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TWIN TRANSITION AND CHANGING PATTERNS OF SPATIAL MOBILITY: A REGIONAL APPROACH

MOBI-TWIN 2.3. TYPOLOGIES OF EU REGIONS BASED ON THE REGIONAL ATTRACTIVENESS INDEX

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Abstract

This report examines drivers of spatial mobility and immobility using econometric analysis on diverse data sources. Key factors focus on green and digital transition indicators, together with individual demographics, regional conditions, and life stages, assessing their influence on mobility types (permanent, circular, short-term).

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ABSTRACT

This document presents a strategic typology of European regions based on comprehensive analyses of their attractiveness and associated mobility dynamics. Employing a multidimensional framework, this study categorises EU regions into six distinct clusters, each defined by unique characteristics in terms of economic, digital, and environmental factors. The clusters identified are: Metropolitan Leaders, Balanced Innovators, Industrial Heartlands in Transformation, Economies in Structural Transition, Catch-Up Cohesion Regions, and Structurally Lagging and Peripheral Regions. Each cluster exhibits specific patterns of spatial mobility, encompassing permanent migration, seasonal mobility, commuting flows, and student mobility, providing insights into the underlying demographic and economic trends.

Metropolitan Leaders represent Europe's most dynamic regions, primarily large urban areas that attract significant skilled labour and sustain robust economic growth, despite challenges related to housing affordability and congestion. **Balanced Innovators** show well-rounded performance across economic, digital, and environmental dimensions, acting as connectors that diffuse innovation regionally. **Industrial Heartlands in Transformation** encompass traditionally industrial regions facing challenges in adapting to digital and green transitions, requiring targeted interventions in skills training and modernisation. **Economies in Structural Transition** reflect regions with moderate performance but considerable potential, contingent upon improvements in governance, institutional quality, and connectivity. **Catch-Up Cohesion Regions**, primarily located in Eastern and Southern Europe, exhibit developmental gaps but also show emerging strengths in green and digital dimensions, highlighting opportunities for targeted cohesion funding. Lastly, **Structurally Lagging and Peripheral Regions** face profound developmental challenges, necessitating comprehensive, long-term, place-based interventions focused on rural innovation, sustainable economic activities, and enhanced infrastructure.

The document further provides a detailed SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis for each cluster, emphasising their distinctive features and identifying key policy implications. It underlines the importance of tailoring policy interventions to the specific contexts and needs of each cluster, strengthening regional resilience by leveraging mobility flows, and aligning EU and national funding mechanisms with territorial realities. Recommendations emphasise the critical role of multi-level governance, evidence-based monitoring systems, and targeted investments to foster sustainable development, innovation diffusion, and regional convergence.

The deliverable presents a detailed country-level analysis of regional attractiveness and mobility for five selected EU Member States: Finland, Greece, Italy, the Netherlands, and

Spain. It employs the Regional Attractiveness Index (RAI), incorporating net migration flows, commuting patterns, and student mobility data to provide an in-depth view of how regional characteristics influence demographic and functional dynamics at the subnational level. For each country, the section outlines the regional variations in overall attractiveness as well as the traditional, green, and digital components of the RAI. The analysis examines population growth and mobility flows, differentiating among six mobility types: permanent migration, seasonal mobility, cross-border commuting, long-distance commuting, and short-term and long-term student mobility.

A set of panel regression models is used to investigate the relationship between regional attractiveness (overall RAI and its specific dimensions) and various mobility flows. Findings indicate that the overall RAI positively correlates with most mobility types, particularly permanent migration and short-term student flows. The digital dimension notably influences permanent migration and long-term student mobility, suggesting digital infrastructure's critical role in attracting residents and students. The traditional dimension strongly affects short-term student and seasonal migration flows, underscoring economic fundamentals and institutional quality as pivotal for temporary mobility decisions. Conversely, the green dimension demonstrates minimal impact, only marginally influencing seasonal migration, which suggests environmental factors are secondary to economic and digital considerations when driving mobility. Cross-border commuting shows negligible responsiveness to RAI factors, likely due to its dependence on geographical proximity and neighbouring labour markets rather than internal regional attributes.

The regional typology presented in this deliverable offers a robust, evidence-driven framework for policymakers, enabling precise and spatially sensitive interventions aimed at enhancing territorial cohesion, balanced regional development, and equitable participation in Europe's ongoing structural transformation. The policy recommendations derived from this typology highlight the importance of tailoring interventions to the specific needs of each cluster and their dominant mobility flows. They call for improved mobility infrastructure, especially for labour and student movements; strategic investments in digital, educational, and transport systems; and alignment of EU and national funding with regional realities. Strengthening multi-level governance and adopting adaptive monitoring systems are also key to ensuring that policy responses remain flexible and effective across diverse territorial contexts.

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1. INTRODUCTION

The MOBI-TWIN project aims to understand and respond to the spatial consequences of the Twin Transition—digital and green—through the lens of regional development and mobility patterns. In this context, Task 2.4 focuses on developing a robust set of regional typologies that can serve both as a diagnostic and strategic tool to inform place-sensitive policies. This task builds upon the conceptual and methodological foundation set by previous work, especially the development of the Regional Attractiveness Index (RAI) in Task 2.3, which quantified the ability of European regions to attract and retain population in the face of shifting economic, environmental, and technological paradigms.

The Regional Attractiveness Index, detailed in Deliverable 2.2, highlighted significant spatial disparities across EU regions, particularly in how well they perform across traditional, digital, and green dimensions. These findings underscore the need for a nuanced regional classification that goes beyond economic performance to account for multi-dimensional vulnerabilities and opportunities in the face of transformation. The typologies to be developed in this deliverable will synthesise this evidence into a categorisation of regions based on shared structural features, performance profiles, and transition readiness—recognising that the capacity to adapt to and benefit from the twin transition is unevenly distributed.

This deliverable introduces a typological approach as a natural progression from the synthetic index methodology employed previously. While composite indices provide powerful comparative insight, they do not necessarily capture the structural similarities or policy needs of groups of regions. Typologies, on the other hand, aim to classify territories into coherent groups based on combinations of indicators that reflect not only current performance but also development pathways, institutional settings, and socio-demographic characteristics. This shift is crucial for supporting targeted and place-based policy design, as called for in the EU's Territorial Agenda and Cohesion Policy framework.

The primary objective of Deliverable D2.3 is to develop a comprehensive typology of EU regions by leveraging the Regional Attractiveness Index. This typology will be built through the application of cluster analysis, aiming to group regions based on their attractiveness characteristics—particularly regarding their potential to attract or retain individuals in the digital and green transition era. The typology will be constructed at the EU level, identifying broad regional categories sharing similar attractiveness profiles. This will be complemented by six country-level in-depth typologies, developed for the countries with pilot regions: Greece, the Netherlands, Spain, Finland, and Italy.

The deliverable analyses intra-country regional variation and perform SWOT analyses to uncover region-specific strengths, weaknesses, opportunities, and threats.

A key focus of D2.3 is to uncover what types of individuals are attracted by different regions, and to explore how regional features (e.g., market access, economic diversity, demographic dynamics) relate to mobility flows and attractiveness. This analysis will allow MOBI-TWIN to identify both leading and lagging regions in terms of their capacity to attract talent, providing a basis for targeted policy recommendations and comparative regional development insights.

The proposed typologies will integrate dimensions from the RAI—economic performance, environmental sustainability, digital capacity, and social well-being—with spatial mobility patterns and institutional capacity. Special attention will be given to identifying “trapped” or “left-behind” regions, which exhibit structural disadvantages despite transition pressures, and “transition leaders” that are well-positioned to leverage emerging opportunities. Ultimately, the typology approach will allow for a clearer understanding of not only where regions stand, but how and why they respond differently to the drivers of change—and what interventions might help them thrive.

The following sections of this report are structured to guide the reader through the full process of typology development. Section 2 presents the conceptual framework underpinning the classification exercise, drawing on existing literature and policy priorities. Section 3 details the data sources and methodological approach used to construct the typologies, including indicator selection, statistical techniques, and clustering strategies. Section 4 introduces and describes the resulting typologies, highlighting the key characteristics of each group of regions. Section 5 provides illustrative examples through selected case studies. Section 6 reflects on the policy implications of the typologies and offers conclusions and recommendations for how they can inform regional strategies in the twin transition era. Section 7 concludes summarising the more important aspects of the analysis.

2. CONCEPTUAL FRAMEWORK

The identification and comparison of regions through typologies is a longstanding practice across the social sciences, providing critical tools for understanding and organising spatial diversity. From early sociological studies (e.g., Lynd & Lynd, 1929) to contemporary applications in marketing, energy geography, marine social sciences, and urban planning, typologies enable both researchers and practitioners to simplify complex realities by classifying regions into meaningful categories. These classifications allow for more accurate comparisons across space, identification of representative places, and the development of tailored strategies.

In research, regional typologies have played a central role in comparative studies where finding similar cases is essential. The US Federal Reserve Bank of Chicago's 'Peer City Identification Tool' exemplifies the practical utility of typologies by helping municipalities benchmark themselves against demographically and economically similar cities. In market research, typifying territories aids in understanding consumer behaviour—testing products and services in representative locations can provide valuable insights that can be generalised to similar markets (Hay et al., 1988). Other fields have also relied on typologies. In marine social sciences, researchers often examine typical coastal communities to study policy uptake or social attitudes (Graziano et al., 2019). Similarly, in energy geography, the assessment of community-level engagement with energy transitions is facilitated by working with categories of representative settlements (Calvert, 2016). These examples underline how the identification of types allows for inference, prediction, and policy design beyond single-case studies.

Typologies are also essential in understanding territorial dynamics linked to attractiveness. As shown by Petrakos et al. (2004), spatial inequalities in the EU are strongly driven by externalities related to market access. Core regions, which benefit from high accessibility and infrastructure, tend to attract mobile production factors such as capital and skilled labour (Head & Mayer, 2003). In contrast, peripheral regions are often limited by geographic and infrastructural disadvantages, leading to higher transport costs (Lima & Venables, 2001) and reduced capacity to engage in beneficial trade (McCallum, 1995; Resmini, 2002). Such conditions contribute to unbalanced economic structures and divergent regional development paths (Petrakos & Christodoulakis, 1997).

New economic geography further strengthens the link between typologies and attractiveness by emphasizing the role of increasing returns to scale and agglomeration economies (Monfort & Nicolini, 2000). Economic integration enhances the

attractiveness of regions with large market size potential, particularly those situated near national capitals or major urban centres (Alesina et al., 2000). These regions enjoy clustering effects, while distant or less accessible regions may experience limited spillover effects unless their cross-border connections and market opportunities expand (Damijan & Kostevc, 2002).

In the realm of policy-making, typologies are critical for decision-makers in allocating resources, benchmarking territorial performance, and designing geographically targeted interventions. The European Union (EU) has made extensive use of typologies to guide regional policy. Through initiatives such as the European Observation Network for Territorial Development and Cohesion (ESPON), the EU has invested in mapping urban and rural areas, incorporating spatial accessibility, socioeconomic data, and institutional indicators. Several examples arise, such as the EDORA project (European Development Opportunities for Rural Areas), which developed typologies of rural areas based on a wide range of indicators, enabling more nuanced targeting of the European Regional Development Fund (ERDF). Copus (2015), building on this work, conceptualised a ‘new rural economy’ through a typological lens, suggesting that structural economic differences across regions demand differentiated policy tools. These insights demonstrate the power of typologies not just for understanding space, but for actively shaping its development.

Typologies are also applied in cross-border studies and cohesion policy analyses. As highlighted in Topaloglou et al. (2005), border regions possess distinctive profiles shaped by both economic integration and cultural heterogeneity. Their typology of NUTS-3 border regions revealed five clusters, each with specific developmental needs, illustrating how typification informs strategic policymaking in complex, transitional areas.

Moreover, typologies play an indirect role in shaping discourse and perception. By establishing ‘types’ of regions, they influence how territories are understood in public and institutional contexts—often reinforcing or challenging assumptions about peripherality, remoteness, or opportunity. As such, their design must be sensitive to both methodological rigor and political implications.

Overall, regional typologies are essential not only in academic disciplines but also in applied domains where decisions must be made about investment, development, and governance. From identifying typical coastal communities in environmental research to enabling territorial cohesion funding in the EU, typologies help simplify complexity while guiding effective, place-sensitive interventions. Their versatility and relevance across disciplines underscore their enduring value in spatial analysis and policy design.

2.1. KEY CRITERIA AND DIMENSIONS FOR TYPOLOGY CLASSIFICATION OF REGIONAL ATTRACTIVENESS

The typology classification of regional attractiveness is structured around three main dimensions defined in the Regional Attractiveness Index: traditional, digital, and green factors. Each dimension integrates multiple indicators that reflect both structural conditions and transition readiness.

The **traditional dimension** captures long-established drivers of regional development, such as economic performance, labour market conditions, and sectoral composition. It includes indicators like GDP per capita, employment rates, and the presence of high value-added services. It also accounts for social well-being (e.g. access to healthcare, student populations), institutional quality (measured through the European Quality of Government Index), and environmental comfort (including air quality and climate-related variables like heating and cooling degree days).

The **digital dimension** focuses on a region's integration into the digital economy. It includes broadband coverage, high-tech employment, and digital skills, as reflected in behaviours such as online communication, e-government interactions, digital transactions, and online banking. This dimension highlights how regions support remote work and digital services, which are increasingly relevant in the context of the twin transitions.

The **green dimension** evaluates environmental performance and adaptation to the green transition. It includes greenhouse gas emissions, employment in circular economy sectors, and the ecological orientation of economic activity. Indicators such as the weight of agriculture and tourism in GDP, and average wages in environmentally sensitive sectors (e.g. mining), reflect both vulnerability and potential for sustainable transformation.

Methodologically, the RAI assigns 50% weight to the traditional dimension and 25% each to digital and green dimensions (for more details on the methodology see Deliverable 2.2). These dimensions together provide the foundation for grouping regions into typologies based on their ability to attract and retain population, investment, and talent in the context of ongoing digital and ecological transformations.

3. METHODOLOGY

3.1. FROM CONTINUOUS SINGLE CRITERIA TO MULTIVARIATE CLUSTERING ANALYSIS

The classification of space into typologies has deep roots in social science, particularly in rural studies, where early efforts such as those by Sorokin and Zimmerman (1929) and Cloke (1977) focused on the urban–rural continuum. This approach assumed a linear gradient where socioeconomic vitality decreases with distance from urban cores. However, its limitations soon became evident. Pettersson (2001) demonstrated that remote areas can exhibit high socioeconomic status while some urban areas may underperform, challenging the unidimensional continuum logic. As early as Pahl (1966), scholars argued for a more complex spatial model, likening rural space to overlapping meshes rather than a linear scale. Further critiques, such as those by Falk (1976), showed that variables traditionally used to define rurality were often not strongly correlated, and Cloke’s own principal component analysis explained barely half of the internal variation.

