of knowledge-intensive activities in German city regions with regard to the functional relationships between large cities or core centres and small towns. Referring to the definition provided by the Federal Ministry of Building, Urban Affairs and Spatial Development (BBSR, n.d. a), large cities are considered as municipalities with at least 100,000 inhabitants and small towns as municipalities or municipal associations with between 5,000 and 20,000 inhabitants and (at least) a basic central function. To address the research gaps, the article responds to the following research questions with the aim of identifying the focal points and specialisation tendencies of knowledge-economy development in urban systems outside of large city centres:

- a) How do knowledge-economy activities spatially concentrate in small towns compared to large cities in agglomeration areas in Germany?
- b) To what extent does the functional specialisation of core cities also apply to small towns in large city regions and how are small-town and core-city development interlinked?

The paper is structured as follows. Section 2 provides a brief overview of the polycentric German urban system and the development of small towns in a regional context before Section 3 establishes the theoretical foundations for (knowledge-)economy concentration and specialisation. Section 4 explains the data, the study units and the methods used. Section 5 presents the results before the study concludes with a critical reflection on the substantive findings, applied methods and policy implications.

## **The historical and economic development and political structure of the polycentric German urban system**

The German urban system represents a special example among European countries due to its historical position and the changing relationships and interconnections between cities of different sizes and centralities. Although the European Spatial Development Perspective (ESDP) calls for a “polycentric and balanced urban system and a new urban-rural relationship” (European Commission, 1999: 11) for the whole of Europe – and associated decentralised functions – monocentric structures predominate. That is, the pronounced polycentricity of the German urban system, which has developed over centuries, differs fundamentally from countries such as France, England and Spain, which are controlled centrally from the large centres of Paris, London and Madrid (Blotevogel, 2002). This is accompanied by the differing significance of small and medium-sized urban structures, which have other tasks and functions and whose inhabitants travel shorter distances to larger important cities. Cities can be distinguished – albeit not sharply – either by a regional division of labour (e.g. into industrial, commercial and administrative cities) or on the basis of specific historical-hierarchical functions. In particular, manufacturing industries tend to be associated with the division of labour, whereas retail occupations and highly skilled business-related service occupations tend to be oriented towards the hierarchical level of cities (Blotevogel, 2002).

At its core, the development of the German urban system can be compared to the federally structured urban system of the Middle Ages (Volgmann, 2014). Later, the 19<sup>th</sup>-century founding of the German Empire (in 1871) enabled Berlin and Hamburg to establish themselves as metropolises alongside smaller regional metropolises. By advancing expansion processes via political control, Berlin was able to quickly attain the status of a metropolis, gaining a mono-central position within Germany, including economically due to the high-ranking functions of the finance and media industries (Blotevogel, 2002). With the political turmoil that accompanied the Second World War and the inter-German division, Berlin lost its supremacy and the regional metropolises, which had previously been left behind, attained greater importance both economically and functionally. However, the different political-administrative functions were not distributed uniformly among the individual cities, and the functional specialisation of the individual large cities, many of which have already been subject to case studies, can largely be traced to Germany’s polycentric urban system (Volgmann, 2014; Growe, 2012; 2016).

An important role is also played by the concept of “central places” developed by Walter Christaller in 1933. The aim of German regional planning and development is to achieve equal living conditions throughout the country and, as a result, to create comprehensive infrastructure. Drawing on Christaller’s concept, it is possible to distinguish between cities of different hierarchical levels which are connected to each other by means of large-scale development axes (Sachs, 2002).

For the reference year 1995, Blotevogel (2002) described 14 large cities as regional metropolises: Munich, Nuremberg, Karlsruhe, Stuttgart, Frankfurt, Bonn, Cologne, Düsseldorf, Hanover, Bremen, Hamburg, Berlin, Leipzig and Dresden. These are distinguished in their importance from the subsequent subordinate high-order centres.

In addition to the historical development of the urban system, the federal structure of the German Republic represents a special characteristic in the exercise of state power, which can influence regional differences and thus also individual cities and municipalities (see also Lüthi, 2017). Germany is divided into 16 federal states or city states. In accordance with the principle of subsidiarity, these federal states are assigned certain sovereign powers and tasks by the Basic Law (*Grundgesetz*), which they are responsible for developing. These sovereign powers include, for example, the areas of culture and education. The decentralised control of these issues is intended to ensure that regional and individual preferences can be addressed in a more targeted manner (Stehn, 2021). However, it is becoming apparent that the creation of equal living conditions through cooperative federalism is reaching its limits, particularly in light of major regional differences across the country. Therefore, the concept of federalism has been repeatedly criticised (Berthold & Müller, 2010) and functional specialisation and concentration processes can still be identified, even in cities.

## **Spatial concentration and specialisation of knowledge-intensive business activities**

The following section identifies different knowledge-economy activities according to their respective form of knowledge (Section 3.1) before considering the concentration and de-concentration (Section 3.2) and specialisation and distribution (Section 3.3) of knowledge-intensive activities in the urban system.

### **Differentiation of knowledge-economy activities: knowledge bases**

With the shift from an industrial society to more knowledge- and service-based activities, the requirements for work models are changing and not only in the economic sphere. Knowledge no longer serves only as a resource for conducting activities but also increasingly represents the product of work processes, especially around knowledge-intensive business-related activities (Gallego & Maroto, 2015). This is accompanied by the increased importance of models of flexible and mobile working times, which can manifest differently depending on the work assignment and project phase (Ojala & Pyöriä, 2018; Reuschke & Ekinsmyth, 2021). Another decisive factor concerns the concrete functional activity being performed and the form of knowledge that is specifically required. Depending on the degree of innovation and the process of knowledge transfer, three knowledge bases can be distinguished (Asheim & Coenen, 2005; Asheim & Gertler, 2005; Asheim et al., 2007): analytical, synthetic and symbolic knowledge, which also require different levels of geographical proximity in the work

process, as documented in Table 1 with additional input from the analysis by Wagner & Growe, 2023b (for a detailed account of derivation and discussion, please refer to the original studies). Although analytical knowledge (e.g. activities in the field of research) can also be communicated over greater geographical distances and at different locations due to its relatively high capacity for codification, activities in the field of synthetic knowledge (e.g. business or financial services) require interactive exchange with customers and time on site to perform individual process steps to set learning processes in motion and align expectations accordingly (Asheim & Coenen, 2005; Asheim & Gertler, 2005). Activities in the field of symbolic knowledge (e.g. creative work in the fields of architecture and advertising) demand team-based exchange at the most creative locations, which are kept alive by *local buzz* (Bathelt et al., 2004) and *noise* (Grabher, 2002).

	Analytical knowledge	Synthetic knowledge	Symbolic knowledge
<b>Modes of knowledge sharing</b>	<ul style="list-style-type: none"> <li>- Creation of new knowledge</li> <li>- Radical change</li> <li>- Easily codified knowledge</li> </ul>	<ul style="list-style-type: none"> <li>- Problem-oriented adaptation or combination of existing knowledge</li> <li>- Interactive learning processes necessary</li> <li>- More implicit than analytical knowledge</li> </ul>	<ul style="list-style-type: none"> <li>- High level of interaction in creative, flexible teams is necessary</li> <li>- Exchange of tacit knowledge in co-presence</li> </ul>
<b>Linking the knowledge base concept to proximity terms according to Boschma (2005) (Mattes, 2012; Davids &amp; Frenken, 2018)</b>	Geographical proximity: not necessary	Geographical proximity: helpful	Geographical proximity: indispensable
<b>Linking the knowledge base concept to centre affinity (Growe, 2012)</b>	Wider hinterland of centres/periphery possible	Immediate vicinity of centres possible	Centre affinity necessary

Table 1 – Differentiation of knowledge bases and their linkage to geographical location (Wagner & Growe, 2023b; Asheim & Coenen, 2005; Asheim & Gertler, 2005; Asheim et al., 2007).

