



Suspended in time? Peripheralised and “left behind” places in Germany

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Abstract. The term “left behind” has regained attention with the increasing signs of political dissatisfaction in the Global North, e.g. the rise of right-wing populist parties and politicians. In Germany, terms such as *abgehängte Regionen* (suspended regions) or “structurally weak” regions are often employed as alternatives. However, there is a certain fuzziness in these terminologies, as they often encompass different spatial scales and temporal dependencies and refer to a variety of regions, e.g. deindustrialising cities as well as peripheral and remote rural areas. Our approach conceptualises “left-behindness” as an outcome of peripheralisation. This allows for a theory-based selection of social, economic, and infrastructural indicators to operationalise left-behindness in Germany at the NUTS3 (nomenclature of territorial units for statistics) level with combining a factor analysis and a *k*-means cluster analysis. The former resulted in four dimensions of left-behindness with distinct spatial patterns, leading to the classification of six regional types, characterised by varying scores for the four dimensions.

1 Introduction

The notion of “left behind places” regained traction in discussions about disadvantaged regions regarding social, demographic, cultural, and economic dimensions (Fiorentino et al., 2024). The rapid transformation of the East German socialist planned economy to a market economy and the transfer of the decentralised and democratic political and institutional system of West Germany in the early 1990s caused profound social and spatial disruptions (Enenkel and Rösel, 2022; Röhl, 2018). This resulted in large investments and policies designed to facilitate the modernisation of infrastructure and the equalisation of living standards. However, the public and private sectors were treated inconsistently, overlooking spatial wage differentials (Enenkel and Rösel, 2022). As a consequence an unequal spatial-economic development emerged in the east, characterised by the centralisation of the public sector in larger cities, while manufacturing prioritised small- and medium-sized towns (Enenkel and Rösel, 2022; Hüther et al., 2019). These developments were accompanied by significant selective migration flows towards the west (Enenkel and Rösel, 2022; Leibert, 2016, 2020), resulting in a high degree of spatial polarisation

(Dvořák and Zouhar, 2023). The legacy of a divided Germany with two distinct political and economic systems is still evident today. Nevertheless, the disparity is narrowing as a consequence of the expansion of eastern German cities, including Berlin, Leipzig, and Jena (Gohla and Hennicke, 2023). Nevertheless, the majority of regions in southern Germany continue to outperform those in rural eastern Germany, as well as the older industrial regions in the north and west.

To describe and analyse the regions negatively affected by the aforementioned spatial disruptions, the metaphor *abgehängte Regionen* (literally: “suspended regions”) has been coined by both media and academia (Oberst et al., 2019; Milbert and Demmer, 2017; Diekman and Grigat, 2019). The term is frequently employed to elucidate the electoral triumphs of the populist right-wing party “Alternative for Germany” (AfD) in the 2017 federal election (Deppisch, 2021; Fink et al., 2019), entering the federal parliament with 12.6 % of the votes – an 8 percentage point increase compared to the 2013 elections. Furthermore, the term *abgehängte Regionen* is frequently used in conjunction with the international concept of “left behind places” (Pike et al., 2023; Röhl, 2018), which has become the “leitmotif of regional inequalities” since the 2008 financial crisis (Pike et al., 2023:1), as

well as an explanation of expressions of political discontent (Ejrnæs et al., 2024; Furlong, 2019; Rodríguez-Pose, 2018). The notion originated in an Anglo-American context (Pike et al., 2023) and is frequently employed to describe former industrial regions¹. Tomaney et al. (2019) characterise left behind places with an above-average proportion of jobs in industry, a lack of white-collar and graduate-level employment, below-average pay and employment rates, a greater reliance on in-work and especially incapacity benefits, and ageing populations. Martin et al. (2018) and Rodríguez-Pose (2018), on the other hand, focus on deindustrialisation and political discontent.

Similar debates in continental Europe frequently adopt a more rural perspective, focusing on topics such as profound demographic change, inadequate service provision and urban amenities, digital disconnection, and political disengagement (Proietti et al., 2022). In France, the debate focuses on the growing divide between booming metropolises and declining rural areas and medium-sized cities (Fink et al., 2020; Fourquet, 2019; Guilluy, 2014). In Italy, Portugal, and Spain, the focus is on inequalities in socio-economic conditions and infrastructure, especially on the accessibility of mobility, education, and health (Vendemmia et al., 2021; Proietti et al., 2022). A comparable debate on depopulation and the withdrawal of the state and market in rural Latvia is based on the concept of “emptiness” (Dzenovska, 2020), while Dvořák and Zouhar (2023) employ peripheralisation to examine the geography of populist voting in the Czech Republic.

This paper uses the framework of peripheralisation to examine the empirical understanding of left-behindness. This framework views the relationship between core areas and peripheries as a dynamic process that changes over time. This approach integrates economic, demographic, social, and infrastructural dimensions to provide a more comprehensive understanding of the factors that shape regional development (Kühn and Weck, 2013; Bernt and Liebmann, 2013). We, therefore, posit that left behind places may be a potential outcome of peripheralisation. This interpretation leads to the development of a framework for operationalising the concept of left-behindness, building on a theory-based selection of indicators and linking debates on unequal development of living conditions (e.g. Weingarten and Steinführer, 2020) to the international (academic) literature. Our methodology, a factor analysis followed by a *k*-means clustering at the district level (NUTS3²), enables us to comprehend the underlying dimensions of left-behindness and peripheralisation and to analytically capture the diversity of left behind places that authors such as Oberst et al. (2019), Nilsen et al. (2023), and Velthuis et al. (2023a) have emphasised. A broader range of indicators at a finer scale is employed to provide a more nuanced and multifaceted analysis of left behind places (Tierney et al.,

2023). In addition, we consider how different regional or local combinations of indicators can lead to different “varieties of ‘left-behindness’” (Velthuis et al., 2023a; MacKinnon et al., 2022). The focus on one country enables us to situate the analysis and findings within the specific policy discourses at the national level.

The subsequent sections will address the issue of unequal developments in Germany. This is followed by a theoretical discussion on peripheralisation and left-behindness. In Sect. 3, the data and methodologies employed are described, followed by a presentation and critical discussion of the results and ending with concluding thoughts.

