Potential and resilience:
Evidence from peripheral regions of Germany

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1 Introduction

Economic, technological and social imbalances are a fundamental problem of many countries. As noted by Logan et al. (2021) "modern-day social and economic inequality is rooted in a combination of factors, including geographic endowments, agglomeration economies, regional differences in human and physical capital investments, and, importantly, persistence of past policy decisions, investments, and choices". Resulting from the first manifestation of new technological paradigms in specific areas and other historical developments, those regions that were not the first to see specific developments tend to remain or fall back to a less developed position. Subsequently, a vicious circle tends to unfold: Lagging regions lack the necessary resources and human capital to develop their own technological breakthrough, remain in a backward position and as a consequence of this lack of development do not develop urban centres.

Regional imbalances often lead to negative consequences: they hinder economic growth and restrain countries' economic development potential as a whole (Floerkemeier and Spatafora 2021). Likewise, peripheral regions tend to fall behind their urban counterparts in terms of business activity and productivity (Lee and Xu 2020; Bürcher et al. 2015). Existing unevenness in wealth distribution may result in self-reinforcing economic and infrastructural gaps, which may subsequently become a source of social (Case and Deaton 2020) and political (Wilkinson 2019) tensions. For decades, therefore, much effort has been directed to territorial cohesion. In the current discussions on European Union policies for the coming years, on regional policies and regional projects once more occupy centre stage (STOA 2018). In this context, many now argue that respective measures should focus not only on economic development, but also on social aspects (Wardenburg and Brenner 2020), including demographic patterns and local culture (COHSMO 2021).

More generally, recent studies tend to pay more and more attention to the specifics of structurally weak regions. There is an increasing acknowledgement of the complex, multidimensional nature of regional disparities – and the fact that these will create a complex fabric of preconditions for future development. In such a large and diverse country as Germany, peripheral regions vary largely in their geographic, economic and demographic characteristics as well as in their technological and industrial base.

Currently, all regions are subject to a highly dynamic national and global context: changes of the technological landscape and political agenda, shifts in demand and values, natural and social disruptions. At a time of such dynamic changes in technological drivers and normative development imperatives, differences in preconditions will determine potentials for future development. For some lagging regions, such overall changes may offer new windows of opportunity and give impulses to regional change while others may be at risk of declining even further (Kroll and Koschatzky 2020). Finally, the fate of regions will not be determined by structural preconditions alone but it is also the result of – individual and collective – decisions. Consequently, current research gives more and more attention to an agency perspective seeking to understand if and how development opportunities will be exploited, e.g. through innovative entrepreneurship (Nilsen et al. 2023).

While recent studies pay more attention to specifics of peripheral regions' development and their foundations (Benneworth 2004; Bürcher et al. 2015), more evidence is needed about how development dynamics differ from one lagging region to another (Bürcher et al. 2015). Hence, it is an important task for scientists to identify these differences, describe them and take them into account in a structured manner. As pointed out by Nilsen et al. (2023), "one size does not fit all", meaning that there is neither one type of 'lagging' regions, nor a universal solution to attenuate regional disparities.

Against this background, it is this paper's main ambition to provide a typology of lagging regions of Germany that can in itself constitute an informed contribution to the debate, and, more importantly, serve as a reference for future research. Based on a balanced set of socio-economic indicators, it will develop structured systematics of lagging regions, aiming to determine groups characterised by specific sets of challenges and opportunities. This typology will help to evaluate the potential of German peripheries to develop in a framework of changing opportunities – and to assess their resilience towards negative consequences of external shocks.

In the following, this paper thus sets out to improve our understanding of places which have not previously been able to link up with the social and technological dynamics that drive overall national economic development and leverage them to their benefit. Accordingly, we will refer to them as 'relationally peripheral', preferring the term 'peripheral' over rural. While, by definition, peripherality thus understood rules out that such regions are characterised by large urban centres, it is not the technical degree of urbanization as such that motivates our decision. Instead, our choice is motivated more indirectly, by the fact that we want to focus on regions that so far have not profited from relevant trends – or not very much. On the one hand, that does not necessarily require that they are in a traditional, spatial sense peripheral, i.e. located far from all centres or that the agricultural sector dominates their economic system. On the other hand, it does seem very implausible that any major city in Germany could be bypassed and fail to leverage such developments in the sense at which we aim in this study. Put more simply, we aim to improve our understanding of places outside the centres, no matter how much diversity we eventually allow, ruled out that we include the centres themselves.

2 Theoretical background

2.1 Peripheral regions – Definition and characteristics

Very often regional development studies concentrate on core regions (Isaksen and Trippl 2014; Calignano et al. 2022) or big metropolitan areas. However, differences between metropolitan and peripheral regions are too significant (Nilsen et al. 2023) to extrapolate insights taken from observing core regions on peripheries.

It is often stressed in regional development literature that the definition of the periphery is not univocal (Pugh and Dubois 2021; Nilsen et al. 2023). The model suggested by Friedmann (1966) dealt mainly with spatial distance from the core (Klimczuk-Kochańska and Klimczuk 2019), however, as argued by Noguera & Copus (2016), the concept of peripherality evolved to "aspatial" with the increased importance of socio-economic characteristics. Various studies outline such indicators as low population density, organizational thinness, lack of knowledge, capital and networks (Nilsen et al. 2023; Martinus and O'Neill 2022), downward mobility or socio-cultural and political-administrative disintegration (Stöhr 1981). Pugh and Dubois (2021) mention steady depopulation trends and asymmetrical power relations. Glükner et al. (2023) characterize peripheral regions as "distant, dispersed and disconnected", and suggest that it is important to distinguish between geographical location and position in the social network as depending on the dimension the same region can be defined as central or peripheral.

Scale also matters for the definition of periphery. Stöhr (1981) suggests three integration scales: worldwide, continental (e.g. Europe) and national. Recent studies often consider sub-national levels, as peripheral regions, although they represent parts of the same country and thus are embedded in its economic and political context, differ considerably among each other (Gaddefors et al. 2020; Nilsen et al. 2023). One of the attempts to concentrate on a sub-national level was the relatively new concept of inner peripheries, which was introduced at the Territorial Agenda 2020 meeting (Hungary 2011) and then developed further by ESPON (2013, 2017). This concept focuses on low economic potential, poor access to services of general interest and lacking relational proximity as key characteristics of peripheral regions. It adds to the picture such indicators as negative demographic trends and unemployment rates. This approach was, however, criticised for shifting the scope too much towards the quality of life and thus blurring the definition (Noguera and Copus 2016). At the same time, in the case of Germany, the indicators proposed in this concept definitely deserve to be considered: Although in terms of geographical distance Germany does not have genuinely remote areas, certain regions can be nevertheless characterized as structurally weak given their socio-economic conditions (Kroll and Koschatzky 2020). As noted by Wardenburg and Brenner (2020), overcoming regional inequalities that have social and political implications requires "not only economic efficiency, but also social and regional justice".

Peripheries deserve more attention, not only in regard of their less vibrant economic performance and possible social consequences. Recent works of the Thünen-Institute of Rural Studies show that today in Germany, around 70% of the population lives outside large cities. It is actually comparable with the situation at the beginning of the 20th century, when this number was around 80%. The detailed breakdown has however changed: in 1910 half of the population lived in rural areas and approximately a quarter in small and mid-sized cities, now it is the opposite – around half of the population lives in small and mid-sized cities and only 17% in rural areas (Steinführer 2020). This trend definitely points to the necessity of studying these types of regions more carefully.

Given the number of existing (and emerging) approaches to define periphery and the amount of indicators and underlying theories that are suggested to be taken into account, it becomes obvious

that peripheral regions are not homogeneous (Calignano et al. 2022; Nilsen et al. 2023). This consideration increases the importance of research at the sub-national level. The common approach is to work with NUTS-2 (Kluza 2020) level for this kind of studies, however, some scholars suggest that it is not consistent enough to develop meaningful regional policies and propose more detailed levels (Kluza 2020; Calignano et al. 2022). So far, not so many studies are dedicated to how peripheral regions vary at the sub-national level. Yet, recognising heterogeneity of peripheral regions is crucial when it comes to supporting economic and regional growth, as different combinations of conditions can yield the same result – presence or absence of new path development (Grillitsch et al. 2023).