Thus, differentiating the knowledge economy into the three different knowledge bases can enable the present study to examine different tendencies of concentration and specialisation in large cities and small towns located in city regions. Various hypotheses and conjectures can be derived from the available literature. On the one hand, the different knowledge bases can be assumed to have not only different centre affinities but also different concentration affinities (analytical knowledge is the least concentrated; symbolic knowledge is the most



concentrated). On the other hand, it can be conjectured that specialisation in the individual knowledge bases of small towns primarily develops when the large city/cities of the same city region also demonstrate disproportionately high specialisation in these knowledge bases. This assumption derives from two facts: first, certain functions also spill over into the surrounding areas, especially due to the close links between the surrounding areas and the core centres; second, face-to-face exchange is possible due to the accessibility of the city regions.

### **Spatial concentration and de-concentration processes of knowledge-intensive business services**

Theories concerning the spatial concentration of economic activities already have a long tradition in geographical research. Traditional conceptualisations such as the Thünen model (Thünen, 1875) cite transport costs as a limiting factor for spatial diversification and the evening-out of interregional differences predicted in neoclassical theories (Weber, 1909). Meanwhile, polarisation theory postulates the further differentiation of existing spatial differences and, thus, further concentration processes. Concepts such as *economies of scale*, which describe a price reduction of unit costs with agglomerated increased production volume, and *economies of scope*, which describe the spatial bundling of the production of different products, are considered factors that drive concentration in economic activities (Perroux, 1955). Elsewhere, researchers have described the agglomeration advantages resulting from infrastructural and transport connections as well as the availability of short transport distances to suppliers or customers (Hoover, 1937).

The change from an industrial society to more knowledge- and service-related activities has prompted a re-evaluation of location concepts, and an expansion of the agglomeration approach has also come into effect. Knowledge is no longer considered a ubiquitously available commodity but a location factor: due to the new types of production in the service economy, transport costs are becoming increasingly obsolete, and the significance of geographical economic concentrations has been called into question (Friedman, 2006). However, due to changing work processes, transport costs have been replaced in significance by transaction costs (Grove, 2012), which, in turn, react in a geographically sensitive manner. According to Williamson (1985), transaction costs derive from the procurement and utilisation of information, the assurance of quality, the conclusion of contracts and agreements, and the organisation and management of processes (Scott, 1998). Because transaction costs increase due to uncertainty, specificity and less frequent exchange processes (Williamson, 1979), the spatial concentration of economic activities and the associated simplification of negotiation processes may be helpful and can reduce costs.

The concept of agglomeration effects has been similarly extended to new knowledge-intensive activities: no longer do cities provide only hard location advantages (e.g. infrastructural facilities), but instead also offer attractive locations for the acquisition of

human capital via soft locational factors (Elche et al., 2021), the simplification of knowledge-spillover processes (Breschi & Lissoni, 2001; Südekum, 2006) and the assurance of face-to-face contact within teams and with customers (Storper & Venables, 2004; Growe, 2019). This ultimately produces positive agglomeration effects, with these locations acting as “sticky places” for knowledge workers (Markusen, 1996).

In addition to concentration processes in large centres, recent research has also increasingly found evidence of spatial-economic de-concentration processes and the upgrade of surrounding areas as work locations (Growe, 2016; Wagner & Growe, 2023b). Conceptually, two considerations should be mentioned here to further explain the de-concentration of knowledge-economy activities. On the one hand, large agglomerations, such as core cities, present agglomeration disadvantages in addition to positive effects. These include higher rental costs for office space, lower land availability, higher tax rates and increased traffic congestion (Volgmann et al., 2022). In contrast, the conditions in smaller cities and rural areas are quite different.

Moreover, the availability of information and communication technologies, among other things, enables individual project phases to be performed at a physical distance from knowledge workers. However, according to Cohen and Leventhal (1990), knowledge workers need to be able to recognise existing knowledge and then use and process it accordingly (*absorptive capacity*). Thus, they need to be familiar with the subject matter to be able to understand shared information and convert it into knowledge (Meusbürger, 2017). To acquire this capacity, forms of proximity beyond geographical proximity are needed in the production process. Boschma (2005) has identified four such forms: cognitive, organisational, social and institutional. These contribute to the success of the process of knowledge-intensive service production in different ways that can be divided according to knowledge bases (Mattes, 2012). These forms of proximity are not based on purely spatial conditions but on aspects including trust, social and cognitive embeddedness in the project team, and institutional and contractual arrangements. Thus, for many projects that concern analytical or synthetic knowledge, it is sufficient to meet face-to-face in a particular location only at certain stages of the process, which favours the de-concentration of workplaces via temporary places of encounter (Wagner & Growe, 2023b).

The following hypothesis can be derived from these conceptual considerations:

**H1** – Particularly for analytical and synthetic knowledge, lower concentration processes of knowledge-economy activities can be demonstrated in city regions that are characterised by prosperous and economically robust small and medium-sized towns in the surrounding areas.



## Spatial functional specialisation and distribution processes of knowledge-intensive business services

In economic theory, specialisation effects have been discussed for just as long as the concentration processes of economic activities. As early as 1890, Marshall described how the development of sector-specialised labour markets in a limited region can promote increases in knowledge and, thus, localisation effects (Marshall, 1890). Other approaches are based on the realisation that areas characterised by a certain degree of economic diversification (Jacobs, 1970) have positive regional economic effects.

The distinction between sectoral and functional specialisation trends has been applied to the urban system by Duranton and Puga (2005), who observe that traditional manufacturing industries continue operating in more remote areas, while knowledge-intensive and organisational activities tend to agglomerate in core cities due to the importance of transaction costs (see Section “Spatial concentration and de-concentration processes of knowledge-intensive business services”). Thus, spatial specialisation processes occur according to a sectoral rather than a functional economic view. According to Duranton and Puga (2005), these specialisation tendencies influence the formation of urban systems that differ in terms of functional orientation, explaining the increasingly diversified structures. This is accompanied by the importance of knowledge in individual production processes, with Scott (2008) arguing that different concentration and specialisation effects can be observed, depending on the qualification level of workers and the standardisation of activity. Again, highly skilled knowledge-intensive activities tend to be located in core cities and standardised activities in smaller towns. However, more recent studies show that knowledge-intensive services are also losing their centre affinity to some extent, although evidence of concentration or specialisation in SMSTs is yet to appear (Wagner & Growe, 2023b; Growe, 2012).

In this context, the separation of individual activities is increasingly called into question (Daniels & Bryson, 2002) because the production of goods is always associated with service provision, meaning knowledge is of considerable importance in all sectors. It is thus important to refer again to *absorptive capacity* (Cohen & Leventhal, 1990) and, thus, Boschma's different forms of proximity (2005), which are simplified in the area of spatial specialisation processes by geographical proximity (Growe, 2016).

Previous studies employing systematic-quantitative analyses of the concentration and specialisation processes associated with knowledge-economy activities have focused on large cities or entire metropolitan areas in (mostly) national or European comparisons (e.g. Growe, 2016; Jennequin, 2008). Therefore, the present study aims to separately consider specialisation tendencies in core centres and those in small towns from city regions, and to identify possible similar tendencies with regard to the focus on individual knowledge bases by emphasising the concept of urban-rural linkages (Funell, 1988) and the increasing importance of smaller towns for knowledge-intensive activities (Wagner & Growe, 2023b; Glückler et al.,

2023). This idea goes hand in hand with Alonso's concept of *borrowing size*, which focuses on the advantages of small and medium-sized towns surrounding large cities and metropolises. The concept describes the way in which agglomeration advantages of large cities can be "borrowed" by medium and small-sized towns in the immediate surrounding areas, so that they do not have to provide individual functions and facilities themselves (Burger & Meijers, 2017). Thus, the concept of borrowing size can also explain how large cities and small towns may have the same specialisation tendencies since certain economic sectors or even employees have the same location requirements and both large cities and small towns are similarly equipped through borrowed functions and facilities.

Extending and synthesising the argument of Duranton and Puga (2006), the importance of *absorptive capacity* (Cohen & Leventhal, 1990) for knowledge-intensive exchange processes and the concept of *borrowing size* (Burger & Meijers, 2017), I advance the following conjecture:

**H2** – With regard to spatial specialisation processes, there is an interregional correlation between core centres and small towns: if the expression of a knowledge base within the core cities of a city region is disproportionately high compared to all core cities in the city regions, the same functional specialisation is also found in the small towns in the surrounding areas and vice versa.