2 Unequal developments in Germany

To understand left-behindness and peripheralisation, it is essential to possess a comprehensive understanding of Germany’s socio-economic and demographic developments since the reunification in 1990. Since then, the German national economy has experienced an exceptional economic recovery due to the decentralisation of wage bargaining to firm level leading to lower unit labour costs (Dustmann et al., 2018), improved product quality (Marin, 2018), and the opening of the eastern European labour market and its low-cost and skilled labourers (Marin, 2018). Südekum (2018) further posits that the rise of eastern Europe facilitated a more efficacious absorption of the China shock³ and the robotisation of industry compared to the USA. Nevertheless, this economic recovery is a national phenomenon, with different regional outcomes. In particular, regions with large and mainly import-competing manufacturing sectors were struck harder by job losses and lower growth rates despite the expansion of their service sector (Dauth and Südekum, 2016). This resulted in a growing divide between dynamic and disadvantaged regions (Fink et al., 2019)⁴. The socio-economic consequences of reunification in East Germany included large-scale closures of non-competitive companies, mass unemployment, the disappearance of millions of jobs (especially in industry in the early 1990s), and high out-migration to West Germany (Enekel and Rösel, 2022). This de-industrialisation was followed by a “de-infrastructuralisation” (Kersten et al., 2019:7) in numerous rural regions. Nevertheless, the resulting east–west disparities narrowed over time due to regional policies, although the gap has not yet been fully closed (Kersten et al., 2019). A comprehensive set of economic policies was implemented under the label *Aufbau Ost* (literally: “build-up east”), with the objective of privatising the nationally owned enterprises, preparing the East German economy for global competi-

³Accession of China in the WTO in 2001.

⁴Weingarten and Steinführer (2020:656) argue that claims that German regions are drifting apart and that especially rural areas are being decoupled from societal development are not supported by statistical data.

¹However, especially in the USA, peripheral and rural places are also mentioned in the discussions (Rodríguez-Pose et al., 2021).

²Nomenclature of territorial units for statistics 2016.

tion, rebuilding the infrastructure and encouraging investments (Pohl, 2021; see Blum, 2023, for a detailed analysis of the economic challenges and demographic consequences of these policies). Pohl (2021:19) posits that the *Aufbau Ost* initiative has achieved its intended objectives whilst leading to the emergence of regional economic disparities. The East Germans’ assessment of the economic development since reunification is less positive. A significant proportion of 26 % views it as a failure, while the majority remains undecided regarding the successfulness (Pohl, 2021).

2.1 Regional disparities and regional development policies in Germany

Since the end of World War II, policies of convergence and balancing regional disparities have been in place in (West) Germany with the notion of “equivalent living conditions” as one of the most important socio-political promises of cohesion aiming at reducing disparities between the *Länder* (German states) and between urban and rural areas (Kersten et al., 2019). Over time, the principles of regional policy in Germany have changed. Equalisation policies were superseded by policies designed to enhance the competitiveness of metropolitan regions (Keim, 2007). These policies promote and encourage centralisation, leading to a concentration of productivity, innovation, and infrastructure in centres. At the same time, they result in a gradual weakening of the development potentials of peripheries in the form of de-differentiation, fragmentation, and contraction (Keim, 2007). Tierney et al. (2023:2–3) contend that market-based regional development policies engender inequalities and that left-behindness represents the “dark side” of such policies. Resulting from these growing disparities, the concept of equivalent living conditions recently regained interest. The federal government’s “Plan for Germany” states that “It is a fundamental objective to guarantee equivalent living conditions throughout the entire territory of Germany. For this reason, the resources of the public sector should be allocated in a manner that ensures the provision of equivalent services and development opportunities in all regions” (BMI, 2019a:9). The creation of equivalent living conditions is a cross-cutting task that requires the collaboration and coordinated efforts of different federal ministries, as well as the involvement of the *Länder* and municipalities (BMI, 2019a). The “Plan for Germany” is largely comprised of “conclusions” and “recommendations” pertaining to various aspects, including the development of structurally weak and rural areas; the generation of employment; and investments in technical and social infrastructure and in networks promoting social engagement, better education, and community building (BMI, 2019a).

The political debate on regional disparities has been criticised as rather unsystematic and not supported by concrete policy (Kersten et al., 2019; Kallert et al., 2021). Firstly, this may be attributable to the limited competencies of the federal government in the field of spatial planning since the consti-

tutional reform of 1994 (Kersten et al., 2019). The responsibility for establishing equivalent living conditions lies with the *Länder*, which have different priorities and foci (Ragnitz and Thum, 2019). This complicates the way German policies address cross-sectional issues (e.g. regional development), resulting in a situation where regional policy becomes the product of poorly coordinated measures, concepts, and programmes with low overall effectiveness (Keim, 2007). Secondly, there appears to be a contradiction between the reluctance to accept peripheralisation and the expectation that public authorities should “tackle it” (Keim, 2007). A third reason may be that the term equivalent living conditions can be characterised as an “empty signifier” that has never been properly defined and operationalised and hence remains “imprecise and open to different interpretations” (Kallert et al., 2021:330). It is therefore important to carefully measure the consequences of unequal developments, including equivalent living conditions and left-behindness, using indicators supported by theory (Milbert, 2019).

Germany has a long tradition of regional policy (Kersten et al., 2019; Kallert et al., 2021) which contrasts with the unitary systems in countries such as the UK, France, and Italy and the bottom-up approach implemented in the USA (Cox, 2016). One might posit that the objective of spatially balanced economic development has become more salient in the Global North in the aftermath of the Global Financial Crisis in 2008, resulting in new spatial policies pertaining to the interaction of three processes: neoliberalism, the rise of state capitalism, and the emergence of populism and discontent in certain regions (MacKinnon et al., 2023). MacKinnon et al. (2023) identify the emergence of new spatial and industrial policies designed to support left behind places that rejected elements of globalism and neoliberalism while maintaining a focus on growth and competitiveness. Notable examples of such policies include the UK’s “levelling up” strategy, which is also motivated by the Conservative government’s objective of maintaining support for the party in former Labour strongholds in Northern England (Hudson, 2022) and President Joe Biden’s Inflation Reduction Act in the USA (MacKinnon et al., 2023).

3 Peripheralisation as theoretical framework to understand left-behindness

Left-behindness is approached as both a cause and consequence of unequal living conditions starting from “peripheralisation”, which helps to frame it in the relational and agency-sensitive understanding of spatially uneven development (Lang, 2015). Peripheralisation focusses on the formation of (socio-economic and/or political) peripheries (Bernt and Liebmann, 2013). The concept of “periphery” is inherently vague (Pugh and Dubois, 2021). However, it refers to a state and is often described as a specific locality characterised by a lack of resources and remoteness, while pe-

peripheralisation focusses on centre–periphery relations. By referring to processes and actions, it emphasises the distribution of resources. The focus is on the multifaceted nature of relations between actors and places (Bernt and Liebmann, 2013). Hence, this theory permits the inclusion of not only physical peripheries but also places that lost social or economic importance in relation to other places. Peripheralisation can be defined as a “gradual weakening and/or decoupling of the socio-spatial development in a given region vis-à-vis the dominant process of centralisation” (Keim, 2006:3). Peripheries are thus not simply geographical entities but rather (re-)produced through the actions of actors (Kühn and Weck, 2013). The interplay of peripheralisation and centralisation results in socio-spatial polarisation (Barlösius and Neu, 2007). One example of this link between inequality and the multi-dimensional nature of peripheralisation is austerity management at local levels where struggling municipalities are forced by state governments to increase local taxes and cut services in order to reduce debts. This results in reduced competitiveness with their less-left-behind neighbours and a deterioration in the quality of life for the local population (Dudek, 2021).