2.2 Periphery struggles: Structural change and path creation

As outlined by Frank and Mayhew (2021), "disadvantaged regions fall into three categories: those which have been relatively poor in the very long term; those which failed to adjust to structural change; and those disproportionately affected by a macroeconomic shock". For the case of Germany this is in line with the argument of Kroll and Koschatzky (2020), who differentiate between the old industrial regions of Germany, which suffered from structural change and weak regions that have never experienced proper industrialization, adding that the latter are problematic, not only from a dynamic but also from a static perspective. This means that a combination of poor preconditions and external crises represents an additional challenge for weak regions: not only do they suffer from "baseline" disadvantages, but they also have to face new external challenges and opportunities with lesser means.

A first central dimension that determines advantages are basic social and material endowments. The traditional literature on economic geography stresses their role e.g. with respect to raw materials, water supply, access to labour and access to markets and others (Nilsen et al. 2023). Rich endowments in that sense favour regions, providing a more suitable environment for developing certain technologies and industries. However, it is important to keep in mind that the role of such preconditions is dynamic, multidimensional and contingent. Evidence from the mining industry, for example, shows that the exploration of raw materials usually spurs the growth of a dynamic local community, but once resources are depleted and mining ceases, the surrounding social structures dissolve and residential areas fall into decay (Syahrir et al. 2021). This example illustrates the power of structural change, which can be a result of various events: shifts in the economic structure (Boschma 2021), rise of new technologies, political decisions, shifts in values (e.g. transition to sustainable development (Kołoszko-Chomentowska and Sieczko 2018)), and even climate change (GTAI 2023). Some of them can be controlled to a certain extent (digitalization, energy transition), others are completely beyond control (natural disruptions). However, regardless of the nature of those events they affect core-periphery structures at national and regional levels (Boschma 2021). If once thriving agglomerations fail to adapt flexibly they may also fall victim to structural change, a loss of equilibrium is much likely to occur in the less resilient periphery where most regions lack a fabric of socioeconomic actors. They are therefore more vulnerable to external shocks (Kroll & Koschatzky 2020). Evidence from Swedish rural regions even shows that a small population size (i.e. limited critical mass) alone makes regions more vulnerable to external shocks (Haberzetser et al. 2021). In summary, some of the most significant endowments with relevance for regional economic development in the periphery include the overall economic size of the region as well as its demographic potential and current migration balance.

A second major dimension that determines advantages is the regions' structural capacity to accommodate change and leverage it for their benefit. While external shocks and related structural changes seem to have a predominantly negative influence on the socio-economic environment of regional structures in general and on the periphery in particular, they may also be regarded as

windows of opportunity: according to Grillitsch et al. (2023) they "free up resources from previously profitable economic activities". The same authors mention that changes are more likely to happen during crises than in more stable times. A recent example of such an external event that provoked drastic technological and societal changes is the Covid-19 pandemic, which facilitated the widespread adoption of teleworking as well as advancements in related infrastructure. For now, however, it remains unclear how this might affect regional disparities (Floerkemeier and Spatafora 2021). On the one hand, peripheral regions may benefit from the trend of remote work, which diminishes the negative influence of physical distance. On the other hand, it might even widen the gap between developed and peripheral regions due to the inability of the latter to adjust to the new requirements because of the insufficiently developed network infrastructure (Balakrishnan et al. 2022). Some limiting preconditions and other factors can thus hardly be influenced by single (groups of) individuals, but they can make a difference by grasping the existing opportunities.

Although preconditions matter, it is equally important to encourage the local population to develop an agency to harness this (Bækkelund 2021). Sotarauta and Suvinen (2018) define the term "agency" as "action or intervention by an actor to produce a particular effect", and Fredin et al. (2018) emphasize its key role for the emergence of new paths. Nilsen et al. (2023) mention a tendency to downplay the role of agency while stressing the importance of preconditions. With respect to new path development in times of crisis and change, such a focus cannot be instrumental. Instead, it is useful to draw on a "triad" of "preconditions, structural change and agency". In this "triad", preconditions represent a certain static basis that is available from the past. Structural change defines the dynamic current circumstances which a region is facing and agency may be regarded as a means to shape the yet undefined future in a space of opportunity provided by aspects from both (Nilsen et al. 2023; Grillitsch and Sotarauta 2020; Kurinka et al. 2020). This was succinctly summarized by Grillitsch et al. (2023), who proposed a theoretical framework, which includes three elements: regional preconditions, agency and external events, where agency is regarded as a driving force for developing new economic activities. Such innovation-driven economic change based on a targeted local agency usually requires a highly educated workforce, not only to fulfil technical tasks but also to spot entrepreneurial opportunities (Anderson 2000). A natural shortage of human capital resulting from limited educational opportunities will not only limit development directly but may also exacerbate the tendency of locals to move to more developed areas (Felzenstein et al. 2013).

Scholars distinguish between economic activities that are based on an already existing industrial base but also on completely new ones. In particular, it is reflected by the concepts of related and unrelated diversification (Boschma 2021) and path dependence versus new path creation for regional development (Hassink, Isaksen and Trippl 2019). Isaksen (2015) suggests that structurally weak regions are more likely to go the way of path renewal rather than creation, relying on the infrastructure base that already exists in the region. The same view is expressed by Boschma (2021), who describes this approach as related diversification mentioning that it is in general more likely to happen than unrelated diversification, which is more radical and risky in nature and requires more effort.

Various studies point out the parallel importance of both ways of development, however, the latter seems to represent a more radical "way to overcome an inevitable process of negative lock-in" (Boschma 2021). This refers to the concept of Schumpeterian entrepreneurship, which assumes 'breaking with existing paths and working towards the establishment of new ones' (Grillitsch and Sotarauta 2020), and innovative entrepreneurship in general. Innovations though do not have to be necessarily high-tech: they can have a form of new business models (Hassink, Isaksen and Trippl 2019), organizational (Kroll and Koschatzky 2020) or social innovations (Bosworth et al. 2020).

2.3   Entrepreneurship and its specifics in the periphery

With regard to processing a new path creation, evolutionary economic geography (EEG) stresses both the central role of firms (Hassink, Isaksen and Trippl 2019) and entrepreneurship as an important driver of economic change (Bürcher et al 2015; Felzenstein et al 2013). Many authors recognize the contribution of entrepreneurship to regional development (Benneworth 2004; Bürcher et al. 2015; Grillitsch and Sotarauta 2020) and diversification (Boschma 2021). Its role for regional development was stressed in particular by several national and EU-level programs (European Commission 2003; OECD 1998). Recent studies also pay attention to how entrepreneurial activity shapes economic growth in different regions and why certain regions demonstrate faster growth than others (Felzenstein et al. 2013). For example, Habersetzer et al. (2021) characterise entrepreneurship as a "regional event", which means that specific features of a given region tend to shape entrepreneurial activity in a certain way, which is especially relevant for peripheral regions that lack resources and agglomeration externalities. This argument is supported by Calignano et al. (2022), who describe firm agency as being 'embedded', stressing the role of regional context and adjacent actors. In general, many scholars agree that this process involves multiple actors (Bækkelund 2021; Grillitsch and Sotarauta 2020), such as universities or local governments. Against this background, a second key dimension, which should be noted as a relevant factor, is the relative role of established firms. At the same time, the extent to which existing firms default can give an indication how healthy the existing basis of the local economy still is. Furthermore, there are more direct factors that help entrepreneurial activity to flourish, such as a good technological infrastructure, skilled workers in knowledge-intensive branches and the availability of growth finance coming with them (Benneworth 2004).

Entrepreneurship in non-metropolitan areas has certain specifics. With regard to business activity periphery is characterized by remoteness, presence of small firms and lack of skilled labour plus limited local markets (Anderson 2000; Goudi et al. 2003; Nilsen et al. 2023). Remoteness causes logistic problems, such as limited access to markets and suppliers, which inevitably results in additional costs for transportation, service and manufacturing (Anderson 2000). However, some studies suggest that for high-tech companies geographical factors might be less important (Felzenstein et al. 2013) as they are characterized by "low-input-high output". In any case, territorial remoteness does matter, where given. While we renounce a simplistic, purely spatial concept of periphery, it does seem necessary to include accessibility as one central aspect into our considerations.