Extant observations demonstrate that concentration and specialisation effects are strongly related. In their study on concentration and specialisation effects in the Romanian urban system, Goschin et al. (2009: 100f.) summarise the distinction as follows: "Regional specialisation expresses the regional perspective and depicts the distribution of the sectoral shares in its overall economy, usually compared to the rest of the country. [...] [The] geographic concentration of a specific industry reflects the distribution of its regional shares." The present study adapts this distinction to a functional view and applies it to the city regions of Germany. The following sections examine and test the hypotheses via empirical analysis.

## Research area, data and methods

### Research area

The study area for the present analyses is the 50 city regions of Germany as of 2019. The city regions and, thus, the relationships between centres (large cities) and surrounding areas (medium-sized towns, small towns, rural municipalities) are defined by using the commuter flows of all employees subject to social insurance contributions between their places of residence and their workplaces. Four different demarcation regions can be distinguished: (1) *core centres*, which represent large cities with at least 100,000 inhabitants and a commuter surplus (commuters into the centre > commuters out of the centre into surrounding

municipalities); directly adjacent to the centres, most city regions have (2) *supplementary areas* that are very closely interwoven with the core centre and have a daily population that exceeds 500 (inhabitants + in-commuters – out-commuters) as well as a commuter surplus or an out-commuter rate of at least 50% to the core city; then, the wider hinterland contains (3) the *narrower commuting area*, from the municipal associations of which at least 50% of inhabitants commute to the core centre or the supplementary area and (4) the *wider commuting area*, from the municipal associations of which between 25% and 50% of commuters commute to the core centre or the supplementary area (BBSR, n.d. b).

Within these city regions, not only medium-sized but also small towns are of particular importance as places of work and residence. At the same time, it should be noted that the fifty city regions differ greatly in terms of their magnetic effect as labour market centres both nationally and intra-regionally (Wagner & Growe, 2023b). Furthermore, the various settlement types have a different weight depending on the region. Considering the percentage of knowledge-intensive employees within the city regions across the individual settlement types in Figure 1, a very differentiated picture emerges. The lines represent the average percentages for the different settlement types in all city regions. Notably, those regions that have smaller core centres in terms of population size and are mostly located in the southwest of Germany record a particularly above-average percentage of knowledge-intensive employees in the small towns. This is consistent with Germany's settlement structure, with the southern federal states being especially characterised by the predominance of SMSTs. Furthermore, the centres in these regions have a below-average share of the labour market structure of the knowledge economy compared to the other city regions. Overall, it is notable that, in 18 out of 50 city regions, small towns account for at least 20% of the labour market structure and in almost all these same regions, also account for a greater share of employees than that of the medium-sized towns.

These first descriptive analyses go hand in hand with the historical development of the economic situation in Germany. Thus, various studies to date show, on the one hand, an east-west divide with regard to dimensions of economic structure, labour market and quality of life, with the exception of the capital Berlin and its surrounding areas. On the other hand, the analysis also shows a particular prosperity with regard to the current economic situation and future development potentials (Hünemeyer & Kempermann, 2020). Looking to the future, southern Germany, which is characterised by small and medium-sized towns, can also be predicted to do well in terms of knowledge-intensive employment. In the EU's innovation rankings, Baden-Württemberg and Bavaria occupy the top two places, ahead of the two capital cities of Paris and Berlin (Statistisches Landesamt Baden-Württemberg, n.d.).

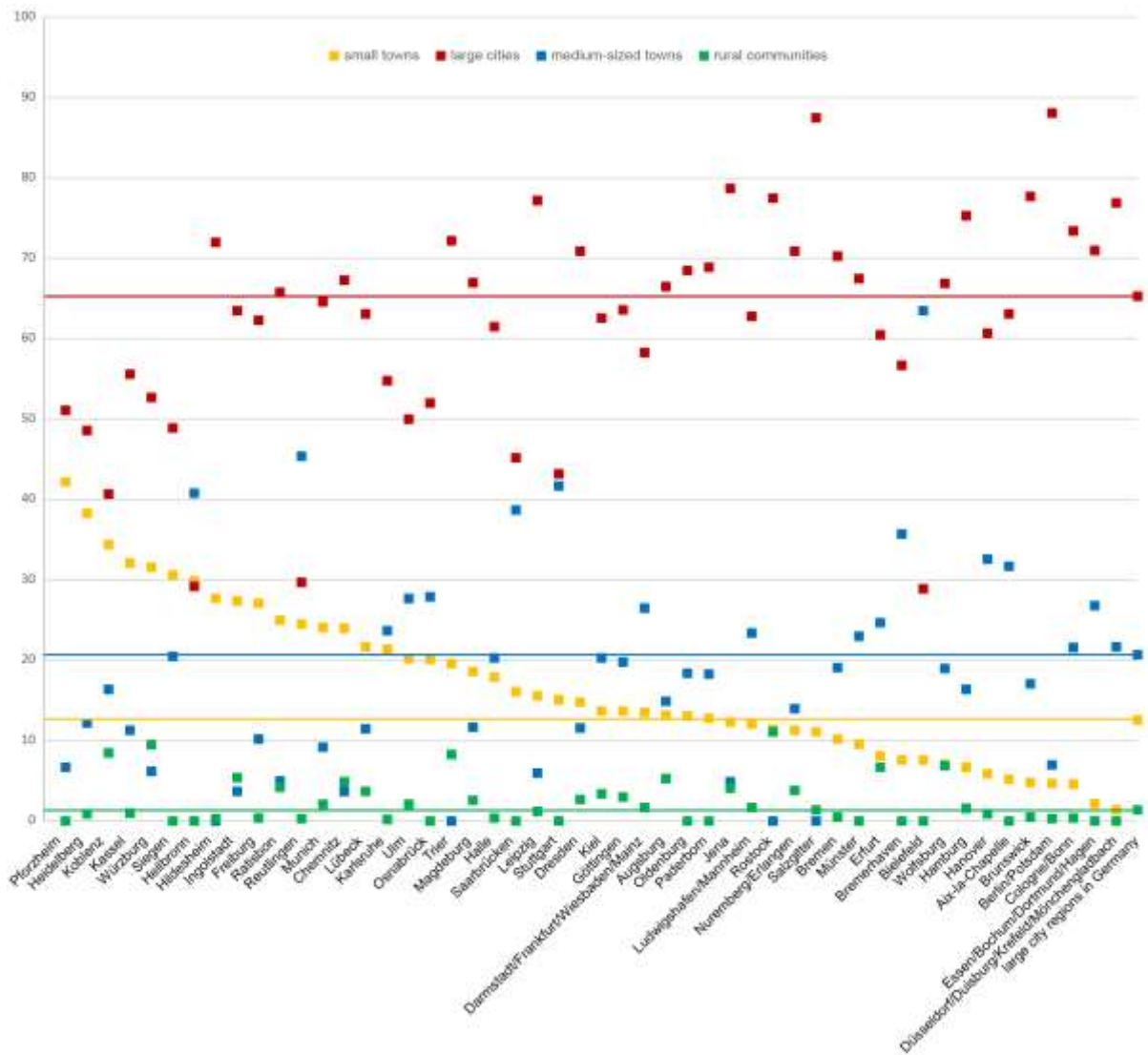


Figure 1 – Distribution of knowledge-intensive service employees across settlement types within the city regions for 2019 (by %; author's calculation).

Furthermore, hidden champions, i.e. small and medium-sized global market leaders, can also be used as an indicator of the economic strength of regions and innovative power. In addition to large cities, medium-sized and smaller towns and even rural municipalities are also home to hidden champions. From a regional perspective, major differences can be seen in Germany: in addition to the metropolises of Hamburg and Berlin, the densely populated state of North Rhine-Westphalia and, above all, the southern German states of Baden-Württemberg and Bavaria stand out (Vonnahme, 2021). In addition to other factors, the historical path dependency and the long tradition of economically strong company headquarters in southern Germany play an important role for regional development (Hassink, 2010; Vonnahme, 2021).

