# LEFT-BEHIND REGIONS IN THE EUROPEAN UNION

## Conceptualisation – Operationalisation – Classification

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## Abstract

The concept of left-behind places or regions has skyrocketed in recent years and various empirical studies are using the concept to describe (not only) economically lagging regions. Yet, there is still no settled definition and method of measurement of left-behindness in the social sciences.

In the methodological part this working paper presents a plausible conceptualisation and operationalisation of left-behind regions in European Union countries. The operationalization of "left-behindness" is guided by several principles: it is relative to national standards, multidimensional, and both structural and dynamic. Labour market regions are identified as the appropriate spatial unit for analysis. The study uses NUTS3 regions, aggregated for metropolitan areas and adjacent regions, excluding extraterritorial and small countries. A total of 918 regions across 25 countries are analysed using indicators related to economic viability, social structure, and population development from 1993 to 2021.

Our empirical analysis highlights how the nature of "left-behindness" varies across Europe, with a particular focus on Central and Eastern Europe. In these regions, left-behindness is closely tied to regional disadvantages, characterized by low economic prosperity, reduced social status, and higher poverty rates. These areas often experience stagnation or shrinkage, with non-metropolitan regions being particularly affected, possibly due to poorer infrastructure. In other parts of Europe, the different dimensions of left-behindness are less coherently associated and do not form clear spatial patterns. In particular, poverty is spatially decoupled from low economic prosperity in many countries. Overall, we identified macro-regional differences of left-behindness manifestation across Europe, shaped by historical, economic, and social factors unique to each region.


***Keywords:*** left-behind regions; European Union

***JEL-Codes:*** F63, O18, R11, R12


## Kurzfassung

Das Konzept der „abgehängten" Orte oder Regionen hat in den vergangenen Jahren stark an Bedeutung gewonnen, und verschiedene empirische Studien verwenden das Konzept, um (nicht nur) wirtschaftlich rückständige Regionen zu beschreiben. Dennoch gibt es in den Sozialwissenschaften bislang keine einheitliche Definition und Methode zur Messung von „Abgehängtsein".

Im methodischen Teil dieses Thünen Working Papers wird eine neue Konzeptualisierung und Operationalisierung von „abgehängten" Regionen vorgestellt. Die Operationalisierung von „Abgehängtsein" orientiert sich an mehreren Prinzipien: Sie ist relativ zu nationalen Standards, multidimensional und sowohl strukturell als auch dynamisch.

Arbeitsmarktregionen werden als geeignete räumliche Einheit für die Analyse festgelegt. Die Studie verwendet dafür NUTS3-Regionen und aggregiert dabei Großstadtregionen und angrenzende Regionen. Insgesamt 918 Regionen in 25 Ländern werden anhand von Indikatoren für die wirtschaftliche Lebensfähigkeit, die Sozialstruktur und die Bevölkerungsentwicklung von 1993 bis 2021 analysiert.

Unsere empirische Analyse zeigt, wie „Abgehängtsein" in Europa variiert, wobei der Schwerpunkt auf Mittel- und Osteuropa liegt. In diesen Regionen ist „Abgehängtsein" eng mit regionalen Benachteiligungen verbunden, die durch geringen wirtschaftlichen Wohlstand und höhere Armutsraten gekennzeichnet sind. Diese Gebiete sind häufig von Stagnation oder Schrumpfung betroffen, wobei die nicht-metropolitanen Regionen besonders betroffen sind, was möglicherweise auf eine schlechtere Infrastruktur zurückzuführen ist. In anderen Teilen Europas sind die verschiedenen Dimensionen des „Abgehängtseins" weniger kohärent miteinander verbunden und bilden keine klaren räumlichen Muster. Insbesondere Armut ist in vielen Ländern räumlich von einem geringen wirtschaftlichen Wohlstand entkoppelt.

Insgesamt haben wir für Europa regionale Unterschiede in der Ausprägung des „Abgehängtseins“ festgestellt, die durch historische, wirtschaftliche und soziale Faktoren geprägt sind und für jede Region einzigartig sind.

***Schlüsselwörter***: abgehängte Regionen; Europäische Union

***JEL-Codes:*** F63, O18, R11, R12

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# 1 Introduction

The aim of this methodological working paper is to present a plausible conceptualisation and operationalisation of left-behind regions in European countries.

The popularity of the concept of left-behind places or regions has skyrocketed in recent years and a considerable number of empirical studies have emerged using the term to describe (not only) economically lagging regions. A concept experiencing a surge in popularity cannot be expected to have a settled definition and method of measurement in the social sciences. At the same time, however, if references to being left-behind are more than a metaphor, it makes sense to strive for a concise way of capturing left-behind regions in reality so that their identification matches the complexity of the concept and allows for a thorough description.

This study presents a novel approach to measuring regions that are left behind. The approach´s key advantages are that it fully incorporates the multidimensional, relative, and contrastive aspects of the concept of "left behind places", as well as a combination of structural and dynamic elements. At the same time, it aims to establish transparent dimensions of "left behindness" that summarise the most crucial aspects of potential regional disadvantage.

This method has allowed us not only to classify European regions according to a uniform methodology, but also to describe how the nature of left-behindness differs from one another in different parts of Europe. One important finding is the specificities of the countries of Central and Eastern Europe. The situation in Central and Eastern Europe aligns most closely with the concept of left-behindness as a regional disadvantage composed of several interrelated dimensions that capture mutually reinforcing aspects of limited opportunities and wealth. In left-behind central and east European regions, low economic prosperity is strongly associated with lower socio-economic status of the population and higher poverty rates. As a rule, economically left-behind regions exhibit low growth, stagnation or shrinkage. Left-behindness is primarily concentrated in non-metropolitan areas, potentially indicating poorer infrastructure provision. This link between the different aspects of left-behindness is not so well evident in other parts of Europe.

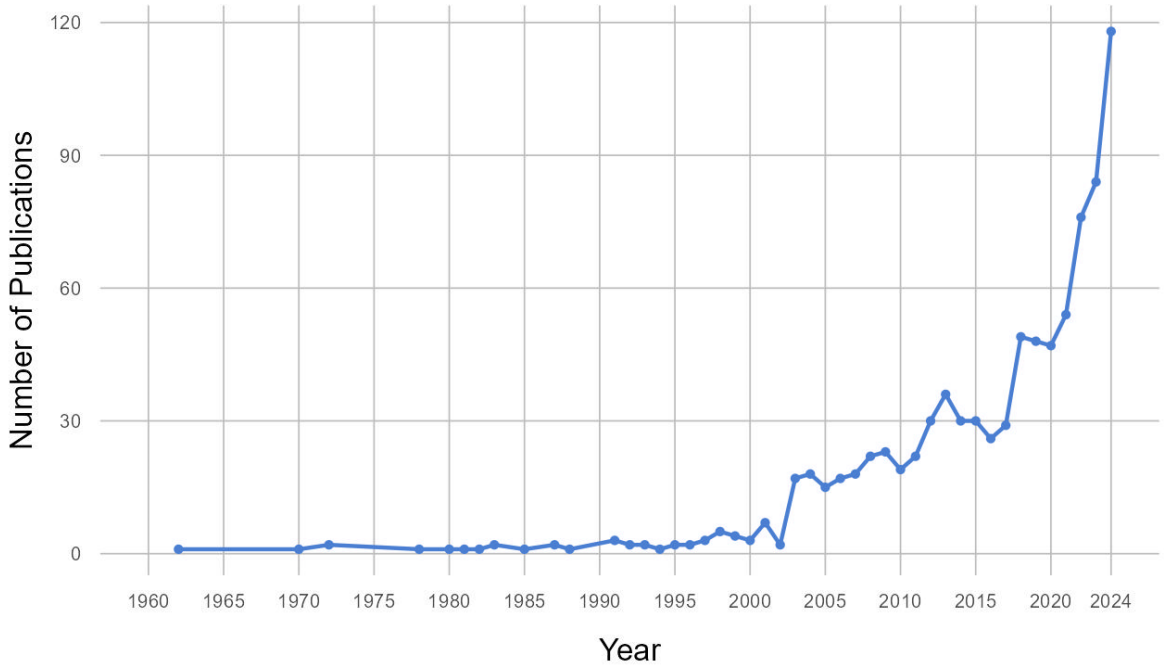
The vast majority of studies on left-behind places have so far avoided Central and Eastern European regions. Our results can therefore also be read as a call for more attention to the situation of left-behind places in post-communist countries.

## 2 Background: Approaches to measure left-behind places

In the last few years, the notion of left behind places or regions has established itself as one of the central concepts for research on spatial inequalities. In addition to a wide range of empirical studies that use the term to refer to differently disadvantaged areas, a number of review papers have recently summarised the use, varieties and etymologies of the concept (Fiorentino et al. 2024; MacKinnon et al. 2024; Pike et al. 2023), thus contributing to fixing its position in the scientific discourse, although not always unifying the perspective on what the term exactly means and where its boundaries are.

A key aspect of viewing regions through the prism of left-behindness is the focus on the living conditions and opportunities of the inhabitants (Fiorentino et al. 2024). An interesting point of the term left-behind is the urgency and appeal associated with its use. The designation of a place as left-behind is not a neutral, purely scientific description, but it is value laden and includes evaluative connotations. It places a specific regional situation into normative coordinates, implicitly raising questions about responsibility, morality and desirability – and opening up space for potential disputes over these normative foundations (Pike et al. 2023). At the same time, the term left behind place lacks a clear uniform definition and may be used to include different perspectives on what are the central features of left behindness (Deppisch 2021; MacKinnon et al. 2024). This perhaps contributes to the growing popularity of the concept of left-behind places since its first use in rural poverty research in the early 1970s (Pike et al. 2023:1170; see also Figure 1).

**Figure 1: Scopus search results for "left-behind" AND "places" in title, abstract, and keywords (1970–2025)**




Source: www.scopus.com, advanced search for TITLE-ABS-KEY (left-behind AND places) AND (LIMIT-TO (SUBJAREA, "EART") OR LIMIT-TO (SUBJAREA, "SOCI") OR LIMIT-TO (SUBJAREA, "ECON")); own depiction.

Seminal texts on left-behind places derive left-behindness from economic underperformance (Rodríguez-Pose 2018), arguing that the economic performance of regions, measured in terms of gross domestic product (GDP) per capita, and its changes over time reflect fittingly the wealth and life prospects of regional residents. McCann

(2019) makes this explicit by stating that "measures such as GDP per capita […] are the best proxy for a range of different issues, including the level of wages, opportunities for high value employment and career progression, opportunities for business investment, entrepreneurship and innovation" (McCann 2019: 258). However, more recent articles emphasize that capturing the concept of left behindness calls for a "relational, multidimensional, and multi-scalar approach" (Pike et al. 2023: 1177). The economic aspect forms only one, albeit important, part of the conditions and opportunities that regions provide for their inhabitants.

## 2.1 Characteristics of the concept

Above mentioned review papers on left-behind places agree on the following characteristics of the concept:

**1) Explicit multidimensionality**

There is a broad array of potentially identifying features of left-behind places, like: economic under-performance and/or decline, lower levels of educational qualifications and skills; increased levels of poverty and disadvantage; out-migration, ageing and population shrinkage; reduced service provision; lack of civic assets and community facilities; or even poor health (Velthuis et al. 2023). Comim et al. (2024) classify the existing approaches to conceptualise left-behind places into four categories with different focus on multidimensionality: 1.) "Econcore" includes conceptualisations relying on GDP, gross value added (GVA) and unemployment. 2.) "Econwider" maintains an emphasis on economic prosperity, but sees it more broadly, inclusive skills, education and employment prospects. 3.) "Left-behind" is broader and characterises disadvantaged areas based on a variety of multidimensional criteria, including, e.g., infrastructure, demographic and cultural influences, or health. Finally, 4.) "geodiscontent" approaches address subjective conditions of negative regional well-being with particular emphasis on political discontent and dissatisfaction.

**2) Relationality**

Left behind places are disadvantaged because their structural conditions and development trajectories fall short of and can be contrasted against an expected standard level, which is usually understood as the national average. Indeed, the literature on regional left-behindness originated as a description of sub-national spatial inequalities and assumes that it makes sense to measure the situation of regions within a country against each other (Rodríguez-Pose 2018). This has serious implications for the conceptualization of left-behind places, because conditions in a particular region cannot be described as left behind in themselves, but only in contrast to other regions. Thus, poor and rich countries alike have their left-behind places which fall behind the average country-level of prosperity. Even in countries that are growing in population as a whole, there are demographic left-behind places whose population growth does not reach the level of the others or is even declining.

**3) Cross-sectional and dynamic nature**

Since the beginning of the rise in popularity of the term left-behind places, the whole concept has been used in two ways – as a label for regions that are poorer or structurally disadvantaged compared to others, and for regions whose development trajectory is lagging behind – for example, they have lower economic growth, are losing population, have worse income dynamics. Within the 'geography of discontent', there is a lively debate about whether it is the cross-cutting or dynamic characteristics of regions that are among the dominant triggers of discontent, increasing support for populist parties (e.g., Dijkstra et al. 2020; Lenzi and Perucca 2021). According to Rodríguez-Pose´s classic argument, the driver of discontent is the "long-term economic decline of places that have seen far better times" (Rodríguez-Pose 2020: 1). This can be contrasted against studies relating left-behindness, e.g., to rurality arguing that rural regions are traditionally economically subordinated to cities, and many of them are chronically poor (Ulrich-Schad and Duncan 2018). In any case, much of the research on left-behind places emphasizes both low dynamics or shrinkage, as well as substandard economic opportunities and social amenities compared to other areas.

**4) Multiscalarity**

The concept of left behind place, or left behind region, does not explicitly prefer one spatial scale to which this conceptualization corresponds (Fiorentino et al. 2024). In contrast to research, e.g., on neighbourhood effects which focuses usually on the immediate surrounding of one´s residence, the literature on left-behind places generally uses larger spatial units. Given the explicit multidimensionality of the concept, the clear dominance of one spatial scale does not make good sense. However, the strong emphasis on the economic aspects of the region somewhat pushes to the fore spatial scales that correspond to spatial labour markets or "regional opportunity structures" (Bernard et al. 2023) that create economic and job opportunities.

## 2.2 Operationalisation of the concept

The definitional expansiveness of the concept left-behind places/region leads authors of empirical studies to adopt diverse methods of operationalization. A systematic review of how to identify left-behind places or measures of "left behindness" has not yet been conducted. Here, we provide a brief overview of several different approaches to operationalization found in the literature. These methods vary in terms of the input indicators used, the analytical approaches taken, and the choice of spatial scale. Table 1 summarises the operationalisation choices in twelve recent empirical papers dealing left-behind places.