Some scholars do not regard peripherality as a predominately negative factor and point out benefits of such regions. Grabher (2018) thus suggests that periphery is not perceived as an obstacle to, but as a potential asset for creativity. Similar findings were reported by Kleeber and Tyler (1995), whose study has shown that "accessible rural firms are more innovative, dynamic and develop more in-house technological expertise than their urban or remote rural counterparts", which actually proves again the importance of differentiating between various types of peripheral regions (here the author differentiates between accessible rural and remote rural). Among other positive factors for entrepreneurial activity, scholars name natural beauty (Goudi et al. 2003), a psychologically more plausible working atmosphere (Bürgin et al. 2021) and strong informal networks (Bücher et al. 2015).

2.4 Dimensions of peripheral potential

First, a certain economic size may make regions less vulnerable to external shocks. Unless the overall systems display a certain critical size, a region is continuously at risk to experience substantive disruptions due to the loss of one or a few critical actors. A certain density of activities will also facilitate the emergence of synergies. Where efforts are spread very thinly, chance encounters are rare and benefits of serendipity less likely.

Second, a good endowment with human capital will not only ascertain that there is enough capacity for local activities, but also that there is sufficient cognitive flexibility and practical capacity to actively benefit from processes of adaptation and transformation rather than losing out.

Third, existing dynamics will tend to shape future dynamics. Regions already experiencing low birth rates, substantial outmigration and a high rate of insolvencies will be less attractive for investments and it must seem questionable whether those remaining will have high capacities to accommodate or even actively benefit from change.

Fourth, regions may become attractive for dynamic change agents where relevant actors and capacities are already present and can serve as a source for possible spillovers even if the presence of old competences may sometimes also make new path creations more difficult. Such capacities may be found more often in large companies or in research-intensive industries. In that sense positive entrepreneurial climate may be conducive to further developments.

Finally, closeness to centres (i.e. the opposite of remoteness) may enable them to benefit from the dynamics of adjacent centres, be it by commuting, the fact that businesses might tend to relocate to the vicinity rather than operate in the absolute centre for financial or other reasons.

3 Methodology – Case selection, Data and analysis

3.1 Data and region selection

This paper is primarily concerned with peripheral regions of Germany and attempts to create a typology based on their socio-economic characteristics in such a way as to evaluate their resilience and potential, in particular in terms of entrepreneurial activity.

While we agree that regions must be understood in their broader territorial context (Boschma 2004) and boundaries of place-specific socio-economic networks can be fluid, this study adopts a definition of regions as administrative units since most data that it will draw upon is provided in that format. More specifically, it will focus on the different characteristics of counties or "Kreise" in Germany (Puhle 2000; Vukovic and Kochetkov 2017). The choice of the county level (NUTS3) is motivated by the need to make differentiations at a proper level of granularity and at the same time obtain a clean and comprehensive dataset.

There is no established approach neither to define periphery and rurality nor to differentiate clearly between them. Many studies outline a strong similarity between these two concepts (Gruber and Soci 2010; IMF 2019; Kroll and Koschatzky 2020; Pugh and Dubois 2021), while others warn that the terms "peripheral" and "rural" in spite of their similarity refer to different dimensions and may not be used as synonyms (Hadjimichalis 2019; Souza 2017). In this study peripheral areas in line with Nilsen et al. (2023) are defined as non-metropolitan regions.

A pre-selection of counties was performed by removing the major urban areas, following the rationale already outlined above – that major urban centres can by definition not be peripheral, even when a relational concept of peripherality is applied. Technically, we excluded urban districts based on three different urban-rural typologies: European Commission (2016), Thünen (Küpper, 2016) and BBSR (2019). Regions were removed from the analysis if they are classified as

1) predominantly urban (European Comission)

2) non-rural (nicht ländlich) (Thünen)

3) independent major cities (kreisfreie Großstädte) (BBSR)

Furthermore, we removed outliers, for example where rural counties had been merged with urban counties, so that the presence of a major city above 100,000 inhabitants would be overlooked (e.g. Göttingen). The final list includes 255 counties (out of 401).

3.2 Variables selection and cluster analysis

The remaining areas are further stratified with the help of K-means cluster analysis. Variables adopted to perform this analysis are listed in Table 1, which provides further details on each of the variables.

Based on the relevant dimensions of analysis outlined in Section 1.4, seventeen initial candidate variables were obtained from the INKAR (Indikatoren und Karten zur Raum- und Stadtentwicklung) database of BBSR (Bundesinstitut für Bau-, Stadt- und Raumforschung), standardized and added to a long-list. Subsequently, this long list was shortened by confirming the validity of indicators through an in-depth inspection as well as by removing de facto duplications based on Principal Component Analysis (PCA) and Correlation Analysis. For example, the share of employees with an academic professional qualification was removed from the list due to a high (0.9) positive correlation with highly-qualified employees to avoid a duplicating effect (see Figure 4 in APPENDIX 2).

Other than that we removed variables whose vectors demonstrated a too similar direction in the PCA to expect that adding both of them would provide more information than including just one (see Figure 5 in APPENDIX 2). The further consideration behind this approach was to also avoid that one of the major dimensions developed in Section 2.1 would be represented by a set of variables reflecting genuinely distinct sub aspects while another one is represented by a set of those conveying the same notion in slight variation. In addition, we removed variables whose orientation in the PCA and / or whose correlation patterns suggested that they do not practically reflect that aspect for which we had originally included them. The share vacancies with the requirement level specialist or expert was removed as the direction of maximum variance (identified by vector of PCA) was almost identical to those of other human capital indicators (highly qualified employed, number of students). Similarly, the share of those employed in creative industries was removed from the long-list as it proved to be correlated (≥0,5) with other human capital indicators and showed a similar direction of the PCA vector.

Finally, the following fourteen variables were kept, in line with the ambition to reflect the 5 key dimensions highlighted under 1.3 in a balanced manner:

- To account for the role of overall economic size for resilience and the territorial spread of activities in the region, we included the total GDP and the population density.
- To account for the role of human capital currently present in the region we included the number of students and highly-qualified employees as well as highly-qualified unemployed people.
- To account for the role of current socio-economic development dynamics and potential, we included a region's population growth potential, its current migration balance as well as the current rate of insolvencies.
- In order to evaluate the potential for entrepreneurial growth based on existing capacities we include the presence of large companies in the region and the number of people employed in knowledge and research-intensive industries.
- To account for the region's relational accessibility / remoteness several variables were included: distance to the nearest airport and railway station, distance to the nearest regional economic centre and the de facto number of long-distance commuters (with a journey to their workplace of more than 150 km).

Table 1:   **List of variables used for cluster analysis**

Variable	Measurement
Economic size and density	
GDP	Gross domestic product in €1,000 per inhabitant
Population density	Inhabitants per km²
Human capital	
Number of students	Students at scientific universities and technical colleges per 1,000 inhabitants
Highly-qualified employed	Percentage of employed people with a specialist or expert qualification level in relation to the employed
Highly-qualified unemployed	Percentage of unemployed people with a specialist or expert qualification level in relation to the unemployed
Development dynamics	
Population growth potential	Regional population potential of the municipalities within a radius of 100 km in 1,000
Migration rate	Total migration balance per 1,000 inhabitants
Insolvency rate	Corporate insolvency proceedings applied for per 1,000 companies
Existing capacities	
Large companies	Share of branches with more than 250 SV employees in all branches in %
Employed in knowledge and research-intensive industries	Share of people employed in knowledge and research-intensive industries in % of employees[1]
Accessibility	
Distance to the airport	Average driving time to the next international airport in Germany in minutes
Distance to the railway station	Average driving time to the next IC/ICE train station in minutes
Distance to the regional centre	Average driving time to the next regional centre in minutes
Commuters	Share of SV employees with a commute of 150 km and more in %

A typology of peripheral regions in Germany is created with the means of clustering based on standardized variables described above. In this paper K-means clustering (MacQueen 1967) is employed – an unsupervised machine learning algorithm that allows to group the objects (in our case – peripheral regions of Germany) based on the similarity of their properties into a certain number of clusters ("K"). The object is assigned to the cluster based on the distance to the centre of the cluster (centroid), which represents the mean of points assigned to the cluster. This means that regions which are similar to each other are in one cluster (intra-cluster similarity is maximized). In

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[1] Missing values (Emden, Passau, Wittmund) were corrected by imputation of the arithmetic mean of the neighbouring regions.

contrast, objects from different clusters demonstrate different features (inter-cluster similarity is minimized). K-means clustering is a popular tool for object grouping based on similar features and it is widely used in geography and regional studies.