In the Introduction, we briefly discussed the various interpretations of the term left-behindness. We now turn to the more international definition proposed by Velthuis et al. (2023b:03). Their understanding of left-behindness is a multifaceted phenomenon that affects a diverse array of places, ranging from deindustrialised cities to more peripheral and rural regions. It describes places negatively affected by austerity, globalisation, and technological change (Pike et al., 2023; Velthuis et al., 2023b). It is often used as a shorthand for places experiencing decline or stagnation on economic, demographic, and social development, relative to more dynamic and prosperous places (Velthuis et al., 2023b). However, the variegated nature of left-behindness results in local combinations of disadvantage that may not encompass all indicators (MacKinnon et al., 2022). In Germany, the debate revolves around the highly loaded term *abgehängte Regionen* and is situated within the context of academic and policy discussions on structurally weak regions and ensuring equivalent living conditions (Oberst et al., 2019; Milbert, 2019; BMI, 2019b). The term is frequently used to describe rural areas with demographic and economic weaknesses and restricted access to services of general interest (SGI), as well as lower voter participation and electoral preferences for right-wing and populist parties (Deppisch, 2021; Weingarten and Steinführer, 2020; Sixtus et al., 2019; Röhl, 2018; Milbert and Demmer, 2017). The topic frequently encompasses a psychological element that evokes sentiments of left-behindness pertaining to the region’s economic situation, infrastructure, and cultural matters (Deppisch, 2021). Alternatively, it may encompass a collective regional embitterment that has accumulated over an extended period (Haneman et al., 2023).

The connection between the discourse on left-behindness and peripheralisation becomes evident when examining the four interrelated, overlapping, and mutually reinforcing dimensions of the process of peripheralisation (Kühn and Weck, 2013; Bernt and Liebmann, 2013). The term left-behindness describes the current state of regions affected by socio-economic decline and political neglect. The concept of peripheralisation provides a more nuanced understanding of why regions became left behind, including the decisions and processes that keep them in this state and the trajectories they follow. Peripheralisation can be the result of creeping decline, abrupt disruption, or a relative worsening in comparison to neighbouring regions (Beißwenger and Weck, 2020). The process encompasses the following dimensions: (1) (selective) migration resulting in a regional “brain drain” undermining the potentials of endogenous regional development, (2) disconnection from economic systems and political decision-making, (3) a dependency on decision-making centres and transfer payments and subsidies, and (4) stigmatisation (Kühn and Weck, 2013; Bernt and Liebmann, 2013). This is an important aspect in the consolidation of peripheries and peripheralisation (Leibert and Golinski, 2016). The disconnection and dependency dimensions of peripheralisation are closely connected to left-behindness, which manifests at both regional and individual levels. A withdrawal of the state and the private sector from a region results in a “left behind place” and deprives the inhabitants of economic opportunities, which, in turn, produces “left behind people” (Bernard et al., 2023). A lack of economic opportunities can trigger a downward spiral. Lacking job prospects leads to selective migration, which, in turn, entails ageing and population decline, impoverishment, infrastructural disinvestments by both public and private stakeholders, political marginalisation, and a reduced attractiveness of the locality in question for investors and potential in-migrants, leading to further out-migration and a gradual loss of the “critical mass” of users needed to sustain the remaining SGIs and technical infrastructure (Weber and Fischer, 2010). This downward spiral serves to illustrate the pivotal role of selective migration in the process of peripheralisation, both in the short and long term.

4 Data and methods

Our methodological approach to left-behindness is based on the combination of factor analysis and *k*-means cluster analysis. This allows for an understanding of the multidimensionality of left-behindness and the diversity of left behind places. The Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR, 2020) employs a comparable methodology to assess “unequal living conditions”, based on a comprehensive review of existing studies on regional disparities (Fink et al., 2019; Oberst et al., 2019; Sixtus et al., 2019; BBSR, 2017).

The analytical concept is based on the first three dimensions of peripheralisation: selective migration, dependence, and disconnection. Due to the subjective nature of stigmatisation and the lack of quantitative data, this is not considered in the analysis. Selective migration indirectly encompasses population decline and ageing. Nevertheless, we are convinced that both aspects should be more prominently featured, given the close relationship between population development and peripheralisation (see e.g. Bernard and Šimon, 2017; Weber and Fischer, 2010). Furthermore, numerous studies have identified correlations between demographic variables, particularly population decline and ageing, and populist voting and discontent (e.g. Dijkstra et al., 2020; Dvořák and Zouhar, 2023). Dependence and disconnection relate to economic and political decisions that influence employment, innovation, and general economic progress. A lack of these factors can be interpreted as economic left-behindness. Furthermore, deindustrialisation and long-term economic decline are both indicative of a disconnection from the economic system. The differing temporal dimensions of these processes in East and West Germany, in conjunction with the absence of pre-1990 data for East Germany, prompted us to concentrate on the potential for economic progress and innovation in recent decades. Furthermore, the disconnection and dependence also tie together with decisions regarding the reduction in service and infrastructure provision, which can lead to feelings of left-behindness regarding the accessibility of infrastructure (Deppisch, 2021). Additionally, we see political disengagement and discontent (Proietti et al., 2022; MacKinnon et al., 2022; Deppisch, 2021; Hannemann et al., 2023) and right-wing voting (Rodríguez-Pose, 2018; Martin et al., 2018; Tomaney et al., 2019) as a reflection of a disconnection from political decision-making centres. Political disengagement is included in the form of voter turnout in federal elections, as it is comparable across the whole country. Right-wing or populist voting exhibits a specific spatial pattern that will skew the analysis towards a strong east–west division. Consequently, we have decided to exclude this as an indicator. Furthermore, it can be argued that deprivation and disadvantage are absent from the peripheralisation framework despite being frequently mentioned in discussions on left-behindness. This is indicative of an individualised disconnection from society and life opportunities. Statistical data on deprivation and disadvantage demonstrate the spatial concentration of “left behind people” rather than identifying left behind places. Therefore, this dimension is incorporated into our analysis. It is anticipated that the combination and regional distribution of these indicators and processes will result in diverse pathways of peripheralisation and multiple types of peripheries (see e.g. Bernard and Šimon, 2017, and Dvořák and Zouhar, 2023, for the Czech Republic). This rationale led to the selection of 25 indicators of left-behindness available at the district level (NUTS3).

With regard to data availability, the most recent data, which were not affected by the COVID-19 pandemic, were selected. Post-pandemic data (i.e. for 2023) were not available at the time of conducting the analysis. The indicators are described in Table 1 and linked to a dimension of peripheralisation or one of the missing aspects of left-behindness addressed above.