**Table 1: Operationalisation of left behind places in recent papers with European focus**

| Paper | Geographical reference | INDICATORS OF LEFT-BEHINDNESS | | | | | Spatial scale | Application method |
|---|---|---|---|---|---|---|---|---|
| | | Economic | Demographic | Social structure | Infrastructure[1] | Attitudes | | |
| Gordon 2018 | EU | • industrial employment change (D)[2]<br>• total employment change (C) | | • mean labour market position (C) | • urban population (C) | • populist attitudes mean (C) | • NUTS2<br>• NUTS1 | separate variables |
| Dijkstra et al. 2019 | EU | • GDP per capita growth (D)<br>• industrial employment change (D)<br>• total employment change (D) | • population change (D) | | | | • NUTS3 | single dimension |
| Koeppen et al. 2021 | EU | • GDP per capita level, unemployment | | | | | • NUTS2<br>• NUTS | separate variables |
| DiMatteo and Mariotti 2021 | Italy | • GDP per capita growth (D)<br>• employment rate | • population density change (D)<br>• ageing (C) | | | | • municipality | separate variables |
| Greve et al. 2023 | Germany | • long term income rank (D) | | | | | • NUTS3 | single variable |
| McKay et al. 2024 | DE, ES, FR, HR, UK | | | • Income (C) | • Rurality (C)<br>• distance from Capital (C) | | • postcode<br>• NUTS3 | separate variables |
| Rodríguez-Pose et al. 2023 | EU, US | • GDP per capita growth & level (D) (C) | | • interpersonal inequality (C) | | | • NUTS3<br>• County | separate variables |

| Paper | Geographical reference | INDICATORS OF LEFT-BEHINDNESS | | | | | Spatial scale | Application method |
|---|---|---|---|---|---|---|---|---|
| | | Economic | Demographic | Social structure | Infrastructure[1] | Attitudes | | |
| Velthuis et al. 2023 | 15 Western European countries | • GDP per capita growth & level (D) (C)<br>• industrial employment change (D)<br>• total employment change (D) | • population change (D)<br>• migration rate (D)<br>• youth migration rate (D)<br>• ageing | • poverty (C) | • supermarket access (C) | | • NUTS3 | exploratory cluster analysis |
| Vasilopulou and Talving 2024 | EU | • GDP per capita growth & level (D) (C) | | | | | • NUTS1<br>• NUTS2 | separate variables |
| Rodríguez-Pose et al. 2024 | EU | • GDP per capita growth (D)<br>• total employment change (D)<br>• productivity growth (D) | | | | | • NUTS3 | single dimension |
| Connor et al. 2024 | US | • Income (C)<br>• Unemployment (C) | | • Poverty (C)<br>• Education (C) | | | • neighbourhood | single dimension |
| Paeth and Vogel 2024 | EU | • GDP per capita growth & level (D) (C) | • median age (C) | | • access to services of general interest (C) | | • NUTS3 | separate variables |

[1] = Urbanisation or rurality-related indicators are regarded proxies for Infrastructure access. Access to services and infrastructures varies across rural areas, but the argument on an urban-rural divide in access is plausible.

[2] = (D) stands for dynamic indicators, (C) for cross-sectional indicators

Source: own compilation.

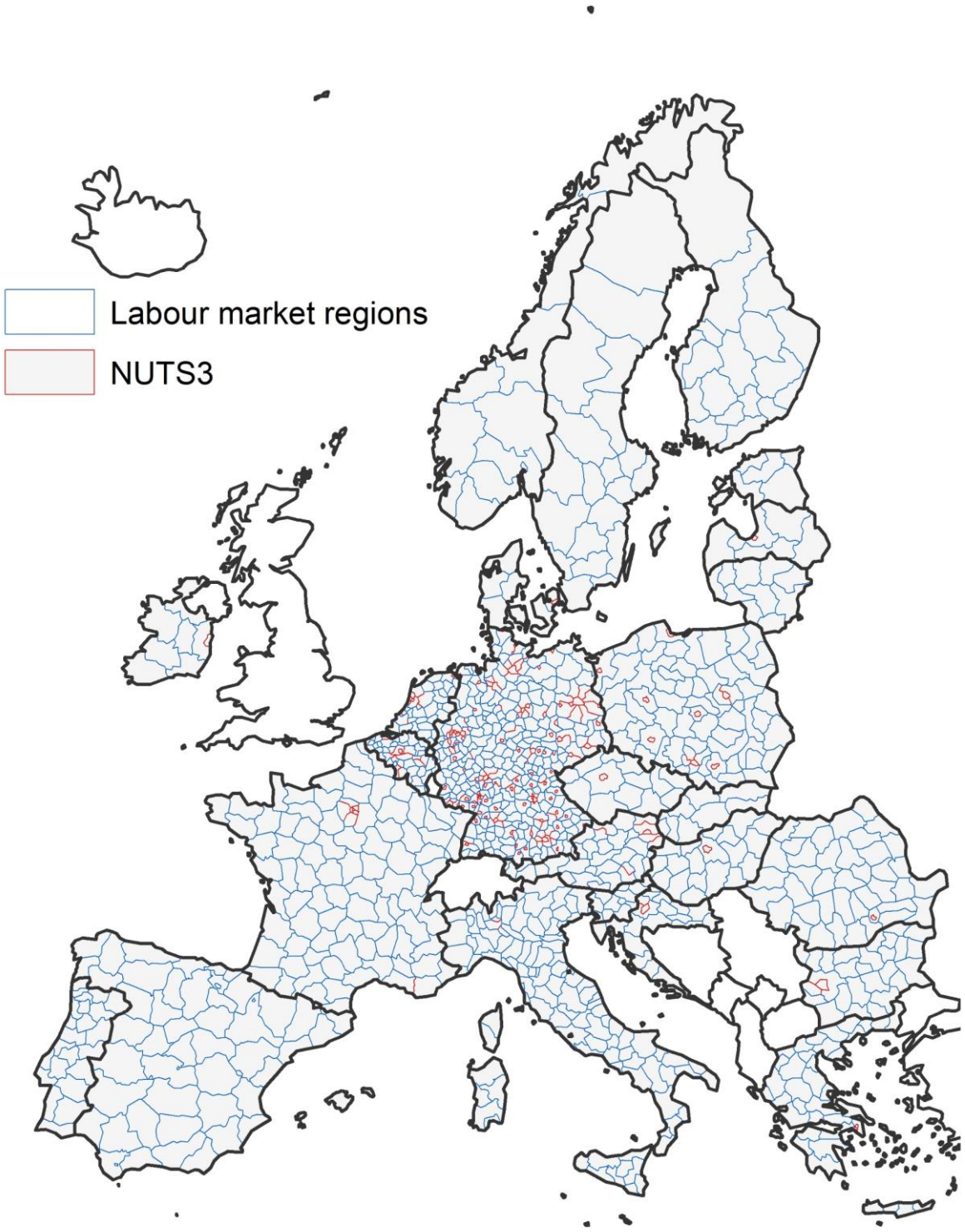
Table 1 shows quite convincingly the strong dominance of indicators related to regional economic performance and economic growth. The emphasis on the challenging economic changes induced by deindustrialisation in Western countries also leads many authors to include the industrial employment share indicator. Economic indicators are almost universally part of the operationalization of left-behindness. Although review articles uniformly emphasize the explicit multidimensionality of the concept, only a minority of empirical studies also use indicators related to demographic change, social structure or social disadvantage (e.g., poverty, education) in regions. Even less used are indicators in the area of infrastructure and amenities (e.g., provision of basic goods). Some papers generally work with the rurality of a region as a proxy for problematic amenities. Gordon`s 2018 paper additionally constructs an attitudinal characterization of European regions using several attitudinal statements taken from European Social Survey (ESS) data.

The most commonly used spatial scales in European countries are NUTS2 and NUTS3 regions. Working at the NUTS3 level allows for a much more detailed geographic view, but is limited by the relatively small number of indicators available for NUTS3 regions and by the fact that their size varies considerably across European countries (see Figure 2 and Figure 3). Unique studies using even more detailed spatial disaggregation at the level of municipalities or neighbourhoods lack an internationally comparative character because such detailed data are usually only available for individual countries or for regions within a country.

Most empirical studies work with regional indicators as individual variables that are not aggregated in any way and use them as exogenous factors in regression analyses. A much less common approach is to aggregate input indicators into a single dimension, for example in the form of the average ranking of regions in each indicator (Connor et al. 2024). A different approach is taken by Velthuis et al. (2023), using cluster analysis based on a series of input indicators to exploratively identify different types of disadvantaged regions.

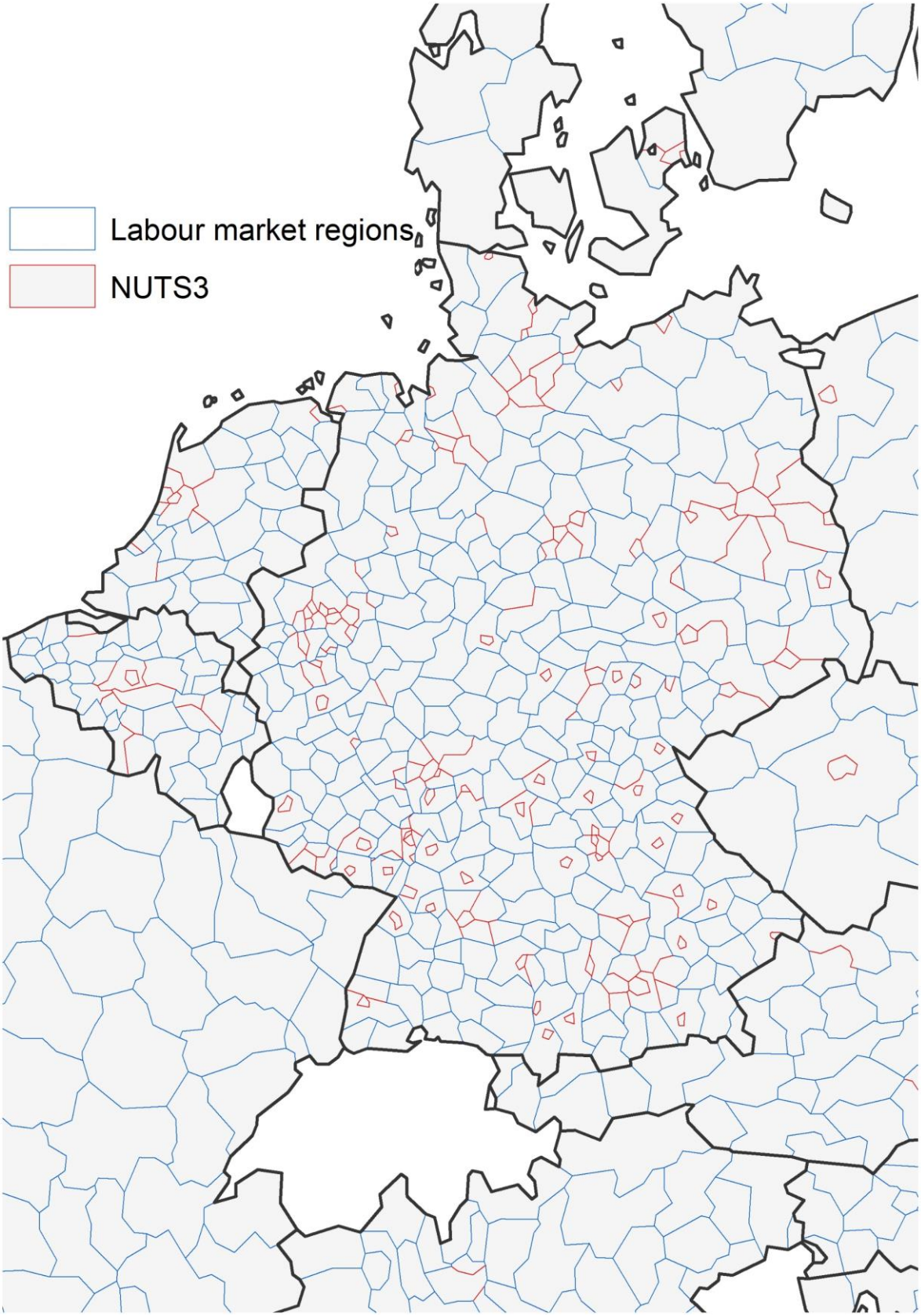
These different analytical approaches have their strengths and weaknesses. The use of separate variables fully accounts for the multidimensionality of left behindness, but fails in its attempt to offer a well-interpretable picture of the main spatial structures of left behindness. Moreover, it exposes itself to a risk of multicollinearity of the input variables, in which there are usually highly intercorrelated clusters. Approaches that construct a single resulting dimension of left-behindness provide a much clearer interpretation of spatial structures, but at the cost of neglecting multidimensionality. They link into a single dimension not only indicators whose distributions are correlated, but also variables that have quite specific spatial patterns and whose spatial distribution is governed by different mechanisms. Exploratory cluster analysis (Velthuis et al. 2023) circumvents these difficulties. However, its results are heavily dependent on a number of arbitrary decisions. In particular, the choice of the resulting number of clusters can greatly affect the classification results, as well as the different size and delineation of NUTS3 regions in different countries.

**Figure 2: NUTS3 and Labour market regions in the European Union**




Source: own depiction.

**Figure 3: NUTS3 and Labour market regions – detail of Germany**




Source: own depiction.

# 3 Basic Principles and Methodological Choices

In this working paper, we describe a way of operationalizing left-behind regions that uses a theoretical conceptualization of left-behindness as a relative, multidimensional, structural and dynamic regional disadvantage that negatively affects the opportunities and well-being of residents. Its key components include regional economies generating employment opportunities, income and well-being. It impacts on the social status and financial security of the population and is reflected in population changes in the region. The operationalisation used here overcomes some of the shortcomings of the above approaches: 1) It preserves multidimensionality without producing a cluttered picture fragmented into a multiplicity of highly intercorrelated dimensions. 2) It is based on spatial scale, which is close to the concept of labour market regions[1] and is roughly equivalent across countries, yet significantly more detailed than NUTS2. The areas are primarily based on NUTS3, which are aggregated into larger units where justified. 3) It uses, among others, variables that are not commonly available and have been constructed from data from national statistical offices.