One of the first and most important steps in cluster analysis is defining the number of clusters K. So far, there is no common approach to define the optimal number of clusters (Calignano et al. 2022) – often the choice is made based on expert knowledge or mathematical methods such as the Elbow method, or combinations of them. In this paper, the number of clusters "K" was determined based on the comparison of the results of several methods: Elbow (K-means) and Silhouette (Partitioning Around Medoids, Hierarchical Clustering). All of them outlined different numbers of optimal clusters (see Figure 1 and 2) and four clusters were chosen for further analysis as this solution is the most effective way of finding a trade-off between optimality of cluster allocation and grasping sufficient heterogeneity of peripheral regions. All calculations were performed in R (packages clustertend, clValid, factoextra, etc.).
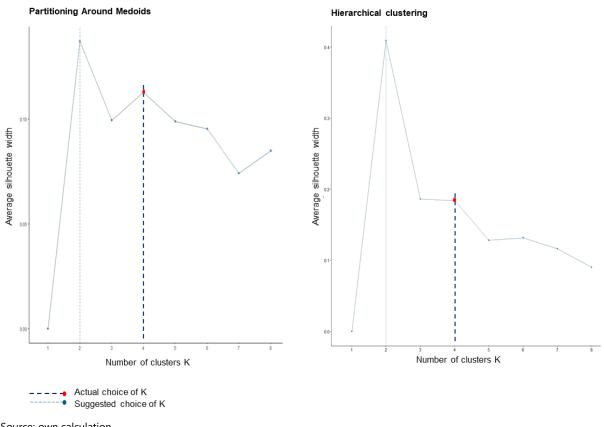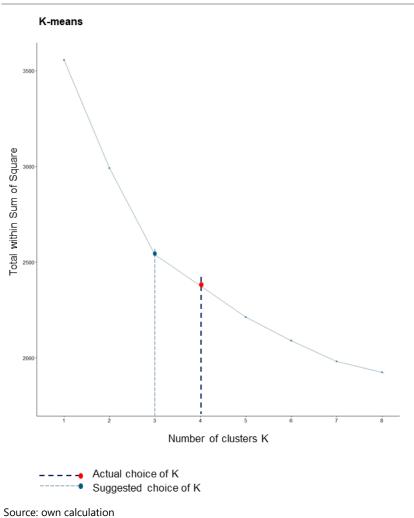
Figure 1:   **Silhouette analysis**

Source: own calculation
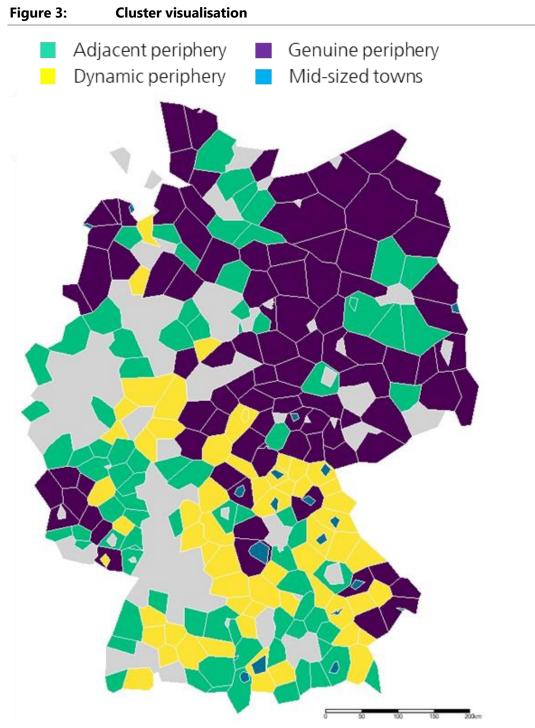
Figure 2: **Elbow method**

Source: own calculation

4 Results

The K-means cluster analysis identified four clusters, which consist of a number of counties (Kreise) that are similar in terms of their socio-economic structure. In general, all four clusters demonstrate considerable internal diversity (see Table 2) and also differ in number of counties included (the geographical distribution of the clusters is illustrated in Figure 3). Clusters 1 and 3 are the largest ones in this sense and include 83 and 93 counties respectively. Cluster 2 is a bit smaller with 60 counties included and Cluster 4 is with just 19 counties the smallest. The detailed assignment of counties to clusters is illustrated in Table 4 (APPENDIX 3).

Table 2:   **Cluster statistics**

Indicator	Average (across all 255 regions)	Adjacent periphery	Dynamic periphery	Genuine periphery	Mid-sized towns
Qualified unemployed	**10.1**	12.8	10.3	7.6	9.9
Qualified employed	**19.5**	20.8	19.3	17.6	23.6
Employed in knowledge-intensive sector	**10.1**	9.6	16.1	6.3	12.2
Students	**12.5**	7.8	8.4	5.0	82.7
Population density	**203.2**	203.9	145.2	99.1	893.4
Population growth potential	**250428**	362803	225458	174402	214283
Airports	**57.3**	43.8	63.3	66.1	54.6
Railway stations	**28.2**	22.9	32.5	31.9	19.7
Regional centres	**29.6**	27.0	27.7	38.6	3.9
Commuters	**4.3**	4.1	3.3	5.1	5.1
Large firms	**0.3**	0.3	0.4	0.3	0.5
GDP	**34.5**	32.3	38.6	28.5	60.0
Insolvency rate	**3.8**	4.3	3.0	3.6	5.0
Migration rate	**4.4**	5.4	3.5	4.1	4.6

Data source: INKAR (2019)

Figure 3: **Cluster visualisation**

Source: own illustration based on INKAR, cartography done in R (sf, tmap, eurostat)

Cluster 4 (mid-sized towns) is the smallest and most urbanized cluster out of all four (see Table 4). Counties in this cluster demonstrate a good economic performance (highest GDP and population density) and highest level of human capital (number of students, percentage of highly qualified workforce). In addition, it is the least remote cluster – the counties included are in close proximity to railway stations and regional centres. However, in terms of business climate this cluster shows a mixed performance: while demonstrating a strong presence of large companies and a high percentage of people employed in knowledge-intensive industries, the cluster has a high (far above average) rate of insolvency. Notably, this cluster consists mainly of cities (Städte) which are nevertheless classified as rural areas, due to the small number of inhabitants and low population density. To a degree, it can thus be considered a statistical artefact resulting from the fact that some federal states designate mid-sized rural cities as independent cities.

Among the non-urban clusters, Cluster 1 demonstrates the best economic performance and a lot of latent potential: for instance, regions in this cluster display positive migration figures and expect significant population growth over the next years. This cluster also demonstrates the lowest insolvency and good proximity to international airports, which is a valuable feature for business development. Finally, it is characterised by a high number of qualified unemployed people. This is an ambiguous finding: on one hand, it shows that a relatively large proportion of the population remains idle, but on the other hand, it indicates a reserve of skilled workforce. Evidently, these regions do not suffer from one of the most vital problems of periphery. It is worth mentioning that many counties that comprise these clusters are in close proximity to dynamic metropolitan regions such as Munich, Hamburg, Berlin and Frankfurt am Main. Hence, the cluster is labelled 'adjacent periphery'.