In a second step, a factor analysis is conducted to reduce the dimensionality of the indicators to a smaller number of underlying dimensions (Bahrenberg et al., 2008) in order to address the complexity and multi-dimensionality of left-behindness. This multivariate approach identifies statistical correlations based on the minimum covariance between different indicators and groups them together, resulting in fewer independent dimensions. This approach facilitates the interpretation of the multi-dimensionality. The analysis was conducted using the statistical software package SPSS (IBM, 2010). The number of factors was determined in accordance with the Kaiser criterion⁵ (Bahrenberg et al., 2008).

Subsequently, a *k*-means cluster analysis is employed to elucidate the different factors that combine and constitute varieties of left behind places. The analysis identifies places with similar scores on the different dimensions of left-behindness and groups them together based on their similarity in scores across all factors. The cluster algorithm employed is Lloyd’s *k*-means clustering (Lloyd, 1982). The algorithm determines centroids that minimise the within-cluster sum-of-squares criterion. To address the potential sensitivity of the clustering algorithm to outliers, the Mahalanobis distance⁶ (Mahalanobis, 1930) is used to identify multivariate outliers⁷, which are subsequently excluded from the analysis. The optimal number of clusters is identified through the elbow plot method and the gap statistic. The analysis is conducted using the Python module scikit-learn⁸ (Pedregosa et al., 2011). The resulting typology combines all regions with similar struggles but seemingly different characteristics, thus avoiding the stigmatisation of the worst-performing districts. However, naming the clusters is challenging and can cause stigmatisation (BBSR, 2020).

5 Results

5.1 Dimensions of left-behindness

The analysis resulted in four different factors explaining 80.9 % of the variance, which are summarised in Tables 2 and

⁵The Kaiser criterion sets the threshold for the eigenvalue at 1, and all factors which comply are retained.

⁶The Mahalanobis distance is a multivariate distance metric for measuring the distance between a point and a distribution. This measure is often used for multivariate outlier analysis.

⁷Wolfsburg, Gifhorn, Gelsenkirchen, Hochtaunuskreis, Munich (city), Munich (district), Starnberg, Erlangen, and Schweinfurt (city).

⁸Open-source software for machine learning.

Table 1. Description of indicators.

Peripheralisation dimension	Indicator	Description
Selective migration	Average age ^a	The average age of the inhabitants in 2020 is directly influenced by large in- or outflows of migrants of a certain age groups.
	Population development of youth and young adults ^b	The population development of 15 to 30 years old in percentages between 2011 (census year) and 2019 indicates age-selective migration of young adults.
	Long-term population change ^b	The long-term population change 1990–2017 accounts for the longer demographic development which is influenced by the outcomes of selective migration. Additionally, population decline is related to populist voting and discontent (Dijkstra et al., 2020; Dvořák and Zouhar, 2023).
	Short-term population change ^b	The short-term population change 2016–2019 is included to account for recent population changes and is influenced by recent migration streams. This time frame is chosen as over this period the spatial pattern of migration changed (Stawarz et al., 2020). Additionally, population decline is related to populist voting and discontent (Dijkstra et al., 2020; Dvořák and Zouhar, 2023).
	Natural balance ^a	The natural balance is calculated as the difference between annual births and deaths averaged over the period 2015–2019. Both births and deaths are influenced by in- and out-migration of younger people, especially women, reflecting the age and gender selectivity of migration streams.
	Share of youth and young adults ^b	The population between 15 and 30 years old divided by the total population in 2019 reflects the outcome of age-selective migration.
	Migration balance of young women ^a	The annual average difference of in- and out-migration of young women between 18 and 25 years over the period 2009–2018 shows age- and gender-selective migration.
Disconnection from economic systems and political decision-making	Employment change ^a	The change of employed persons ^d over the period 2000–2019 can indicate a disconnection of a region from the labour market when negative or small.
	Workforce in business services ^a	The share of employment in the service industry in 2019 compared to the total employment indicates a certain disconnection from the service economy, especially regarding economic progress and innovation when it is low.
	Highly qualified workforce ^a	The share of the workforce (at place of work) with a university degree in 2020 reflects a disconnection from the service economy and illustrates a low innovation potential.
	Workforce in creative industries ^a	The share of the workforce in creative industries ^e in 2019 reflects a disconnection from the economy and a low innovation potential.
	GDP per capita ^a	The gross domestic product per head is used as an indicator of the economic situation in 2019. Low GDP per capita reflects a bad economic situation, which can indicate a disconnection from the economic system.
	Employment sufficiency ^b	The employment sufficiency is the workforce at place of work per 100 workers at place of residence in 2021. Values smaller than 1 indicate a lack of employment opportunities in the district and a disconnection from the economic system and the workforce as well as a dependence on economic centres where the employment sufficiency is higher.
	Voter turnout ^a	The participation rate in the 2017 federal elections shows political engagement of voters which might be low in left behind places (Proietti et al., 2022), reflecting a disconnection of the electorate from the political decision-making process.

Table 1. Continued.

Peripheralisation dimension	Indicator	Description
Dependence on the decision-making centres and transfer payments and subsidies	Supermarket radius ^a	The supermarket radius (the population-weighted Euclidean distance to the nearest supermarket or discount store in 2017) illustrates the availability of nearby SGIs, as the availability of most SGIs is correlated (Royer et al., 2022). The provision of SGI is an important component of equivalent living conditions in Germany (Dehne, 2019). It illustrates disconnection from infrastructure and services due to a dependency on political or economic decision-making in the centres.
	Hospital beds per 1000 inhabitants ^a	The number of hospital beds per 1000 inhabitants in 2019 is a measure for service availability or quality and is highly influenced by political decision-making.
	Commuter balance ^a	The commuter balance is the difference of in- and out-commuters per active population in 2019 and illustrates the dependence on other districts for either workers or workplaces.
	Income tax ^a	Income tax in euros per inhabitant in 2019 is used as a proxy for the wealth of local governments. Municipalities get 15 % of the income tax revenue, the rest is split equally between the federal and the state government. This shows a possible dependence on transfer payments.
Deprivation and disadvantage	Unemployment rate ^a	The share of unemployed people of working age (18–65 years old) that are available for work in 2019 relates to a personal disconnection from the labour market and economic systems.
	Youth unemployment ^a	Share of population under 25 years old that is unemployed compared to the labour force under 25 years old in 2019.
	Child poverty ^a	The share of children (younger than 15 years) that live in poverty in 2019 reflects the disadvantaged starting position of the children to improve their welfare and living conditions.
	Teenage fertility ^a	The fertility rate for women under 20 years in 2019 is seen as an outcome of deprivation.
	Household income ^a	The average household income in euros per inhabitant in 2019 gives an indication of wealth or disadvantage.
	Low income ^c	The share of households with a low income in 2019.
	Life expectancy ^a	The average life expectancy by birth in 2019 is a health outcome which is influenced by deprivation and disadvantage and shows in Germany large regional variations (Mühlichen et al., 2023).

^a BBSR (2023). ^b Source data: Statistische Ämter des Bundes und der Länder (2023), own calculations. ^c Bertelmann Stiftung (2023). ^d Employees subject to social insurance contributions, i.e. excluding the self-employed, family workers, and public servants. ^e Generation or exploitation of knowledge and information.