There are the following guiding principles of the operationalisation:

- Left-behindness is **relative** in terms of relation to the "national standard".
- Left-behindness is **multidimensional**. It can be expressed as a spatial universe with a few dimensions that capture the main aspects of regional disadvantage. These dimensions are not fully independent of each other. Instead, they are related, overlapping and mutually conditioning in space.
- Left-behindness is both **structural** (conditions here and now are worse than elsewhere) and **dynamic** (the development trajectory is lagging).
- Labour market regions represent an appropriate trade-off measure for identifying left behind places because regional economies generate opportunities and wealth through regional labour markets.

[1] Consisting of a centre and the corresponding commuting zone, thus representing a relatively closed labour market in terms of demand a supply relations.

# 4 Operationalisation

## 4.1 Identification of labour market regions

- We primarily use data for the NUTS3 regions in the current (2021) version.
- We aggregate together all NUTS3 regions that compose one "metropolitan region" according to Eurostat[2], because metropolitan regions are intentionally composed as labour market regions of bigger cities, including their commuter belts.
- In a final step, we aggregate all regions which are fully surrounded by another NUTS3 with their surrounding regions. This particularly affects the regional classification in Germany, where the NUTS3 classification as a rule separates cities ("Kreisfreie Städte") from their hinterland.
- We exclude all extraterritorial regions (France, Spain, Portugal) due to the fundamentally different conditions of socio-economic development in some remote overseas area. We also exclude countries with less than 3 regions (Luxembourg, Malta, Cyprus), for which inter-regional inequality can hardly be measured. All remaining countries have at least 5 regions.
- In the remaining data set, there are 918 regions divided into 25 countries, as displayed in Figure 2 for whole EU, and in Figure 3 for Central Europe in detail.

## 4.2 Selection of indicators

We pre-selected indicators related to the various domains of left behindness – economic situation, social structure, population, and their development (see Table 2). For dynamic indicators of development, we use a long period – ranging from 1993 (1995) to 2021 (2019) for most variables. We omitted indicators related to infrastructure and accessibility due to lack of recent comparable data.

1. Economic indicators (indicator of labour market viability and the resulting economic opportunities)
   - GDP per capita (measured in Purchasing Power Standard (PPS)), 2021[3]
   - Share of jobs in the most dynamically evolving sector (Business and financial services), 2019[4]
   - Unemployment rate, 2021[5]
   - GDP gross change, 1993–2021[6]

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[2] The metropolitan typology is applied at the level of NUTS level 3 regions and identifies metropolitan regions in the European Union (EU). These regions are defined as urban agglomerations (NUTS level 3 regions or groups of NUTS level 3 regions) where at least 50% of the population lives inside a functional urban area (FUA) that is composed of at least 250 000 inhabitants.

[3] GDP per capita in PPS is used to indicate the overall level of economic development of a region. As Iammarino et al. (2019) put it: "GDP per head for the economy of any given country, region or city-region is a good indicator of many of its key characteristics. Economies at similar income levels often share many structural attributes, including education levels, science and technology endowments, infrastructure and institutional quality." Source: ARDECO.

[4] Business and financial services can be regarded a very advanced part of the services sector, with particularly high pay, requiring advanced skills. High shares of business and financial services jobs are typical for core and metropolitan areas. Source: ARDECO.

[5] Unemployment rate refers on one hand to increased poverty levels, as unemployed persons are usually in high poverty risk (Gallie et al. 2003). On the other hand, it measures poor access to labour market opportunities. Source: National statistical offices. The exact calculation varies across countries.

[6] Long-term GDP growth indicates the dynamic aspect of the local economy development, differentiating between economically growing, stagnating and shrinking regions. Source: ARDECO.

- Employment change, 1995–2021[7]

2. Social structure indicators
   - Tertiary education, 2021[8]
   - Low education (at most ISCED2), 2021[9]
   - Poverty (AROPE indicator, NUTS2 level), 2021[10]
3. Population development
   - Population change, 1993–2021[11]
   - Share of youth, 2021[12]
   - Share of seniors, 2021[13]

**Table 2: Overview of indicators used**

| 1. Economic indicators | 2. Social structure indicators | 3. Population development |
|---|---|---|
| GDP per capita PPS | Tertiary education | **Population change (1993–2021)** |
| Share of jobs in the most dynamically evolving sector (Business and financial services) | Low education (at most ISCED2) | Share of youth |
| Unemployment rate | Poverty (AROPE indicator, NUTS2 level) | Share of seniors |
| **GDP real growth (1993–2021)** | | |
| **Employment change (1995–2021)** | | |

**bold** = dynamic indicators

Source: own compilation.

[7] Long-term change of the number of jobs in a region indicates the general dynamics of viability of the regional labour market. It stands for the number of employment opportunities in a region. Source: ARDECO.

[8] In most EU countries, tertiary education is becoming the norm. Tertiary education is a typical middle-class feature. Regions with low shares of inhabitants with tertiary education thus fall short in capturing the trend of educational increase. It is also related with lower labour market opportunities for highly skilled people and lower attractiveness for the middle class and less human capital. Source: National statistical offices. The exact calculation varies across countries.

[9] Very low education is a clear risk factor of poverty. It can be also considered a proxy for low social mobility (see Pike et al. 2023), and indicates low human capital. Source: National statistical offices. The exact calculation varies across countries.

[10] AROPE (At Risk Of Poverty and Social Exclusion) is the basic EU poverty indicator, used to measure the extent of regional and nation-wide poverty. It is based on the combination of income poverty rate, material and social deprivation, and low work intensity. It has significant shortcomings for cross-national comparisons, because of its relative nature – income poverty is measured as related to the national median. Thus, in very poor, low-income countries, the extent of income poverty can be actually low. However, it can be well used to measure the intra-country regional variation in poverty levels. The data is published for NUTS2 regions. Source: Eurostat.

[11] Population change is an important indicator, serving as a proxy for the general residential attractiveness of a region. Source: Eurostat.

[12] Above-average share of the young population (younger than 15) indicates a regional population with limited ageing issues and low outmigration of the youth. Source: Eurostat.

[13] Share of inhabitants older than 65 as a complementary indicator to share of the youth. Source: Eurostat.

## 4.3 Data collection and relativization

There are two main data sources: Eurostat for variables related to population development, and ARDECO[14] for a majority of the economic variables. Unemployment, educational and occupational structure data were taken individually from national statistical offices. The poverty indicator AROPE (At risk of poverty or social exclusion) is taken from Eurostat and relates to NUTS2 regions, as there are no cross-country comparable poverty indicators at lower spatial scales.[15]

For some countries, some of the data are not available, or not available for all regions. We decided to impute missing educational data for regions with missing values in those countries, where some regions have data available and some not (Germany, Spain). The imputation was based on predictions using the other available data in the country. Educational data were imputed for 108 German regions and 3 Spanish regions.

All variables were relativised according to national values. For cross-sectional variables relativised values are expressed in terms of percentage of the national values. For dynamic indicators of change, relativised values are expressed in terms of standard deviations from national values. National values are either derived directly, or expressed as population weighted mean of the regional data.[16]

## 4.4 Dimensionality analysis

Inspired by previous work on the spatial structures of peripheral regions (Tagai et al. 2018) and disadvantaged regions (Bernard and Keim-Klärner 2023), we first explored the statistical relationships within the cross-country data set using exploratory factor analysis with varimax rotation. Regions have been weighted so that each country contributes the same weight in the analysis (countries with more regions have lower weights, countries with less regions higher weights). The results indicated preliminarily the existence of three factors – see the rotated component matrix in Table 3:

[14] https://urban.jrc.ec.europa.eu/ardeco/explorer?lng=en

[15] The higher level of regional aggregation of AROPE leads to the fact that in the resulting map (see Figure 12) the dimensions of social exclusion form significantly more concentrated spatial structures than the other dimensions. This needs to be taken into account when interpreting spatial patterns.

[16] If the values of an indicator differ systematically between more and less populated regions, the relativization procedure can result in most regions being below/above 100 (or below/above 0 in case of dynamic indicators). Typically, this is the case, e.g., for GDP figures, where large metropolitan areas tend to have significantly above average GDP values. The vast majority of other regions will then have a value below 100.

**Table 3: Exploratory factor analysis of indicators of left-behindness**

| Rotated Component Matrix | | | |
|---|---|---|---|
| | Component | | |
| | 1 | 2 | 3 |
| GDP per capita PPS logged 2021 | .245 | **.701** | -.418 |
| Share of jobs in B&F services 2019 | .301 | **.840** | -.104 |
| Low education 2021 | .011 | **-.811** | .191 |
| Tertiary education 2021 | .248 | **.891** | -.081 |
| Share of seniors 2021 | **-.904** | -.100 | -.124 |
| Share of youth 2021 | **.859** | .004 | .044 |
| GDP real growth 1993–2021 | **.589** | .301 | -.414 |
| Employment change 1995–2021 | **.708** | .353 | -.252 |
| Population change 1993–2021 | **.807** | .294 | -.187 |
| Unemployment 2021 | -.072 | -.094 | **.895** |
| Poverty AROPE 2021 (NUTS2) | -.012 | -.274 | **.838** |

Extraction Method: Principal Component Analysis / Rotation Method: Varimax with Kaiser Normalization / **bold** = factor loadings above 0,5 or below -0.5.

Source: own compilation.

In a second step, we performed a Pearson correlation analysis to control for the strength of associations between variables which fall within one factor in the exploratory factor analysis. The results revealed bivariate correlations coefficients above 0.5 or below -0.5 within all factors, with the exception of seniors share and youth share with the other dynamic indicators – see Table 4. The mutual combinations of variables falling into one factor are color-coded.

**Table 4: Bivariate Pearson correlations between left-behindness indicators**

| | Share of jobs in B&F services 2021 | Low education 2021 | Tertiary education 2021 | Share of seniors 2021 | Share of youth 2021 | GDP fixed change 1993–2021 | Employment change 1995–2021 | Population change 1993–2021 | Unemployment 2021 | Poverty AROPSE 2021 (NUTS2) |
|---|---|---|---|---|---|---|---|---|---|---|
| GDP per capita logged 2021 | .707** | -.542** | .643** | -.264** | .201** | .545** | .499** | .404** | -.420** | -.501** |
| Share of jobs in B&F services 2019 | | -.542** | .806** | -.329** | .263** | .419** | .514** | .512** | -.198** | -.361** |
| Low education 2021 | | | -.693** | .083* | -.054 | -.323** | -.314** | -.264** | .300** | .341** |
| Tertiary education 2021 | | | | -.307** | .245** | .408** | .460** | .499** | -.223** | -.332** |
| Share of seniors 2021 | | | | | -.772** | -.434** | -.569** | -.686** | 0.004 | -0.033 |
| Share of youth 2021 | | | | | | .370** | .446** | .622** | -.089* | -0.014 |
| GDP fixed change 1993–2021 | | | | | | | .681** | .558** | -.357** | -.318** |
| Employment change 1995–2021 | | | | | | | | .695** | -.240** | -.283** |
| Population change 1993–2021 | | | | | | | | | -.241** | -.285** |
| Unemployment 2021 | | | | | | | | | | .655** |

Source: own compilation and calculation.

In a final step, we decided which indicators to include into which dimension of left-behindness. We used the factor structure form the initial exploratory factor analysis, from which we omitted the both variables related to the age structure, because of their below-average correlation coefficients with the other indicators. Finally, we also decided to omit the low education variable so that the first dimension is not disproportionately affected by the educational structure. The values of the final dimensions were calculated by averaging the values of the individual variables falling into each dimension. These mean composite indices can be interpreted in the following way: In case of dimension "economic prosperity" and "social exclusion": The value reflects the average percentage of the region in the dimension vis-a-vis the national standard. Values above 100 are above average, values below 100 are under average. In case of dimension "relative expansion": The value reflects the standard deviation of the region from the national mean. Positive values are above average, negative values are under average.

The first dimension – **economic prosperity**, is thus based on the current GDP per capita, the share of jobs in business and financial services and the share of highly educated population. All these three indicators point at regions with high economic output, based on skilled workforce and highly financially rewarding jobs – and on the other hand at regions that fail in offering these conditions.

The second dimension – **social exclusion**, relies on two variables – unemployment and the "at risk of poverty and social exclusion rate". It indicates regions under-(over)performing in terms of poverty reduction and social inclusion.

The third dimension – **relative expansion**, is indicated by three underlying dynamic variables – long-term GDP growth, long-term population change, and long-term change in the number of jobs. It thus combines an economic and demographic perspective on the regional development, which proved to be highly inter-correlated. Expanding also tend to have a younger age structure.

For the purpose of representation in maps and an easily manageable classification, the dimensions have been classified into quintiles. We label regions that fall in the most underperforming quintile as left behind, while regions in the best-performing quintile are labelled "leading". In all 25 countries there are 183 left-behind regions

in each dimension. However, due to different levels of spatial polarisation, not each country has the same share of left behind regions. The use of quintiles is an arbitrary decision. It is not our goal to show exactly how many left-behind regions exist. We neither claim that a certain extent of socioeconomic gap fully classifies certain regions as left-behind. Rather, we understand left-behindness as a multitude of quantitative dimensions. Thus, the classification serves for visualization purposes and to allow for a simple description of what characteristics are typical of left-behind regions.

# 5 Description of the resulting classification

To describe the features typical of left-behind regions, Table 5 summarises the average values of the non-relativised input indicators according to the resulting regional classifications. The indicators used to construct the dimensions are supplemented by some additional related variables (grey columns) which provide a more plastic picture of the situation.[17] Due to differences in regional populations, the average values were weighted according to population of each region. The values obtained by this procedure express the characteristics of the three categories of regions as a whole, across all included countries. They take into account that more populated regions have a stronger influence on the characteristics typical of each category.

**Table 5: Description of the situation in left-behind, average, and leading regions in the dimension economic prosperity**

| ECONOMIC PROSPERITY | GDP per capita in PPS logged 2021 | Share of jobs in business and financial services 2019 | Tertiary education 2021 | *Low education 2021* | *Employment in professional occupations (ISCO2) 2021* | *Employment in typical manual occupations (craft, operators, assemblers (ISCO 7&8) 2021* | *Population density (inh/km²) 2021* |
|---|---|---|---|---|---|---|---|
| **Left-behind** | 4.26 | 6.3% | 17.1% | *25.5%* | *13.7%* | *28.2%* | *70.7* |
| **Average** | 4.42 | 12.6% | 22.7% | *25.7%* | *16.4%* | *26.0%* | *145.2* |
| **Leading** | 4.58 | 19.7% | 31.9% | *21.1%* | *23.3%* | *18.7%* | *365.8* |

Source: own compilation.