Regions in Cluster 2 represent a "golden middle" in almost all dimensions. While they are decisively non-urban, their levels of economic performance and human capital endowment are at least average and their average remoteness indicates that they do not widely profit from adjacency. Even the geographical position of the counties from this cluster is "average": most of them are located in central parts of Germany. In the majority of these regions, a good presence of large firms and a high share of the working population is employed in knowledge-intensive industries exists. Accordingly, we label this cluster 'dynamic periphery', indicating that it harbours significant potential for self-development while at the same time remaining substantially peripheral. This, in turn, becomes obvious in the fact that, different from Cluster 1, migration to Cluster 2 regions is very low (since it does not naturally benefit from adjacency).

Cluster 3 represents the most vulnerable areas, i.e. the 'genuine periphery'. This cluster consists of the most distant areas and demonstrates the poorest economic performance, showing the lowest numbers for almost all of our indicators, including human capital. The socio-economic state of this cluster does not seem to provide many natural foundations for further development, neither from the current nor from a future perspective. In contrast to Cluster 1 (adjacent periphery), which demonstrated population growth potential and high shares of qualified unemployed people, who might take advantage of new opportunities if they arise, regions in this cluster do not have this kind of a "latent backup". In contrast to Cluster 2, local development capacities are low, and the rate of out-commuters is high (as the local potential cannot provide for everyone).

In terms of NUTS-2 aggregation level, this cluster is the most homogeneous: it covers Mecklenburg-West Pomerania and substantial parts of Brandenburg and Thuringia.

5 Concluding remarks

In conclusion, our analysis has demonstrated a threefold subdivision of what we tend to refer to as "the periphery" in Germany. Leaving aside a cluster of mid-sized, rural centres, which is to a degree a statistical artefact based on specific administrative delineations, we find three main groups of regions that share specific starting conditions with a view to adapting overarching processes of change and transformation and leveraging their potential for regional growth. A first cluster that benefits from its relative adjacency to dynamic urban centres. A second cluster that, while not profiting in the same way still displays some positive fundaments for future development. A third cluster, finally, comes closest to representing what Rodríguez-Pose (2018) described as "places that do not matter", peripheral in a territorial and economic, but also social sense.

Very clearly, our analysis reflects the known North East-South West divide structuring the spatial distribution of economic potential in Germany, without failing to account for particularities and systematic deviations. By default, even more remote regions in South Western Germany tend to be assigned to Cluster 2, while in North Eastern Germany they would be assigned to Cluster 3. This can be explained to some extent by the legacy of reunification. Eastern Germany had to go through a complex transition process, involving firm restructuring, wage adjustments, harmonization of institutional systems, etc. (Siebert 1991). As a result, many Eastern regions experienced a sharp reduction in output, rise in unemployment (Hunt 2008) and extensive outmigration. Some of them never fully recovered, which resulted in a negative demographic structure (The Economist 2015). Importantly, however, what we find is not a pure East-West divide that could be one-dimensionally explained by the legacies of reunification. Instead, it reflects different starting conditions resulting from historical developments that in part date back even further. Some of those have simply always been empty and never participated even in the first waves of industrialisation. Such "structurally empty" regions are characteristic for much of North Eastern Germany, including of course Mecklenburg-West Pomerania but they can as well be found in Lower Saxony, Schleswig-Holstein, pockets of Hesse, and, as an exception from the strict North East-South West division, Rhineland-Palatinate. Cluster 2 regions, on the contrary, are not uncommon in Thuringia, where the disruptions in the 1990s were as such less dramatic or the human capital broader and the subsequent processes of recovery therefore more effective.

Why it is this way, would have to be subject of future research as would a detailed interpretation of differences within the three main clusters. At the same time, specific assignments to clusters also result from local idiosyncrasies so that it appears questionable whether a comprehensively "systematic explanation" can ever be found.

One systematic deviation from the overall North East-South West divide, which can be identified, however, is that regions in the vicinity of larger centres tend to profit from the closeness of those. To what degree this happens depends on the dynamism of the larger centre itself (compare Hamburg and Munich vs. Dresden and Leipzig) and which gradient this effect will diminish depends on the overall environment that the larger centre is embedded in (compare Munich to Hamburg). Furthermore, it depends partially on the specific territorial delineation of regions whether, where and to what extent these effects will show statistically. This can for example be observed in the comparatively large regions bordering Berlin. Only some of them are affected by the vicinity to Berlin sufficiently that they would be assigned to another more prosperous type of cluster based on their average statistical characteristics.

While, in summary, individual assignments of regions to groups will remain debatable and there is methodologically no way to establish a 'truth' on that matter, our analysis has achieved a threefold objective. First, it has documented that, as expected, there are substantive differences within the

non-central domain. Very clearly, it could demonstrate that – at least in Germany – no more than half of this domain belongs to what we have become used to discussing as "the periphery" based on the current literature. Second, it has demonstrated that socio-economic differences within the periphery are not one dimensional but rather reflect the degree to which a region still maintains a healthy socio-economic fabric or not. Third, it has provided an empirical basis to exclude the broader vicinity of dynamic centres from later analysis, if that appears expedient. And, indeed, the specific characteristics of cluster 1 might suggest that it be excluded for some type of analysis. Even where the intention is not to focus on the 'genuine periphery' alone, excluding those regions that can substantially 'borrow' their strengths from adjacent cities may clarify the results of some further analysis.

Overall, our analysis has thus lived up to provide a sound, robust and well-documented basis for future analysis. It structured the German periphery into three subdomains from which future researchers can choose in a way that seems fit given their specific ambition and object of analysis. To those that remain critical of our approach or some of the specific methodological choices we have taken, it has at least provided some conceptual inspiration. First, regarding the key dimensions of socio-economic characteristics that may determine future development and, second, with regard to the way that the German periphery is structured into major domains, regardless of which exact regions belong to the specific clusters.

6 References

Anderson, A. R. (2000): Paradox in the periphery: an entrepreneurial reconstruction? Entrepreneurship & Regional Development, 12(2), 91-109.

Balakrishnan, R.; Ebeke, C.; Firat, M.; Malacrino, D.; Rabier, L. (2022): "Regional Disparities in Europe." IMF Working Paper WP/22/198.

Bækkelund, N. G. (2021): Change agency and reproductive agency in the course of industrial path evolution, Regional Studies, 55:4, 757-768. https://doi.org/10.1080/00343404.2021.1893291.

BBSR. (2019): Siedlungsstruktureller Typ von Stadt-Land-Regionen. https://www.bbsr.bund.de/BBSR/DE/forschung/raumbeobachtung/Raumabgrenzungen/deu tschland/regionen/siedlungsstrukturtypen-stadt-land-regionen/slr-siedlungsstruk-typen-2019.csv?__blob=publicationFile&v=2

Benneworth, P. (2004): In what sense 'regional development?'. Entrepreneurship, underdevelopment and strong tradition in the periphery. Entrepreneurship & Regional Development. 16. 439-458. https://doi.org/10.1080/0898562042000249786.

Boschma, R. (2004): Competitiveness of Regions from an Evolutionary Perspective. Regional Studies, 38:9, 1001-1014, https://doi.org/10.1080/0034340042000292601.

Boschma, R. (2021): The Geographical Dimension of Structural Change. https://doi.org/10.1093/oso/9780198850113.003.0009.

Bosworth, G.; Price, L.; Hakulinen, V.; Marango, S. (2020): Rural Social Innovation and Neo-endogenous Rural Development. In: Cejudo, E., Navarro, F. (eds) Neoendogenous Development in European Rural Areas. Springer Geography. Springer, Cham. https://doi.org/10.1007/978-3-030-33463-5_2.

Bürcher, S.; Habersetzer, A.; Mayer, H. (2015): Entrepreneurship in Peripheral Regions: A Relational Perspective.

Bürgin, R.; Mayer, H.; Kashev, A.; Haug, S. (2020): Digital multilocality: New modes of working between center and periphery in Switzerland. Journal of Rural Studies, Volume 88, Pages 83-96, ISSN 0743-0167. https://doi.org/10.1016/j.jrurstud.2021.09.024.

Calignano, G.; Nilsen, T.; Jørgensen Nordli; A.; Hauge, A. (2022): Beyond 'periphery': a detailed and nuanced taxonomy of the Norwegian regions. Geografiska Annaler: Series B, Human Geography. https://doi.org/10.1080/04353684.2022.2141654.