3 and illustrated in Fig. 1. The first factor explains 40.6 % of the variance. It is influenced by the unemployment rate, child poverty, youth unemployment, teenage fertility, and low incomes and inversely by household income, life expectancy, voter turnout, and income tax. Additionally, it is to a lesser extent inversely influenced by long-term population change and employment change. Since many of those indicators are included in the analysis to give an indication of limited life opportunities and disadvantage, this factor is named “deprivation”. Districts in southern Germany are characterised by lower deprivation rates than in the north. Areas affected by high deprivation include old-industrialised regions, e.g. the Ruhr area and Saarland, as well as sparsely populated ru-

ral areas in the northeast and the city states of Bremen and Berlin.

The second factor explains 28.2 % of the variance with high positive factor loadings on the population development of youth and young adults, short- and long-term population change, the natural balance, the share of youth and young adults, employment change, and to a lesser extent the migration balance of young women. Most of these variables relate to demographic change and are (indirectly) affected by selective migration and processes of demographic change. This factor shows a rather clear east–west division of Germany except for Berlin and the surrounding districts in Brandenburg. In the west, Upper Franconia, Saarland, Western Palatinate,

Table 2. Initial eigenvalues and variance explained for the first four factors.

Factor	Eigenvalue	Initial eigenvalues	
		% of the variance	Cumulated %
Deprivation	10.2	40.6	40.6
Demographic change	7.1	28.2	68.8
Economic centrality	1.6	6.3	75.1
Human capital	1.4	5.8	80.9

Table 3. Rotated component matrix. Only factor loadings larger than 0.4 are reported.

Indicators	Components			
	Deprivation	Demographic change	Economic centrality	Human capital
Unemployment rate	0.910			
Child poverty	0.868			
Youth unemployment	0.842			
Teenage fertility	0.787			
Household income	−0.782			
Life expectancy	−0.775			
Voter turnout	−0.737			
Low income	0.719			
Income tax	−0.672	0.478		
Average age		−0.871		
Development percentage of youth and young adults		0.819		
Long-term population change	−0.493	0.787		
Short-term population change		0.783		
Natural balance		0.783		
Share of youth and young adults		0.747	0.441	
Employment change	−0.469	0.680		
Employment sufficiency			0.925	
Commuter balance			0.888	
GDP per capita			0.758	
Hospital beds per 1000 inhabitants			0.756	
Migration balance of young women		0.448	0.555	0.469
Workforce in business services				0.875
Highly qualified workforce				0.850
Workforce in creative industries				0.826
Supermarkets radius			0.451	0.599

North Hesse, and adjacent South Lower Saxony are most affected by negative values of the demographic change factor.

The third factor accounts for 6.3 % of the variance and is influenced by the employment sufficiency ratio; the commuter balance; GDP per capita; hospital beds per 1000 inhabitants; and to a lesser extent the migration balance of young women, the accessibility of supermarkets, and the share of youth and young adults. This factor is named “economic centrality” as the majority of the indicators reflect a certain degree of centralisation of economic activities and infrastructure. The spatial distribution of this factor reveals a more pronounced centrality for numerous smaller urban districts (which are more prevalent in the south) and lower values for the surrounding rural districts.

The fourth factor accounts for 5.8 % of the variance. It is primarily influenced by the workforce in business services, a highly qualified workforce, the workforce in creative industries, and to a lesser extent the distance to supermarkets and the migration balance of young women. These indicators are indicative of a higher presence of “human capital”. The spatial pattern indicates that higher factor scores are present in larger conurbations and major cities, including the Rhine–Ruhr and Cologne–Bonn area, the Rhine–Main area, Munich, Berlin, Hamburg, Bremen, Stuttgart, and Dresden. Furthermore, lower scores for this factor can be found in more peripheral areas, such as the east of Lower Bavaria, the Eifel, and the Weser–Ems region.

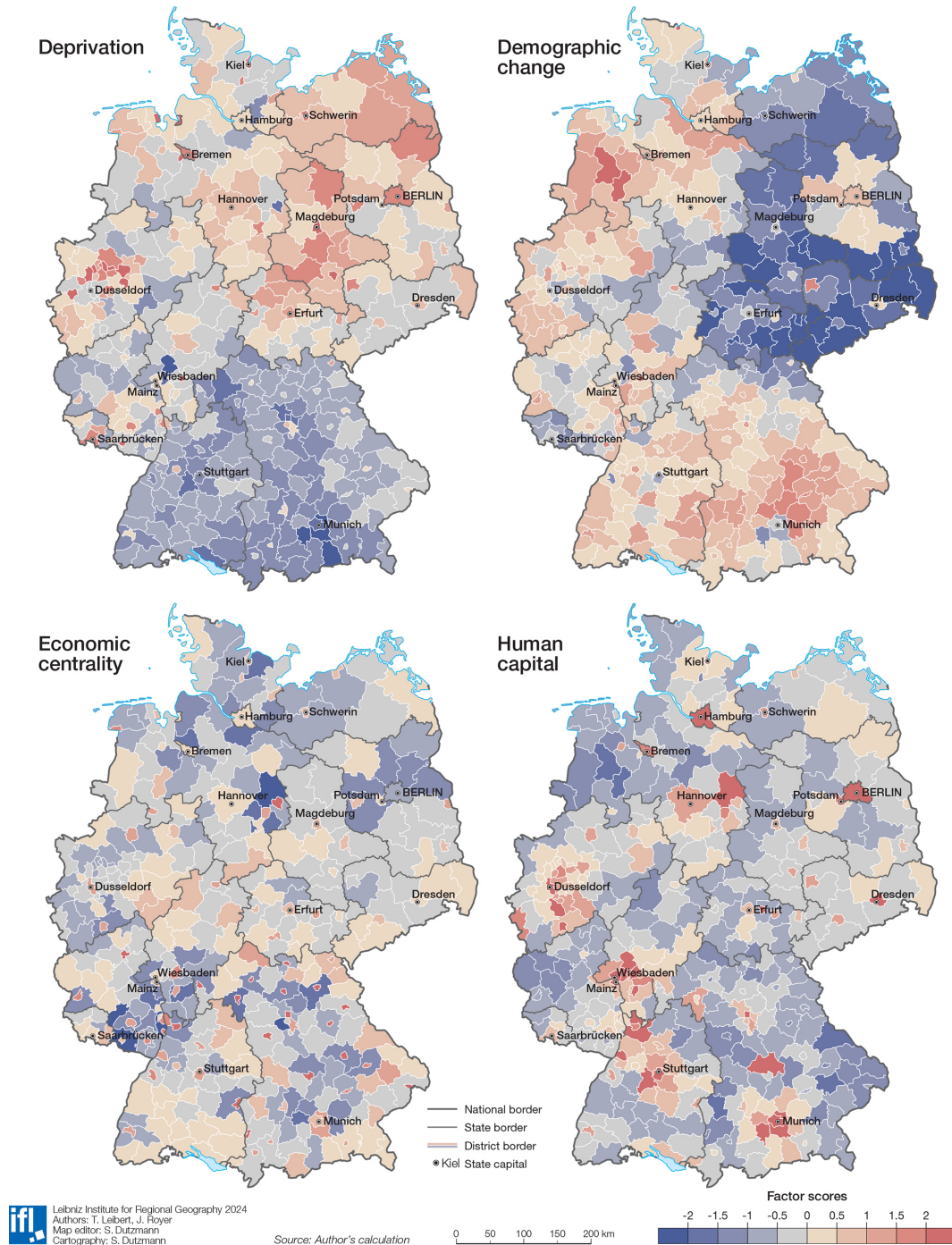


Figure 1. Spatial pattern of the four left behind factors.