More recent work has transitioned toward recognizing the multidimensionality of rural heterogeneity. For example, Hedlund (2016) develops a socioeconomic typology of rural Sweden based on high-resolution data and cluster analysis, explicitly rejecting the continuum approach. His study reveals five distinct rural clusters with sixteen subtypes, each shaped by unique demographic, economic, and spatial dynamics. This perspective aligns with the OECD’s (2006) call for place-based policies that reflect the diversity of rural contexts, rather than relying on one-size-fits-all approaches tied to sectoral or administrative boundaries. Comparative studies across Europe (e.g., Copus et al., 2008; Aubert et al., 2006; Banski & Stola, 2002) have reinforced the value of such context-sensitive typologies, which show limited alignment with national administrative divisions.

The logic underpinning these multidimensional rural typologies applies equally to the classification of regional attractiveness. Just as the rural–urban continuum oversimplified rural realities, a typology of attractiveness must move beyond single-dimensional indicators such as income or population density. Attractiveness is inherently multidimensional, encompassing traditional economic strength, access to services, governance quality, digital connectivity, and ecological sustainability. The Regional Attractiveness Index, as developed in MOBI-TWIN, embodies this complexity. It synthesises indicators across traditional, digital, and green domains, capturing how

different regional attributes interact to affect a region's ability to attract and retain people, talent, and investment.

This multidimensional view is reinforced by recent work in regional innovation and economic geography. Eder (2019), for instance, challenges the classical core–periphery model by introducing the concept of peripheralization, which integrates not only geographical and demographic factors, but also economic and knowledge-based dimensions. His typology of Austrian regions demonstrates that peripheral regions can vary substantially in their innovation potential, especially when differentiated knowledge bases—analytical, synthetic, and symbolic—are considered. The combination of these knowledge bases, Eder argues, results in higher innovation output and suggests that peripheral regions may thrive under the right structural and institutional conditions.

This mirrors findings in the literature on regional innovation systems (Asheim & Gertler, 2005; Tödtling & Trippl, 2005), which have also advocated for moving beyond binary classifications. Eder's framework aligns closely with the principles of the RAI, which recognises that regional performance is shaped not solely by geographic centrality, but by complex, interdependent factors such as industrial structure, demographic trends, institutional capacity, and environmental adaptation. His work affirms that a region's attractiveness and development prospects must be evaluated through a multidimensional lens.

Ultimately, moving from a continuum model to a multidimensional typology enhances both explanatory and prescriptive power. It avoids the pitfalls of overgeneralization and supports targeted, evidence-based regional policies. In both rural typology and regional attractiveness analysis, acknowledging complexity is a prerequisite for effective spatial planning.

3.2. CLUSTERING TECHNIQUES

Cluster analysis refers to a family of statistical methods used to group a set of units—such as NUTS2 regions, as in our case—into mutually exclusive clusters based on shared characteristics. The fundamental objective of clustering is to maximize similarity within clusters and minimize similarity between clusters, thereby uncovering latent structures in multivariate data. This technique is particularly valuable for exploratory research and typology construction, as it facilitates dimensionality reduction and helps identify meaningful groupings that may not be evident through direct observation.

There are various clustering algorithms, each with distinct assumptions and applications. Traditional approaches include hierarchical methods (agglomerative or divisive) and non-hierarchical algorithms such as K-Means, often based on distance measures like Euclidean or Manhattan metrics. The choice of algorithm should reflect the nature of the input variables—quantitative or categorical—as well as their distributional properties.

An essential first step in cluster analysis is the selection of appropriate input variables. Using highly correlated indicators can distort results by overemphasising certain dimensions, so variable selection should aim to balance discriminatory power and dimensional coverage. Equally important is the validation of the resulting classification. While there is no universally correct clustering, well-formed solutions should exhibit clear internal consistency and external validity, often assessed through measures of inter-cluster variance and silhouette scores. Cluster analysis is thus not only a tool for categorising cases, but also a method for hypothesis generation and typology refinement. When used carefully, it reveals insights into spatial patterns and functional distinctions between regions, supporting comparative analysis and targeted policy design.

In situations where the complexity of regional characteristics defies simple binary classifications, fuzzy clustering techniques offer a more nuanced approach to typology construction. Unlike hard clustering, where each region is assigned to a single group, fuzzy clustering allows for partial membership in multiple clusters, better reflecting overlapping regional traits. The fuzzy c-means (FCM) algorithm, developed by Bezdek (1981), iteratively adjusts cluster centers and membership grades to minimize distances between data points and centers, weighted by degree of membership (Topaloglou et al., 2005). This approach seeks to minimize intra-cluster variation while maximizing differences between clusters (Rogerson, 2001).

Fuzzy clustering creates interpretable cluster centers for each variable, allowing analysts to identify which attributes most strongly define each group. Evaluation criteria such as the partition coefficient, classification entropy, and proportion exponent help assess the reliability and clarity of the clustering structure (Chiu, 1994; Photis & Manetos, 2003). Given the multidimensional nature of regional attractiveness—spanning economic, digital, and environmental factors—fuzzy clustering is especially suited to typology development. As shown in Topaloglou et al. (2005), applying this technique to EU border regions helped capture their diverse and overlapping characteristics more effectively than rigid classification schemes.

To develop a robust and interpretable regional typology, we employed a multi-stage clustering approach combining hierarchical, non-hierarchical, and fuzzy techniques. This sequence allowed for both exploratory insight and confirmatory precision, ensuring a well-grounded classification based on the multidimensional indicators of regional attractiveness. In the first stage, we applied an exploratory hierarchical cluster analysis using Ward's method and Euclidean distance. This approach allowed us to explore the data structure without predefining the number of clusters. The resulting dendrograms provided a visual representation of agglomeration patterns and supported the identification of the optimal number of clusters. This decision was guided by standard criteria such as jumps in fusion coefficients and the visual clarity of cluster separation. In the second stage, we implemented a K-Means clustering algorithm to refine the classification using the optimal number of clusters derived from the hierarchical stage. K-Means offers computational efficiency and stable results for larger datasets. This step enabled us to fine-tune the grouping of regions based on proximity to centroid values, producing clearly defined and non-overlapping clusters. In the third and final stage, we applied a fuzzy approach to capture the inherent ambiguity and overlap in regional characteristics. The fuzzy indicators assign each region a degree of membership in multiple clusters, offering a more realistic view of multidimensional territorial identities. This method is particularly suited for contexts like regional attractiveness, where economic, institutional, and environmental factors may intersect in ways not easily reducible to rigid categories.

The combination of these methods allows us to balance exploratory flexibility with analytical rigor. Hierarchical clustering provided the initial structure, K-Means ensured replicability and precision, and fuzzy techniques introduced interpretative depth. This hybrid approach aligns with best practices in regional typology research and enhances the policy relevance of the resulting classifications.

4. TYPOLOGY CLASSIFICATION AND PROFILES

4.1. EXPLORATORY ANALYSIS

We begin by examining the variables that underpin the concept of Regional Attractiveness. The first step involves selecting the clustering variables to be included in the analysis. It is advisable to avoid using an excessive number of clustering variables, as this increases the likelihood that they will no longer be sufficiently dissimilar. A high degree of collinearity between variables diminishes their ability to distinguish between groups. For example, if highly correlated variables (e.g. with a correlation of around 0.90) are included in the cluster analysis, the specific dimensions they represent may become overrepresented in the resulting clusters.

As mentioned in the previous section, the RAI is structured around three main dimensions: traditional, digital, and green. Deliverable 2.2 developed a composite indicator based on a structural composition grounded in theoretical considerations. While this approach may be appropriate in ensuring the coherence of the index, it is worth noting that a strong correlation exists between its key dimensions. For the most recent year available, 2022, the cross-sectional correlation between the index of traditional attractiveness factors and that of the digital dimension is notably high, at 0.722. By contrast, the correlation of the green index with the other two dimensions does not exceed 0.35. To reduce the correlation between dimensions—and thereby enhance the discriminatory power of the data—we have chosen to conduct a Principal Components Analysis (PCA) using all variables associated with regional attractiveness. Although we maintain our confidence in the composite index of attractiveness, for the purpose of cluster analysis, we consider this approach—widely used in the literature—as the preferred option.

The data considers a list of indicators over EU NUTS2 regions over the 2010-2022 period. The original [Table 4.1](#) displays the descriptive statistics of all considered variables defining Regional Attractiveness.

Table 4. 1. Descriptive statistics and values for standardization of indicators

<i>Variable</i>	<i>Mean</i>	<i>SD</i>	<i>Min</i>	<i>Q1</i>	<i>Q2</i>	<i>Q3</i>	<i>Max</i>
<i>Employment rate</i>	75.13	7.44	46.20	72.10	76.60	80.10	89.70
<i>GDP pc</i>	33968.4	13200.1	14100.0	25000.0	31500.0	39700.0	101200.0
<i>Share of industry</i>	19.92	7.97	4.17	13.92	20.32	25.13	54.13
<i>Share of services</i>	21.33	5.94	7.75	17.42	21.26	24.62	47.73
<i>Tourists per 100k</i>	2.49	2.61	0.35	1.20	1.83	2.77	21.92
<i>Tertiary students</i>	33.32	10.38	13.70	26.00	32.40	40.70	62.10
<i>Physicians per 100k</i>	407.4	113.1	105.8	332.6	398.5	455.0	827.0
<i>Housing cost overburden rate</i>	9.02	5.36	2.30	6.00	7.40	10.40	31.40
<i>Robberies per 100k</i>	38.90	45.90	2.23	11.34	26.15	48.18	380.90
<i>Institutional Quality</i>	0.14	1.01	-2.16	-0.68	0.28	0.97	2.55
<i>Cooling degree days</i>	138.68	170.65	0.00	24.82	47.28	210.99	841.72
<i>Heating degree days</i>	2442.2	901.9	103.3	1904.9	2478.4	2951.9	6015.3
<i>Air quality</i>	10.68	3.51	3.65	8.47	9.91	12.80	23.14
<i>Broadband coverage</i>	89.68	4.73	73.50	86.90	89.70	92.54	100.00
<i>High Tech employment</i>	4.32	2.47	0.90	2.50	3.80	5.60	13.60
<i>Use of internet: private</i>	59.95	20.18	10.46	46.89	59.60	76.58	94.35
<i>Use of internet: public</i>	60.84	18.79	12.94	48.89	60.31	74.44	95.88
<i>Use of internet: banking</i>	89.70	5.45	73.29	86.61	91.01	93.38	98.99
<i>Use of internet: selling</i>	19.01	9.68	2.45	12.36	17.02	24.97	50.17
<i>GHG emissions</i>	14966.3	12097.1	86.3	6960.0	11856.0	18913.1	66938.9
<i>Circular employment</i>	891.7	511.1	156.9	575.6	773.5	1119.9	4228.4
<i>Wages in mining</i>	2.91	5.16	0.00	0.65	1.47	3.06	49.63
<i>Agricultural Share</i>	2.75	2.48	0.00	0.90	1.99	3.78	11.95
<i>Tourism over GDP ratio</i>	116.52	126.72	2.27	45.47	77.05	131.03	1006.13

Using this list of variables, we perform the PCA. The scree plot of the analysis is presented in [Figure 4.1](#). Up to six components have an eigenvalue greater than one, collectively accounting for 71.6% of the total variance. The first two principal components explain 30% and 15% of the variance, respectively. [Figure 4.2](#) shows the loading plot of the rotated first two components, while [Table 4.2](#) presents their correlation with the attractiveness variables. Although a detailed interpretation of these components is not required for our purposes, we briefly outline the main results below.

Figure 4. 1. Scree plot of the PCA analysis of regional attractiveness factors.

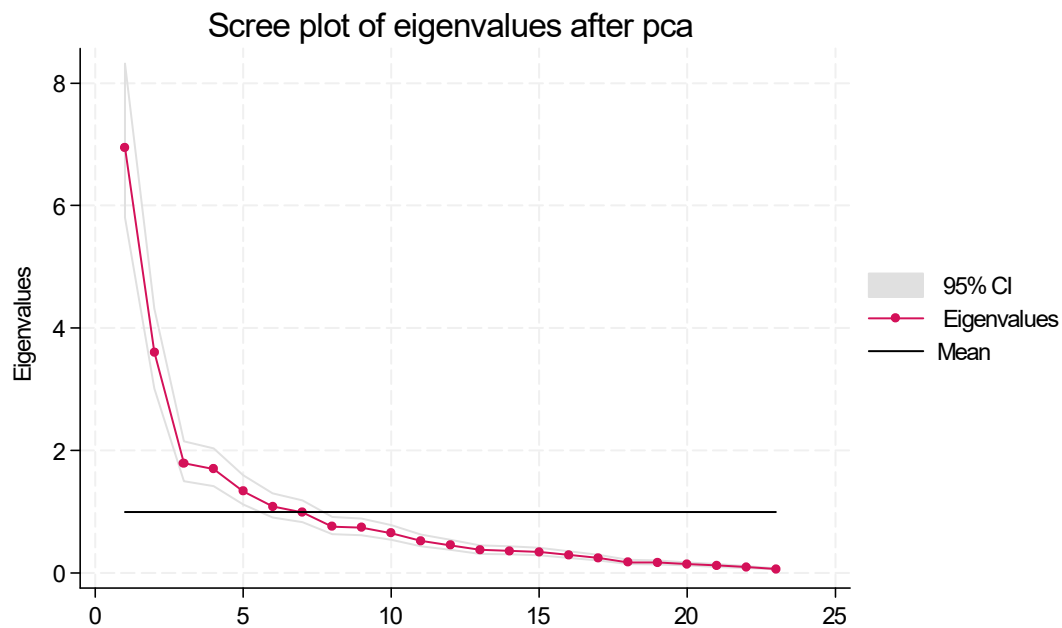
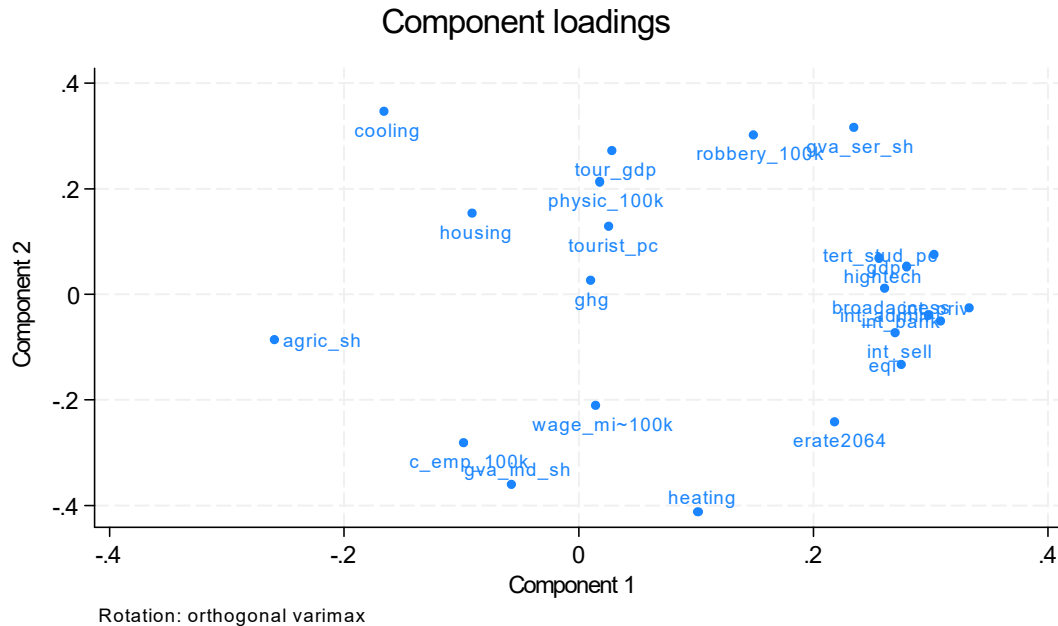


Figure 4. 2. Loading plot of the first two principal components



Component 1 – Advanced Socioeconomic and Digital Integration: This component explains approximately 30% of the total variance, making it the dominant dimension in the analysis. It characterizes regions with elevated GDP per capita, high-quality

institutions, significant tertiary student populations, extensive broadband access, and robust digital engagement. The emphasis on digital and educational attributes strongly suggests regions well-integrated into advanced socioeconomic networks, reflecting an overall profile of economic prosperity and technological sophistication.