**Table 6: Description of the situation in left-behind, average, and leading regions in the dimension social exclusion**

| SOCIAL EXCLUSION | unemployment 2021 | Poverty AROPE 2021 (NUTS2) | *Share of employed in elementary occupations (ISCO9) 2021* | *Population density (inh/km²) 2021* |
|---|---|---|---|---|
| **Left-behind** | 11.6% | 30.7% | *11.5%* | *174.2* |
| **Average** | 6.9% | 20.7% | *9.8%* | *159.3* |
| **Leading** | 5.2% | 15.3% | *8.8%* | *219.4* |

Source: own compilation.

[17] Some of these variables are not available for all countries.

**Table 7: Description of the situation in left-behind, average, and leading regions in the dimension relative expansion**

| RELATIVE EXPANSION | GDP real growth 1993–2021 | Employment change 1995–2021 | Population change 1993–2021 | *Share of youth 2021* | *Share of seniors 2021* | *Yearly migration rate 2011–2021 per 1000* | *Change of industrial jobs share 1995–2019* | *Population density (inh/km²) 2021* |
|---|---|---|---|---|---|---|---|---|
| **Left-behind** | 27.9% | -4.6% | -9.5% | *13.6%* | *24.5%* | *-0.2* | *-3.9%* | *97.6* |
| **Average** | 66.8% | 15.0% | 5.1% | *15.0%* | *21.0%* | *1.7* | *-5.1%* | *175.9* |
| **Leading** | 107.3% | 40.9% | 20.5% | *15.5%* | *19.4%* | *4.8* | *-5.4%* | *246.2* |

Source: own compilation.

Table 5, Table 6, and Table 7 show the structural and developmental characteristics of the left-behind, average and leading regions in the aggregate of all 25 countries included in the analysis. Thus, they average significant differences in the socio-economic situation between European countries. Nevertheless, they capture the existence of significant within-country disparities.

Left behind regions in terms of economic prosperity (see Table 5) have significantly below average economic performance, half the share of jobs in B&F services compared to average regions and a third of the share compared to leading regions, as well as a below average share of university education. Several other variables illustrate these specificities in terms of social structure. The very low proportion of professionals is offset by the above-average proportion of employees with manual jobs. However, even in left-behind regions, manual worker occupations with about 28% do not constitute the majority type of employment. Left behind places in terms of low economic prosperity are mostly low-urbanised regions with very below-average population densities. The population density across the EU is about 105 inhabitants per square km. Left behind regions have only about 70. In contrast, leading regions are predominantly urban places, including most of the important metropolitan areas. Of the three dimensions, the economic prosperity dimension most strongly reflects the difference between economic centres and peripheral rural regions.

In left behind regions with high poverty rates, unemployment averages over 10% and the rate of exposure to income poverty as measured by the AROPE indicator is over 30%. Poverty may result not only from high unemployment rates but also from a higher-than-average proportion of the population in routine unskilled jobs. In terms of settlement structure, these regions are not very specific, comprising both rural and urban areas.

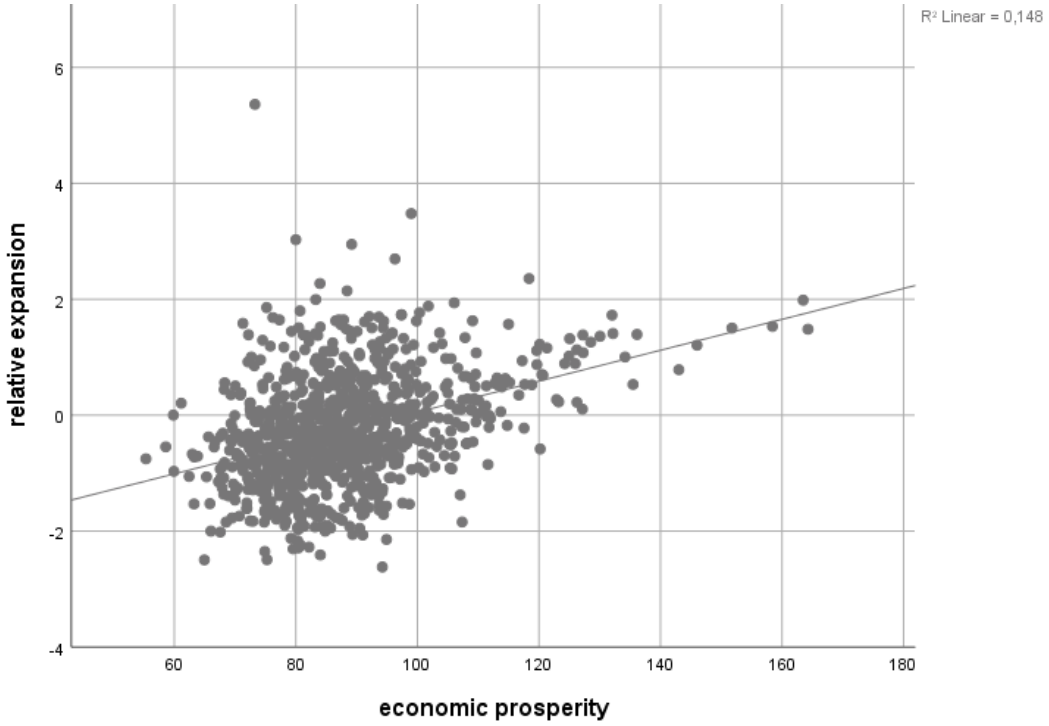
Regions left behind in the dimension of relative expansion achieved only about 28% of real GDP growth in the period 1993–2021, lost almost 5% of jobs and 10% of population. This is reflected in a relatively lower share of young people under 15, and conversely a high share of seniors over 65 (about 25%). They have experienced a negative migration balance over the past decade. However, their challenging dynamics is on average not due to deindustrialisation. Rather, the opposite is true. In the 24 years from 1995 to 2019, the share of jobs in industry has fallen by around 4% in left-behind regions, while in the leading regions, i.e., high-growth, this loss of industrial importance in the labour market is much higher. Similar to left-behind regions in terms of economic prosperity, these are significantly less densely populated rural regions.

The different dimensions of left-behindness have different value range in different countries. In countries with more pronounced regional polarisation the dimensions have a more extensive range and vice versa. This leads to identify a higher proportion of left-behind (or leading regions) in some countries and a lower proportion in others. In some countries, some dimensions indicate no left-behind region (for economic prosperity it is the case

of Belgium, Denmark, the Netherlands, Norway and Slovakia; for social exclusion Denmark and Ireland; for expansion Norway). Figures 13, 14, and 15 in Annex display the spatial distribution of the three left-behindness dimensions across Europe.

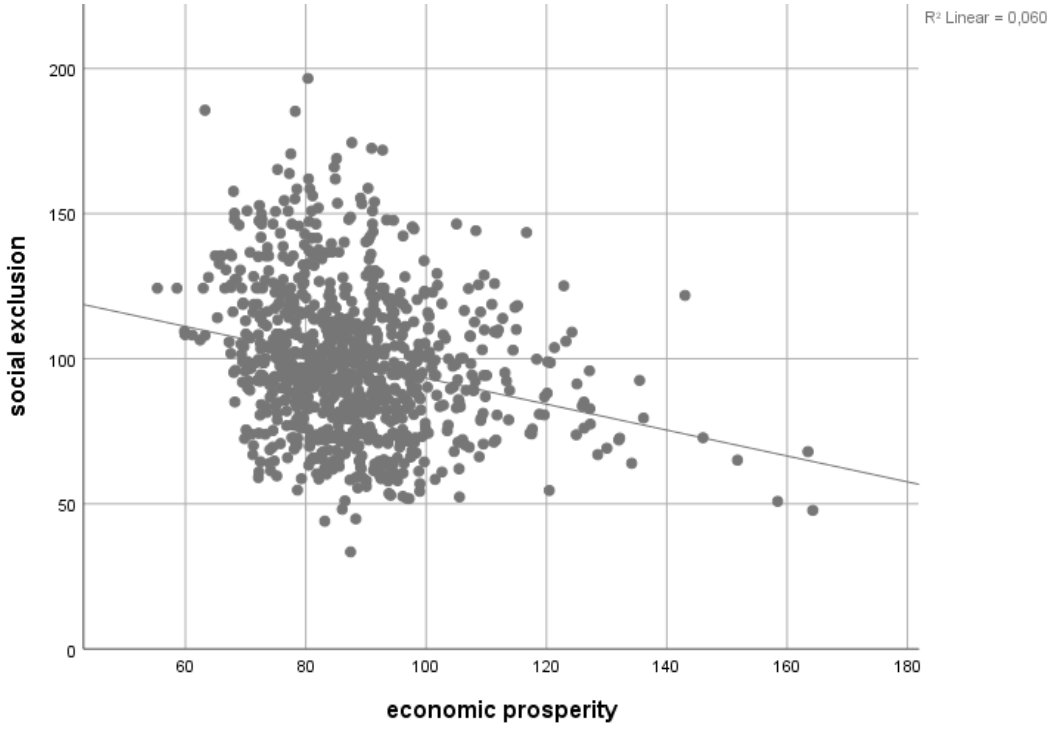
The dimensions of left-behindness are not independent of each other. The scatterplots in Figure 4, Figure 5, and Figure 6 show their interrelationship. Economic prosperity is closely associated with relative expansion, suggesting that the most relatively prosperous regions have simultaneously experienced mostly significant economic and population growth in recent decades. In contrast, social exclusion and poverty are negatively correlated to both prosperity and growth.

**Figure 4: Association between economic prosperity and relative expansion**



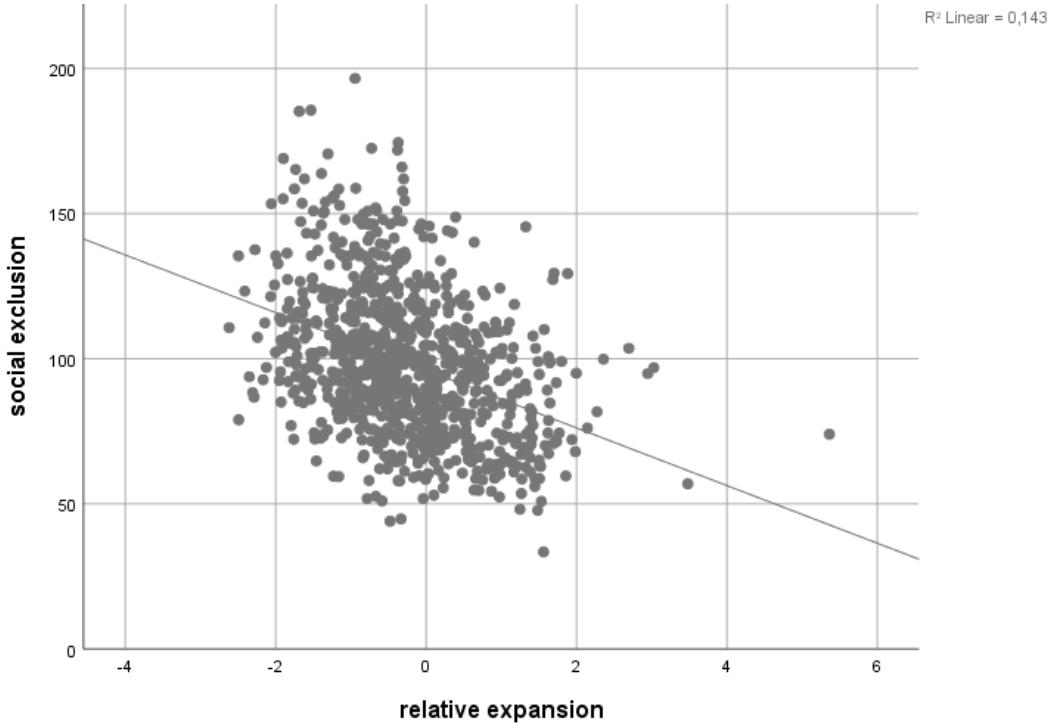

Source: own calculation.

**Figure 5: Association between economic prosperity and social exclusion**




Source: own calculation.

**Figure 6: Association between relative expansion and social exclusion**



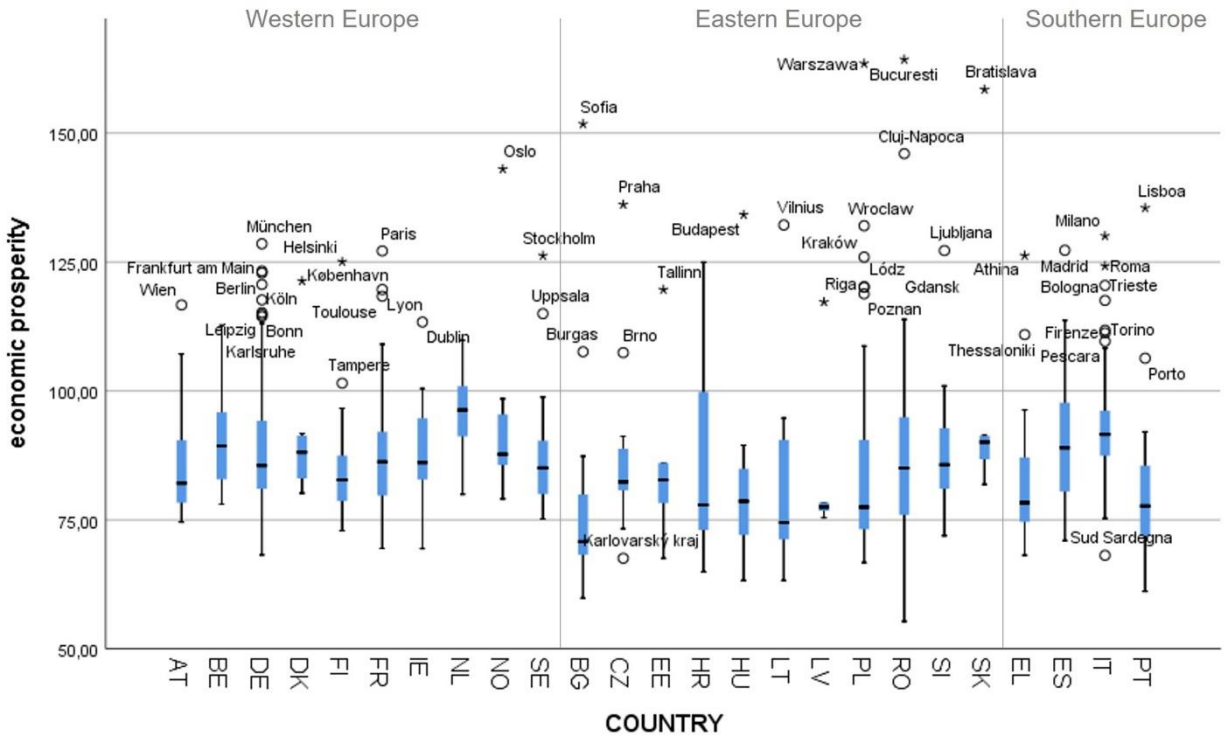

Source: own calculation.