Considering the dynamics of the large cities and small towns in the respective city regions in terms of their population development and knowledge-economy employment figures between 2012 and 2019, further differentiated results can be derived. The population

development in small towns during this period exceeds the growth dynamics of the associated large cities in the regions of Ingolstadt, Munich, Freiburg, Göttingen, Rostock and Lübeck. In these six of the fifty city regions (12% of all city regions), spillover effects can be observed in the small towns of the surrounding areas due to the large booms in the core cities (see Figure 2). By contrast, the cities of eastern Germany (with the exception of Leipzig as a magnet for demographic reurbanisation) have experienced shrinkage of the small towns in surrounding areas, while Chemnitz, Saarbrücken (western Germany), Halle, Magdeburg and Hildesheim (central Germany) have experienced shrinkage across the entire city region, large cities excluded.

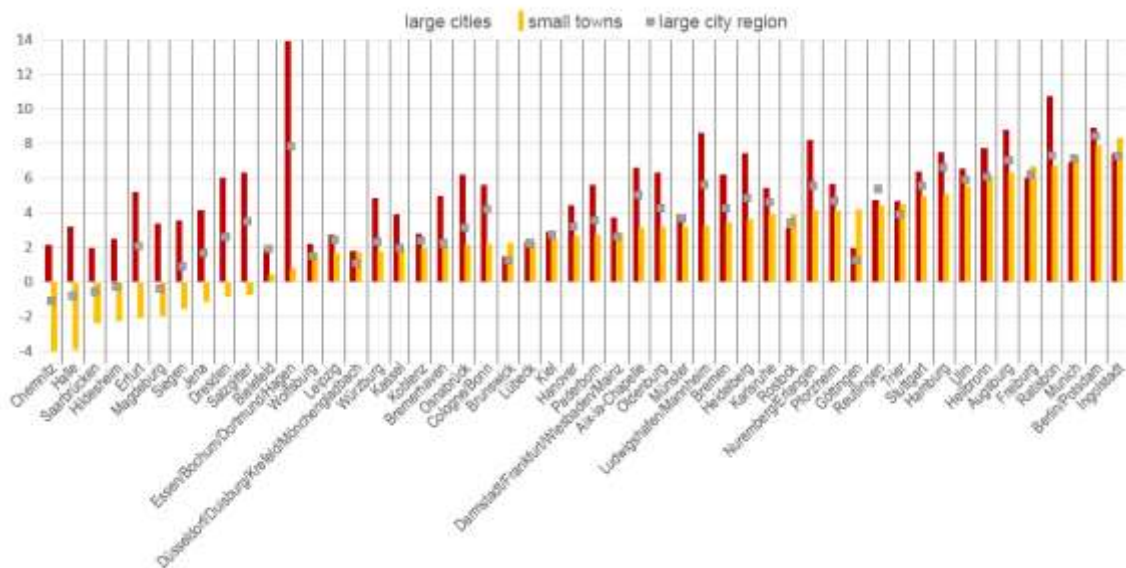


Figure 2 – Population development between 2012 and 2019 in large cities and small towns within Germany's city regions (average value for large cities: 5.6%; small towns: 3.4%; total: 4.3%). Author's calculation.

The increase in the number of knowledge-economy employees between 2012 and 2019 in small towns compared to the large cities in the city regions presents a completely different picture (see Figure 3). Here, in 24 out of 50 regions (48% of all regions), small-town development exceeds the growth of the large cities. Only in Salzgitter do the small towns in the city region record declining employment figures in the knowledge sector. From a regional perspective, those city regions that experience catch-up (knowledge) economic development or spillover effects from the large cities to the small towns in the surrounding areas are distributed across the entire country (Volgmann et al., 2022), although a certain focus can again be identified in the small centres in southern Germany. Building on these initial analytical-descriptive findings regarding the development of small towns in city region contexts, the following sections will examine knowledge-economy concentration, especially specialisation processes, in greater detail.







The available data differentiate employees subject to social insurance contributions at the place of work according to the respective occupational groups (three-digit, Bundesagentur für Arbeit 2013). Approximately 70% of all employees in Germany are included, with civil servants, self-employed persons, unpaid family helpers and persons working in so-called marginal jobs not included. The cut-off date for data collection is 31 December of each year. The aggregated occupational groups were each assigned to a knowledge base for the analysis (see Section “Differentiation of knowledge-economy activities: Knowledge bases”). For 2019, this results in 2,373,660 employees in the analytical knowledge base in Germany’s city regions (33% of all German knowledge-intensive-business-services workers in the city regions), 3,831,338 employees in the synthetic knowledge base (53% of all German knowledge-intensive-business-services workers in the city regions), and 1,088,243 in the symbolic knowledge base (14% of all German knowledge-intensive-business-services workers in the city regions). As Table 2 illustrates, comparing city regions and more rural areas reveals that a substantial proportion of all knowledge-intensive business activities take place in the densely populated areas.

	<b>Germany (total)</b>	<b>city regions (line percentage)</b>	<b>Outside city regions (line percentage)</b>
<b>Analytical knowledge</b>	2,972,220	2,373,660 (80%)	598,560 (20%)
<b>Synthetic knowledge</b>	4,807,109	3,831,338 (80%)	975,771 (20%)
<b>Symbolic knowledge</b>	1,312,831	1,088,243 (83%)	224,588 (17%)
<b>Knowledge economy</b>	9,092,160	7,293,241 (80%)	1,798,919 (20%)

Table 2 – Distribution of knowledge-intensive employees by knowledge base in Germany’s municipal associations within and outside city regions as of 2019. Author’s calculation.

## Methods

To respond to the research questions posed, two different methods have been adopted. First, the concentration of employees in the different knowledge bases in the city regions of Germany is measured by applying the normalised Hirschman-Herfindahl Index. Second, the analytical-cartographic method of sectoral functional specialisation developed by Blotevogel (1998) is applied to determine the degree of specialisation of the individual knowledge bases in both the large cities and the small towns of the city regions.

The Hirschman-Herfindahl Index (HHI) is considered a proven calculation method for measuring the geographical concentration of economic indicators, alongside other measures, including the Gini coefficient, Theil’s entropy and the Rosenbluth Index (Drucker, 2011; Panzera et al., 2022). The HHI, which was originally used to measure the market concentrations of companies in a given industry to determine oligopoly or monopoly positions (Hirschman 1980; Herfindahl 1950), has been frequently applied in spatial studies in the field of (economic) geography (e.g., Fornahl & Brenner, 2009; Oliveira et al., 2020; Teixeira, 2006;

Giuliani, 2006). The HHI is calculated from the sum of the squared relative market shares: in a first step, the relative shares of knowledge-intensive employees per knowledge base are calculated for each city region for each municipal association. Then, these relative shares are squared and finally aggregated.  $N$  represents the number of municipal associations within the respective city region and  $MS_{kb}$  describes the market share of the knowledge base  $kb$  in the city region:

$$HHI = \sum_{i=1}^N (MS_{kb})^2$$

The HHI can take on values between  $1/N$  and 1. However, the comparability of the HHI can be impaired, especially if the number of units  $N$  varies greatly. In the example of the present study, the number of municipal associations in the respective city regions varies from six (city region of Salzgitter) to 235 (city region of Darmstadt/Frankfurt/Wiesbaden/Mainz). For this reason, the present analysis uses the normalised Hirschman-Herfindahl-Index (HHI\*):

$$HHI * = \frac{HHI - \frac{1}{n}}{1 - \frac{1}{n}}$$

The HHI\* can assume values between 0 and 1; higher values indicate a greater concentration.

To be able to make statements about the sectoral functional specialisation of the core centres or small towns in the respective city regions in Germany, I adopt the analytical-cartographic form of representation presented by Blotevogel (1998; 2002). In a first step, the average share of the three knowledge bases is calculated for the core centres or small towns across all city regions (shown in Figures 5 and 6 as Share of Sectors). This average share is expected for all city regions as the usual sector distribution in the respective city region. Therefore, in a second step, the absolute number of employees in each knowledge base is calculated according to the expected sector distribution. The “real” sector distribution is then subtracted from this expected sector distribution to obtain the below-average or above-average disproportionate specialisation of the respective large cities or small towns in the city regions in absolute figures. To clarify the cartographic representation, the percentage of over- or under-representation of the individual knowledge bases is then transferred to the radii of the district segments. Blotevogel (1998: 74) describes the graphical representation as follows: “The diagram areas correspond to employees subject to social insurance contributions in knowledge-intensive services. The angles of the circle sectors show the share of the industries in the total number of employees subject to social insurance in all [small towns or large cities in all 50 city regions] (the angles are therefore the same in all 50 city regions), therefore the radii of the sectors show the above-average or below-average expression of the individual [knowledge bases] in the respective [city regions]” (see Figures 5 and 6).