Component 2 – Climatic and Sectoral Structure: The second component accounts for about 15% of the variance, underscoring notable climatic and structural economic distinctions. Regions positively scoring on this factor typically experience higher cooling degree days and economies oriented towards services and tourism. Conversely, areas negatively associated with this component display colder climates (high heating degree days) and industrial economic profiles. Thus, this component clearly distinguishes between regional economies shaped by climate and economic specialization.

Component 3 – Innovation and Environmental Efficiency: Explaining around 8% of total variance, this dimension captures regions combining strong innovative capacities, as indicated by high-tech employment, with favourable environmental outcomes such as improved air quality and lower greenhouse gas emissions. The positive correlation with healthcare infrastructure further illustrates broader social benefits accompanying innovation-led development, highlighting environmentally conscious, knowledge-intensive regional profiles.

Component 4 – Public Services and Environmental Stress: Component four explains approximately 7.3% of variance and is characterized by regions with robust public service provision, notably healthcare and affordable housing challenges, juxtaposed with environmental stress indicators such as reduced tourism reliance and lower greenhouse gas emissions. This dimension emphasizes urban-type regions managing advanced public services alongside ecological pressures and infrastructure burdens.

Component 5 – Tourism and Resource-Intensive Economies: Representing about 5.7% of total variance, this component highlights regional economies heavily reliant on tourism, as indicated by high tourist numbers and a substantial tourism-to-GDP ratio. The associated high mining wages underscore the coexistence of tourism with resource-intensive economic activities. Consequently, this factor identifies regions leveraging both scenic assets and resource extraction sectors, reflecting diverse yet complementary economic structures.

Component 6 – Circular Transition and Environmental Governance: Explaining roughly 4.9% of variance, the final component identifies regions undergoing a transition towards circular economy sectors, indicated by strong employment in

related activities and good air quality. However, a negative correlation with institutional quality suggests governance constraints or ongoing institutional transitions. Positive loadings for digital infrastructure further underline a dual transition—ecological and digital—in contexts of institutional challenge.

Table 4. 2. Correlation matrix between the attractiveness variables and the PCA results

Variable	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6
<i>GDP pc</i>	0.272	0.052	0.252	0.180	0.079	-0.030
<i>Employment rate</i>	0.215	-0.242	0.127	0.119	0.093	-0.128
<i>Share of industry</i>	-0.056	-0.363	0.200	-0.124	0.041	-0.153
<i>Share of services</i>	0.227	0.316	0.099	-0.001	-0.075	-0.038
<i>Tourists per 100k</i>	0.032	0.133	-0.326	0.260	0.433	0.059
<i>Tertiary students</i>	0.295	0.075	0.067	0.097	-0.088	0.173
<i>Physicians per 100k</i>	0.013	0.211	0.268	0.442	0.139	0.126
<i>Housing cost overburden rate</i>	-0.090	0.153	0.025	0.332	0.079	-0.307
<i>Robberies per 100k</i>	0.145	0.302	0.033	-0.181	0.103	0.003
<i>Institutional Quality</i>	0.281	-0.127	-0.111	0.014	0.158	-0.411
<i>Cooling degree days</i>	-0.166	0.346	-0.103	-0.012	-0.013	0.249
<i>Heating degree days</i>	0.103	-0.413	0.086	0.097	0.134	0.077
<i>Air quality</i>	-0.184	-0.032	0.366	-0.110	-0.191	0.319
<i>Broadband coverage</i>	0.251	0.010	0.048	-0.169	-0.171	0.247
<i>High Tech employment</i>	0.244	0.065	0.360	0.171	-0.144	0.179
<i>Use of internet: private</i>	0.298	-0.036	-0.275	-0.027	-0.057	0.105
<i>Use of internet: public</i>	0.306	-0.048	-0.242	-0.070	-0.066	0.191
<i>Use of internet: banking</i>	0.330	-0.023	-0.043	-0.043	0.035	0.015
<i>Use of internet: selling</i>	0.267	-0.070	-0.223	-0.171	-0.199	0.052
<i>GHG emissions</i>	0.002	0.022	0.322	-0.523	0.324	-0.081
<i>Circular employment</i>	-0.091	-0.280	-0.137	0.168	0.238	0.507
<i>Wages in mining</i>	0.015	-0.211	0.096	-0.005	0.395	0.235
<i>Agricultural Share</i>	-0.251	-0.085	-0.265	-0.045	-0.176	0.052
<i>Tourism over GDP ratio</i>	0.026	0.272	-0.053	-0.319	0.469	0.109

4.2. DECISION OF THE NUMBER OF CLUSTERS

The next step in the analysis involves performing hierarchical clustering. Single linkage and complete (multiple) linkage methods represent two opposite approaches in hierarchical clustering, differing primarily in how they measure the distance between clusters. Single linkage clustering calculates the distance between clusters based on the minimum distance among their individual observations. Consequently, it focuses on the closest pairs of points, often producing elongated, loosely structured clusters or chain-like patterns. While it can identify clusters linked by narrow paths and detect outliers, it can also merge clusters prematurely, creating less distinct or meaningful groupings. In contrast, complete linkage clustering defines the distance between clusters as the maximum distance between observations in different clusters. This approach prioritizes compactness and internal cohesion, resulting in tighter and more clearly separated clusters. However, it can be overly sensitive to outliers and may lead to excessively fragmented groupings, as it requires high internal similarity before merging clusters. The Ward's linkage method provides an alternative that seeks to minimize within-cluster variance. By focusing on clusters' internal homogeneity,

Ward's method effectively balances the limitations inherent in single and complete linkage approaches, producing groupings that are both cohesive and interpretable.

[Figure 4.5](#) displays the dendrogram generated by Ward's linkage. Compared to the chain-like clusters produced by single linkage ([Figure 4.3](#)) and the fragmented structure typical of complete linkage ([Figure 4.4](#)), Ward's dendrogram yields clearly defined, balanced clusters that optimize within-group similarity. This balanced structure facilitates better identification and interpretation of distinct regional typologies, making Ward's linkage the preferred clustering method for subsequent analyses.

Figure 4. 3. Dendrogram of Single Linkage. First 30 groups.

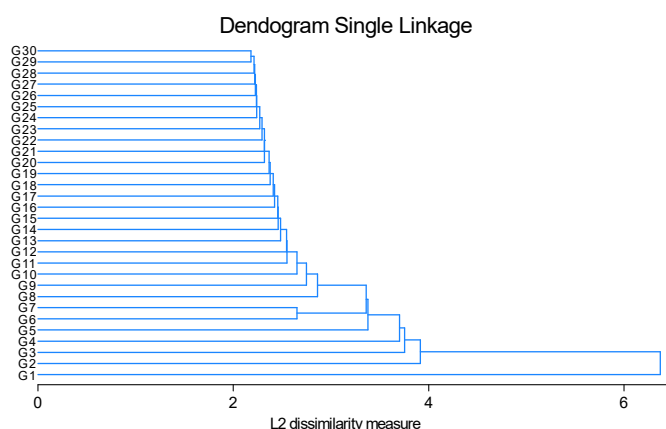


Figure 4. 4. Dendrogram of Complete Linkage. First 30 groups.

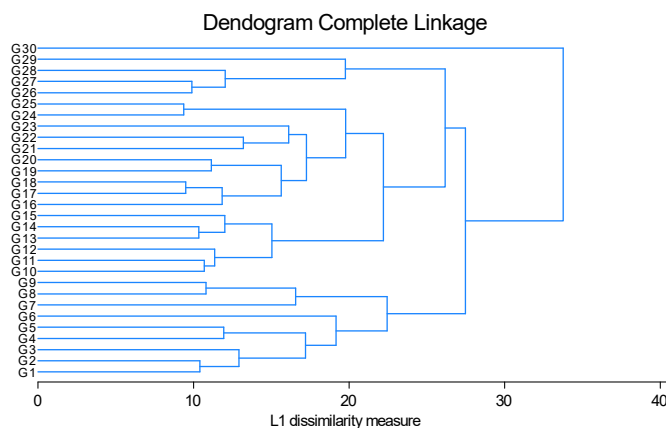
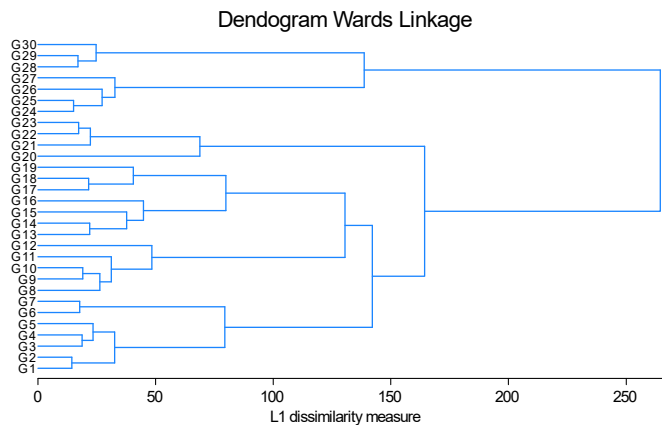


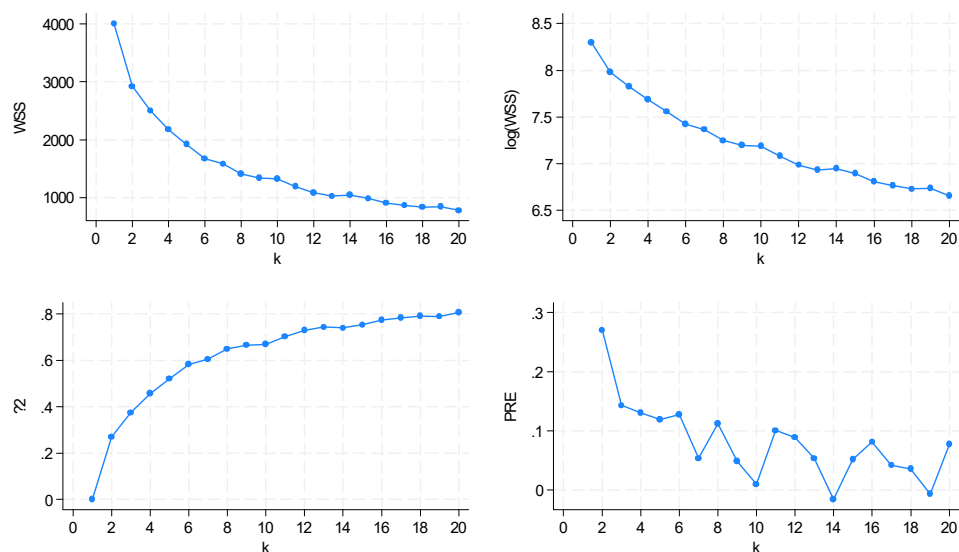
Figure 4. 5. Dendrogram of Wards Linkage. First 30 groups.



Once the clustering method has been selected, the next step is to determine the optimal number of clusters. This decision is not purely statistical; it also involves balancing interpretability, empirical coherence, and analytical utility. Various approaches exist for identifying the appropriate number of clusters, each with its own advantages. Next, we explore the most robust criteria to guide this decision, ensuring that the resulting typology is both meaningful and methodologically sound.

To support this decision, we computed and examined four classic clustering evaluation metrics across a range of potential cluster solutions ($k = 2$ to 20): the Within-Cluster Sum of Squares (WSS), the logarithmic transformation of WSS ($\log(WSS)$), the proportion of variance explained (η^2), and the Proportional Reduction of Error (PRE). Each of these metrics, displayed in [Figure 4.6](#), provides complementary insight into the clustering structure and helps to balance between parsimony and explanatory richness.

Figure 4. 6. Diagnostic measures for determining the optimal number of clusters.



The WSS and $\log(\text{WSS})$ plots suggest an elbow around $k = 6$, indicating that the inclusion of additional clusters beyond this point yields diminishing returns in terms of reducing within-cluster heterogeneity. Similarly, the η^2 curve showed a marked increase up to $k = 6$, after which the incremental gain in explained variance begins to taper off. These indicators would typically suggest a preference for a six-cluster solution. However, further consideration was given to the PRE plot and, importantly, the structure of the dendrogram generated by Ward's method (Figure 4.5). The dendrogram provides a hierarchical representation of the clustering process and offers valuable qualitative insights into the natural grouping of the observations. Upon inspection, the dendrogram displays a noticeable branching structure that supports a six-cluster configuration: the vertical distances (dissimilarity levels) at which merges occur suggest that a cut at the six-cluster level would respect the most meaningful divisions in the data, without over-fragmenting the sample.

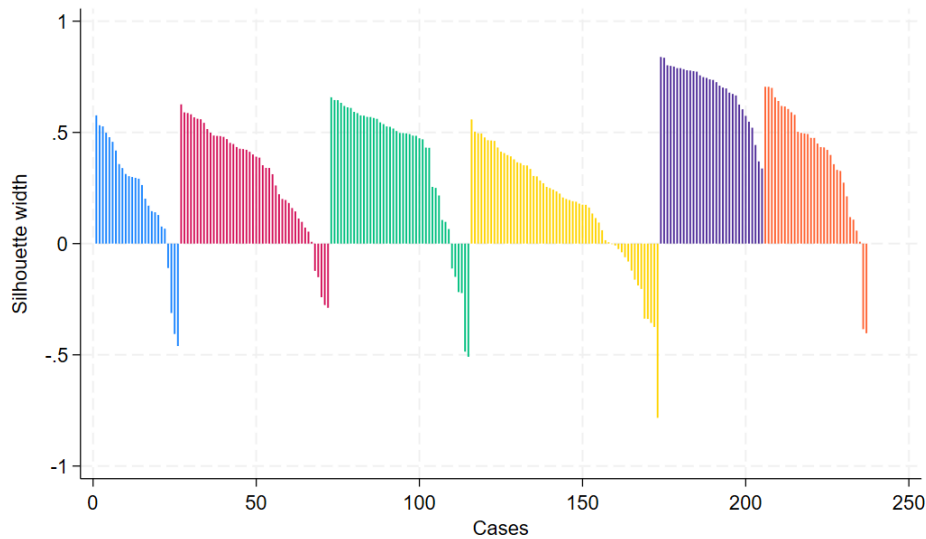
Moreover, the six-cluster solution balances granularity and interpretability: while fewer clusters (e.g. four) may simplify the typology, they risk masking relevant distinctions between regional profiles. Conversely, a solution with a significantly higher number of clusters may overfit the data and reduce analytical clarity. The six-cluster configuration therefore emerges as a reasoned compromise, grounded in both statistical diagnostics and structural visualisation.