Case, A.; Deaton, A. (2020): Deaths of Despair and the Future of Capitalism.

COHSMO (Former Hans Thor Andersen) Project. Results in brief. H2020. Location-sensitive policies can better address social inequalities. CORDIS | European Commission (europa.eu). Retrieved Jan 3, 2023, from: https://cordis.europa.eu/article/id/430218-location-sensitive-policies-can-better-address-social-inequalities".

Cörvers, F.; Mayhew, K. (2021): Regional inequalities: causes and cures. Oxf Rev Econ Policy. 2021 Apr 5;37(1):1-16. https//doi.org/10.1093/oxrep/graa067. PMID: 34191914; PMCID: PMC8083473.

ESPON GEOSPECS (2013): Inner Peripheries: a socio-economic territorial specificity, Luxembourg. Retrieved from

https://www.espon.eu/sites/default/files/attachments/GEOSPECS_Final_Report_inner_peripheries_v14.pdf [Accessed 06.09.2023].

ESPON (2017): "Inner Peripheries: National Territories Facing Challenges of Access to Basic Services of General Interest | ESPON." https://www.espon.eu/inner-peripheries.

European Commission (2003): Green paper: Entrepreneurship in Europe. Brussels, Belgium: Author.

European Commission. (2016): Urban-rural typology. https://ec.europa.eu/eurostat/documents/35209/35256/Urban-rural-NUTS-2016.xlsx

Felzensztein, C.; Gimmon, E.; Aqueveque, C. (2013): Entrepreneurship at the periphery: exploring framework conditions in core and peripheral locations. The Free Library (July, 1), Retrieved from: https://www.thefreelibrary.com/Entrepreneurship at the periphery: exploring framework conditions in -a0338778660 (accessed September 05 2023).

Floerkemeier, H.; Spatafora, N. (2021): Regional Disparities, Growth, and Inclusiveness, IMF Working Papers, 2021(038), A001. Retrieved Jan 3, 2023, from https://www.elibrary.imf.org/view/journals/001/2021/038/article-A001-en.xml.

Fredin, S.; Miörner, J.; Jogmark; M. (2018): Developing and sustaining new regional industrial paths: investigating the role of 'outsiders' and factors shaping long-term trajectories, Industry and Innovation, DOI: 10.1080/13662716.2018.153542.

Friedmann, J. (1966): Regional development policy: A case study of Venezuela. Cambridge: MIT Press.

Gaddefors, J.; Korsgaard, S.; Bruun Ingstrup, M. (2020): Regional development through entrepreneurial exaptation: Epistemological displacement, affordances, and collective agency in rural regions. Journal of Rural Studies, Volume 74, 2020, Pages 244-256. ISSN 0743-0167. https://doi.org/10.1016/j.jrurstud.2019.10.010.

Glückler, J.; Sheamur, R.; Martinus, K. (2023): Liability or opportunity? Reconceptualizing the periphery and its role in innovation. Journal of Economic Geography, Volume 23, Issue 1, January 2023, Pages 231–249, https://doi.org/10.1093/jeg/lbac028.

Goudi, A; Skuras, D.; Tsegenidi, K. (2003): Innovation and Business Performance in Rural and Peripheral Areas of Greece, 43rd Congress of the European Regional Science Association: "Peripheries, Centres, and Spatial Development in the New Europe", 27th – 30th August 2003, Jyväskylä, Finland, European Regional Science Association (ERSA), Louvain-la-Neuve.

Grabher, G. (2018): Marginality as strategy: Leveraging peripherality for creativity. Environment and Planning A 50(8): 1785-1794.

Grillitsch, M.; Sotarauta, M. (2020): Trinity of change agency, regional development paths and opportunity spaces. Progress in Human Geography, 44(4), 704–723. https://doi.org/10.1177/0309132519853870.

Grillitsch, M.; Sotarauta, M.; Asheim, B.; Fitjar, R. D.; Haus-Reve, S.; Kolehmainen, J.; Kurikka, H.; Lundquist, K.-J.; Martynovich, M.; Monteilhet, S.; Nielsen, H.; Nilsson, M.; Rekers, J.; Sopanen, S.; Stihl, L. (2023): Agency and economic change in regions: identifying routes to new path development using qualitative comparative analysis, Regional Studies, 57:8, 1453-1468, DOI: 10.1080/00343404.2022.2053095.

Gruber, S.; Soci, A. (2010): 'Agglomeration, Agriculture, and the Perspective of the Periphery', Spatial Economic Analysis, 5: 1, 43-72.

GTAI (2023): Structural Change – Germany's Prospering Regions (gtai.de).

Habersetzer, A.; Rataj, M.; Eriksson, R. H.; Mayer, H. (2021); Entrepreneurship in rural regions: the role of industry experience and home advantage for newly founded firms, Regional Studies, 55:5, 936-950, DOI: 10.1080/00343404.2020.1826038.

Hadjimichalis, C. (2019): "New" Questions of Peripherality in Europe or How Neoliberal Austerity Contradicts Socio-Spatial Cohesion. In: Lang, T., Görmar, F. (eds) Regional and Local Development in Times of Polarisation. New Geographies of Europe. Palgrave Macmillan, Singapore. https://doi.org/10.1007/978-981-13-1190-1_3.

Hassink, R.; Isaksen, A.; Trippl, M. (2019): Towards a comprehensive understanding of new regional industrial path development. Regional Studies 53(11): 1636-1645.

Hunt, J. (2008): German Reunification, Economics Of. In: The New Palgrave Dictionary of Economics. Palgrave Macmillan, London. https://doi.org/10.1057/978-1-349-95121-5_2520-1.

International Monetary Fund (2019): World Economic Outlook: Global Manufacturing Downturn, Rising Trade Barriers. Washington, DC, October.

Isaksen, A.;, Trippl, M. (2014): New Path Development in the Periphery, No 2014/31, Papers in Innovation Studies, Lund University, CIRCLE – Centre for Innovation Research, https://EconPapers.repec.org/RePEc:hhs:lucirc:2014_031.

Isaksen, A. (2015): Industrial development in thin regions: Trapped in path extension? Journal of Economic Geography 15(3): 585-600.

Keeble, D.; Tyler, P. (1995): "Enterprising Behaviour and the Urban-Rural Shift," Urban Studies, Urban Studies Journal Limited, vol. 32(6), pages 975-997, June.

Klimczuk-Kochańska, M.; Klimczuk, A. (2020): Core-Periphery Model, [in:] Romaniuk, S. M.; Thapa, M.; Marton, P. (eds.), The Palgrave Encyclopedia of Global Security Studies, Palgrave Macmillan, Cham 2019, pp. 1–8, https://doi.org/10.1007/978-3-319-74336-3_320-1.

Kluza, K. (2020): When rural boroughs turn into inner peripheries: a link between their socioeconomic characteristics and distance to large cities, Regional Studies, Regional Science, 7:1, 75-91, DOI: 10.1080/21681376.2020.1733437.

Kołoszko-Chomentowska, Z.; Sieczko, L. (2018): Peripheral rural areas in face of challenges of sustainable development. 10.22616/ERDev2018.17.N277.

Kroll, H.; Koschatzky, K. (2020): "Potentials and role of peripheral or weakly structured regions in national innovation systems," Working Papers "Firms and Region" R1/2020, Fraunhofer Institute for Systems and Innovation Research (ISI).

Logan, T., Hardy, B., and Parman, J. (2021), 'Long-run Analysis of Regional Inequalities in the US', Oxford Review of Economic Policy, 37(1), 49–69.

Kurikka, H.; Kolehmainen, J.; Sotarauta, M. (2020): Agency and perceived regional opportunity spaces.

Küpper, P. (2016): Abgrenzung und Typisierung ländlicher Räume. Braunschweig: Johann Heinrich von Thünen-Institut, 53 p, Thünen, Working Paper 68, DOI:10.3220/WP1481532921000

Jungho, L.; Jianhuan, X. (2020): Why do businesses grow faster in urban areas than in rural areas? Regional Science and Urban Economics, Volume 81, 103521, ISSN 0166-0462, https://doi.org/10.1016/j.regsciurbeco.2020.103521.