# 6 Specifics of European macro regions

The specificities of the left-behind regions described above and the observed associations obscure the significant heterogeneity of socio-spatial structures and mechanisms within the European Union. They only indicate the most general trends without taking into account the differences between countries. In fact, forms of spatial inequalities are strongly dependent upon the historical development of individual countries and their institutional settings.

To illustrate the importance of such differences, we classified European countries into three macroregional clusters: 1) Western Europe, 2) Southern Europe, 3) Central and Eastern Europe. Looking separately into these macroregions reveals striking differences. We describe them focusing on the overall level of the indicators, polarisation, and mutual associations of the dimensions.

**Figure 7: Distribution of regional economic prosperity in EU countries**



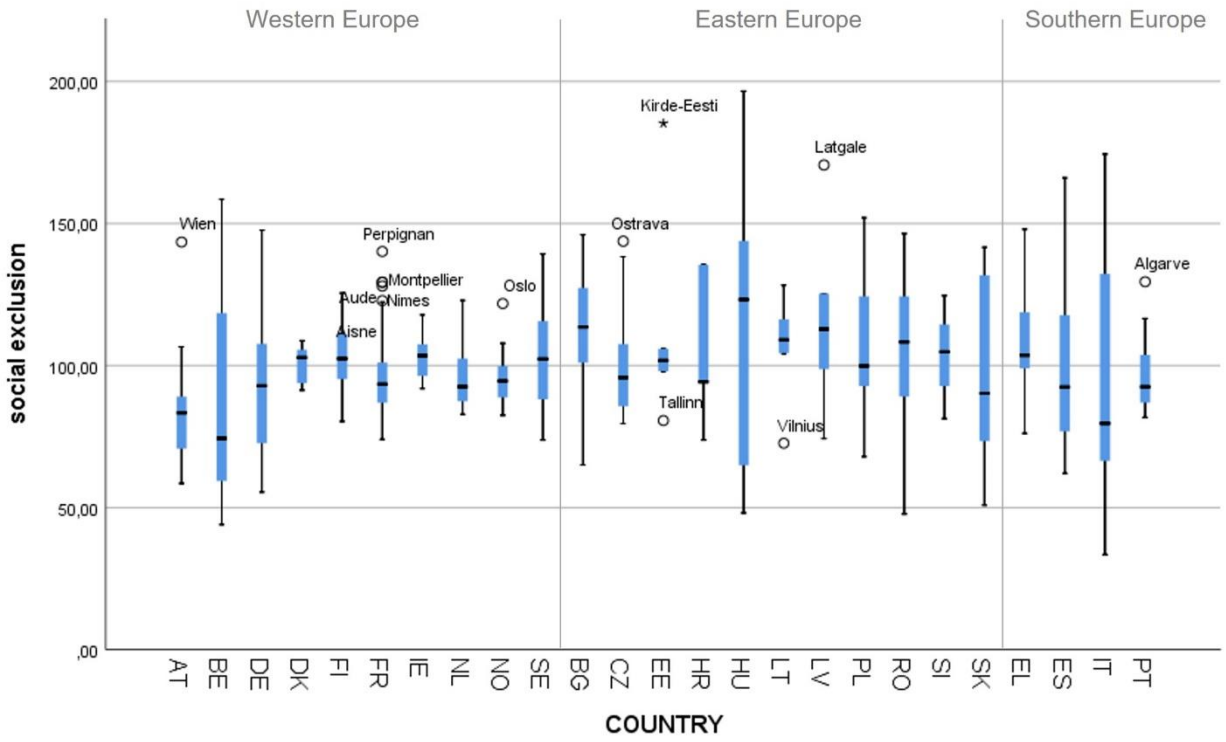

Source: own calculation.

When examining economic prosperity, Western European countries show the highest absolute figures for underlying indicators (high GDP, skilled population, well developed sector of business and financial services), whereas Central and Eastern Europe generally display lowest values. Interestingly, in Central and Eastern Europe, all indicators of economic prosperity are closely interrelated. Regional educational attainment strongly correlates with regional GDP, and employment opportunities in business and financial services. These interrelations are much weaker in Southern and Western Europe. In most countries the boundary between economic prosperity and left-behindness is clearly distinguishing metropolitan (and particularly the Capital regions) from non-metropolitan areas. Metropolitan areas benefit economically across whole Europe, with 57% belonging to the leading regions in terms of prosperity, and only two (Schweinfurt, DE, and Tarnów, PL) classified as economically left behind. However, the degree of benefits is particularly pronounced in Central and Eastern Europe, where the polarization between metropolitan and non-metropolitan areas is exceptionally strong. This results on one hand in extremely high values of prosperity particularly in the Capital metropolitan regions in Central Europe (see

Figure 7), and on the other hand in 53% of non-metropolitan regions in CEE being economically left-behind, compared to only 15% in Western Europe and 22% in Southern Europe.

Regarding social exclusion, Southern European countries have notably high unemployment and poverty rates. Compared to it the values of unemployment in Central and Eastern Europe are extraordinarily low. The nature of polarisation varies across Europe. In Western Europe, metropolitan areas are more prone to above-average social exclusion, while non-metropolitan areas are less affected. In Central and Eastern Europe, the reverse is true; metropolitan areas tend to be more inclusive, while rural regions face higher poverty and social exclusion levels. In Southern Europe, the metropolitan/non-metropolitan divide is less relevant to social exclusion levels, which are more influenced by polarisation across macro-regional distinctions, such as the disparity between southern and northern Italy. Furthermore, Figure 8 displays the varying scope of the dimension in different countries, pointing to particularly stark inequality in Hungary and Italy.

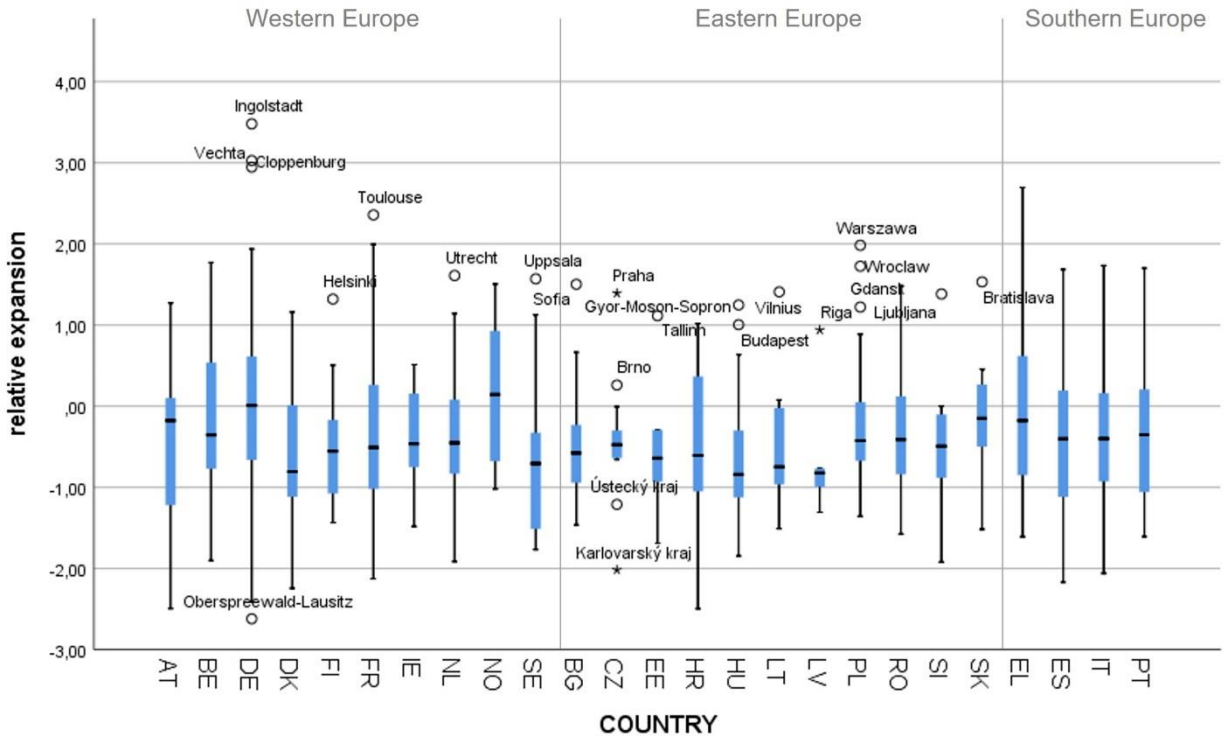
**Figure 8: Distribution of regional social exclusion in EU countries**




Source: own calculation.

The dimension of relative expansion also shows regional specificities across Europe. Western Europe experienced significant real GDP growth between 1993 and 2021, along with modest population and job increases. Southern Europe saw economic growth at about half that rate. Central and Eastern Europe grew economically most notably, at nearly twice the rate of Western Europe, although its population remained stagnant. Leading regions in Central and Eastern Europe saw a substantial real GDP increase of about 200%, and even the left-behind regions experienced at least 30% growth. However, economic growth in these left-behind regions was accompanied by significant population loss, exceeding 20%. In Southern Europe, economically stagnant left-behind regions had only about 7% real GDP growth since 1993 and lost around 10% of their population, similar to left-behind regions in Western Europe. The winners of regional growth since the 1990s in Central and Eastern Europe have almost universally been the metropolitan regions, a phenomenon that has not been observed to such an extent in Western or Southern Europe, where the landscape of the fastest growing regions is much more diverse (Figure 9).

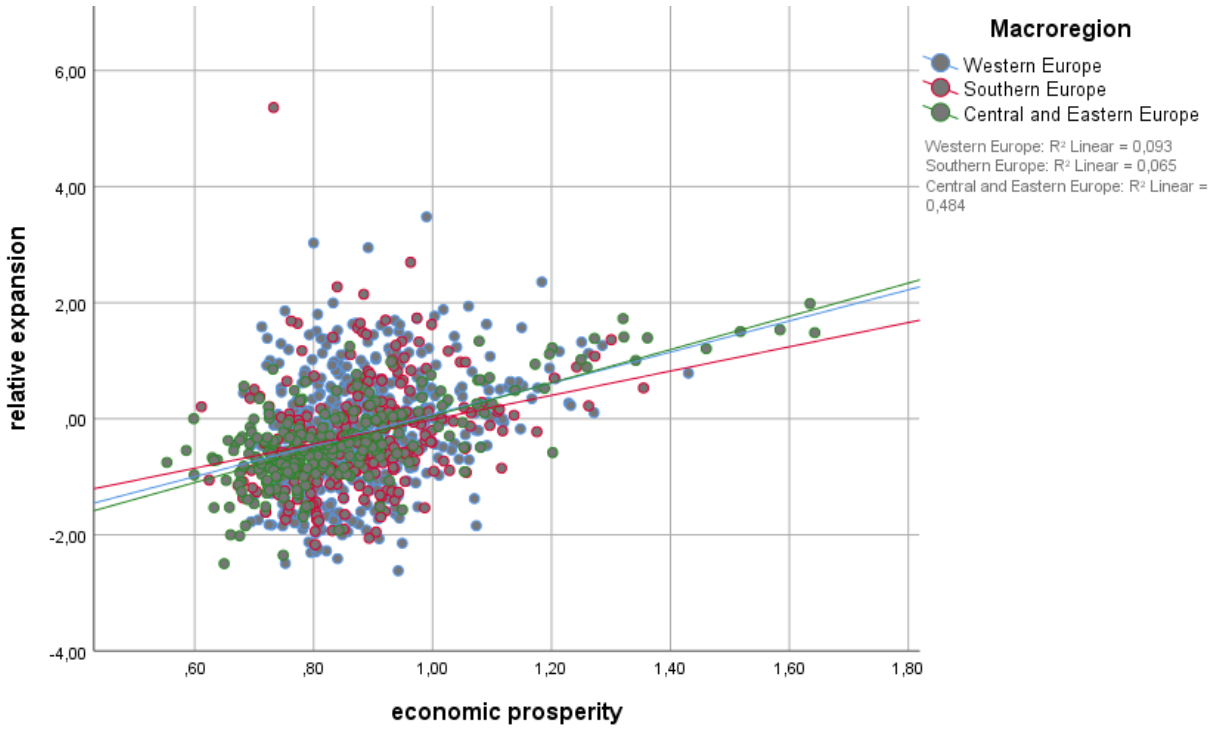
**Figure 9: Distribution of relative regional expansion in EU countries**




Source: own calculation.