In line with standard practice in regional typology analysis, the selected number of clusters is not intended to be a definitive or universal classification, but rather a useful analytical tool tailored to the aims of this study. By adopting a multi-criteria decision-making approach—incorporating both quantitative and qualitative assessment—we ensure that the resulting typology is both methodologically robust and conceptually meaningful.

4.3. FUZZY MEMBERSHIP APPROACH

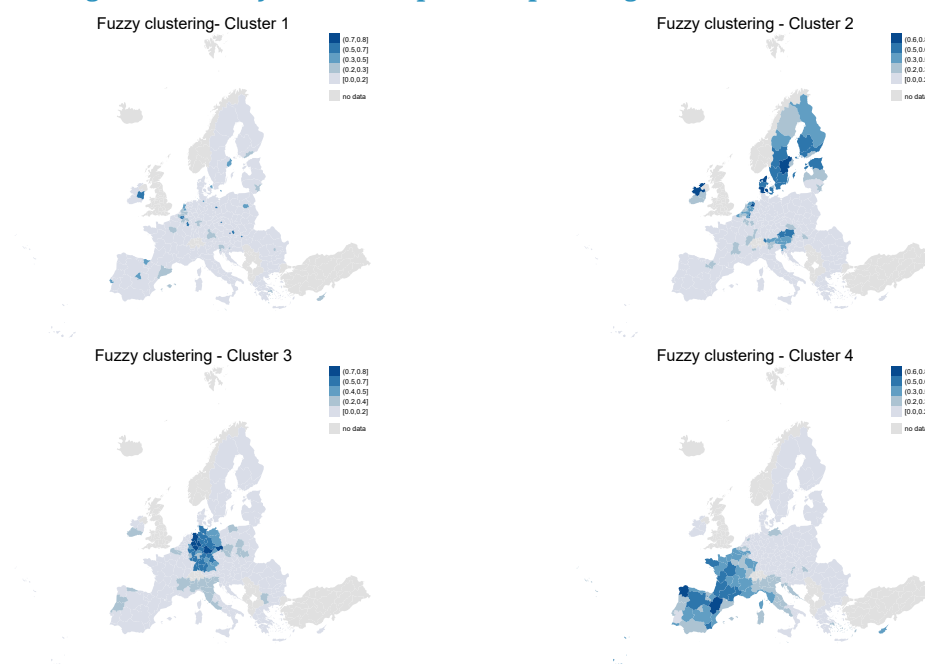
To address the limitations of hard clustering and better capture transitional regional profiles, we complemented our hierarchical Ward clustering with a fuzzy-like membership approach. While the Ward method assigns each region exclusively to one cluster, the silhouette plot revealed that a number of regions exhibit low or even negative silhouette widths (see [Figure 4.7](#)), suggesting that they do not clearly belong to any single cluster. This ambiguity indicates the need for a more nuanced representation of cluster affiliation.

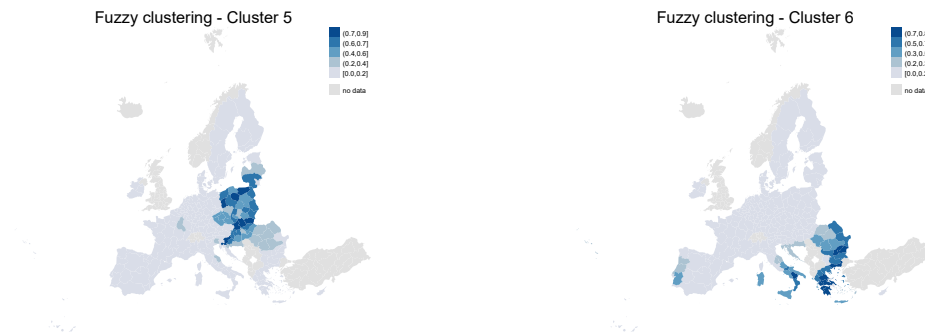
Figure 4. 7. Silhouette plot - 6 clusters result.



To explore the heterogeneity of regional profiles more flexibly, we implemented a distance-based fuzzy clustering approximation. This method relied on computing the Euclidean distance between each region and the centroids of the six previously defined clusters, based on their positions along the first six principal components (PC1 to PC6). Each region's similarity to a given cluster was calculated as the inverse squared distance to that cluster's centroid. These similarity scores were then normalised across all clusters, producing a fuzzy membership matrix in which each region received a value between 0 and 1 for each cluster, with all values summing to one. [Figure 4.8](#) (panels a to f) displays the fuzzy membership of each region to every cluster.

Figure 4. 8. Fuzzy membership of European Regions to the defined Clusters.





This fuzzy approach revealed important nuances that would remain hidden in a traditional hard clustering setting. It uncovered both clearly defined regional profiles, where membership in a single cluster dominates, and ambiguous or hybrid cases, where regions exhibit meaningful affiliations with multiple clusters. To better capture this ambiguity, we computed an uncertainty index for each region, defined as one minus the highest membership value across all clusters. [Figure 4.9](#) and [Figure 4.10](#) displays the statistical and geographic distribution of the uncertainty measure. The resulting uncertainty index serves to highlight borderline regions—those lacking a clear cluster identity—which may merit differentiated policy attention or further investigation. The analysis of fuzzy uncertainty across European regions provides insights into the robustness and clarity of regional classification based on fuzzy cluster membership scores. The geographical distribution map clearly highlights variations in uncertainty, with several regions in Northern Europe, parts of Spain, Southern France, Italy, and Eastern European areas displaying higher uncertainty. In contrast, regions scattered throughout Central and Eastern Europe exhibit lower uncertainty, indicating clearer cluster assignments.

Complementing this geographical distribution, the boxplot detailing fuzzy uncertainty scores across the six defined clusters further elaborates on these patterns. Cluster 4 demonstrates the highest median uncertainty, reflecting substantial ambiguity in regional memberships. This ambiguity suggests that Cluster 4 might represent diverse regional characteristics that are less distinctly classified by current variables. Clusters 1 and 2 also show relatively high median uncertainty, indicating significant ambiguity and the need for further exploration and refinement. Clusters 3, 5, and 6 display moderate to lower median uncertainty, indicating clearer and more stable classifications. The narrower interquartile range in Cluster 5 particularly underscores consistent and robust regional typologies within this cluster.

Overall, these visualisations suggest caution in interpreting the clustering results, particularly for those clusters exhibiting higher uncertainty such as Cluster 4,

highlighting the importance of carefully considering regional typologies before drawing definitive conclusions.

Figure 4. 9. Fuzzy uncertainty. Statistic.

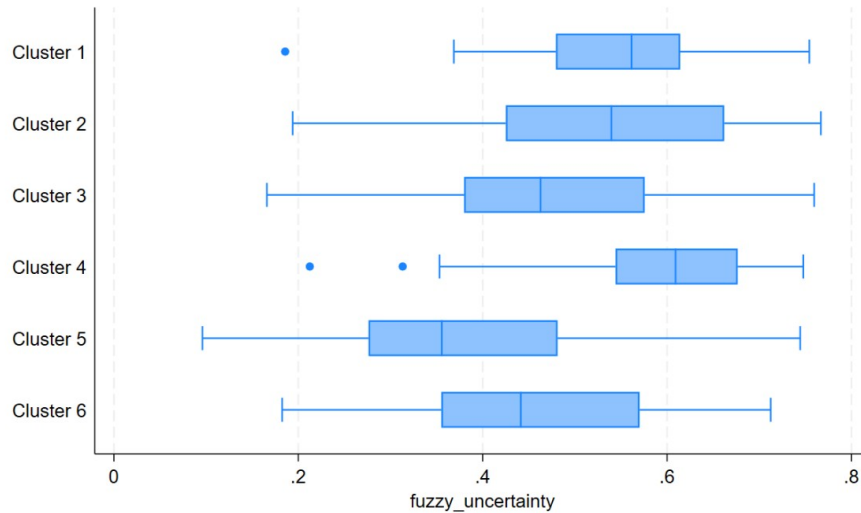
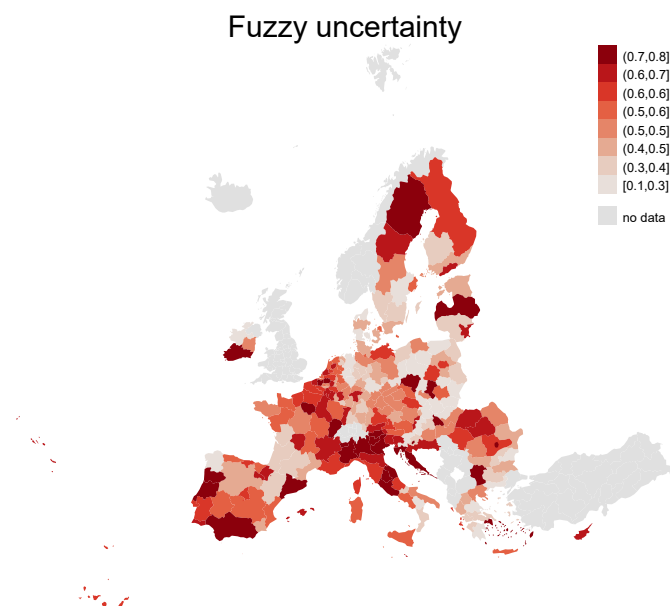


Figure 4. 10. Fuzzy uncertainty. Geographic distribution.



According to the list of conflicting fuzzy uncertainty, we found 36 regions with a distance between the first and the second assigned cluster being lower than 0.05 or with an uncertainty measure above 0.70. [Table 4.3](#) presents detailed information on the fuzzy cluster assignments for the selected NUTS2 regions, focusing on the two clusters with the highest membership values for each case. For each region, the table shows the maximum fuzzy membership score, the corresponding cluster, the second-highest score and its associated cluster, the distance between them, and the uncertainty measure. These two measures, the distance and the uncertainty, provides a simple yet effective measure of classification ambiguity: the smaller the gap between the two top scores, the

more uncertain the assignment. As shown, most regions exhibit a degree of ambiguity in cluster allocation that warrants cautious interpretation. This is particularly relevant in regions like BE21 (Antwerpen) or PL22 (Slaskie), where the closeness of the top two membership values indicates a more blended regional profile. Such cases underline the importance of complementing clustering results with qualitative assessments or sensitivity analyses to ensure robust territorial interpretations.

The next and final step consists on inspecting the regional attractiveness of the selected regions and their relative position within the clusters. The final decision of the assignment of every region to a cluster is based on the initial assignment of the clustering method and how close is the Regional Attractiveness Index of every region to the average RAI of every initial cluster. The final assignment is made by expert judgement.

Table 4. 3. Fuzzy Cluster Assignments and Uncertainty Measures for Selected NUTS2 Regions

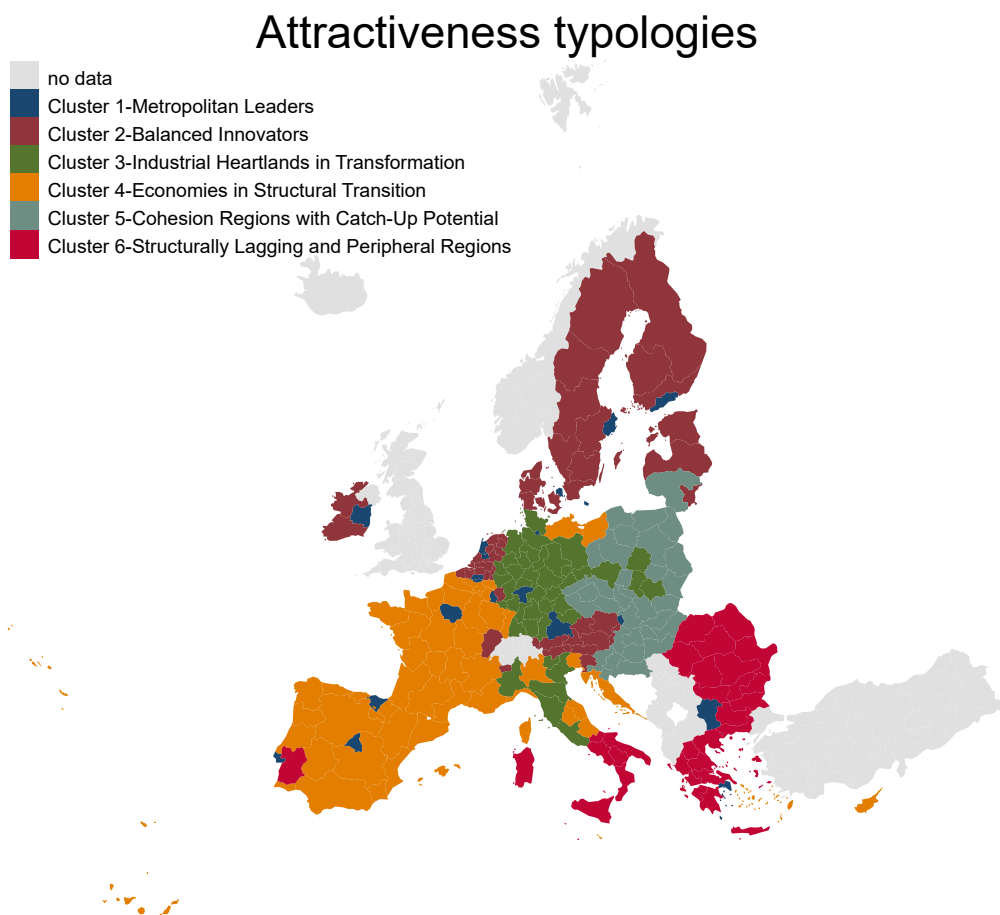
NUT S2	Region Label	1st Assigned Cluster		2nd Assigned Cluster		Distance between 1st and 2nd	Fuzzy Uncertainty.	RAI	Standardized RAI distance	
		Cluster #	Fuzzy Distance	Cluster #	Fuzzy Distance				1st cluster	2nd cluster
SE33	Övre Norrland	2	0.233	5	0.183	0.050	0.767	80.7	0.51	1.70
ITH1	Provincia Autonoma di Bolzano/Bozen	2	0.237	4	0.211	0.026	0.763	70.1	-1.71	1.54
ITC2	Valle d'Aosta/Vallée d'Aoste	2	0.237	4	0.215	0.022	0.763	73.4	-1.01	1.98
PL22	Śląskie	5	0.240	3	0.234	0.007	0.760	45.9	-2.38	-2.28
EL30	Attiki	1	0.246	4	0.198	0.047	0.754	57.6	-2.55	-0.09
ES51	Cataluña	4	0.252	1	0.200	0.052	0.748	56.5	-0.24	-2.66
HU12	Pest	5	0.256	2	0.203	0.052	0.744	73.3	0.83	-1.04
BE21	Prov, Antwerpen	1	0.256	2	0.256	0.001	0.744	78.7	-0.56	0.09
ITI3	Marche	4	0.260	5	0.242	0.018	0.740	56.8	-0.20	-1.11
BG41	Yugozapaden	3	0.260	1	0.169	0.089	0.740	67.7	0.89	-1.60
ES61	Andalucía	4	0.264	3	0.171	0.093	0.736	35.1	-3.05	-3.86
ITH3	Veneto	3	0.266	4	0.264	0.002	0.734	54.6	-1.02	-0.49
ITI2	Umbria	4	0.267	6	0.247	0.021	0.733	56.9	-0.19	3.00
BE23	Prov, Oost-Vlaanderen	2	0.269	1	0.228	0.041	0.731	79.1	0.17	-0.52
IE05	Southern	3	0.275	2	0.266	0.008	0.725	93.9	4.71	3.24
PT11	Norte	4	0.276	3	0.254	0.021	0.724	59.1	0.11	-0.35
ITI4	Lazio	4	0.278	3	0.200	0.078	0.722	58.0	-0.04	-0.52
ITC4	Lombardia	3	0.279	4	0.206	0.073	0.721	52.9	-1.27	-0.72
FR10	Ile-de-France	1	0.282	4	0.215	0.068	0.718	73.0	-1.10	1.93
PT16	Centro (PT)	4	0.283	6	0.219	0.064	0.717	58.2	-0.01	3.22
ITH2	Provincia Autonoma di Trento	4	0.284	3	0.198	0.086	0.716	68.5	1.34	1.01
FRC2	Franche-Comté	4	0.285	2	0.265	0.020	0.715	71.7	1.76	-1.36
RO32	București-Ilfov	1	0.287	3	0.185	0.102	0.713	78.4	-0.59	2.45
EL42	Notio Aigaio	6	0.288	4	0.210	0.077	0.712	50.1	1.88	-1.08
HR03	Jadranska Hrvatska	4	0.292	6	0.194	0.098	0.708	57.5	-0.11	3.10
HR05	Grad Zagreb	1	0.293	3	0.174	0.119	0.707	80.8	-0.36	2.80