5.2 Typology of left behind places

In order to gain a better understanding of how these four different dimensions coincide spatially, a *k*-means cluster analysis was carried out. This resulted in six clusters. The average values of each cluster for the left behind dimensions, their share of the national population, and the share of rural dis-

tricts per cluster are given in Table 4, while their geographies are mapped in Fig. 2.

The first cluster “C1: more deprived urban districts” is characterised by slightly higher levels of human capital, pronounced deprivation, a favourable demographic trajectory, and a certain degree of economic centrality. This cluster encompasses 49 districts, including cities with sizable student

Table 4. Average values of each left behind dimension by cluster (without outliers).

Cluster name	Deprivation	Demographic change	Economic centrality	Human capital	Number of districts*
C1: more deprived urban districts	1.68	0.67	0.25	0.38	49 (8 rural)
C2: prosperous districts with low human capital	-0.47	0.27	-0.01	-0.78	120 (81 rural)
C3: districts affected by demographic shrinkage and ageing	0.46	-1.66	-0.03	-0.27	70 (61 rural)
C4: small economic centres	-0.19	0.61	2.34	-0.39	23 (12 rural)
C5: economically dependent districts	-0.41	0.35	-0.91	0.15	97 (38 rural)
C6: centres of knowledge and innovation	-0.14	0.23	0.45	2.06	33 (1 rural)

* Number of rural districts as defined by BBSR (2018).

populations and older industrial cities undergoing structural change. The majority of districts in this cluster are situated in the northwest, e.g. Bremen, Bielefeld, and cities in the Ruhr area. The cluster also includes cities in Rhineland-Palatinate, the regional district of Saarbrücken, and most of the eastern German cities. According to a discriminant analysis of the outliers, Gelsenkirchen could be assigned to this cluster because of extremely high deprivation scores.

The characteristics of the second cluster “C2: prosperous districts with low human capital” have low human capital, little deprivation, a rather positive demographic development, and limited dependence on economic centres. This is the largest group, containing 120 districts, accounting for 24.5 % of the German population. They are in a relatively favourable socio-economic situation. Most of these districts are rural and located in the west of Germany.

Cluster “C3: districts affected by demographic shrinkage and ageing” contains 70 districts that are characterised by a very unfavourable demographic situation combined with deprivation and very low human capital. These districts are predominantly rural and mostly located in eastern Germany, along the former intra-German border, and in Saarland.

The 23 districts in cluster “C4: small economic centres” have a high economic centrality, combined with a positive demographic development, low deprivation, but also low human capital. These are mostly smaller urban districts located in the south of Germany, representing 2.5 % of the German population. The outliers Schweinfurt (city) and Wolfsburg would be assigned to this category by a discriminant analysis due to their very high economic centrality.

Cluster “C5: economically dependent districts” is more of a suburban cluster, characterised by slightly above-average human capital, low deprivation, slightly positive demographic development, and low economic centrality. These 97 districts have strong links to central cities and are mostly ur-

banised rural districts. The districts of this cluster contain 25.8 % of the population; this is the largest share.

The final cluster “C6: centres of knowledge and innovation”, comprises 33 districts characterised by high human capital, relatively low deprivation, positive economic development, and a certain economic centrality. The majority of these districts are large urban centres, such as Berlin, Cologne, Dresden, and Stuttgart, or important centres of higher education, including Heidelberg, Jena, and Münster. The outliers Gifhorn, Hochtaunuskreis, Munich (city and district), and Starnberg are assigned to this cluster based on their high scores on the human capital dimension. Erlangen is included due to its combination of high economic centrality and high human capital.

6 Discussion

Several authors (e.g. Velthuis et al., 2023a; Proietti et al., 2022; Milbert, 2019; Oberst et al., 2019; Fink et al., 2019) analysed unequal regional developments with different scales, time frames, and methodologies. Our analysis focuses on the national context of Germany, which allows for an understanding of national policy discourses, outcomes, and history, as well as for the consideration of data availability. Moreover, as Milbert (2019) has observed, a significant proportion of similar studies lack a theoretical framework as a starting point. This contrasts with our approach, which employs the concept of peripheralisation as a causal process of left-behindness and thus integrates it into the relational and agency-sensitive understanding of spatially uneven development (Lang, 2015).

The factor analysis resulted in four dimensions of left-behindness: “deprivation”, “demographic change”, “economic centrality”, and “human capital” with a distinct composition and spatial pattern. These dimensions stress the significance of the debate on left behind places as both places