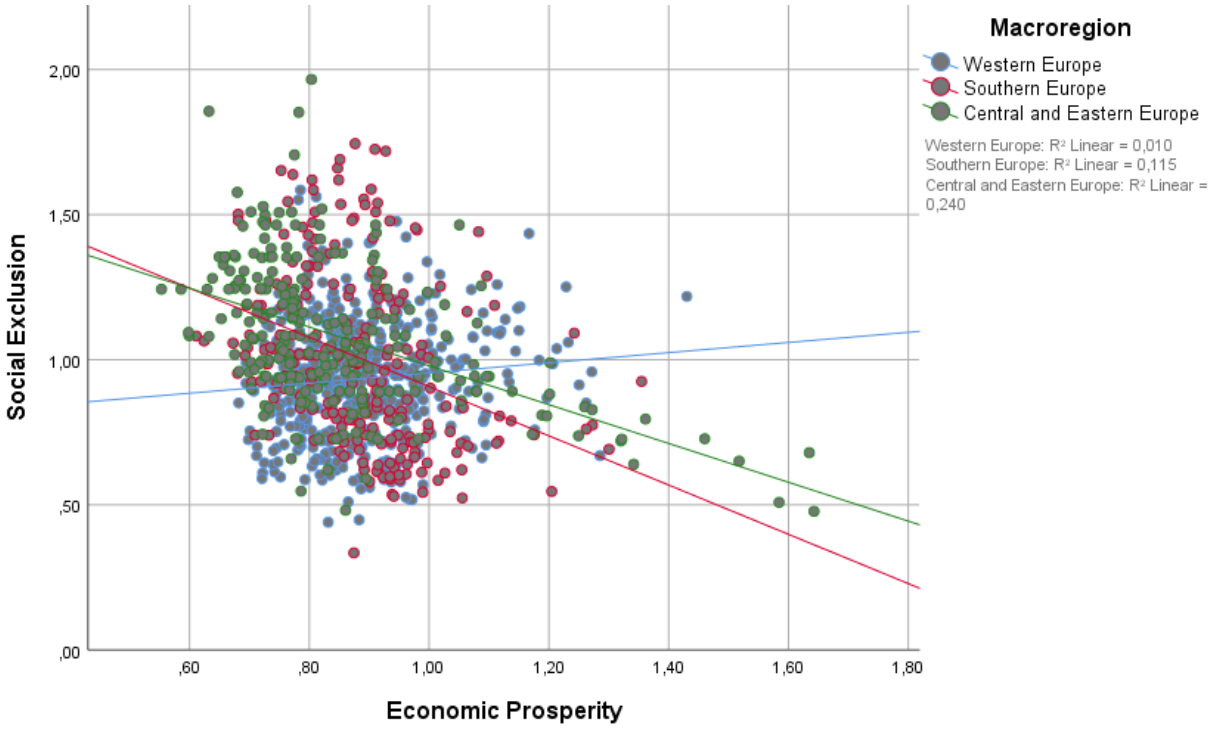
The interrelations between individual left-behindness dimensions also differ across European macro-regions. In Central and Eastern Europe, the dimensions are most strongly interconnected, with prosperity closely linked to growth and low poverty rates. In Southern Europe, the links are weaker but follow the same direction. Western Europe presents the most complex situation, with relatively weak associations between dimensions. This might be rooted in country-level differences, which can be subject of further investigations. Social exclusion is disconnected from prosperity in Western Europe; economically lagging regions do not necessarily exhibit higher poverty rates than leading regions. In fact, the opposite is true, albeit the association is very weak. Figure 10, Figure 11, and Figure 12 highlight these macro-regional differences, classifying labour market regions into Western, Southern, and Central-East European, and showing fit lines and association strengths (expressed as $R^2$) for each subgroup.

**Figure 10: Association between economic prosperity and relative expansion in different parts of Europe**



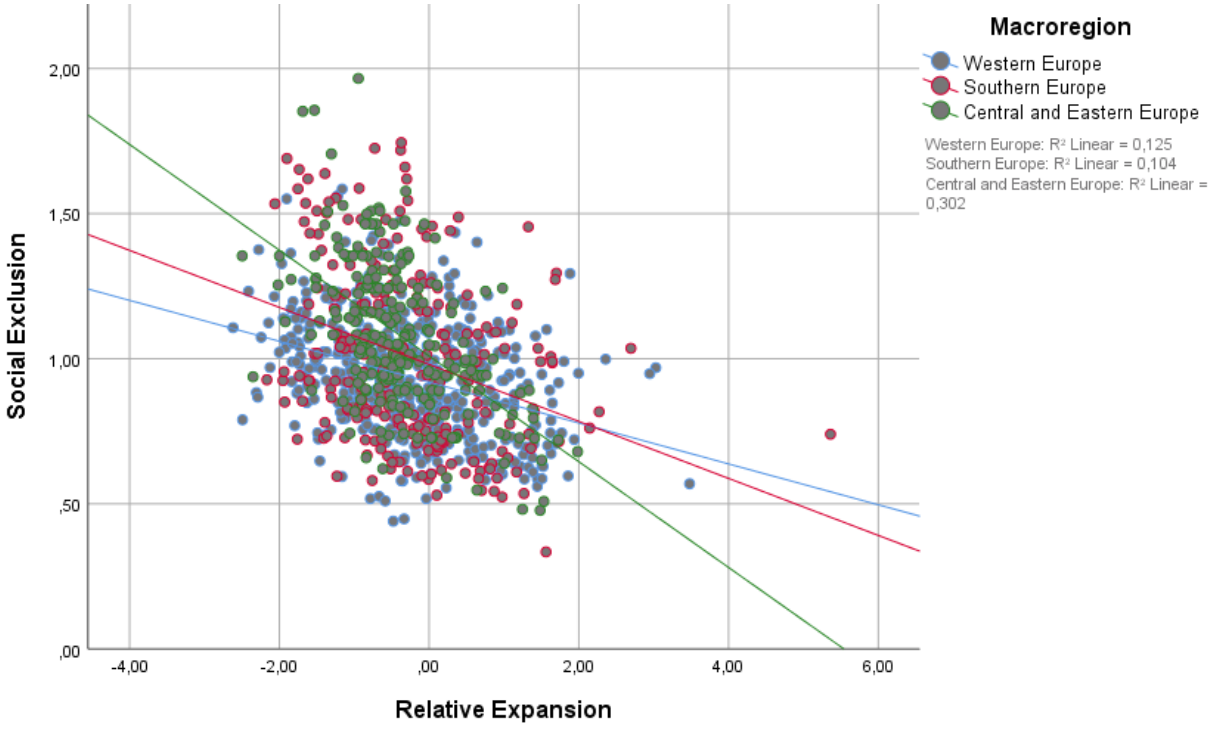

Source: own calculation.

**Figure 11: Association between economic prosperity and social exclusion in different parts of Europe**




Source: own calculation.

**Figure 12: Association between relative expansion and social exclusion in different parts of Europe**




Source: own calculation.

# 7 Conclusions

In the introduction to this study, we mentioned explicit multidimensionality and within-country relativity as the both main advantages of the presented conceptualization of left-behindness.

Both of these features allowed us to highlight some frequently overlooked aspects of spatial inequalities in the EU. First, they demonstrated that different aspects attributed to left-behindness are only weakly correlated and represent distinctive regional characteristics with specific spatial patterns, depending on different spatial-structural mechanisms. The spatial distribution of economic prosperity differs from the distribution of social exclusion and growth dynamics (see Figure 13, Figure 14, and Figure 15). Such a finding not only complicates, but also enriches the arguments on the social and political effects of left-behind regions. It questions one-dimensional explanations of left-behindness as a consequence of deindustrialisation and a manifestation of the globalisation backlash. Rather, it calls for macro-regional, or even country-specific expositions of left-behind places that take account of the historical particularities within which the global economic forces are projected into the local socio-economic context.

The approach allowed us to discover three separate macro-regional constellations of left-behindness, differentiating the situation in Central and Eastern Europe, Southern Europe and Western Europe from each other. These macro-regional differences in the form and structure of regional left-behindness can be summarized as follows:

**Central and Eastern Europe**

The situation in Central and Eastern Europe (CEE) aligns closely with the concept of left-behindness as a regional disadvantage composed of several interrelated dimensions that capture mutually reinforcing aspects of limited opportunities and wealth. In the CEE countries low economic prosperity is strongly associated with higher social exclusion rates. As a rule, economically left-behind regions exhibit also low growth, stagnation or shrinkage. Despite solid economic growth in absolute terms, population loss remains a significant challenge for these regions. Left-behindness is primarily concentrated in non-metropolitan areas, potentially indicating poorer infrastructure provision. There is a stark polarization between rural and metropolitan regions; most metropolitan areas, particularly the capital city regions, concentrate economic prosperity and growth while maintaining relatively low levels of poverty.

**Western Europe**

In Western Europe, the associations within and between the dimensions of left-behindness are much weaker and less clear. Lower economic prosperity is not directly associated with social exclusion and poverty. Poor people are not significantly more prevalent in economically lagging regions. However, there remains a noticeable link between prosperous and growing regions. The association between left-behindness and rurality is less evident. Consequently, the overall picture of regional left-behindness in Western Europe is more complex. Regions are more likely to be left-behind from one particular perspective than from multiple dimensions. For example, Germany exemplifies this complex situation, affected significantly by the reunification in the early 1990s. The spatial patterns of the individual dimensions of left-behindness differ from each other and there are no uniform spatial patterns across the indicators, as other studies on spatial disparities in Germany have shown before (Küpper and Peters 2019). The transformation of eastern Germany´s economy and significant outmigration to the western part of the country have led to significant regional shrinkage in most eastern German areas, including major cities. In recent years, a number of eastern German regions have started a growth trajectory, but in a longer-term view applied to the dimension of regional expansion, the majority of the eastern German regions are still labelled as left-behind. This is particularly true for rural eastern regions, whereas urban centers have more quickly recovered from the shrinkage. On the contrary, the economic and demographic growth has concentrated predominantly, albeit not exclusively into southern and north-western German regions. A strong and

still evident consequence of reunification was the increase in unemployment, poverty and social exclusion in the regions of eastern Germany. Despite considerable social consolidation in recent years, many regions of eastern Germany continue to experience elevated levels of social problems, and eastern Germany, including and led by the Berlin metropolitan area, represents the largest contiguous area with above-average values in the social exclusion dimension. On the other hand, the economic prosperity dimension does not match with this "reunification" regional pattern. Its underlying indicators (the sectoral composition of jobs, educational levels and economic outputs in terms of GDP per capita) in eastern German regions have on average matched the western German figures at the end of the 2020s. The regional pattern is similar in both parts of Germany. Metropolitan areas benefit from the strongest values of current economic prosperity, while the countryside as a whole has below-average figures. Germany is not exceptional in this respect. The same pattern can be observed in other European countries. At the same time, the urban-rural gap is not determinant and economically strongly prosperous rural areas can also be observed throughout Germany.

**Southern Europe**

Southern European regions exhibit patterns of left-behindness that fall between those of Western and Central and Eastern Europe. A distinctive feature of left-behindness in Southern Europe is particularly significant unemployment, high regional poverty rates, and substantially low economic growth. The associations between dimensions of left-behindness are rather weak. Some southern European regions experience growth alongside high social exclusion levels (e.g., the southern Spanish Málaga), many prosperous areas are stagnating or growing on average (e.g., Athens, Barcelona, Torino). Thus, left-behindness is clearly manifested here as a multidimensional phenomenon with distinctive forms and patterns.

Overall, these macro-regional differences highlight the varying degrees and manifestations of left-behindness across Europe, shaped by historical, economic, and social factors unique to each region.

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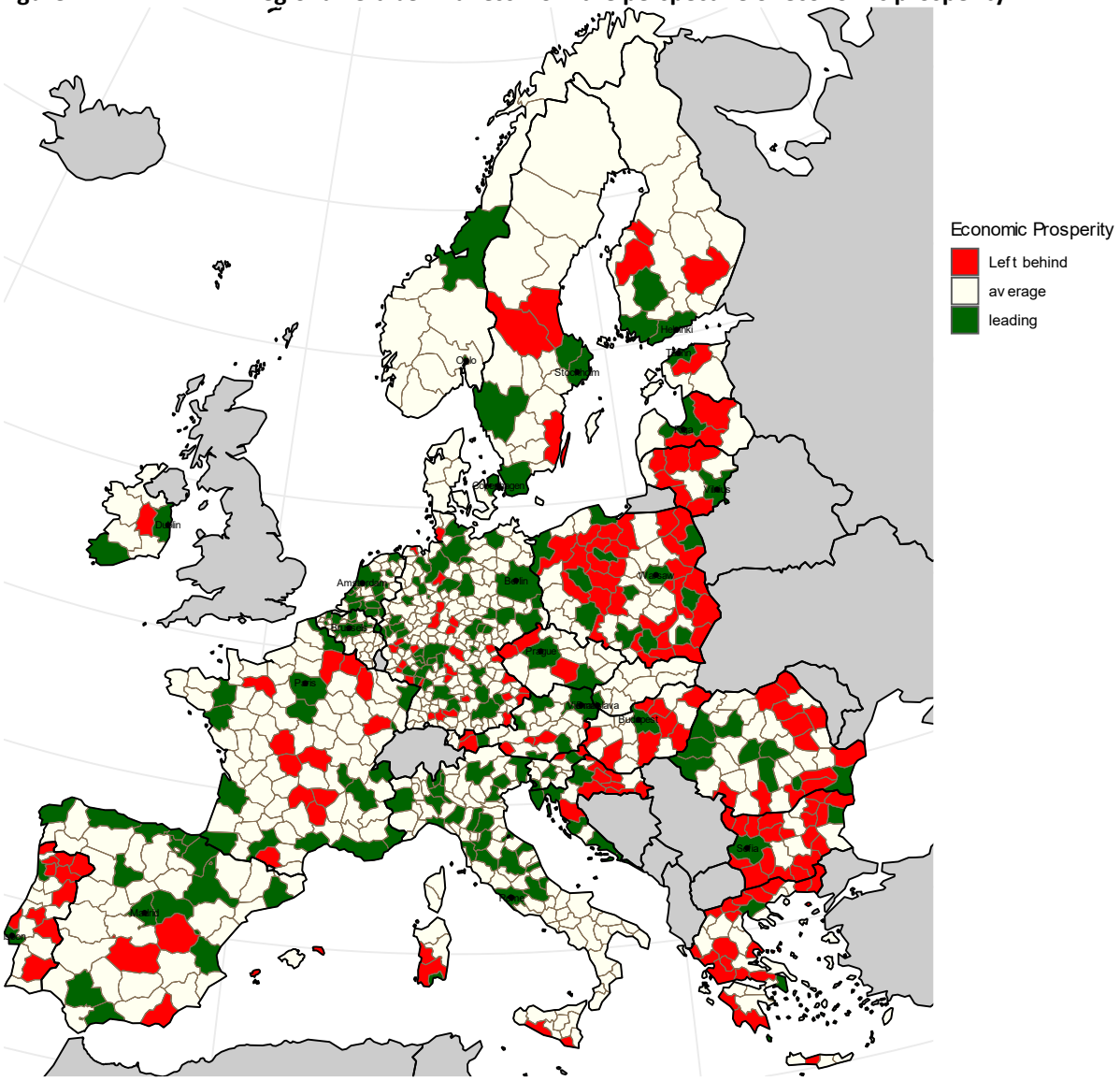
# Annex 1: Projection of left-behind dimensions into maps