D2.3 TYPOLOGIES OF EU REGIONS (RAI)

<i>LV00</i>	Latvija	2	0.295	5	0.271	0.024	0.705	71.5	-1.41	0.62
<i>PL51</i>	Dolnośląskie	5	0.295	3	0.280	0.015	0.705	59.8	-0.75	-0.26
<i>ITC1</i>	Piemonte	3	0.296	4	0.233	0.063	0.704	55.4	-0.89	-0.38
<i>ES23</i>	La Rioja	4	0.309	2	0.269	0.040	0.691	68.0	1.27	-2.13
<i>LT01</i>	Sostinės regionas	1	0.311	2	0.267	0.044	0.689	88.5	0.36	2.11
<i>PT20</i>	Região Autónoma dos Açores	6	0.311	4	0.283	0.028	0.689	54.3	2.58	-0.52
<i>DE71</i>	Darmstadt	3	0.314	1	0.293	0.021	0.686	75.3	2.00	-0.88
<i>FI1B</i>	Helsinki-Uusimaa	1	0.314	2	0.307	0.007	0.686	94.9	0.97	3.43
<i>BE34</i>	Prov, Luxembourg (BE)	2	0.330	4	0.292	0.038	0.670	68.7	-1.98	1.37
<i>RO11</i>	Nord-Vest	5	0.356	6	0.310	0.046	0.644	46.5	-2.31	1.29

These reclassifications, grounded in a distance-based threshold, fuzzy uncertainty measure, and expert judgement improve the coherence of the typology by aligning each region with the cluster whose centroid it most closely resembles, helping to resolve uncertainty and enhance interpretative clarity. [Figure 4.11](#) displays the map of the regionally typologies. Appendix 1 reports the full list of regions and the corresponding cluster.

Figure 4. 11. Regional Clusters of Attractiveness in the EU (Ward's Method, k = 6).



4.4. CLUSTERS DESCRIPTION

Following the application of Ward's hierarchical clustering algorithm and the selection of a six-cluster solution—supported by diagnostic indicators and dendrogram structure—a comprehensive typology of European regions was established. This subsection describes in detail the regional typologies.

[Figure 4.12](#) displays the dendrogram of the 6 groups option. It displays a well-balanced hierarchical structure, with a clear visual justification for the selection of six clusters. The vertical distances at which branches merge reveal natural groupings within the data, and the cut at the six-cluster level respects these structural divisions without leading to excessive fragmentation. [Table 4.4](#) shows the distribution of regions by cluster and country.

Notably, the clusters are relatively balanced in terms of the number of regions assigned to each, avoiding the typical pitfalls of highly asymmetric clustering solutions in which one or two dominant clusters absorb most observations while others are reduced to outliers. This balance enhances both the statistical robustness and interpretative clarity of the typology.

More specifically, while perfect symmetry is rarely expected in hierarchical clustering, the six resulting clusters display a satisfactory spread, with no cluster being excessively small (e.g. a singleton) or disproportionately large. This allows for meaningful comparison across clusters and ensures that each group retains internal coherence while being externally distinct. Such balance is particularly valuable in regional typology construction, where overly skewed cluster sizes could obscure important policy-relevant heterogeneity. The structure achieved through Ward's method thus not only optimises within-group similarity but also supports a nuanced yet manageable classification of the regions under study.

In the final distribution of clusters a clear pattern emerges in most countries, a majority (or even all) of their regions fall into the same or adjacent clusters. For example, Austria and Spain are predominantly classified into Cluster 2 (Balanced Innovators) and Cluster 4 (Economies in Structural Transition), respectively, while Romania and Greece are strongly represented in Cluster 6 (Cohesion Regions with Catch-Up Potential). This suggests that national-level factors play a key role in shaping regional attractiveness profiles.

Figure 4. 12. Dendrogram of regional clusters using ward's linkage.

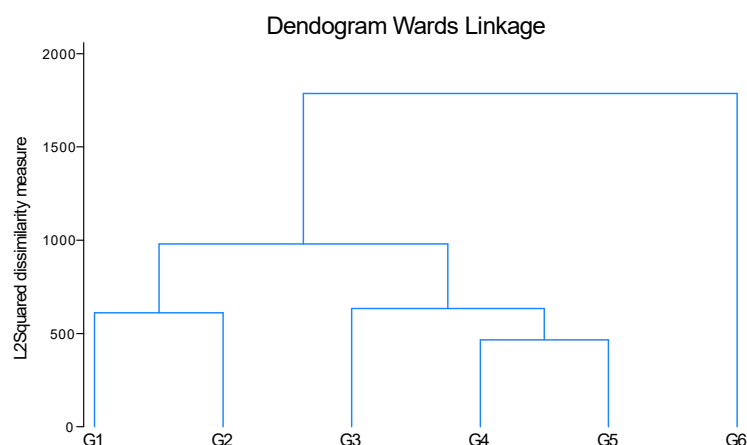


Table 4. 4. Cluster Membership of European NUTS2 Regions by Country

Country	Cluster						Region s
	1	2	3	4	5	6	
AT	11%	89%					9
BE	27%	36%		36%			11
BG	17%					83%	6
CY				100%			1
CZ	13%				88%		8
DE	11%	3%	84%	3%			38
DK	20%	80%					5
EE		100%					1
EL	8%			8%		85%	13
ES	11%			89%			19
FI	20%	80%					5
FR	5%	5%		91%			22
HR	25%			25%	50%		4
HU	13%				88%		8
IE	33%	67%					3
IT		10%	29%	29%		33%	21
LT		50%			50%		2
LV		100%					1
LU	100%						1
MT				100%			1

	%						
NL	17%	83%					12
PL	6%		24%	6%	65%		17
PT	14%			71%		14%	7
RO	13%					88%	8
SE	13%	88%					8
SI		50%			50%		2
SK	25%				75%		4
All countries	11%	20%	18%	24%	14%	13%	237
# Regions	27	47	42	58	32	31	237

[Table 4.5](#) and [Figure 4.13](#) display the descriptive statistics graphical box-plot distribution of the RAI and dimensions. Overall, we can see that the six-cluster typology not only captures territorial diversity but also reflects clear performance patterns across key dimensions of regional attractiveness. Appendix 2 displays the descriptive statistics of the key variables of the analysis for every cluster.

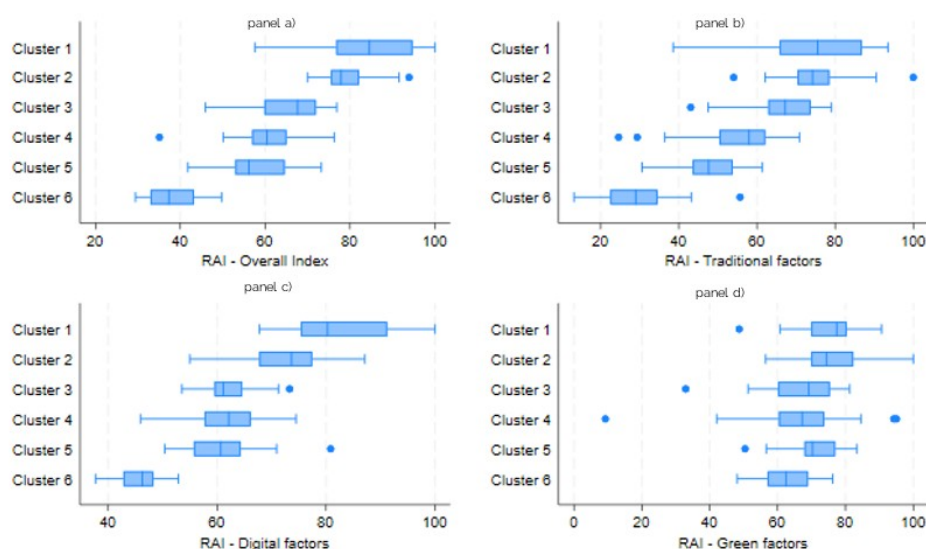
The six clusters reflect distinct territorial profiles based on their performance across traditional, green, and digital dimensions of attractiveness. Cluster 1 (Metropolitan Leaders) includes regions that act as advanced innovation hubs, with strong performance across all dimensions. Cluster 2 (Balanced Innovators) groups regions with consistently high and well-balanced scores, reflecting integrated and resilient development paths. Cluster 3 (Industrial Heartlands in Transformation) comprises manufacturing-oriented areas that, while economically solid, are adapting to the demands of digitalisation and sustainability. Cluster 4 (Economies in Structural Transition) represents intermediate regions that combine legacy strengths with emerging efforts towards modernisation. Cluster 5 (Cohesion Regions with Catch-Up Potential) features territories showing signs of green and digital progress despite weaker structural foundations. Lastly, Cluster 6 (Structurally Lagging and Peripheral Regions) encompasses areas facing persistent development challenges, often located in remote or disadvantaged contexts.

Table 4. 5. Descriptive Statistics of the Regional Attractiveness indices by Cluster

Index	Cluster	Mean	SD	Min	Q1	Q2	Q3	Max
Traditional	1	75.0	13.6	38.5	65.8	75.5	86.9	93.5
Green	1	75.3	8.7	48.7	69.9	77.5	80.4	90.6
Digital	1	82.2	9.2	67.8	75.4	80.3	91.3	100.0
Overall	1	84.2	10.6	57.6	76.8	84.6	94.8	100.0
Traditional	2	74.5	7.4	54.0	70.3	74.2	78.5	100.0
Green	2	75.8	8.7	56.5	69.9	74.4	82.3	100.0

Digital	2	72.6	6.6	55.0	67.7	73.7	77.5	87.1
Overall	2	78.7	5.2	70.1	75.5	77.9	82.2	93.9
Traditional	3	66.0	9.1	43.0	62.9	67.2	73.7	79.1
Green	3	67.2	10.0	32.9	60.2	69.2	75.4	81.2
Digital	3	61.9	4.1	53.5	59.5	61.1	64.6	73.3
Overall	3	65.9	7.2	45.9	59.8	67.7	72.0	76.9
Traditional	4	55.9	9.6	24.6	50.4	57.9	62.1	70.8
Green	4	66.3	13.0	9.2	60.3	67.3	73.7	95.0
Digital	4	61.6	6.5	45.9	57.7	62.1	66.2	74.5
Overall	4	60.9	6.8	35.1	56.9	60.4	65.1	76.3
Traditional	5	48.2	7.4	30.6	43.5	47.6	53.8	61.4
Green	5	70.5	8.2	50.4	67.9	70.3	77.0	83.4
Digital	5	60.9	6.6	50.4	55.7	60.7	64.3	80.9
Overall	5	58.3	7.6	41.8	52.9	56.2	64.6	73.3
Traditional	6	28.7	8.8	13.2	22.4	29.0	34.5	55.7
Green	6	63.0	7.2	48.1	57.1	62.5	69.0	76.2
Digital	6	45.8	3.9	37.7	42.8	46.3	48.3	52.9
Overall	6	38.4	5.8	29.4	33.0	37.3	43.3	49.7

Figure 4. 13. Regional Typology According to the Regional Attractiveness Index (RAI).



The following set of figures presents a comprehensive overview of regional attractiveness trends between 2010 and 2022, distinguished by the six clusters previously defined. [Figure 4.14](#) (panels a to d) illustrates the trajectory of the Regional Attractiveness Index and its Dimensions. The graphs reveal a clear and consistent hierarchy in regional performance over the 2010–2022 period.

Traditional factors show the most pronounced divergence. Cluster 2 scores highest throughout the period, followed closely by Cluster 1 (leading in the last years), and Cluster 3 (Industrial Heartlands in Transition). Clusters 5 and 6 display the lowest traditional performance, although improvements are observed post-2015, likely linked

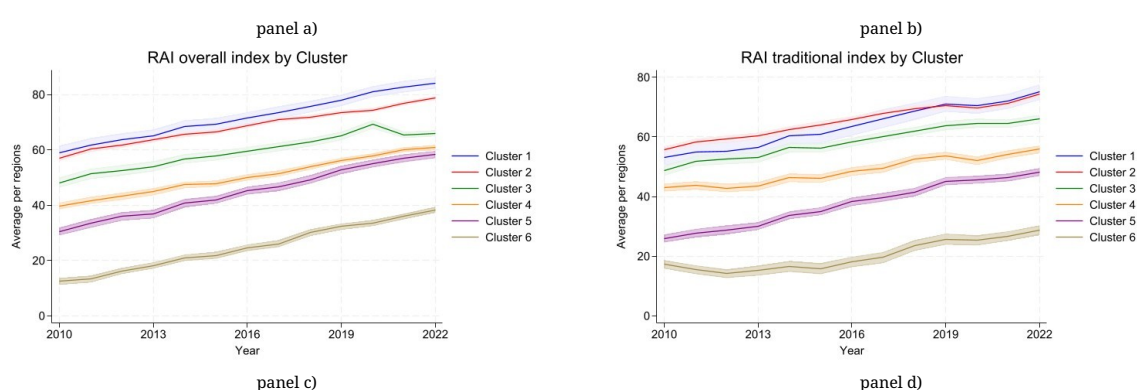
to infrastructure upgrades or broader economic recovery. Overall there is a divergence pattern, with the first two clusters (and Cluster 5, Cohesion Regions with Catch-Up Potential) growing at a faster pace.