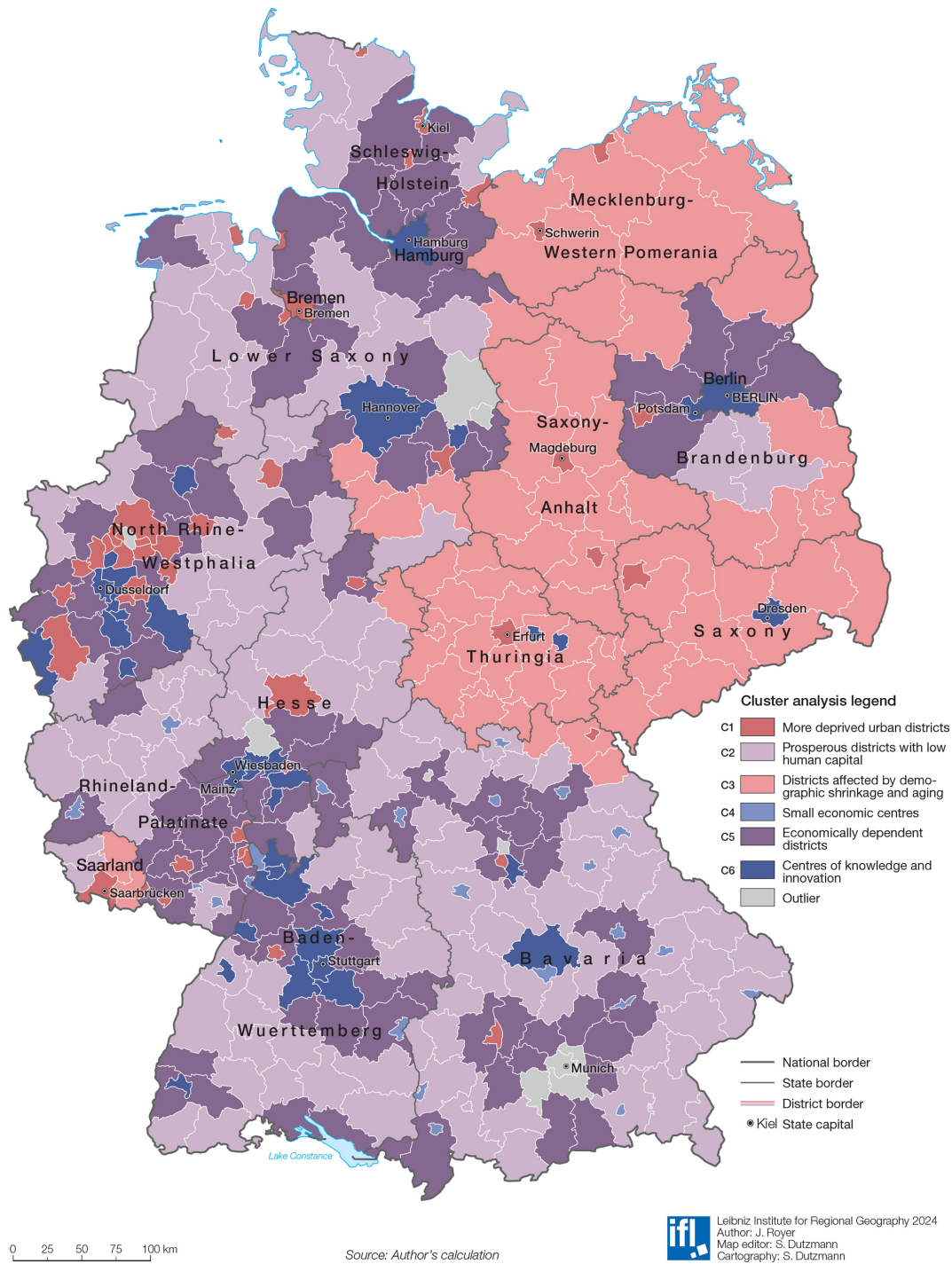


Figure 2. Results of the *k*-means cluster analysis.

with high concentrations of “left behind people” and places that are left behind due to poor transport infrastructure or low economic dynamism. Deprivation is a more individual-level phenomenon, indicating where individuals are left behind. In contrast, demographic change, economic centrality, and human capital are structural aspects of regions, illustrat-

ing where regions are left behind by people, politics, and the economy. The dimensions highlight both central and centralising places, as well as those undergoing peripheralisation or “places becoming left behind”.

There are strong parallels with the dimensions of peripheralisation and the aforementioned factors. Firstly, the factor

“deprivation” resonates with deprivation and disadvantage, which was included based on a review of the literature. The spatial pattern demonstrates elevated factor values in northern and eastern Germany and diminished values in the south. It was argued that this dimension fits into the framework as it relates to an individualised disconnection from society and life opportunities. Furthermore, other authors connected poverty with feelings of economic left-behindness (Deppisch, 2021) and political discontent (Rodríguez-Pose, 2018). Secondly, the factor “demographic change” is associated with the indicators of selective migration. However, these indicators relate more generally to demographic change rather than selective migration, hence, the renaming. Furthermore, both ageing (Dijkstra et al., 2020) and demographic decline (Dvořák and Zouhar, 2023) are linked to discontent and a sense of being left behind. The other dimensions of left-behindness – “economic centrality” and “human capital” – combine indicators of disconnection and dependency. This is partly attributable to the interconnection between certain indicators of dependency and disconnection. For instance, decisions regarding investments or reductions in service infrastructure or employment are typically made in economic and political decision-making centres. In the event of financial cutbacks, this can result in the closure of businesses in less-profitable areas, leading to a greater reliance on central locations for the provision of SGI and employment opportunities. This can also result in a sense of disconnection from political decision-making, which may give rise to feelings of left-behindness due to deficiencies in infrastructure and/or lacking economic opportunities (Deppisch, 2021). Furthermore, the concentration of human capital observed in large cities and metropolitan areas, characterised by above-average service sector employment and innovation, is in contrast to low values in remote and rural districts. This dichotomy between more progressive and innovative metropolitan areas and more conservative and traditional rural regions may give rise to feelings of cultural left-behindness (Deppisch, 2021).

Two of the clusters identified through the *k*-means clustering align with the discussion of left behind places: C1 “more deprived urban districts” and C3 “regions affected by demographic shrinkage and ageing”. Both illustrate that the challenges faced in these districts are connected to more general trends, such as the concentration of poverty in urban areas or ageing and selective migration in rural areas (Fink et al., 2019; Proietti et al., 2022). Many C1 districts are classified by other researchers into similar categories, including “Economic decline and deindustrialisation” (Velthuis et al., 2023a), “Predominantly urban areas with ongoing structural change” (Fink et al., 2019), and “large cities with problems” (Sixtus et al., 2019), aligning well with the Anglo-American discourse. Indicators of deprivation, such as unemployment, youth unemployment, and negative employment change, reflect (personal) disconnection from the economic system. Furthermore, a negative relation with voter turnout shows there is a disconnection between the electorate and the po-

litical system. Both link deprivation with peripheralisation. Some C1 districts are characterised by structural change and difficulties in adapting to the shift towards a service-oriented economy. Despite the general increase in service jobs in Germany, the loss of manufacturing jobs in these districts was not offset by gains in other sectors, resulting in higher unemployment rates among young people (Dauth and Südekum, 2016). This, in turn, contributes to the high deprivation scores observed in these districts. These districts have experienced a loss of importance in comparison to the national (or even international) economic system, becoming more peripheral as a result. This is also reflected in the lower economic centrality of these districts in comparison to the other central districts. Nevertheless, the presence of higher education and research institutions can result in differential outcomes of peripheralisation (Butzin and Flögel, 2024). Such locations frequently exhibit a positive demographic development, as they tend to attract younger individuals seeking education or work experience. This is reflected in the slightly higher human capital, which in turn leads to a certain economic centrality. Additionally, many students with limited or no individual income are registered at their place of study, which skews income statistics and gives the impression of greater deprivation in dynamic cities with a youthful population, despite the support of their parents. This “informal” support is not included in official income statistics, leading to financial challenges due to reduced tax incomes. In other studies, some districts are classified as either “Long-term economic prosperity” (Velthuis et al., 2023a) or “Dynamic large and medium-sized towns/cities with risk of exclusion” (Fink et al., 2019), e.g. Leipzig, Flensburg, and Kiel.