Martinus, K.; O'Neill, P. (2022): Disruption, transformation, and innovation in the peripheries. Geographical Research, 60: 251-255. https://doi.org/10.1111/1745-5871.12538.

MacQueen, J. (1967): Some methods for classification and analysis of multivariate observations, Proceedings of the Fifth Berkeley Symposium On Mathematical Statistics and Probabilities, 1, 281-296.

Nilsen, T.; Grillitsch, M.; Hauge, A. (2023): Varieties of periphery and local agency in regional development, Regional Studies, 57:4, 749-762, DOI: 10.1080/00343404.2022.2106364.

Noguera, J.; Copus, A. (2016): Inner Peripheries: What are they? What policies do they need? Agriregionieuropa, (45). Retrieved from: https://agriregionieuropa.univpm.it/it/content/article/31/45/inner-peripheries-what-are-they-what-policies-do-they-need (19/04/2020).

OECD (1998): Fostering entrepreneurship. Paris, France: Author.

Pugh, R.; Dubois, A. (2021): Peripheries within economic geography: Four "problems" and the road ahead of us. Journal of Rural Studies. 87. 267-275. 10.1016/j.jrurstud.2021.09.007.

Puhle, H. (2000): Regions, Regionalism, and Regionalization in 20th-Century Europe.

Research Service Scientific Foresight Unit (STOA). New technologies and regional policy: Towards the next cohesion policy framework. 2018. EPRS | European Parliamentary.

Rodríguez-Pose, A. (2017): The revenge of the places that don't matter (and what to do about it), Cambridge Journal of Regions, Economy and Society, Volume 11, Issue 1, March 2018, Pages 189–209, https://doi.org/10.1093/cjres/rsx024.

Rodríguez-Pose, A.; Storper, M.; Iammarino, S. (2018): Regional inequality in Europe: Evidence, theory and policy implications. CEPR. Retrieved Jan 3, 2023, from Regional inequality in Europe: Evidence, theory and policy implications | CEPR.

Siebert, H. (1991): German unification: the economics of transition, Kiel Working Paper, No. 468, Kiel Institute of World Economics (IfW), Kiel.

Sotarauta, M.; Suvinen, N. (2018): Institutional agency and path creation: Institutional path from industrial to knowledge city. In A. Isaksen, R. Martin, & M. Trippl (Eds.), New avenues for regional innovation systems: Theoretical advances, empirical cases and policy lessons (pp. 85–104). Springer.

Souza, P. (2017): The Rural and Peripheral in Regional Development: An Alternative Perspective. 10.4324/9781315211183.

Steinführer A. (2020): Dörfer und Kleinstädte im Wandel. Inf Polit Bildung 343(2):8-15, zu finden in <https://www.bpb.de/izpb/laendliche-raeume-343/> [zitiert am 03.08.2020].

Stöhr, W. (1981): Structural Characteristics of Peripheral Areas and the Relevance of the stock-in-trade Variables of Regional Science. WU Vienna University of Economics and Business. IIR-Discussion Papers No. 13 http://www-sre.wu.ac.at/sre-disc/IIR_Disc_13.PDF.

Syahrir, R.; Wall, F.; Diallo, P. (2021): Coping with sudden mine closure: The importance of resilient communities and good governance. The Extractive Industries and Society, Volume 8, Issue 4, 101009. ISSN 2214-790X. https://doi.org/10.1016/j.exis.2021.101009.

The economist. Germany's reunification 25 years on. (2015). Retrieved Jan 3, 2023, from https://www.economist.com/graphic-detail/2015/10/02/germanys-reunification-25-years-on.

Vukovic, D.; Kochetkov, D. (2017): Defining Region. 3. 76-81. 10.15826/recon.2017.3.2.009.

Wardenburg, S.; Brenner, T. (2020): How to improve the quality of life in peripheral and lagging regions by policy measures? Examining the effects of two different policies in Germany. J Regional Sci. 2020; 60: 1047–1073. https://doi.org/10.1111/jors.12500.

Wilkinson, W. (2019). "The Density Divide: Urbanization, Polarization, and the Populist Backlash". Before using the template

A.1 ISI ANNEX H1

List of counties, which were removed from the final selection list based on the number of inhabitants, overall socio-economic profile of a given county and its regional importance:

Table 3: **Excluded regions**

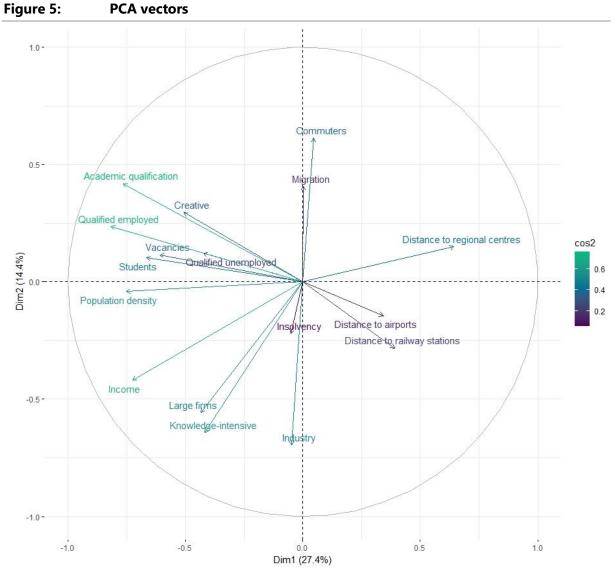| County	Number of inhabitants
Alzey-Worms	129687
Breisgau-Hochschwarzwald	263601
Cottbus, Stadt	99678
Dessau-Roßlau, Stadt	80103
Düren	264638
Enzkreis	199556
Flensburg, Stadt	90164
Gera, Stadt	93125
Gießen	270688
Göttingen	326041
Heilbronn	344456
Hildesheim	275817
Kaiserslautern, Stadt	100030
Kassel	236764
Konstanz	286305
Minden-Lübbecke	310409
Neumünster, Stadt	80196
Oldenburg	130890
Osnabrück	358080
Paderborn	307839
Schwarzwald-Baar-Kreis	212506
Schwerin, Stadt	95653
Siegen-Wittgenstein	276944
Tübingen	228678
Zwickau	315002

Source: INKAR (2019)

A.2 ISI ANNEX H2

Figure 4: **Correlation table**

	Qualified unemployed	Vacancies	Academic qualification	Qualified employed	Knowledge-intensive	Creative	Students	Population density	Population potential	Distance to airports	Distance to railway stations	Distance to regional centres	Commuters	Large firms	Income	Migration	Insolvency
Qualified unemployed	1.00	0.21	0.39	0.44	0.17	0.33		0.11	0.41	-0.30	-0.21	-0.33	-0.23	-0.19	0.13	0.21	
Vacancies	0.21	1.00	0.48	0.50	0.20	0.27	0.33	0.40	0.06	-0.05	-0.12	-0.35		0.14	0.37		0.06
Academic qualification	0.39	0.48	1.00	0.90	0.12	0.53	0.47	0.42	0.29	-0.31	-0.33	-0.28	0.21	0.08	0.31	0.05	-0.08
Qualified employed	0.44	0.50	0.90	1.00	0.29	0.50	0.42	0.45	0.30	-0.29	-0.26	-0.35	0.06	0.20	0.42	0.06	
Knowledge-intensive	0.17	0.20	0.12	0.29	1.00		0.06	0.20	0.10	-0.13	0.08	-0.28	-0.37	0.35	0.52	-0.20	0.07
Creative	0.33	0.27	0.53	0.50		1.00	0.27	0.25	0.19	-0.15	-0.19	-0.24			0.12	0.05	
Students		0.33	0.47	0.42	0.06	0.27	1.00	0.64			-0.23	-0.36	0.23	0.35	0.57	-0.05	0.07
Population density	0.11	0.40	0.42	0.45	0.20	0.25	0.64	1.00	0.20	-0.21	-0.24	-0.53		0.37	0.64		0.08
Population potential	0.41	0.06	0.29	0.30	0.10	0.19		0.20	1.00	-0.54	-0.17	-0.12	-0.26	-0.08		0.15	
Distance to airports	-0.30		-0.31	-0.29	-0.13	-0.15		-0.21	-0.54	1.00	0.31	0.23	0.08			-0.16	
Distance to railway stations	-0.21	-0.12	-0.33	-0.26		-0.19	-0.23	-0.24	-0.17	0.31	1.00	0.18	-0.10		-0.18	-0.07	0.10
Distance to regional centres	-0.33	-0.35	-0.28	-0.35	-0.28	-0.24	-0.36	-0.53		0.23	0.18	1.00	0.16	-0.32	-0.44		-0.08
Commuters	-0.23		0.21		-0.37		0.23		-0.26	0.08	-0.10	0.16	1.00	-0.20	-0.13		
Large firms	-0.19	0.14	0.08	0.20	0.35		0.35	0.37				-0.32	-0.20	1.00	0.60	-0.23	0.12
Income	0.13	0.37	0.31	0.42	0.52	0.12	0.57	0.64			-0.18	-0.44	-0.13	0.60	1.00	-0.09	0.12
Migration	0.21		0.05	0.06	-0.20			0.15	-0.16	-0.07			-0.23	-0.09		1.00	
Insolvency		-0.08	-0.08		0.07		0.07	0.08		0.10	-0.08		0.12	0.12			1.00