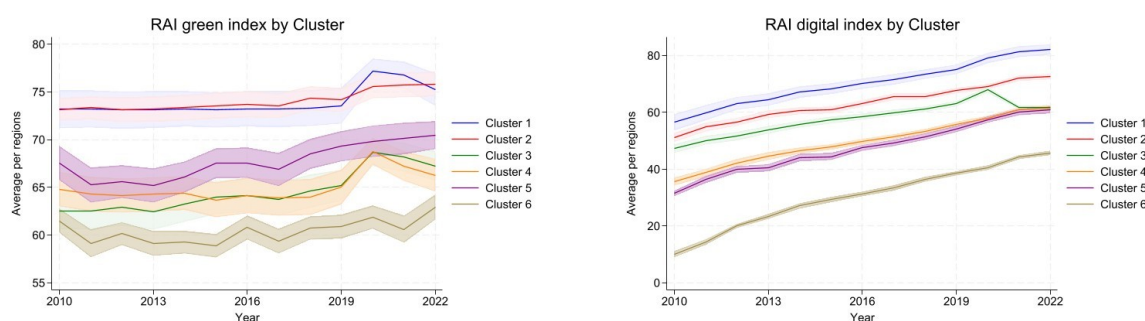
The green index shows flatter trends overall, with smaller inter-cluster gaps. Cluster 2 and Cluster 1 are again the top performers, though with less pronounced differences. Interestingly, Cluster 5 (Cohesion Regions with Catch-Up Potential) scores higher here than in other dimensions, suggesting targeted efforts or successful environmental policies. The post-2019 uptick in most clusters may reflect the temporary green stimulus during the COVID-19 recovery phase.

The digital component exhibits the steepest growth across all clusters, underscoring the accelerating impact of digitalization. Cluster 1 significantly outpaces others, followed by Cluster 2 and Cluster 3. Clusters 5 and 6 start from much lower levels but show the sharpest relative growth, indicating digital catch-up dynamics. This trend highlights the transformative potential of digital investments in bridging regional gaps.

Cluster 1 (Metropolitan Leaders) and Cluster 2 (Balanced Innovators) lead in overall attractiveness, with both showing a steady upward trend and widening their lead over other clusters. Cluster 1, in particular, consolidates its top position in 2022. Conversely, Cluster 6 (Structurally Lagging and Peripheral Regions), although it shows notable progress, consistently ranks lowest, indicating gradual relative convergence. Clusters 3–5 exhibit intermediate trajectories, with modest but positive growth.

Figure 4. 14. Trends in Regional Attractiveness Index (RAI) and Its Dimensions by Cluster (2010–2022).





Finally, we provide an overall picture of the capacity of regions—grouped by cluster—to attract new residents or retain existing ones. [Figure 4.15](#) presents a series of scatterplots comparing the Regional Attractiveness Index (RAI) on the horizontal axis with net flows of different types of spatial mobility on the vertical axis. All values correspond to averages over the considered period for every type of flow. Each region is colour-coded by cluster, allowing for a more nuanced interpretation of how regional attractiveness relates to diverse mobility patterns across the EU.

The top-left panel shows net permanent migration flows, where a clear positive relationship with the RAI is visible. Most regions in Cluster 1 (Metropolitan Leaders) exhibit positive net migration, while Cluster 6 (Structurally Lagging and Peripheral Regions) tends to experience negative net flows. This suggests that regions with higher attractiveness levels are more successful in retaining and attracting long-term residents. A similar pattern emerges for seasonal mobility (bottom-left panel), confirming the overall alignment between regional attractiveness and the ability to draw temporary or cyclical population inflows.

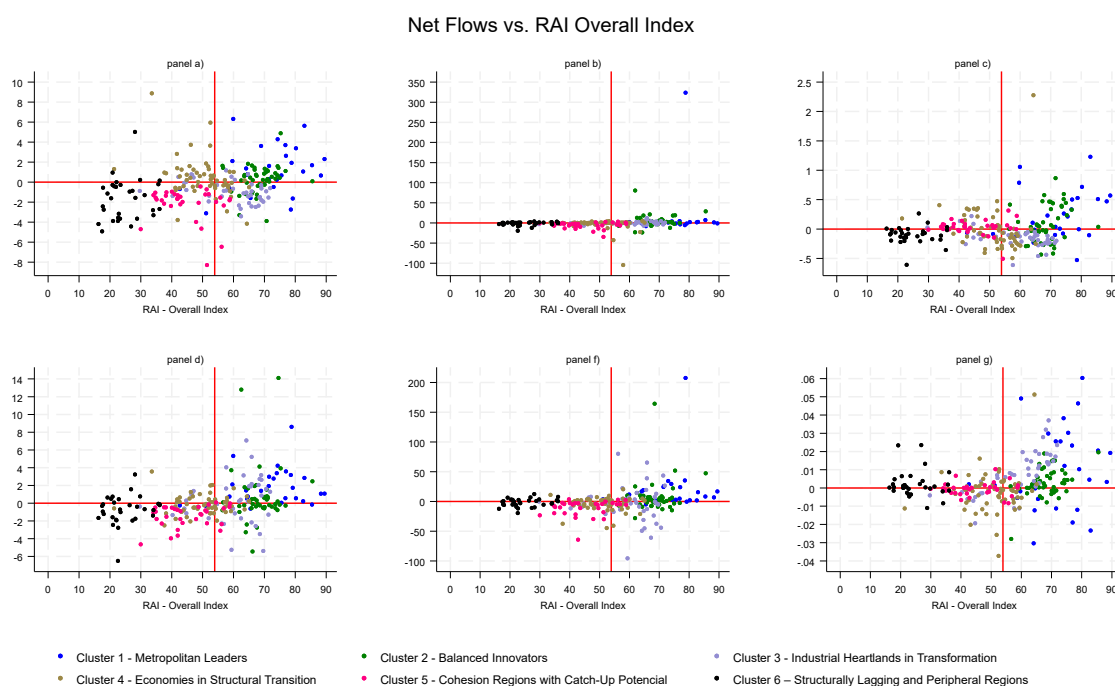
In contrast, cross-border and long-distance commuting (top and bottom centre panels, respectively) reveal a more diffuse picture, with considerable heterogeneity across clusters and individual regions. These patterns likely reflect structural factors beyond attractiveness alone, such as proximity to borders, transport infrastructure, or employment integration across regions.

The top-right panel focuses on short-term student mobility, and the bottom-right panel on long-term student mobility. In both cases, a positive relationship with the RAI is evident, indicating that more attractive regions tend to receive more incoming students. This supports the view that regional attractiveness is also linked to the ability to draw in younger, mobile populations seeking educational opportunities.

Interestingly, however, a notable number of regions from lower-performing clusters—particularly Clusters 4 and 5—register positive net student flows. This suggests that, despite their overall lower RAI scores, these regions may possess specific assets such as affordable living costs, regional universities, or emerging reputations in higher

education that make them appealing to students. These inflows could be an early sign of latent attractiveness and human capital potential that, if nurtured, may contribute to long-term regional resilience and upward mobility.

Figure 4. 15. Regional Attractiveness and Mobility Patterns: Net Flows by Cluster and Mobility Type



The overall pattern is confirmed in [Table 4.6](#), which displays the average net flows by cluster and type of mobility (Table A2.3 in Appendix 2 displays the full descriptive statistics of all flows by Cluster). The results align closely with the visual evidence from Figure 4.15. Cluster 1 (Metropolitan Leaders) consistently shows the highest positive net flows across all types of mobility, particularly in long-term commuting (15.2‰), permanent migration (0.29‰), and seasonal mobility (1.5‰), underscoring the magnetic effect of these regions. Cluster 2 (Balanced Innovators) also exhibits positive values, albeit at a more moderate level, confirming their balanced but less pronounced attractiveness.

Table 4. 6. Average Net Mobility Flows by Cluster and Type of Mobility (‰, annual averages)

	<i>Perman- ent Mobility</i>	<i>Cross- Border Commut- ing</i>	<i>Short- Term Student Mobility</i>	<i>Seasona- l Mobility</i>	<i>Long- Term Commut- ing</i>	<i>Long- Term Student Mobility</i>
<i>Cluster 1 – Metropolitan Leaders</i>	0.2884	3.2374	0.0899	1.5070	15.2028	0.0041
<i>Cluster 2 – Balanced Innovators</i>	0.0950	1.9661	0.0544	0.1611	3.4706	0.0019
<i>Cluster 3 – Industrial Heartlands in Transformation</i>	-0.1535	-0.3680	-0.0679	0.3225	-2.5690	0.0032
<i>Cluster 4 – Economies in</i>	0.1021	-2.6662	-0.0173	-0.2797	-5.2030	-0.0026

<i>Structural Transition Cluster 5 – Cohesion Regions with Catch-Up Potencial</i>	-0.4818	-5.3057	0.0116	-1.2228	-10.8847	-0.0005
<i>Cluster 6 – Structurally Lagging and Peripheral Regions</i>	-0.3945	-2.3077	-0.0568	-1.4314	-4.7514	-0.0004

In contrast, Clusters 5 and 6 show the most negative average values, particularly for permanent (-0.48‰ and -0.39‰, respectively) and seasonal mobility (-1.22‰ and -1.43‰), as well as for long-distance commuting (-10.9‰ and -4.8‰). These figures confirm the vulnerability of lagging and catching-up regions in retaining residents and participating in interregional labour markets.

Interestingly, student mobility again diverges from this general pattern. Despite negative or near-zero values for most types of mobility, Clusters 3 and 5 show modestly positive average flows for long-term student mobility (0.0032‰ and -0.0005‰, respectively), and Cluster 5 even registers a small positive inflow for short-term student mobility (0.012‰). These nuances reinforce the earlier interpretation that student mobility may respond to different drivers—such as cost of living or academic niches—and point to potential future shifts in regional attractiveness.

Taken together, the table corroborates the graphical evidence and supports the broader conclusion: regional attractiveness, as captured by the RAI, is a key correlate of mobility flows, especially for permanent and seasonal movements. At the same time, certain mobility types—particularly student flows—highlight pockets of emerging potential even among structurally weaker regions.

To further explore these dynamics, Appendix 2 presents a series of scatterplots and a correlation matrix relating each individual dimension of the Regional Attractiveness Index—Traditional, Green, and Digital—to the same six types of mobility flows. While the overall trends mirror those of the composite index, the disaggregated analysis reveals important nuances. For example, the Traditional component shows the strongest association with permanent and seasonal mobility, reflecting the enduring influence of economic fundamentals, infrastructure, and services on residential and labour migration. The Green dimension appears particularly relevant for attracting short-term student flows and seasonal mobility, suggesting that environmental quality and sustainability may influence lifestyle-related movements. Finally, the Digital component displays a more scattered pattern, though regions with high digital scores often perform well in student mobility and long-distance commuting, pointing to a growing relevance of connectivity and digital readiness in shaping spatial behaviours. These differentiated patterns underscore the multidimensional nature of regional attractiveness and its varying influence on mobility decisions.

This interpretation is statistically supported by the correlation analysis reported in Table A2.4 in Appendix 2, which shows the strength and direction of association between each component of the RAI (overall and disaggregated) and the six types of mobility flows. The results confirm that permanent and student mobility flows are most strongly associated with the overall attractiveness index, with correlation coefficients of 0.27 and 0.23, respectively—both highly significant. Among the individual components, Traditional attractiveness stands out as the strongest predictor of permanent mobility ($r = 0.29$) and seasonal flows, while Digital attractiveness correlates especially well with both short- and long-term student mobility.

Interestingly, green attractiveness shows weaker correlations overall, although it still exerts a small but significant influence on short-term student and seasonal mobility, suggesting that lifestyle or environmental factors might matter more in temporary or youth-driven movements than in long-term relocation decisions.

However, the picture becomes more nuanced when disaggregated by cluster, as shown in Table A2.5 in the Appendix. While correlations between mobility flows and attractiveness are quite strong across clusters, indicating that higher-attractiveness clusters consistently outperform others in attracting people, the within-cluster correlations are notably weaker and more heterogeneous. For instance, Cluster 1 (Metropolitan Leaders) shows positive but moderate associations across flows and dimensions, while in Cluster 3 (Industrial Heartlands), student mobility flows correlate negatively with attractiveness, reflecting internal contradictions or transitional dynamics. In contrast, some surprising patterns emerge—such as high positive correlations for long-term student mobility in Clusters 2 and 3, and weak or even negative associations for permanent mobility in Clusters 4 and 5, despite modest RAI scores.

This suggests that attractiveness shapes mobility mostly through structural contrasts between regions, rather than through internal variation within each group. In other words, while clusters differ substantially in their mobility performance, regional attractiveness is less decisive in explaining mobility differences among regions of the same cluster, where other factors—such as regional policy, local institutions, or geographic positioning—likely play a more prominent role.

These mobility patterns are further reflected in the population evolution observed between 2010 and 2022, as shown in [Table 4.7](#). The data confirm that regional attractiveness and net mobility flows are closely linked to actual demographic change at the cluster level. Clusters 1 and 2—Metropolitan Leaders and Balanced Innovators—not only showed the most positive net mobility flows across almost all types of mobility but also experienced the highest population growth rates over the period (6.15% and 4.76%,

respectively). This reinforces the idea that their attractiveness translates into both short-term mobility gains and longer-term demographic dynamism.

Conversely, Clusters 5 and 6, which performed worst in terms of net flows—especially for permanent, seasonal, and long-distance commuting—also recorded population losses: -3.91% for Cohesion Regions with Catch-Up Potential and -8.87% for Structurally Lagging and Peripheral Regions. These figures highlight a process of cumulative disadvantage, where weak mobility attractiveness accelerates depopulation and territorial divergence.

Cluster 3 (Industrial Heartlands in Transformation) and Cluster 4 (Economies in Structural Transition) offer intermediate cases. Despite showing mixed results in mobility flows, their population trends diverge: Cluster 3 remained stagnant (+0.17%), while Cluster 4 grew modestly (+2.41%). This suggests that other factors—such as natural population dynamics or domestic migration—may also play a role in shaping demographic outcomes.

Finally, it is important to acknowledge the role of foreign migration in shaping these trends. In Clusters 1 and 2, positive net permanent migration flows reflect a strong capacity to attract international migrants, who are likely drawn by greater employment opportunities, higher quality of life, and strong institutional environments. In contrast, Clusters 5 and 6 have not only failed to retain their local populations but might have also been less successful in attracting foreign migrants, often due to structural barriers such as lower economic performance, limited connectivity, and weaker public services. In some peripheral or rural regions, foreign arrivals—though present—might have not been sufficient to offset ongoing depopulation dynamics. Thus, international migration acts as both a symptom and a driver of territorial divergence, reinforcing the demographic and economic polarisation among European regions.