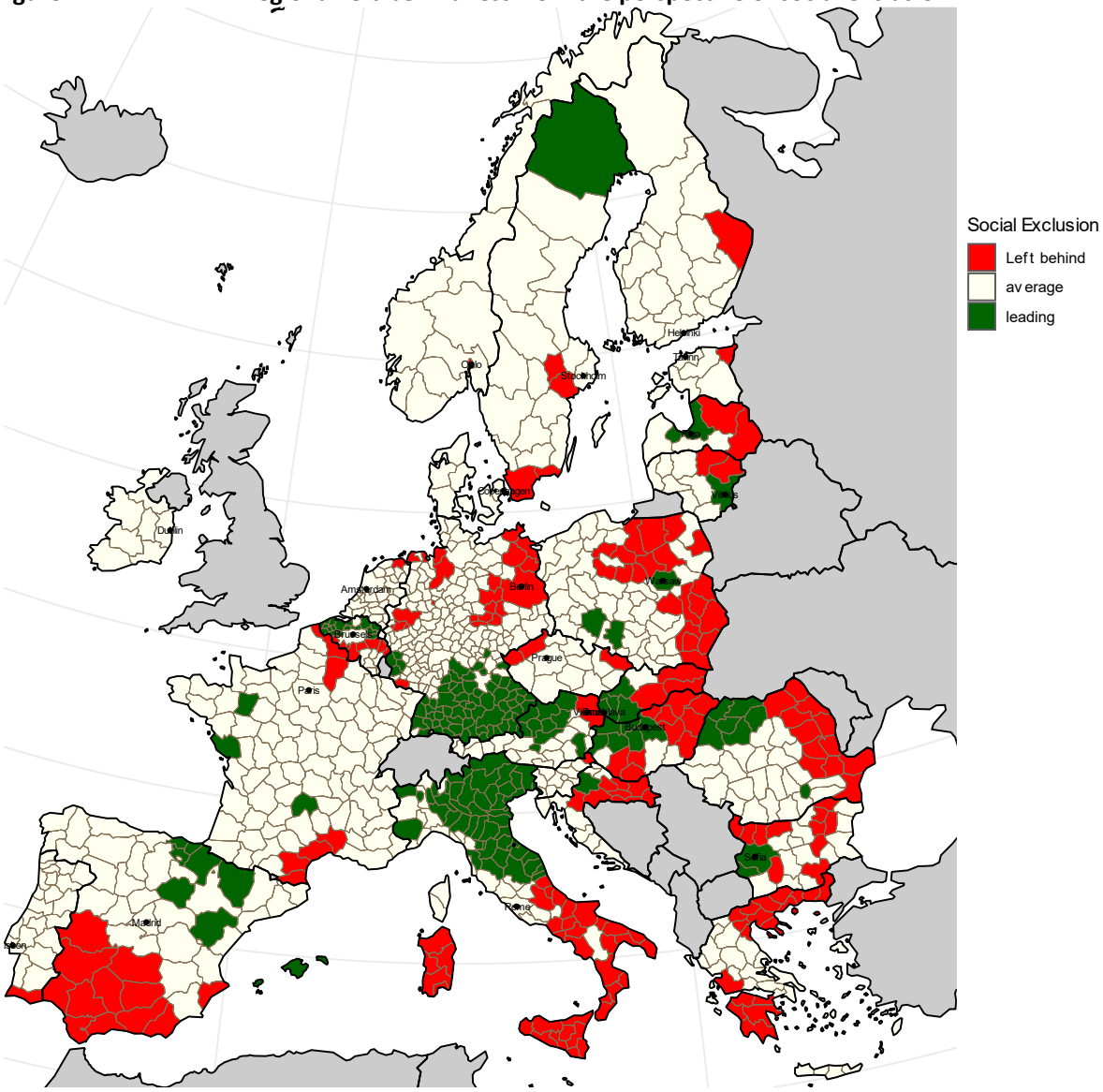
Figures A1, A2 and A3 contain maps of the three dimensions of regional left-behindness.

**Figure A1: Regional left-behindness from the perspective of economic prosperity**



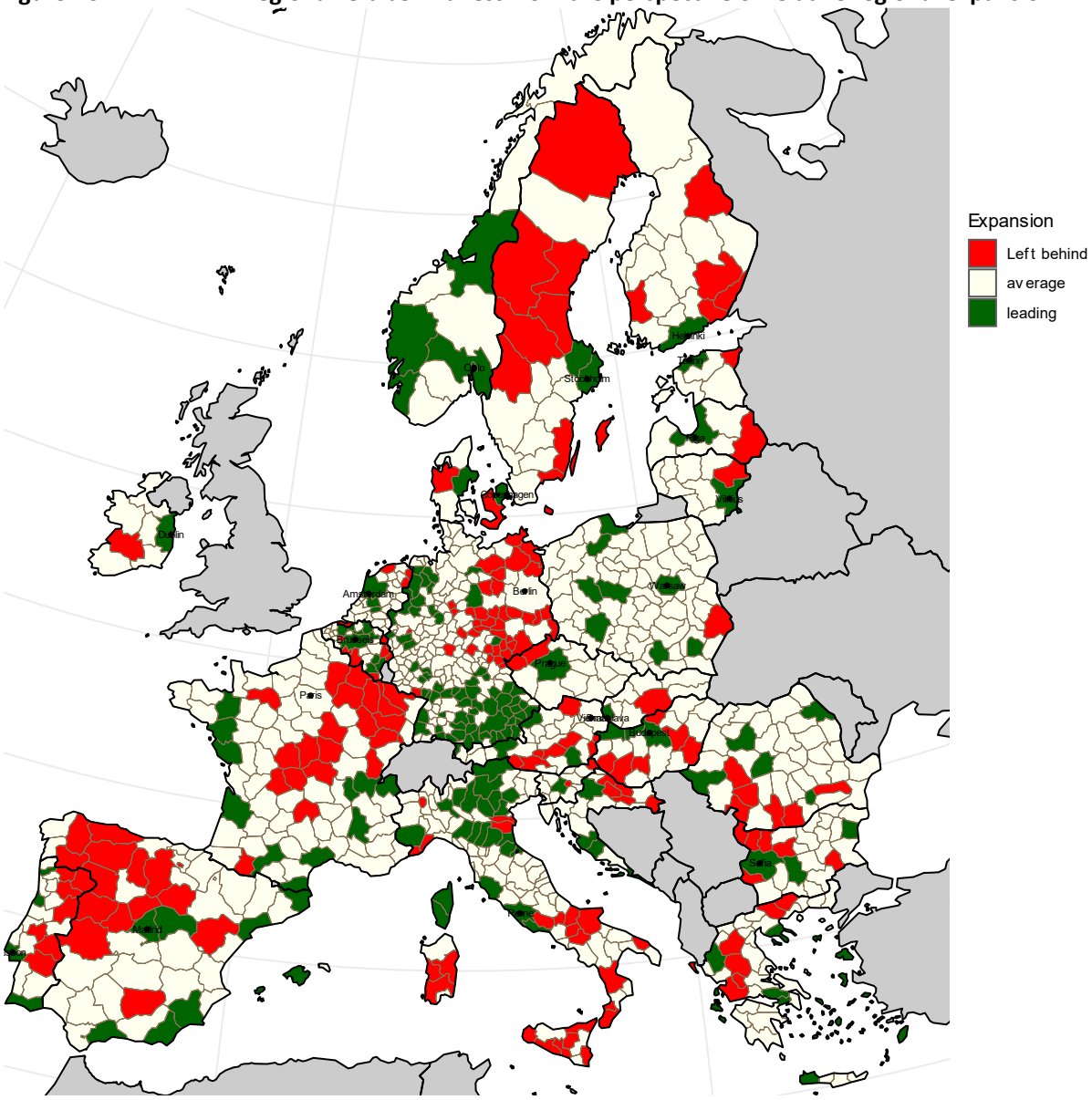

Source: own depiction.

**Figure A2: Regional left-behindness from the perspective of social exclusion**




Source: own depiction.

**Figure A3: Regional left-behindness from the perspective of relative regional expansion**




Source: own depiction.

## Annex 2: Cluster analysis of regional inequalities as a robustness check and another perspective

An alternative way to assess regional inequalities based on a set of economic, social and demographic indicators is the conduction of a cluster analysis. Instead of focusing on the structure within the data, cluster analysis aims to identify groups of observations. This approach has been used in similar studies before. Velthuis et al. (2022) analyse patterns of structural change, and the multidimensionality of left-behindness across EU-15 countries (2023). In order to compare results from the factor analysis with the cluster analysis approach, we conducted a k-means cluster analysis. K-means clustering is an iterative method for partitioning data into $k$ clusters. The process starts by selecting $k$ initial group centers. Each observation is then assigned to the cluster with the closest center. Following this, the mean of the observations in each cluster is calculated, and the centers are updated accordingly. This assignment and updating process is repeated until the cluster assignments remain stable across successive iterations. In order to obtain the optimal number of clusters, we compare the commonly applied criterions within sum of squares (WSS), its logarithm, the $n^2$-values and the proportional reduction of error (PRE) applying k-means cluster analysis with *k* from one to 20 (Makles 2012) (see Figure A4).

To ensure similar influence of indicators on the cluster ascription, we z-standardized the input indicators. Also, we excluded Croatia, Romania and Greece from the analysis as we could not obtain NUTS3-level information on unemployment for these countries. As described above, data was imputed for indicators that were available for some, but not all regions of a country.

The content and statistically sensible solution are seven distinct clusters. Mean values for each input variable per cluster are displayed in Table A1. The allocations of each cluster are depicted in Figure A5 and the numerical distribution of clusters for each country are shown in Table A2.

(1) Cluster 1: Left behind

In national comparison, these areas are lagging behind in indicators with more than 0.5 standard deviations below the average. Particularly pronounced are low GDP values and high unemployment rates. At the same time, population size and number of jobs have been decreasing, pointing towards a multidimensional regional deprivation. The combination of demographic and economic decline is difficult to reverse, meaning that future prospects are unfavorable and sentiments of left-behindness have fertile ground. It is the suspected regions that have been problematized by others, that fall into the Cluster 1: The Italian south, the former industry-based Ruhr area in western Germany, the Polish and Hungarian East, the north of Ireland or the Czech border region to Germany. Whereas in some countries the Cluster 1 regions are mainly rural, as in Spain, Poland, Hungary or Czechia, in other countries some urban areas fall into this cluster, as in Germany and Italy.

(2) Cluster 2: Depopulation

The main characteristics of these areas is a weak development of population size and number of jobs, accompanied by a significantly lower GDP growth than the national average. At the same time, AROPE values are close to the national average. So, poverty issues are far less pronounced than in Cluster 1, resulting in almost all of rural eastern Germany being ascribed to Cluster 2, just as the Spanish northwest, French northeast, or Austrian southeast (excluding Vienna region). In some countries great parts of the country fall into this cluster, e.g., in Sweden eight out of 21 (38%), in Germany 19% and in Austria 28% of the regions are assigned to Cluster 2. In other countries, e.g, Czechia, Belgium, Slovakia, no region is in this cluster (Table A2). On the one hand, this can be explained by different settings of structural inequalities. In Czechia and Belgium, unemployment, out-migration and weak economy go hand in hand, whereas in Germany unemployment is a predominantly urban issue and these experience growth at the same time. On the other hand, the Baltic countries consist of only few NUTS3 regions resulting in a less nuanced regional classification.

(3) Cluster 3: Stable lag

The third cluster characterizes mostly rural regions with low shares of higher educated and jobs in business and financial services. These areas show values slightly below the average in most regards, without having above average unemployment issues. Cluster 3 regions are somewhat stable in lagging behind the growing, in-migration areas, but do not experience severe issues of depopulation or economic decline. Nevertheless, these are areas to keep in sight when monitoring further developments of regional inequalities. Across all countries, this is the most common cluster, with 23% of all regions falling into this cluster.

(4) Cluster 4: Attractive, but high poverty rates

Regions attractive for higher educated, having higher educational institutions and experience increases in population and jobs, with above average job shares in the most growing sector of business and financial services. However, AROPE and unemployment are above the national average, suggesting that upsurge in these areas is selective in terms of who benefits. Agglomerations of Cluster 4 are the Mediterranean areas in France and Spain or the Swedish southwest. Also, southern urban areas in Italy (Bari, Napoli), in Poland (Kielce, Gdańsk, Białystok) or Czechia (Brno) belong to this cluster.

(5) Cluster 5: Average development, low poverty rates

Very low unemployment rates and AROPE values with above average GDP characterize Cluster 5. Changes in population, job number and GDP are close to the national average. These regions represent stability are located, e.g., in the Slovakian west, Italian mid and north, Spanish north, French east and west, Dutch east, Belgian north or German south.

(6) Cluster 6: Most growing, lowest poverty

The areas having experienced the strongest increase in terms of GDP, population and number of jobs also have the lowest unemployment and at-risk-of-poverty rates. Average values in higher education reflect that these areas are mostly located outside the metropolitan capital centers but reflect the family and investment attractive regions with high paid jobs.

(7) Cluster 7: High performers

Regions of Cluster 7 are the national high performers in terms of GDP and are inhabited by high shares of highly educated. Most capitals and other economically strong and attractive metropolitan regions (e.g., Barcelona, Munich, Varna, Innsbruck, Cork, Milano) are grouped in this cluster. Unemployment is below the national average, but not strongly as some outliers like Berlin have relatively high unemployment rates.