Source: own calculation

Figure 5:   PCA vectors

Source: own calculation

A.3   ISI ANNEX H3

Table 4:   **Cluster composition**

Cluster 1 "adjacent periphery"	Cluster 2 "dynamic periphery"	Cluster 3 "genuine-periphery"	Cluster 4 "mid-sized towns"
Ahrweiler	Altenkirchen (Westerwald)	Altenburger Land	Amberg, Stadt
Aichach-Friedberg	Altötting	Altmarkkreis Salzwedel	Ansbach, Stadt
Alb-Donau-Kreis	Amberg-Sulzbach	Anhalt-Bitterfeld	Bamberg, Stadt
Alzey-Worms	Bamberg	Ansbach	Bayreuth, Stadt
Ammerland	Biberach	Aurich	Coburg, Stadt
Bad Dürkheim	Cham	Bad Kissingen	Emden, Stadt
Bad Kreuznach	Coburg	Bautzen	Frankfurt (Oder), Stadt
Bad Tölz-Wolfratshausen	Deggendorf	Bayreuth	Hof, Stadt
Barnim	Dillingen a.d.Donau	Bernkastel-Wittlich	Kaufbeuren, Stadt
Berchtesgadener Land	Dingolfing-Landau	Birkenfeld	Kempten (Allgäu), Stadt
Bodenseekreis	Donau-Ries	Börde	Landshut, Stadt
Borken	Donnersbergkreis	Burgenlandkreis	Memmingen, Stadt
Brandenburg an der Havel, Stadt	Eisenach, Stadt	Cloppenburg	Passau, Stadt
Calw	Freudenstadt	Cochem-Zell	Rosenheim, Stadt
Celle	Fulda	Cuxhaven	Schweinfurt, Stadt
Dachau	Günzburg	Diepholz	Straubing, Stadt
Dahme-Spreewald	Haßberge	Dithmarschen	Weiden i.d.OPf., Stadt
Ebersberg	Heidenheim	Eichsfeld	Weimar, Stadt
Eichstätt	Hochsauerlandkreis	Eifelkreis Bitburg-Prüm	Wilhelmshaven, Stadt
Emmendingen	Hof	Elbe-Elster	Amberg, Stadt
Erding	Hohenlohekreis	Emsland	Ansbach, Stadt
Euskirchen	Holzminden	Erzgebirgskreis	
Forchheim	Kelheim	Freyung-Grafenau	
Freising	Kronach	Friesland	
Garmisch-Partenkirchen	Kulmbach	Gifhorn	
Hameln-Pyrmont	Lahn-Dill-Kreis	Görlitz	
Harburg	Landshut	Goslar	
Heinsberg	Lichtenfels	Gotha	
Herzogtum Lauenburg	Main-Spessart	Grafschaft Bentheim	
Ilm-Kreis	Main-Tauber-Kreis	Greiz	
Kaiserslautern	Marburg-Biedenkopf	Harz	
Kitzingen	Miltenberg	Havelland	
Kleve	Mühldorf a.Inn	Heidekreis	
Landsberg am Lech	Neckar-Odenwald-Kreis	Helmstedt	
Limburg-Weilburg	Neuburg-Schrobenhausen	Hersfeld-Rotenburg	
Lindau (Bodensee)	Neumarkt i.d.OPf.	Hildburghausen	
Lippe	Neustadt a.d.Waldnaab	Höxter	
Lörrach	Olpe	Jerichower Land	
Lüneburg	Ostalbkreis	Kusel	
Main-Kinzig-Kreis	Ostallgäu	Kyffhäuserkreis	
Mainz-Bingen	Pirmasens, Stadt	Landkreis Rostock	
Mayen-Koblenz	Rhein-Hunsrück-Kreis	Leer	
Meißen	Rhön-Grabfeld	Lüchow-Dannenberg	
Merzig-Wadern	Rottweil	Ludwigslust-Parchim	
Miesbach	Schwäbisch Hall	Mansfeld-Südharz	
Neu-Ulm	Schwandorf	Märkisch-Oderland	
Neunkirchen	Sigmaringen	Mecklenburgische Seenplatte	
Neustadt an der Weinstraße, Stadt	Sonneberg	Mittelsachsen	
Neuwied	Tirschenreuth	Neustadt a.d.Aisch-Bad Windshe	
Nürnberger Land	Traunstein	Nienburg (Weser)	

Cluster 1 "adjacent periphery"	Cluster 2 "dynamic periphery"	Cluster 3 "genuine-periphery"	Cluster 4 "mid-sized towns"
Oberallgäu	Tuttlingen	Nordfriesland	
Oberbergischer Kreis	Vechta	Nordhausen	
Oberhavel	Waldeck-Frankenberg	Nordsachsen	
Odenwaldkreis	Waldshut	Nordwestmecklenburg	
Ortenaukreis	Wartburgkreis	Northeim	
Osterholz	Weilheim-Schongau	Oberspreewald-Lausitz	
Peine	Weißenburg-Gunzenhausen	Oder-Spree	
Pfaffenhofen a.d.Ilm	Wesermarsch	Ostholstein	
Potsdam-Mittelmark	Wunsiedel i.Fichtelgebirge	Ostprignitz-Ruppin	
Ravensburg	Zollernalbkreis	Passau	
Regensburg		Prignitz	
Rendsburg-Eckernförde		Regen	
Reutlingen		Rotenburg (Wümme)	
Rhein-Lahn-Kreis		Rottal-Inn	
Rheingau-Taunus-Kreis		Saale-Holzland-Kreis	
Rosenheim		Saale-Orla-Kreis	
Roth		Saalfeld-Rudolstadt	
Saalekreis		Salzlandkreis	
Schaumburg		Schleswig-Flensburg	
Segeberg		Schmalkalden-Meiningen	
Soest		Schwalm-Eder-Kreis	
St. Wendel		Schweinfurt	
Steinfurt		Sömmerda	
Stormarn		Spree-Neiße	
Südliche Weinstraße		Stade	
Teltow-Fläming		Steinburg	
Unterallgäu		Stendal	
Verden		Straubing-Bogen	
Warendorf		Südwestpfalz	
Westerwaldkreis		Suhl, Stadt	
Wetteraukreis		Trier-Saarburg	
Wolfenbüttel		Uckermark	
Würzburg		Uelzen	
Ahrweiler		Unstrut-Hainich-Kreis	
Aichach-Friedberg		Vogelsbergkreis	
Alb-Donau-Kreis		Vogtlandkreis	
Alzey-Worms		Vorpommern-Greifswald	
Ammerland		Vorpommern-Rügen	
		Vulkaneifel	
		Weimarer Land	
		Werra-Meißner-Kreis	
		Wittenberg	
		Wittmund	

Source: own analysis