C3 is comprised primarily of rural districts adversely affected by selective out-migration, resulting in an ageing population. This is consistent with the continental European understanding of left-behindness. The factor scores on the four dimensions of left-behindness illustrate the outcomes of peripheralisation. The ageing population; the emigration of young adults, in particular young women (Leibert, 2016); and high deprivation present significant challenges to future regional development. A relative (or absolute) decline in both employment and population, resulting in a reduction in tax income, has a negative impact on the financial stability of communities. This, in turn, leads to a vicious circle of reduced possibilities to invest in retaining the population and job creation (Wolff et al., 2021). This illustrates a dependence on transfer payments and subsidies to maintain existing SGI and employment, which might result in feelings of left-behindness or collective embitterment (Dvořák and Zouhar, 2023; Hannemann et al., 2023). The demographic situation and deprivation result from the legacy of the German Democratic Republic (GDR) and reunification (Enekel and Rosel, 2022; Fink et al., 2019). Many, but not all, C3 districts are in the former GDR territory, while most of the major East German cities belong to C1 or C6 due to a better demographic situation. Furthermore, the lack of employment

opportunities and economic centrality was caused by the collapse of the East German economy in the 1990s, which resulted in mass unemployment. Additionally, policies applied after the reunification focused strongly on industrial production in rural areas, while neglecting innovation in urban areas (Enekel and Rösel, 2022). Cluster C3 is comparable with categories of other studies, including “Demographic decline and ageing” (Velthuis et al., 2023a) and “Predominantly rural areas in permanent structural crisis” (Fink et al., 2019). The latter focusses strongly on east Germany, with the regions of Saarland and southern Lower Saxony being overlooked. This results in an overemphasis on east–west differences.

The four other clusters do not necessarily qualify as left behind, in particular the clusters C4 “small economic centres” and C6 “centres of knowledge and innovation”. These districts reflect the outcomes of centralisation processes. Notably the spatial pattern of C4 comprises small- or medium-sized towns with high economic centrality and is often surrounded by districts with low economic centrality. The majority of these small- or medium-sized towns are located in Bavaria and Rhineland-Palatinate (Hüther et al., 2019). In other regions of Germany, similar-sized cities are incorporated into the surrounding district, thereby balancing out the respective high and low economic dependency scores. This results in the absence of C4 in northern and eastern Germany. The legacy of medium-sized towns constituting districts in their own right in the south demonstrates how our classification is influenced by the way statistical units are constructed, also known as the modifiable areal unit problem (MAUP) (Openshaw and Taylor, 1981). Consequently, it is of the utmost importance to be critical of these results and to conduct a more in-depth analysis in order to gain a deeper understanding of the underlying local causes before designing policies. Nevertheless, these differences also illustrate the importance of small- and medium-sized towns and cities in regional development. However, the agglomeration effect on the rural surroundings of the C6 cities in eastern Germany (with the exception of Berlin) is less pronounced than in the west.

C2 “prosperous districts with low human capital” and C5 “economically dependent districts” are respectively behind on human capital and economic centrality. However, the majority of these districts are classified by Velthuis et al. (2023a) as either “High growth” or as “Relative economic and demographic stability” or are generalised by Fink et al. (2019) to “Germany’s solid middle”. The majority of districts belonging to C2 and C5 are located within commuter belts of C1, C4, or C6, reflecting a high degree of economic dependence. These districts are assumed to be not left behind. It is crucial to recognise that there may be obstacles when economically central districts encounter difficulties in adopting innovation and transitioning to a more future-oriented economy. Nevertheless, a certain degree of dependence may not be inherently problematic, as some of these areas can be seen as positive peripheries (Pugh and Dubois, 2021). Some

of the indicators of human capital and economic centrality are workplace-based measures and are concentrated in certain districts, while other areas are innovation or economic peripheries lacking human capital or economic centrality. Especially the districts in cluster C5 demonstrate that this lack of economic dynamism is not necessarily linked to unfavourable social or labour market outcomes. Both C2 and C5 illustrate the influence of commuting, which provides a connection to other economic systems and markets (C1, C4, and C6). This implies that these districts provide labour and human capital to central districts while receiving wealth in return due to commuting or home office. Nonetheless, some C2 and C5 districts are less connected with the economic centres. Their low values for human capital and economic centrality reflect disconnection from the economic and political centres resulting from peripheralisation (Kühn and Weck, 2013).

7 Conclusions

In conclusion, there is a continuing debate in Germany about the concept of left-behindness, regardless of the federal structure and the strong regional policies. Our findings indicate that both the Anglo-American and the European understandings of left behind places are present in Germany, with deprivation and demographic change as key dimensions. Consequently, we propose that peripheralisation provides a useful framework for analysing the phenomenon of left-behindness, which can be further refined by incorporating indicators of deprivation, leading to the identification of distinct forms of left-behindness. Furthermore, it allows for a framing within international policy and academic debates on regional development.

Furthermore, our findings demonstrate that economic centrality and human capital are crucial elements in the regional typology, leading to a spectrum of districts that may be (or potentially become) left behind depending on their disconnection from economic systems and political decision-making and dependency on decision-making centres and transfer payments and subsidies. The economic dependency and lacking human capital in many suburban and more peripheral districts also highlight the need for further research into the influence of commuting and the potential of home offices on regional development pathways. Furthermore, the results indicate that medium-sized towns can serve as an anchor for regional development. Nevertheless, the centralisation in medium-sized towns can as well lead to losses of central functions in surrounding towns and districts (Kühn and Miltrey, 2015).

Moreover, the concept of peripheralisation is relatively “neutral”, allowing for its application in different national contexts. This provides a solid foundation for international comparisons, as it allows for the selection of appropriate indicators. Additionally, the concept is sufficiently flexible to

encompass the possibility of exiting the status of left behind place or periphery, as well as the potential for territories to be affected by one or several of the dimensions to varying degrees. In addition, peripheralisation occurs on different scales and in a variety of places, i.e. not only in (physical) peripheries but also in more central places undergoing structural changes. Furthermore, it is crucial to recognise that not only left behind places but also peripheralising middle-income districts can get stuck in a regional development trap (Diemer et al., 2022) and that “non-left behind places” can be home to significant populations of left behind, i.e. marginalised, people. Failure to address the specific needs of these areas in a timely manner may result in regional embitterment (Hannemann et al., 2023). Especially against the backdrop that the “Plan for Germany” has not been very visible since the change in government. Our analysis indicates that the implementation of nationwide spatial policies could be beneficial in enhancing spatial cohesion within the country and in mitigating discontent and regional embitterment.

Data availability. The dataset used for this study is available in the Supplement to this article.

Supplement. The supplement related to this article is available online at: <https://doi.org/10.5194/gh-79-221-2024-supplement>.

Author contributions. Both authors were involved in the production of this research paper. TL was responsible for compiling the data and the factor analysis, while JR carried out the clustering analysis. Both authors jointly developed the concept of the paper and interpreted the results of the analyses. JR wrote the manuscript with the support of TL.

Competing interests. The contact author has declared that neither of the authors has any competing interests.

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