## Results

### Spatial concentration of knowledge-intensive business services in Germany's city regions

The map in Figure 4 reveals considerable regional differentiation of city regions between the north/east and south/west of Germany across all knowledge bases. In the north and east of the country, a high concentration of knowledge-intensive activities can be observed in the city regions, whereas in Baden-Württemberg in southwest Germany and in North Rhine-Westphalia – as well in southern Hesse and northern Rhineland-Palatinate – one can instead speak of de-concentration processes within the city regions. This rough classification can be explained in two ways. First, with the exception of the polycentric city regions of Essen/Bochum/Dortmund/Hagen (four municipal associations as core centres; ten large cities in total), Düsseldorf/Duisburg/Krefeld/Mönchengladbach (four municipal associations as core centres; ten large cities in total), Cologne/Bonn (two municipal associations as core centres; four large cities in total), Darmstadt/Frankfurt/Mainz/Wiesbaden (four municipal associations as core centres; five large cities in total), Nuremberg/Erlangen (one municipal association as core centre; three large cities in total) and Berlin Potsdam (two municipal associations as core centres; two large cities in total), all the city regions have only one municipal association defined as a core centre. Particularly in the polycentric regions that are characterised by four core cities, very weak HHI\*s do not automatically indicate a decentralised concentration in the areas surrounding the core cities but can instead be explained by the distribution of employees across the individual core centres. Figure 1 shows that this assumption particularly applies to the two city regions of Essen/Bochum/Dortmund/Hagen and Düsseldorf/Duisburg/Krefeld/Mönchengladbach in the Ruhr area and, to a lesser extent, the polycentric city region of Darmstadt/Frankfurt/Mainz/Wiesbaden in southern Hesse.

Second, Germany's settlement and urban structure can also be traced from the regional pattern shown on the map. The country's southwest, in particular, is characterised by prosperous and economically important SMSTs (Erdem, 2021), meaning that a decentralised concentration of knowledge-intensive business services tends to be observed in the city regions. In this sense, these city regions can also be described as polycentric urban regions that do not have several large core centres but whose economic structure is shaped not only by the core city but also by important regional hubs in the surrounding areas (Wagner & Growe, 2019).

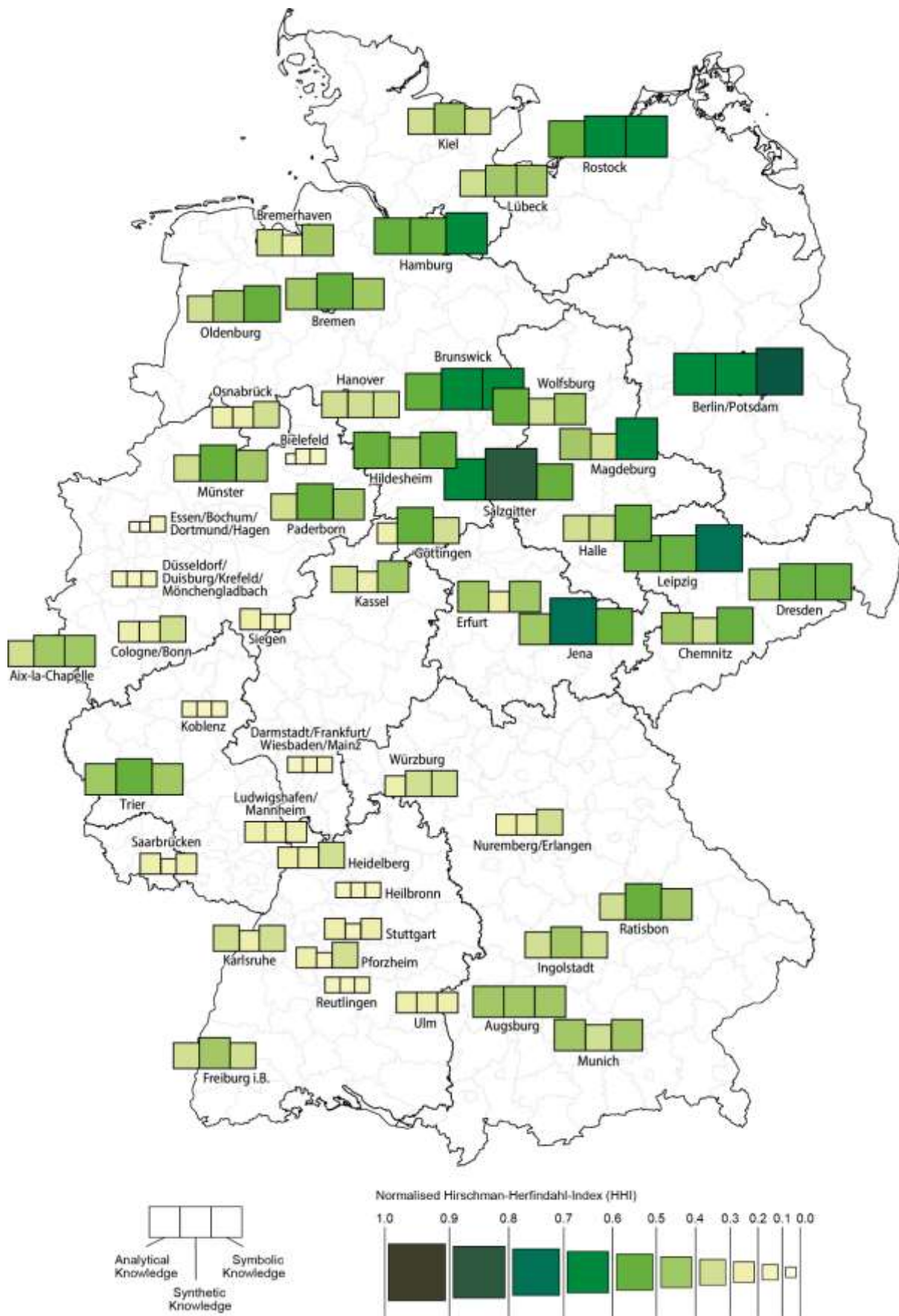


Figure 4 – Degree of concentration of knowledge-intensive service employees according to knowledge bases in the city regions in Germany.

This contrasts with, for example, the high HHI\*s recorded for the Berlin/Potsdam city region. Although Berlin/Potsdam represents a polycentric urban region with two core centres and is the second biggest city region in terms of area (Wagner & Growe, 2023b), a high level of concentration and thus an overpowering position, especially of the capital Berlin vis-à-vis the surrounding area, can be observed in the knowledge-intensive employment sector. Other city regions that are considered special economic centres of Germany, such as Hamburg and Munich, demonstrate a different structure. This is especially true in the case of the large city region of Munich, the third biggest city region in terms of area (Wagner & Growe, 2023b), which is characterised by decentralised concentration processes in nearby municipal associations. Figures 1 and 3 also make clear that the surrounding area and especially the small towns in this region are undergoing dynamic development in both the demographic and knowledge-economy sense.

Furthermore, regional centres designated as regiopolis (see Section “The historical development and political structure of the polycentric German urban system”), such as Rostock, Paderborn, Siegen, Trier and Würzburg, can be identified as interesting examples of concentration processes. While Paderborn, Trier and Rostock show relatively high concentration tendencies in a few municipal associations in the region across all knowledge bases, the picture is different for Siegen and Würzburg. It is interesting here that the share of knowledge-intensive employees in 2019 for these two regiopolis city regions is particularly high in the small towns (see Figure 1). This indicates that small towns are regionally of great importance for the knowledge-economy labour market.