Table 4. 7. Demographic Evolution of EU Regions by Mobility-Attractiveness Cluster (2010–2022)

Cluster	Population 2010	Population 2022	Growth (%)
<i>Cluster 1 – Metropolitan Leaders</i>	68,300,000	72,500,000	6.15
<i>Cluster 2 – Balanced Innovators</i>	49,400,000	51,800,000	4.76
<i>Cluster 3 – Industrial Heartlands in Transformation</i>	103,000,000	103,000,000	0.17
<i>Cluster 4 – Economies in Structural Transition</i>	120,000,000	123,000,000	2.41
<i>Cluster 5 – Cohesion Regions with Catch-Up Potential</i>	47,900,000	46,000,000	-3.91
<i>Cluster 6 – Structurally Lagging and Peripheral Regions</i>	51,500,000	46,900,000	-8.87
Total	440,100,000	443,200,000	0.70

4.5. SWOT ANALYSIS OF ATTRACTIVENESS CLUSTERS

Building on the regional typology derived from the cluster analysis of Regional Attractiveness Index values, this section presents a SWOT (Strengths, Weaknesses,

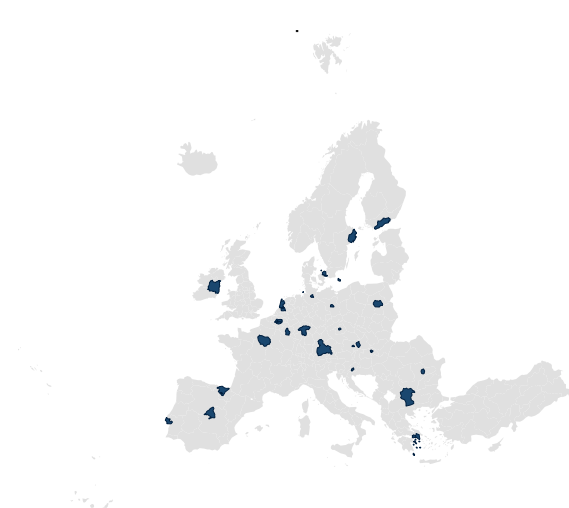
Opportunities, and Threats) analysis for each of the six identified clusters. This framework enables a structured comparison of the internal capacities and external factors that shape the spatial mobility dynamics in different regional profiles. By examining the assets, limitations, potential developments and risks facing each group of regions, we aim to identify strategic insights for fostering territorial attractiveness in the twin transition era. The SWOT analysis will provide policy-relevant guidance by highlighting which features facilitate or hinder regions' ability to retain or attract population, especially in relation to digital and green transitions. Each cluster's specific context—defined by its economic, demographic, and institutional characteristics—will be reflected in the tailored SWOT profile, offering a comparative lens for regional development strategies across the EU.

a. Cluster 1. Metropolitan Leaders

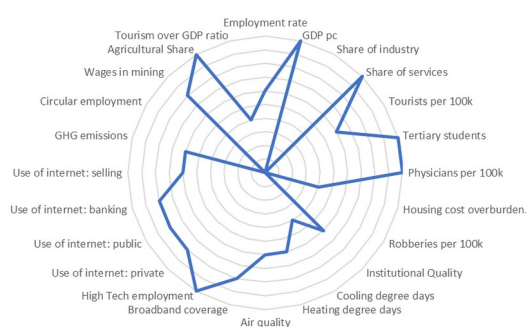
Cluster 1 comprises 27 regions, including 20 of the 27 EU capital regions in the sample, clearly highlighting its metropolitan character. It brings together Europe's most advanced urban areas—such as Paris, Brussels, Vienna, Madrid, Berlin or Stockholm—which stand out for their consistently high levels of regional attractiveness ([Figure 4.16](#)).

Figure 4. 16. Cluster 1 - Metropolitan Leaders

Geographical Distribution



Relative Positioning across Socioeconomic, Digital, and Environmental Metrics



Note: the chart displays normalised rankings of Cluster 1 across multiple indicators. Outer positions reflect higher (better) performance, ensuring all indicators are oriented in the same direction for comparability

Strategic SWOT Profile

Strengths

- Exceptionally high overall RAI (84.2), with very strong digital (82.2), green (75.3), and traditional (75.0) dimensions
- Highest GDP per capita (€44,963) and high-tech employment (7.5%)

Weaknesses

- High living costs reflected in housing overburden rate (12.4%)
- Green dimension shows modest growth over time, suggesting possible stagnation
- Pronounced socio-spatial inequalities (e.g. high

- Strong institutional and innovation capacity (high tertiary education: 43.5%; advanced services employment: 32.7%) - Excellent broadband coverage (84.7%) and digital adoption - Consistently strong performance across all RAI dimensions over time	- robbery rates) - Highest dispersion in institutional quality (CV = 4.88) and internal heterogeneity among regions may lead to unequal trajectories within the cluster - Environmental pressure and high GHG emissions due to urban density
Opportunities	Threats
- Leadership in twin transition: testing grounds for urban green/digital policies - High potential to consolidate position in global innovation networks - Ability to influence EU policy agendas and set strategic urban models - Can attract talent and capital if affordability and inclusivity are addressed	- Infrastructure saturation and congestion may reduce liveability - Increased vulnerability to global economic and digital risks (e.g. cybersecurity) - Rising competition from converging regions (e.g. Cluster 2 in green dimension) threatens leadership - Complacency due to already high scores may slow reforms

These regions lead the rankings with an average overall RAI score of 84.2, underpinned by particularly strong performance in the digital dimension (82.2), alongside robust outcomes in green (75.3) and traditional (75.0) pillars. Over time, these regions have demonstrated remarkable consistency and dynamism, particularly in the digital and overall indices, which show a steady upward trajectory from 2010 to 2022. Their traditional attractiveness has also evolved positively, reflecting ongoing economic modernisation and investment in foundational assets. In contrast, the green dimension, while remaining relatively high, exhibits more modest gains and a plateauing trend, suggesting that environmental transformation is proceeding at a slower pace than other domains.

The regions in this cluster excel notably in GDP per capita (€44,963), broadband access (84.7%), and high-tech employment (7.5%), clearly reflecting their innovation-driven economies. Additionally, the high share of tertiary education attainment (43.5%) and significant employment in services in high value-added private sectors -financial, real estate, professional, scientific, technical, administrative, and support services- (32.7%) underscore their strong institutional frameworks, educational excellence, and knowledge-intensive labour markets. Moreover, these metropolitan regions exhibit relatively favourable environmental conditions, exemplified by good air quality, although high greenhouse gas emissions point to ongoing challenges associated with intensive urbanisation.

However, these considerable strengths coexist with notable internal weaknesses. High living costs manifest in substantial housing overburden rates (12.4%), reflecting persistent affordability challenges. Furthermore, pronounced socio-spatial inequalities are evident in indicators such as high rates of robbery (115 per 100k), indicating notable security issues in densely populated areas. The cluster also displays the highest

dispersion in institutional quality (CV = 4.88) and relatively high variability in tourism intensity, agricultural share, and GHG emissions, suggesting strong internal heterogeneity in policy performance, economic structure, and environmental pressures.

Externally, these regions confront critical threats, including potential infrastructure saturation, reflected in urban congestion and pressure on public services associated to high density. There is also some level of vulnerability associated to global economic fluctuations, given their reliance on international connectivity, tourism and trade. Furthermore, their advanced digital infrastructure creates substantial exposure to cybersecurity risks and digital dependency. The moderate evolution of their green dimension may also pose a longer-term challenge, particularly as other regions begin to converge in sustainability performance.

Metropolitan Leaders possess significant opportunities, particularly through leveraging their digital excellence to lead Europe's twin (digital and green) transition, improving on their circular employment practice. To sustain their competitive edge and attractiveness, these regions will require targeted strategies addressing social inequalities, affordability, and sustainable urban growth, thus ensuring continued resilience and inclusivity in an increasingly volatile global context.

b. Cluster 2. Balanced Innovators

Cluster 2 comprises stable, high-performing regions characterised by balanced performance across all RAI dimensions, achieving an overall attractiveness score of 78.7. among the 47 regions in this Cluster we find Zuid-Holland, Noord-Brabant, Prov. Antwerpen, Västsverige, Salzburg, Etelä-Suomi, Midtjylland, and Tirol, which exemplify the strengths of this cluster, notably through robust governance quality (EQI = 1.07), favourable employment rates (76.3%), substantial broadband access (85.2%), and impressive circular employment levels (1,131.5 per 100k inhabitants), the highest among all clusters ([Figure 4.17](#)).

These regions also demonstrate relatively low levels of crime—robbery rates average just 36.2 per 100k inhabitants—and benefit from strong citizen engagement, as reflected in high digital service usage (internet banking: 88.5%, digital public admin: 70.9%). The digital dimension is also bolstered by top scores in internet access and usage among private users (68.1%), further indicating a mature digital culture. High-quality public services are also reflected in above-average physician availability (347.5 per 100k) and low housing overburden rates (8.4%).

The RAI trends between 2010 and 2022 confirm this cluster's gradual but consistent improvement across all dimensions. Its green index has nearly converged with Cluster 1, while the traditional dimension remains robust and stable. The coefficient of variation values also supports the cluster's internal cohesion, with notably low dispersion across employment (0.05), GDP per capita (0.24), broadband (0.12), and key digital variables—highlighting a high level of territorial homogeneity among members' regions.

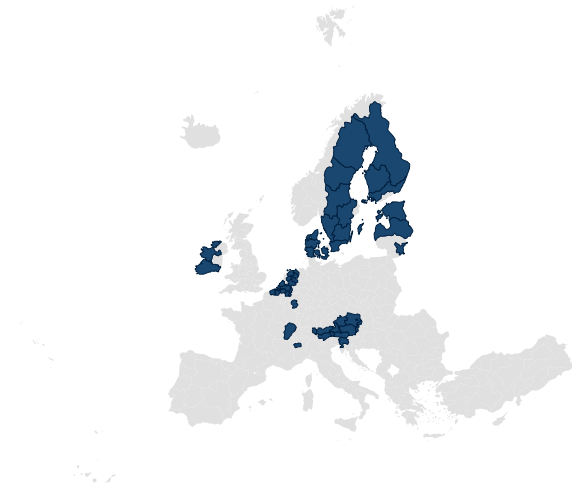
Despite these considerable strengths, Balanced Innovators face internal challenges that could compromise their long-term adaptability. Their high-tech employment share (3.9%) remains modest compared to metropolitan leaders, reflecting limited innovation intensity, and their moderate share of tertiary students (32.9%) suggests potential gaps in long-term human capital development. While circular employment is very high, industry accounts for 22.1% of the labour structure, indicating a need to steer this productive base more decisively toward innovation-intensive sectors.

Externally, these regions possess significant opportunities for enhancing their attractiveness by leveraging their well-rounded socioeconomic foundations and strong institutional capacities to drive targeted, integrated eco-digital transitions. The progressive upward trajectory across all RAI dimensions over the last decade—particularly in digital and green—positions these regions as ideal testbeds for next-generation policies, enabling them to consolidate their attractiveness and serve as policy frontrunners for the EU. The narrowing gap with Cluster 1 in the green index highlights an opportunity to redefine their role in Europe's sustainability agenda.

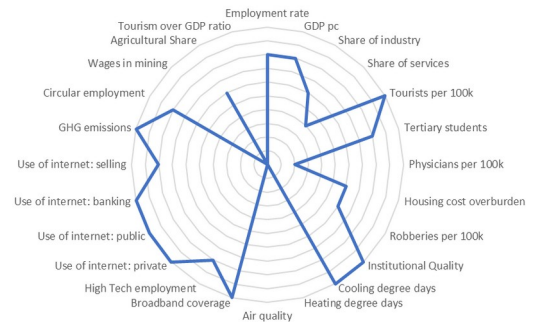
Nonetheless, external threats remain substantial, notably competition from neighbouring metropolitan centres and capital regions, which could attract talent and investment away from Balanced Innovators. Additionally, their moderate pace of innovation, combined with lower GDP per capita (€32,222) compared to metropolitan clusters, exposes these regions to economic shocks or technological disruptions that could challenge their competitiveness and attractiveness in the long term. Given the relatively slower gains in the traditional dimension, strategic investments focused on boosting innovation ecosystems, fostering digital capacities, and accelerating sustainable initiatives will be essential to maintaining and enhancing their balanced attractiveness amidst Europe's rapidly evolving territorial landscape.

Figure 4. 17. Cluster 2 - Balanced Innovators

Geographical Distribution



Relative Positioning across Socioeconomic, Digital, and Environmental Metrics



Note: the chart displays normalised rankings of Cluster 2 across multiple indicators. Outer positions reflect higher (better) performance, ensuring all indicators are oriented in the same direction for comparability

Strategic SWOT Profile

Strengths

- Balanced and steadily improving performance across traditional (74.5), green (75.8), and digital (72.6) dimensions
- High governance quality (EQI = 1.07) and strong employment rate (76.3%)
- High broadband access (85.2%) and widespread internet use (admin: 68.1%, banking: 70.9%)
- Very high circular employment (1131.5 per 100k)
- Low crime levels (robbery: 36.2 per 100k) and strong public service access
- Stable institutions and sound infrastructure
- RAI shows consistent growth across all dimensions over 2010–2022

Opportunities

- Pilot regions for integrated green and digital transition strategies
- Potential to become second-tier innovation hubs through smart specialisation
- Upward trends in green and digital RAI suggest positioning as EU benchmarks
- Can set benchmarks for sustainable regional development in the EU
- Capitalising on cohesion funding to reinforce digital and green transitions

Weaknesses

- Lower high-tech employment (3.9%) indicating moderate innovation intensity compared to Metropolitan leaders
- Moderate GDP per capita (€32,222), below that of top-performing clusters
- Limited global visibility compared to large metropolitan hubs
- Traditional dimension growing more slowly than digital and green
- Risk of institutional inertia in absence of transformation push

Threats

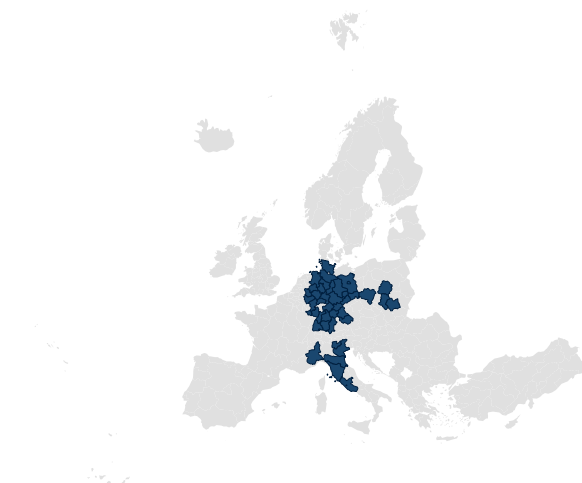
- Competition from neighbouring metropolitan areas may divert talent and investment
- Talent and investment attraction challenged by nearby metropolitan regions
- Exposure to external economic shocks due to moderate innovation pace
- Risk of becoming stagnant if innovation and investment momentum is not maintained
- Vulnerability to demographic decline and labour shortages if ageing not addressed

c. Cluster 3 – Industrial Heartlands in Transformation

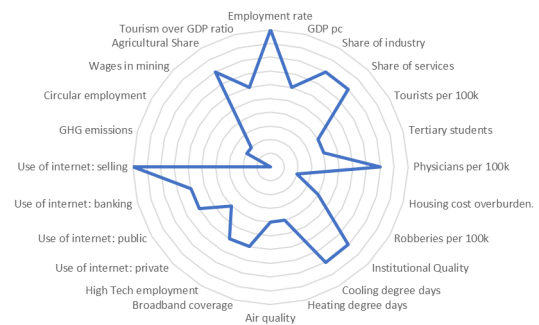
Cluster 3 groups regions (42 in total) primarily from Germany (e.g., Stuttgart, Düsseldorf, Köln, Hannover, Bremen), northern Italy (Piemonte, Emilia-Romagna, Veneto), and selected Polish industrial regions (Śląskie, Małopolskie). These areas represent Europe's industrial core, maintaining a robust traditional economic base (traditional RAI score 66), prominently marked by a substantial industrial employment share (26.6%) and notable GDP per capita (€31,645). Additionally, they benefit from good broadband connectivity (84.2%) and favourable employment conditions (employment rate at 76.4%). Their established infrastructure, particularly in manufacturing and logistics, provides a solid foundation supporting their ongoing economic transformation ([Figure 4.18](#)).