**Table A1: Mean values of the Z-transformed indicators per cluster**

| Cluster | GDP per capita logged 2021 | Share of jobs in B&F services 2019 | Tertiary education 2021 | Unemployment 2021 | Poverty AROPE 2021 | GDP fixed change 1993–2021 | Population change 1993–2021 | Employment change 1995–2021 |
|---|---|---|---|---|---|---|---|---|
| 1) Left behind | -1.12 | -0.52 | -0.62 | 1.65 | 1.56 | -0.79 | -0.61 | -0.54 |
| 2) Depopulation | -0.46 | -0.28 | -0.24 | 0.24 | -0.01 | -0.76 | -1.40 | -1.34 |
| 3) Stable lag | -0.43 | -0.56 | -0.57 | -0.04 | 0.12 | -0.28 | -0.09 | -0.22 |
| 4) Attractive, but high poverty rates | 0.14 | 0.60 | 0.43 | 0.47 | 0.55 | 0.20 | 0.54 | 0.58 |
| 5) Average development, low poverty rates | 0.47 | 0.18 | 0.20 | -0.71 | -1.00 | 0.08 | -0.01 | -0.06 |
| 6) Most growing | 0.80 | -0.07 | -0.12 | -1.08 | -0.76 | 1.70 | 1.18 | 1.25 |
| 7) High performers | 1.76 | 2.12 | 2.04 | -0.32 | -0.59 | 0.83 | 1.00 | 1.10 |

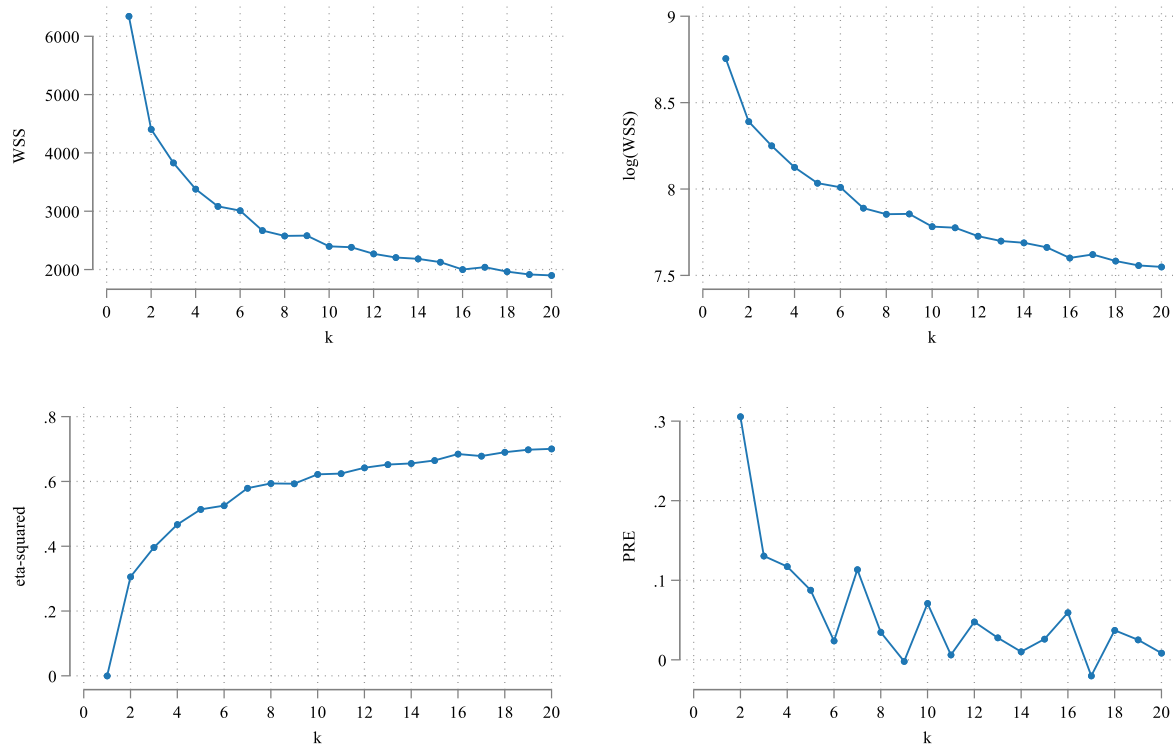
Note: Colours visualise the deviations of the Cluster centers from mean values of the indicators. Blue stands for deviations toward values signalising disadvantage and left-behindness, Green for the opposite. Darker shades indicate deviations larger than 0.5, lighter shades between 0.1 to 0.5.

Source: own calculation.

Comparing the cluster analysis results with the factor analysis approach (see above: Table 5 and Table 6 on page 16, Table 7 on page 17), we mainly find consistencies. E.g., all regions in Cluster 7 (High performers) are in the upper quintile of the prosperity index, all but one Cluster 6 regions (Most growing) are in the upper quintile of the relative expansion index, and 97 per cent of Cluster 1 regions (Left-behind) are in the upper quintile of the social exclusion index. Nevertheless, there are exceptions, as two high performing regions (Berlin and Oslo) fall into left behind quintile of the social exclusion index, pointing at the coexistence of an exceptionally strong and growing economy of these both Capital regions, going hand in hand with high poverty levels.

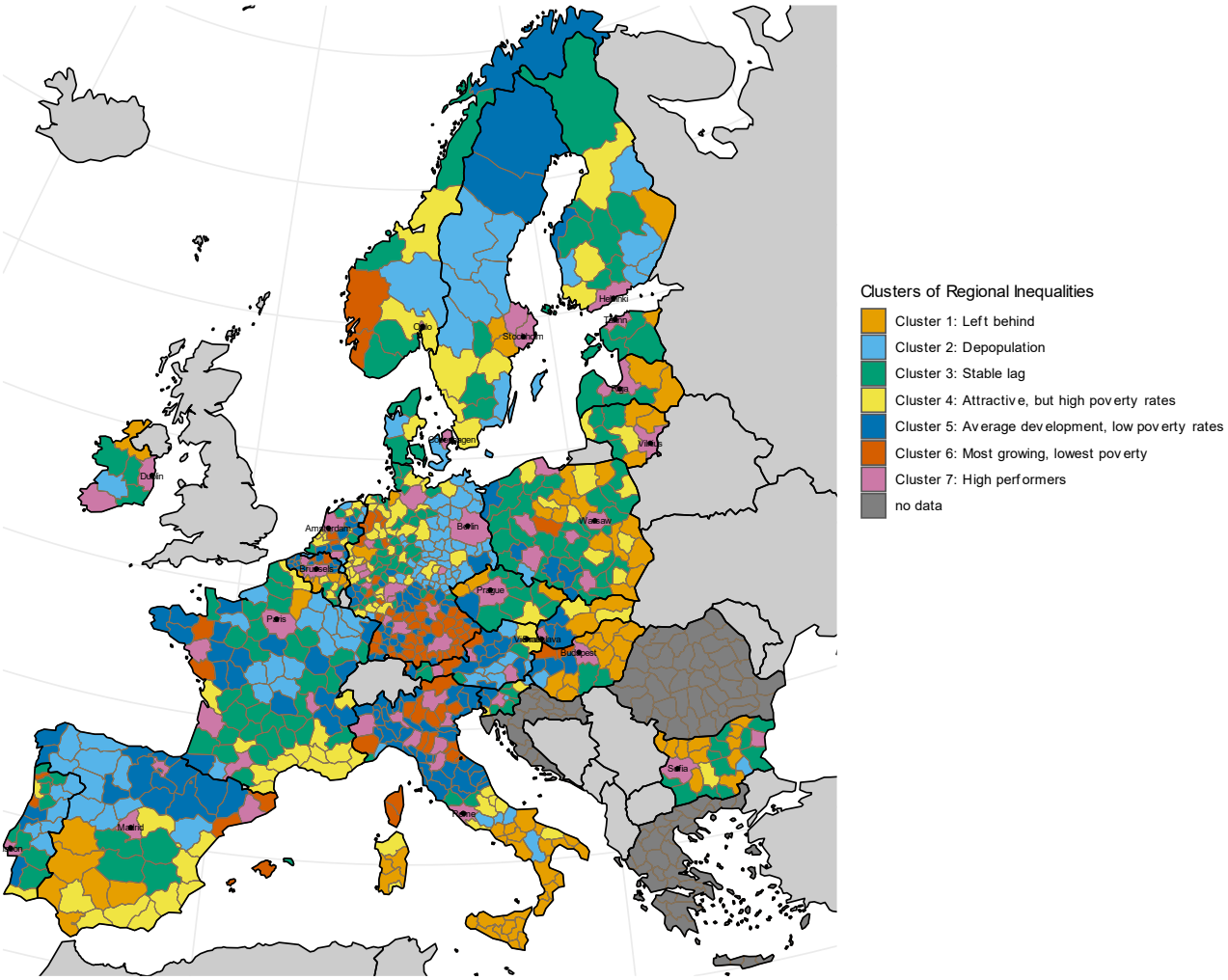
Cramer´s V, derived from the Chi-square statistic, assesses the strength of association between two nominal (categorical) variables. The association of the quintile-based solution and the clusters is 0.53 for prosperity, 0.7 for exclusion, and 0.8 for relative expansion. Overall, the exclusion and expansion quintile-based solution is particularly effective in capturing the clusters, while prosperity quintiles are moderately effective. For a descriptive view of the associations between the quintile-based solutions and the clusters see Table A3.

**Figure A4: Tests for identification of statistical plausibility of number of k-means clusters**




Source: own calculation.

**Figure A5: Clusters of regional inequalities**




Source: own calculation and own depiction.

**Table A2: Distribution of cluster of regional inequalities for selected European countries**

| Country | Left behind | Depopulation | Low values | Attractive | Stable, low poverty | Most growing | High performers | Total |
|---|---|---|---|---|---|---|---|---|
| **Austria** | 0 | 8 | 4 | 1 | 10 | 3 | 3 | 29 |
| | 0.0 | 27.6 | 13.8 | 3.5 | 34.5 | 10.3 | 10.3 | 100.0 |
| **Belgium** | 7 | 0 | 4 | 3 | 14 | 3 | 2 | 33 |
| | 21.2 | 0.0 | 12.1 | 9.1 | 42.4 | 9.1 | 6.1 | 100.0 |
| **Bulgaria** | 11 | 1 | 11 | 1 | 0 | 0 | 2 | 26 |
| | 42.3 | 3.9 | 42.3 | 3.9 | 0.0 | 0.0 | 7.7 | 100.0 |
| **Czechia** | 3 | 0 | 7 | 1 | 1 | 0 | 1 | 13 |
| | 23.1 | 0.0 | 53.9 | 7.7 | 7.7 | 0.0 | 7.7 | 100.0 |
| **Germany** | 4 | 44 | 40 | 36 | 36 | 53 | 13 | 226 |
| | 1.8 | 19.5 | 17.7 | 15.9 | 15.9 | 23.5 | 5.8 | 100.0 |
| **Denmark** | 0 | 3 | 3 | 1 | 0 | 0 | 1 | 8 |
| | 0.0 | 37.5 | 37.5 | 12.5 | 0.0 | 0.0 | 12.5 | 100.0 |
| **Estonia** | 1 | 0 | 3 | 0 | 0 | 0 | 1 | 5 |
| | 20.0 | 0.0 | 60.0 | 0.0 | 0.0 | 0.0 | 20.0 | 100.0 |
| **Spain** | 6 | 10 | 5 | 9 | 13 | 4 | 3 | 50 |
| | 12.0 | 20.0 | 10.0 | 18.0 | 26.0 | 8.0 | 6.0 | 100.0 |
| **Finland** | 1 | 5 | 8 | 3 | 1 | 0 | 1 | 19 |
| | 5.3 | 26.3 | 42.1 | 15.8 | 5.3 | 0.0 | 5.3 | 100.0 |
| **France** | 1 | 16 | 31 | 13 | 18 | 4 | 5 | 88 |
| | 1.14 | 18.2 | 35.2 | 14.8 | 20.5 | 4.6 | 5.7 | 100.0 |
| **Hungary** | 10 | 1 | 2 | 0 | 3 | 2 | 1 | 19 |
| | 52.6 | 5.3 | 10.5 | 0.0 | 15.8 | 10.5 | 5.3 | 100.0 |
| **Ireland** | 1 | 1 | 3 | 0 | 0 | 0 | 2 | 7 |
| | 14.3 | 14.3 | 42.9 | 0.0 | 0.0 | 0.0 | 28.6 | 100.0 |
| **Italy** | 28 | 5 | 3 | 8 | 40 | 12 | 9 | 105 |
| | 26.7 | 4.8 | 2.9 | 7.6 | 38.1 | 11.4 | 8.6 | 100.0 |
| **Lithuania** | 3 | 0 | 4 | 2 | 0 | 0 | 1 | 10 |
| | 30.0 | 0.0 | 40.0 | 20.0 | 0.0 | 0.0 | 10.0 | 100.0 |
| **Latvia** | 2 | 0 | 2 | 0 | 0 | 0 | 1 | 5 |
| | 40.0 | 0.0 | 40.0 | 0.0 | 0.0 | 0.0 | 20.0 | 100.0 |
| **Netherlands** | 0 | 6 | 4 | 8 | 8 | 2 | 2 | 30 |
| | 0.0 | 20.0 | 13.3 | 26.7 | 26.7 | 6.7 | 6.7 | 100.0 |
| **Norway** | 0 | 1 | 4 | 2 | 1 | 2 | 1 | 11 |
| | 0.0 | 9.1 | 36.4 | 18.2 | 9.1 | 18.2 | 9.1 | 100.0 |

| Country | Left behind | Depopulation | Low values | Attractive | Stable, low poverty | Most growing | High performers | Total |
|---|---|---|---|---|---|---|---|---|
| **Poland** | 12 | 1 | 28 | 8 | 5 | 1 | 6 | 61 |
| | 19.7 | 1.6 | 45.9 | 13.1 | 8.2 | 1.6 | 9.8 | 100.0 |
| **Portugal** | 1 | 6 | 10 | 2 | 3 | 2 | 1 | 25 |
| | 4.0 | 24.0 | 40.0 | 8.0 | 12.0 | 8.0 | 4.0 | 100.0 |
| **Sweden** | 2 | 8 | 3 | 4 | 2 | 0 | 2 | 21 |
| | 9.5 | 38.1 | 14.3 | 19.1 | 9.5 | 0.0 | 9.5 | 100.0 |
| **Slovenia** | 0 | 2 | 5 | 2 | 2 | 0 | 1 | 12 |
| | 0.0 | 16.7 | 41.7 | 16.7 | 16.7 | 0.0 | 8.3 | 100.0 |
| **Slovakia** | 2 | 0 | 0 | 2 | 3 | 0 | 1 | 8 |
| | 25.0 | 0.0 | 0.0 | 25.0 | 37.5 | 0.0 | 12.5 | 100.0 |
| **Total** | 95 | 118 | 184 | 106 | 160 | 88 | 60 | 811 |
| | 11.7 | 14.6 | 22.7 | 13.1 | 19.7 | 10.9 | 7.4 | 100.0 |

Source: own calculation.

**Table A3: Cross-tabulation of region categorisation resulting from cluster analysis and factor analysis. Rows show upper and lower quintiles of the three dimensions derived from factor analysis**

| | Cluster 1 | Cluster 2 | Cluster 3 | Cluster 4 | Cluster 5 | Cluster 6 | Cluster 7 | Total |
|---|---|---|---|---|---|---|---|---|
| **Prosperity** | | | | | | | | |
| Left-behind | 37 | 23 | 65 | 1 | 6 | 11 | 0 | 143 |
| Average | 58 | 90 | 119 | 54 | 114 | 67 | 0 | 502 |
| Leading | 0 | 5 | 0 | 51 | 40 | 10 | 60 | 166 |
| **Exclusion** | | | | | | | | |
| Left-behind | 92 | 15 | 6 | 33 | 0 | 0 | 2 | 148 |
| Average | 3 | 99 | 174 | 73 | 74 | 26 | 39 | 488 |
| Leading | 0 | 4 | 4 | 0 | 86 | 62 | 19 | 175 |
| **Expansion** | | | | | | | | |
| Left-behind | 41 | 106 | 11 | 0 | 7 | 0 | 0 | 165 |
| Average | 54 | 12 | 171 | 79 | 150 | 1 | 18 | 485 |
| Leading | 0 | 0 | 2 | 27 | 3 | 87 | 42 | 161 |

Source: own calculation.

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