With regard to the individual knowledge bases, a relatively balanced picture emerges across the individual city regions. In terms of the theoretical considerations detailed in Section “Differentiation of knowledge-economy activities: Knowledge bases”, increased concentration affinity from analytical knowledge to symbolic knowledge should be apparent. The city region of Oldenburg exemplifies this. Individual regions with dynamic centres, such as Berlin/Potsdam and Leipzig, also demonstrate a particularly strong concentration of symbolic knowledge. However, a national comparison does not reveal a uniform and significant picture. This confirms recent studies that explain spillover and catch-up processes in the surrounding areas of large cities (Volgmann et al., 2022), particularly in the sphere of symbolic knowledge (Wagner & Growe, 2023b). It is much more striking that synthetic knowledge is most concentrated in certain city regions (Trier, Ratisbon, Münster, Paderborn, Göttingen, Salzgitter, Jena, Bremen, Ingolstadt and Freiburg).

One explanation for this may be the tendency for certain large companies to focus only on the synthetic knowledge base, such as management consultancies or banks (Jennequin, 2008). Thus, concentration processes can be located below the national or European level in metropolitan areas. A mesoscale approach enables concentrations in individual municipal associations to be identified within city regions.



Therefore, Hypothesis 1 can be only partially confirmed:

**H1** – Particularly for analytical and synthetic knowledge, lower concentration processes of knowledge-economy activities can be demonstrated in city regions that are characterised by prosperous and economically robust small and medium-sized towns in the surrounding areas.

Although decentralised concentration processes can be identified, particularly in southwestern Germany, where city regions are characterised by prosperous, economically strong SMSTs, these cannot be restricted to specific knowledge bases.

### **Spatial specialisation and distribution of knowledge-intensive business services in the core centres and small towns of Germany's city regions**

Beyond the spatial functional specialisation effects of the core centres and small towns in Germany's city regions, the maps in Figures 5 and 6 convey further information. First, comparing the two maps enables a national comparison that clearly shows which city regions are characterised by their core centres and which are characterised by their small towns. Figure 6 shows the strong focus of the urban system on small towns. By contrast, and importantly, the number of knowledge-intensive employees in the core centres is less regionally differentiated, although it is also clear that the smaller city regions are particularly located in central and eastern Germany.

Furthermore, the maps illustrate the average share of the respective knowledge bases for the core centres and all small towns across all city regions. Here it is noticeable that the core centres (16.7%) are somewhat more substantially characterised by symbolic knowledge than small towns (12%), and that small towns (37.1%) have a higher proportion of analytical knowledge workers than core centres (30.9%). Overall, however, the picture is relatively balanced in terms of distribution within the city regions.

Statements about the specialisation of the respective settlement types in the city regions are provided by the radii of the individual sectors. Sectors with radii that protrude beyond the diagram area (circle) display a disproportionately high expression of the respective knowledge base (specialisation), while sectors with radii that remain within the diagram area display a disproportionately low expression of the respective knowledge base.



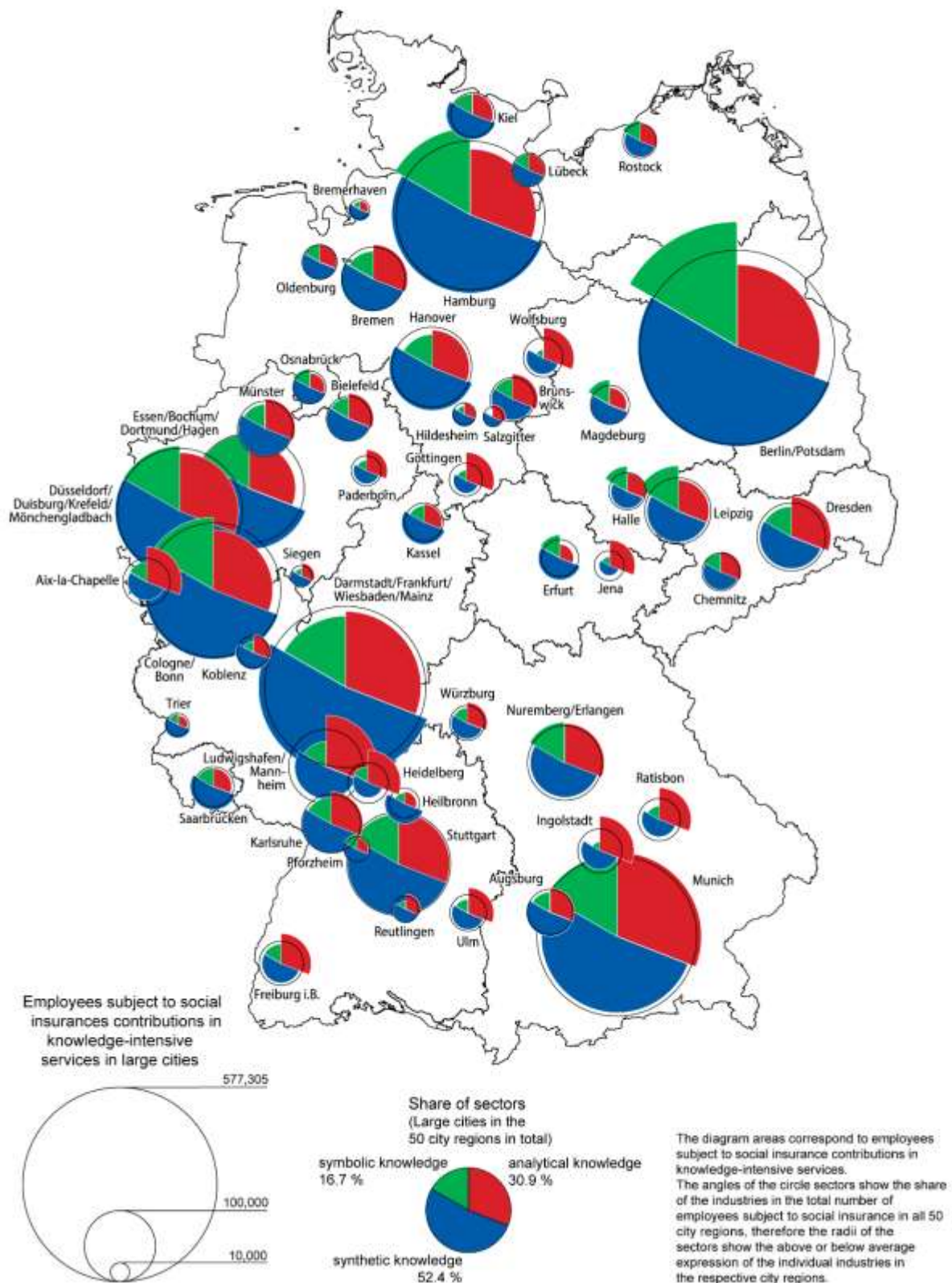


Figure 5 – Sectoral functional specialisation of the individual knowledge bases in the core centres of the city regions of Germany. Calculation according to Blotevogel (1998; 2000).

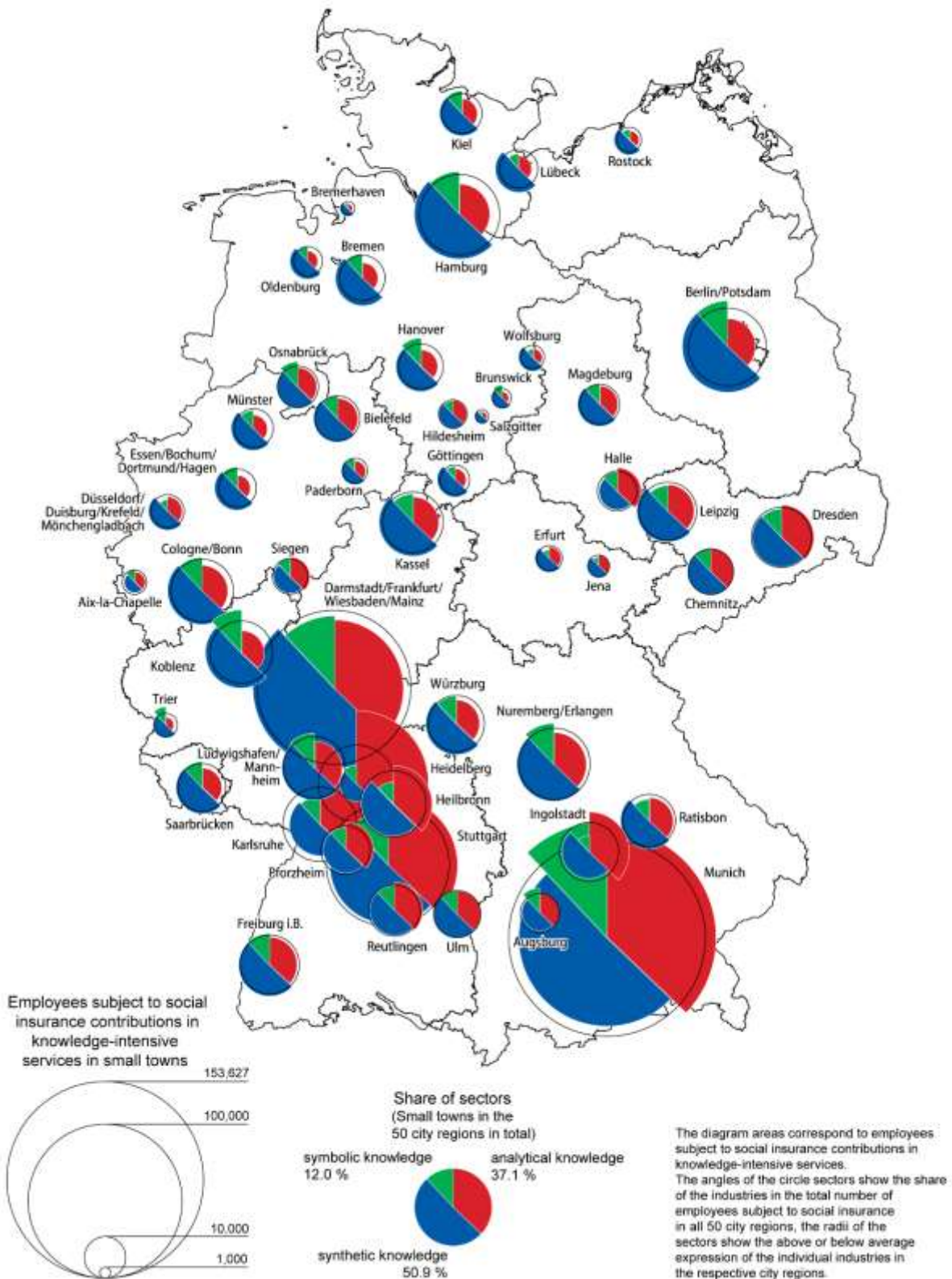


Figure 6 – Sectoral functional specialisation of the individual knowledge bases in the small towns of the city regions of Germany. Calculation according to Blotevogel (1998; 2000).

Turning to the specialisation tendencies of the core centres in the individual city regions, a specialisation regarding symbolic knowledge is noticeable not only for the large centres of Hamburg and Berlin/Potsdam but also for certain cities in eastern Germany, including Erfurt, Halle, Magdeburg and Leipzig. Thus, despite proven spillover and catch-up effects in the surrounding areas, a pronounced specialisation around creative activities can still be identified in at least the city regions in a country-wide comparison of large cities. However, in central and southern Germany, certain core centres demonstrate an above-average specialisation in analytical knowledge. These include cities with a corresponding university focus, such as Aix-la-Chapelle, Jena, Heidelberg, Ingolstadt, Ratisbon, Freiburg and Göttingen. By contrast, the synthetic knowledge base behaves as expected in almost all large cities, although individual deviations can be observed due to a specialisation surplus, as in the case of, for example, Darmstadt/Frankfurt/Wiesbaden/Mainz, which is partly due to the functional specialisation of Frankfurt am Main as a financial centre (Grove, 2016).

Turning to the small towns in the city regions, Berlin/Potsdam, Nuremberg/Erlangen, Munich, Augsburg, Trier, Koblenz, Hanover, Osnabrück and Brunswick are seen to specialise in the field of symbolic knowledge, which reinforces the potential of smaller towns for this form of knowledge and, thus, the interregional interlinkages suggested by the thesis of functions spilling over from the core cities (Wagner & Grove 2023b). Particularly in the southwest, a specialisation of small towns appears in the field of analytical knowledge. In addition to teaching and university activities, technical research and computer sciences, information and communication technologies are assigned to this knowledge base. In southern Germany, the above-average specialisation of small towns in analytical knowledge reflects the economic structure of the region, which features prospering centres, especially in the IT sector and surrounding municipal associations (Maurseth & Frank, 2009). By contrast, below-average specialisations in business and financial services can be observed in small towns, especially in Karlsruhe, Stuttgart, Heidelberg and Munich, which are particularly negative in favour of the analytical knowledge base. Thus, small towns in the city regions in the southwest of Germany tend to specialise in analytical – and, in some cases, symbolic – knowledge bases, whereas in the middle of Germany, they generally display no specialisation in a particular form of knowledge.

Here, it is worth questioning the extent to which specialisation effects of core centres and small towns in city regions can be identified as displaying the same trends and whether there is any regional differentiation. For Hamburg, Hildesheim, Bremerhaven, Cologne/Bonn, Darmstadt/Frankfurt/Wiesbaden/Mainz, Kassel, Heidelberg, Karlsruhe, Ingolstadt, Munich, Berlin/Potsdam and Dresden, 12 out of 50 city regions (24%) are undergoing the same specialisation or distribution tendencies – albeit to different degrees – with regard to both the small towns and their core centres and in terms of all three knowledge bases. Considering the specialisation tendencies for the individual knowledge bases separately according to large-city

and small-town development, a different picture emerges: in both settlement types, 26 out of 50 cases in the field of analytical and synthetic knowledge and 29 cases in the field of symbolic knowledge – thus, over half of the city regions – show uniform specialisation tendencies (see Table 3 and Figures 5 and 6). Specialisation, understood as the disproportionate development of a knowledge base in both core centres and small towns in a city region, can be especially clearly demonstrated for employees in the field of synthetic knowledge. Here, specialisation takes place in both core centres and small towns in 18 city regions. Other studies have already shown specialisation tendencies in individual city agglomerations, particularly around financial services, although these tendencies have yet to be analysed at the interregional scale (see also Volgmann & Münter, 2018; Parr & Budd, 2000; Growe, 2016). In terms of geographic location, it is striking that all city regions – with the exception of Berlin/Potsdam and Erfurt – that specialise in synthetic knowledge in both core centres and small towns are located in western and northern Germany. In the case of analytical knowledge, a similar focus of specialisation can be observed in southern Germany. Meanwhile, specialisation in both small towns and core centres in symbolic knowledge is distributed across the entire country but is especially pronounced in regions with large centres (except the regions of Osnabrück, Halle and Siegen). This can be interpreted as an indication that symbolic knowledge continues to have a certain affinity with core centres, but that shifts to the surrounding areas have already taken place in these areas (Wagner & Growe 2023b; Growe 2016).

Thus, Hypothesis 2 cannot be completely confirmed:

**H2** – With regard to spatial specialisation processes, there is an interregional correlation between core centres and small towns: if the expression of a knowledge base within the core cities of a city region is disproportionately high compared to all core cities in the city regions, the same functional specialisation is also found in the small towns in the surrounding areas and vice versa.

The analysis shows that the specialisation effects of the individual knowledge bases of large cities and small towns in city regions in Germany demonstrate the same tendencies in approximately half of the regions. Thus, knowledge-economy specialisation depends not only on the relationships and interlinkages between large cities and small towns but also on other regional and functional aspects and dimensions. Nonetheless, it can be concluded that small towns also demonstrate specialisation tendencies and that analyses of the development of city regions extend beyond centre-focused and centre-controlled approaches.



City regions	Small towns	Large cities	Small towns	Large cities	Small towns	Large cities	City regions	analytical	synthetic	symbolic
	analytical	synthetic	synthetic	synthetic	synthetic	synthetic		analytical	synthetic	symbolic
Kiel							Kiel			
Lübeck							Lübeck			
Hamburg							Hamburg			
Brunswick							Brunswick			
Salzgitter							Salzgitter			
Wolfsburg							Wolfsburg			
Göttingen							Göttingen			
Hanover							Hanover			
Hildesheim							Hildesheim			
Oldenburg							Oldenburg			
Osnabrück							Osnabrück			
Bremen							Bremen			
Bremerhaven							Bremerhaven			
Düsseldorf/Duisburg/Krefeld/ Mönchengladbach							Düsseldorf/Duisburg/Krefeld/ Mönchengladbach			
Cologne/Bonn							Cologne/Bonn			
Aix-la-Chapelle							Aix-la-Chapelle			
Münster							Münster			
Bielefeld							Bielefeld			
Paderborn							Paderborn			
Essen/Bochum/ Dortmund/Hagen							Essen/Bochum/ Dortmund/Hagen			
Siegen							Siegen			
Darmstadt/Frankfurt/ Wiesbaden/Mainz							Darmstadt/Frankfurt/ Wiesbaden/Mainz			
Kassel							Kassel			
Koblenz							Koblenz			
Trier							Trier			
Stuttgart							Stuttgart			
Heilbronn							Heilbronn			
Ludwigshafen/ Mannheim							Ludwigshafen/Mannheim			
Karlsruhe							Karlsruhe			
Heidelberg							Heidelberg			
Pforzheim							Pforzheim			
Freiburg							Freiburg			





## Discussion and Conclusion

This study aimed to demonstrate the extent to which the spatial concentration processes of knowledge-economy activities are at work in Germany's 50 city regions. It also set out to examine the significance of small towns in contrast to the core centres, differentiated according to three identified knowledge bases (analytical, synthetic, symbolic), and discuss the extent to which spatial specialisation tendencies for the different knowledge bases can be identified in both the core cities and the small towns located in the areas surrounding large centres. In connection to this, the paper has also analysed whether the core centres and small towns within city regions specialise in the same form of knowledge. For this purpose, the study considered functional employment data at workplaces from the Federal Employment Agency for the period 2012 to 2019 and the year 2019.

The results demonstrate that regional differences can be identified with regard to the spatial concentration of knowledge-intensive activities. Particularly in southwest Germany, de-concentration processes rather than concentration processes can be detected. This can be attributed to the strong influence on the region's settlement system of SMSTs with a high share of economic productivity. By contrast, lower HHIs in North Rhine-Westphalia must be attributed to the polycentric urban structures dominated by large cities. Meanwhile, strong concentration tendencies are observed in the middle of Germany and in the polycentric city region of Berlin/Potsdam, illustrating Berlin's special position as an economic centre. Other large economic centres, such as Hamburg and (especially) Munich, present lower concentration values that are reflected in the rather blurred surrounding regions (Lüthi et al., 2010).

Regarding the distribution of different forms of knowledge in large cities and small towns, there is a relative balance, but small towns feature a somewhat higher proportion of analytical knowledge and large towns a somewhat higher proportion of symbolic knowledge across all city regions. Concerning spatial specialisation tendencies, it can be noted that these occur not only in core cities but also (to the same extent) in small towns. In the large core cities of Berlin/Potsdam, Hamburg and Cologne/Bonn, a specialisation in symbolic knowledge can be observed. The analytical knowledge base also shows specialisations in large cities, particularly in the south and in the middle of Germany. Meanwhile, synthetic knowledge is relatively evenly distributed across the country (except for Frankfurt). For small towns, a strong specialisation in analytical knowledge can be observed in the city regions of southwest Germany.

In addition, about half of all city regions show the same specialisation or distribution patterns for both core cities and small towns, if all three knowledge bases are considered together. The individual analysis shows that specialisation tendencies are particularly evident in the area of synthetic knowledge and are geographically focused in the north and west of Germany. However, symbolic knowledge specialisation is more likely to be found in city

regions characterised by large centres, which can be interpreted as evidence of spillover effects into the surrounding areas (Volgmann et al., 2022; Wagner & Growe, 2023b).

Reflecting on the data and methods, it should be noted that applying the HHI\* to determine concentration tendencies only enables statements to be made about the entire city region. This means that it remains unclear exactly where and in which municipal associations – and, thus, in which settlement types – the concentration takes place and what role a location in the narrower or wider hinterland plays. A detailed analysis of the municipal associations would be necessary to provide more precise results on municipality-specific concentration processes. This might involve, for example, location quotients. However, the investigation performed here can still be considered an appropriate procedure for making general statements about concentration processes in city regions and their regionally varying characteristics (Panzera et al., 2022).

For this analysis, it was critical that functional rather than sectoral labour market data were used. This means that individual firms were not grouped into specific sectors; instead, employees were typified according to their respective fields of activity. This enabled the work performed to be mapped according to the logic of value creation. Here, a limiting factor is that only the data at the place of work is included in the analysis, which means that no statements can be made about flexible and mobile working models (Bürgin et al., 2022).

In terms of content, the comparison of specialisation and distribution tendencies in the core centres and small towns must also be considered in a differentiated manner. Because the disproportionately high and disproportionately low characteristics of individual knowledge bases are only calculated within the respective settlement type in comparison to all settlements of this type in all city regions, no conclusive statements can be made about core-periphery effects. Nevertheless, the analysis does provide initial results regarding spatial specialisation patterns of knowledge-intensive activities in small towns. By contrast, comparing similar specialisation and distribution tendencies between core centres and small towns indicates regional and functional-specific interlinkages between these settlement types. To obtain a comprehensive picture of core-regional specialisation processes, medium-sized towns should also be included in the analysis as important anchor points of knowledge-economy activities in a further step (Wagner & Growe 2023a). Nonetheless, the results at hand already provide important insights for future regional planning approaches, which must consider economic specialisation and concentration in, for example, the allocation of subsidies and the creation of equal living conditions in more and less urban and rural areas.

From a theoretical-conceptual perspective, it could be shown that new institutions and infrastructures need to be given more attention and thought in the theoretical discussion. In particular for forms of knowledge formerly described as more centre affine due to their being based on tacit knowledge, suitable conditions are now available in smaller centres that make it possible for the relevant professions to locate there. Conversely, this means that previously

valid theoretical concepts must be reconsidered and supplemented by new spatial requirements. Interaction processes can no longer be easily generated by telecommunication technologies alone, but new infrastructures such as coworking spaces, even outside major cities, can serve as third places and locations of temporary spatial proximity to enable work processes. Thus, the theory discussion must be expanded to include new, spatially effective factors.

Neither core centres nor small towns should be considered self-contained entities. In both agglomeration areas and peripheral regions, they must be considered both in terms of their interactions with neighbouring units and as actors connected by further interlinkages. The analysis captured this notion by choosing city regions instead of administrative spatial units. Because the surrounding areas of the core cities are delimited in this space category using commuter linkages from the surrounding municipal associations to the core centres, labour-market linkages are present (Zhao et al., 2017). Therefore, city regions are suitable for economic analyses that concern issues related to the differential importance of individual spatial units.

There is a particular need for further research regarding three different methodological and content-related research strands. First, especially in the area of systematic-quantitative analyses, further comparisons of small towns and core centres should be considered at both the national and European levels. In this context, the overpowering position of large cities should not be considered a given; instead, specific functions that can be transferred between SMSTs and large cities should also be examined (Meijers & Burger, 2022). Second, the spatial planning approach of regiopoles, which has thus far discussed smaller large cities as centres in rather peripheral areas far from large centres, provides a starting point for using medium-sized or smaller towns as important anchors, distinct from their role as settings for services of general interest, as a new criterion of analysis. Third, in addition to current specialisation and concentration trends, further studies should also examine the development of such trends at different points in time. This can enable statements about changes in the significance of individual settlement types in agglomeration areas and the evaluation of the impact of individual political (funding) programmes.

With reference to the results, I argue for a more advanced and open-minded view of the role of core centres or large cities in relation to small towns. Here, the focus should be on reciprocal interlinkages and considering small towns an equal kind of spatial category – rather than as *secondary towns or cities* – that can also offer functional advantages for medium-sized and large cities.

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**Conflict of interest**

The author declares no conflict of interest.

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