Figure 4. 18. Cluster 3 - Industrial Heartlands in Transformation

Geographical Distribution



Relative Positioning across Socioeconomic, Digital, and Environmental Metrics



Note: the chart displays normalised rankings of Cluster 3 across multiple indicators. Outer positions reflect higher (better) performance, ensuring all indicators are oriented in the same direction for comparability

Strategic SWOT Profile

Strengths

- Strong traditional economic base (score 66.0) anchored in manufacturing and logistics
- High industrial employment share (26.6%) and solid GDP per capita (€31,645)
- Favourable employment rate (76.4%) and good broadband access (84.2%)
- Well-established infrastructure and logistics networks
- Sustained strength in the traditional RAI component over the last decade

Opportunities

- Smart reindustrialisation and Industry 4.0 strategies
- Adoption of sustainable manufacturing and energy-efficient technologies
- Potential to lead industrial modernisation within

Weaknesses

- Moderate performance in digital (61.9) and green (67.2) dimensions
- Modest high-tech employment (3.8%) and limited use of digital tools (e.g., internet banking 48.2%)
- Institutional inertia linked to governance quality (EQI = 0.62)
- Demographic stagnation limiting adaptive capacity
- Slight post-2020 decline in digital index suggests limited adaptability to fast-changing technologies

Threats

- Global supply chain disruptions and market volatility
- Competitive pressure from lower-cost manufacturing regions
- Risk of job losses due to automation and slow

the EU

- Scope for institutional reform and investment in digital skills and green innovation
- Leverage existing strengths to catch up in twin transition implementation

labour market adjustment

- Lagging digital transformation and plateauing green progress may widen gaps with more agile regions
- Failure to adapt quickly could lock regions into mid-tech, low-dynamic growth paths

Over the period 2010–2022, Cluster 3 has shown steady improvement in the overall and traditional RAI scores, confirming the resilience of their economic base. However, their digital and green dimensions have grown at a more modest pace, and a slight decline in the digital index after 2020 suggests vulnerabilities in absorbing disruptive innovations. Despite some progress, this lag in digitalisation and sustainability is becoming increasingly pronounced relative to faster-moving clusters.

Nevertheless, these strengths coexist with critical internal weaknesses. The relatively lower performance in digital (61.9) and green (67.2) dimensions underscores difficulties in fully adapting to the ongoing twin transitions. Despite good basic internet coverage, digital skills and innovation capacity remain modest, reflected in lower high-tech employment rates (3.8%) and comparatively limited engagement in internet banking (48.2%) and digital administrative services (47.8%). Additionally, the moderate quality of governance (EQI = 0.62) introduces institutional inertia, further constraining adaptability and innovation diffusion.

Externally, Industrial Heartlands possess significant opportunities related to their extensive manufacturing heritage. Initiatives promoting smart reindustrialisation, Industry 4.0, and sustainable production methods offer substantial potential to revitalise these regions, enhancing their competitiveness and attractiveness. The recent convergence of green scores with clusters 4 and 5 suggests room to build momentum around sustainable production, particularly in emissions control and circular economy practices. Their existing industrial capabilities position them advantageously to integrate new digital and sustainable technologies, potentially establishing them as models for Europe's industrial modernisation.

However, external threats remain pronounced. These regions are particularly vulnerable to global supply chain disruptions, market volatility, and competition from lower-cost manufacturing hubs. The plateauing or slight downturn of their digital RAI score after 2020 highlights the risk of technological obsolescence, especially if digital transformation is not scaled up. Automation and technological change pose risks of job displacement, exacerbated if rigid labour market structures exist, what would hinder rapid adaptation. To capitalise effectively on their opportunities and mitigate these threats, these regions must actively pursue policy reforms aimed at improving institutional frameworks, accelerating digital skills development, and strengthening

environmental innovation, thus facilitating their ongoing transformation and securing their long-term economic resilience.

d. Cluster 4 – Economies in Structural Transition

Cluster 4 is the largest one, with 58 regions, which include regions across France (e.g., Rhône-Alpes, Provence-Alpes-Côte d’Azur, Bretagne), Spain (Cataluña, Comunitat Valenciana, Andalucía, Galicia), Italy (Lombardia, Liguria, Umbria), Portugal (Norte, Algarve), and others like Malta and Cyprus. These regions display intermediate economic profiles, reflected in an overall attractiveness index (RAI) score of 60.9, with moderate yet improving digital (61.6) and green (66.3) performance alongside weaker traditional scores (55.9). They benefit from substantial EU cohesion investments and ongoing infrastructure modernisation initiatives, resulting in relatively strong broadband access (76.4%) and improving circular employment levels (745.1 per 100k inhabitants). Their moderate environmental quality (air quality at 11.1 $\mu\text{g}/\text{m}^3$) and manageable housing overburden rates (7.7%) indicate conditions favourable for sustained improvements in living standards and regional attractiveness ([Figure 4.19](#)).

The RAI evolution from 2010 to 2022 shows a gradual but steady increase in all three dimensions for this cluster, especially in digital and green indices. The digital index has followed a modest but positive trend, while the green dimension has experienced a noticeable improvement post-2015, suggesting these regions are beginning to capitalise on EU green investment frameworks. However, the traditional dimension lags behind and remains structurally flat throughout the period, confirming persistent economic inertia.

Despite these strengths, significant internal weaknesses remain. Institutional capacity is limited, evidenced by modest governance quality (EQI = 0.12), hindering their ability to effectively implement innovation and sustainability measures. Economic productivity, with GDP per capita (€24,398), remains lower than in leading clusters, highlighting structural vulnerabilities. Furthermore, relatively low digital engagement—such as moderate levels of internet banking (47.0%) and online administrative services (50.6%)—limits their capacity to rapidly adapt to digital transition demands, while substantial internal variability (e.g., high coefficient of variation in greenhouse gas emissions, 0.84, and robbery incidents, 0.90) underscores persistent heterogeneity within this cluster.

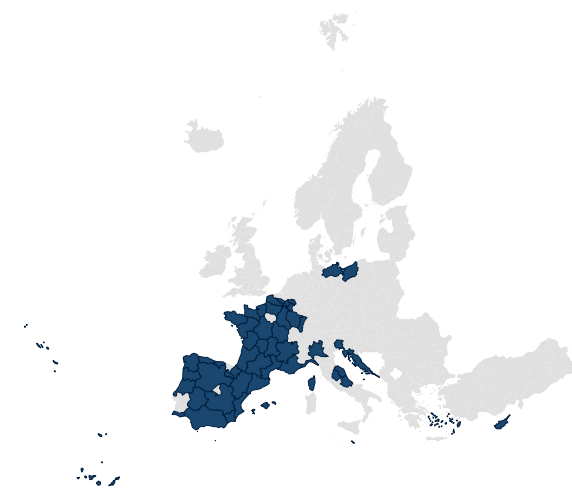
Externally, Cluster 4 regions possess notable opportunities for strategic repositioning. Their existing infrastructural modernisation and geographical attractiveness (e.g., Provence-Alpes-Côte d’Azur, Illes Balears, Algarve) offer considerable potential to

attract remote workers, tourists, and second-tier innovative industries, leveraging lifestyle advantages and cost competitiveness. The continued upward trajectory in their digital and green RAI components provides a strong base to consolidate eco-digital transitions, particularly by linking territorial branding with quality-of-life and sustainability narratives. Additionally, the progressive narrowing of the green gap with more advanced clusters like Cluster 3 suggests realignment opportunities within EU climate-oriented strategies.

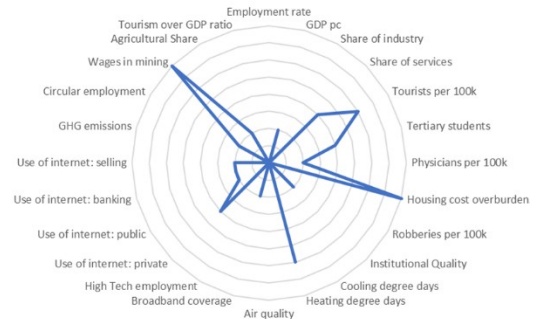
Nevertheless, external threats remain significant. Regions within this cluster face continued competition from more advanced metropolitan and innovative hubs, risking persistent talent and capital migration. Economic stagnation, and legacy constraints further threaten their ability to adapt swiftly to changing economic and technological circumstances. The stagnation of their traditional RAI component reinforces concerns over productivity traps and limited upward mobility in the absence of structural reforms. The green transition might threaten the weight of tourism over the total economy. To secure their economic resilience, these Economies in Structural Transition must prioritise overcoming institutional weaknesses, fostering cohesive innovation strategies, and maximising the potential of ongoing EU-funded modernisation efforts.

Figure 4. 19. Cluster 4 – Economies in Structural Transition

Geographical Distribution



Relative Positioning across Socioeconomic, Digital, and Environmental Metrics



Note: the chart displays normalised rankings of Cluster 4 across multiple indicators. Outer positions reflect higher (better) performance, ensuring all indicators are oriented in the same direction for comparability

Strategic SWOT Profile

Strengths

- Intermediate overall attractiveness (60.9) with steady improvements in digital (61.6) and green (66.3) RAI scores
- Strong broadband access (76.4%) and growing circular employment (745.1 per 100k)
- Moderate air quality (11.1 $\mu\text{g}/\text{m}^3$) and affordable housing conditions (7.7% overburden rate)
- Benefit from EU cohesion funding and visible infrastructure improvement over time
- Positive trajectory in digital and green indices indicates convergence with more advanced clusters

Opportunities

- Attract remote workers and new investment via lifestyle and cost advantages
- Accelerate green and digital transition using EU funding
- Develop second-tier innovation hubs in tourism, digital services, or creative industries
- Capitalize on strategic geographic assets and natural appeal (e.g. coastline, climate, culture)
- Convergence in green RAI with Cluster 3 opens space for environmental policy leadership

Weaknesses

- Low traditional score (55.9) and relatively low GDP per capita (€24,398)
- Limited institutional capacity (EQI = 0.12) affecting implementation of development policies
- Moderate digital engagement (internet banking 47.0%, admin services 50.6%)
- High internal heterogeneity (e.g., GHG and crime variability)
- Persistent lag in traditional RAI dimension suggests structural economic rigidity

Threats

- Competition from metropolitan centers for capital and talent
- Political fragmentation and legacy policy constraints
- Risk of long-term stagnation if institutional weaknesses persist
- Continued brain drain and limited innovation ecosystems may reinforce dependency on external support
- Flat traditional RAI growth risks entrenching structural gaps with high-performing regions

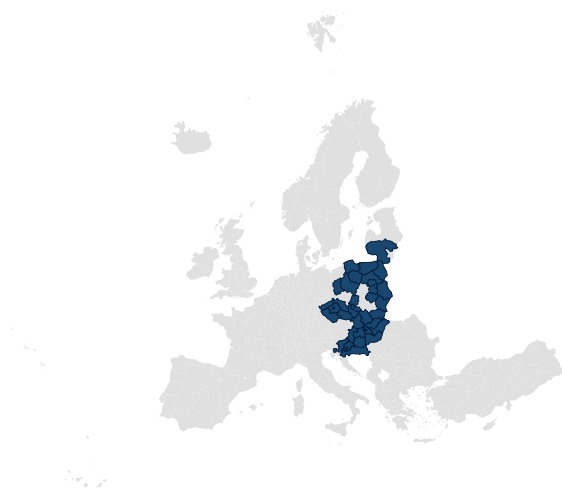
e. Cluster 5 – Cohesion Regions with Catch-Up Potential

Cluster 5 comprises developing regions primarily from Central and Eastern Europe—including substantial parts of Poland (e.g., Wielkopolskie, Pomorskie, Lubelskie), Hungary (Pest, Nyugat-Dunántúl), Slovakia (Západné Slovensko, Východné Slovensko), Czech Republic (Moravskoslezsko, Střední Čechy), along with regions from Croatia

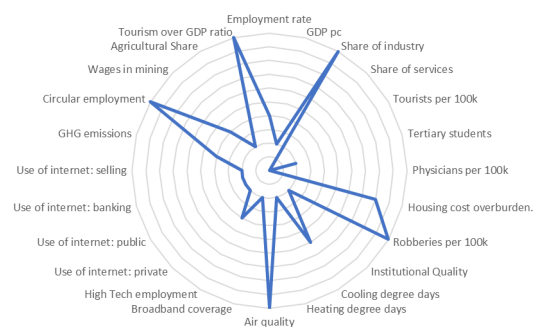
(Panonska Hrvatska) and Lithuania (Vidurio ir vakarų Lietuvos regionas). These territories exhibit relatively high green performance (70.5), reflecting effective use of EU cohesion policy investments targeting environmental sustainability and infrastructure upgrades. They also show moderate digital performance (60.9), supported by improving broadband access (75.2%) and internet use (Internet Private usage at 75.3%). [Figure 4.20](#) summarises geographical distribution, relative position across metrics and SWOT analysis.

Figure 4. 20. Cluster 5 - Cohesion Regions with Catch-Up Potential

Geographical Distribution



Relative Positioning across Socioeconomic, Digital, and Environmental Metrics



Note: the chart displays normalised rankings of Cluster 5 across multiple indicators. Outer positions reflect higher (better) performance, ensuring all indicators are oriented in the same direction for comparability

Strategic SWOT Profile

Strengths

- Strong green performance (70.5), reflecting clear upward trend supported by cohesion funding
- Moderate digital performance (60.9) with decent broadband access (75.2%) and internet use (75.3%)
- Young demographic profile offering long-term human capital potential
- Affordable living conditions and improving air quality (17.7 $\mu\text{g}/\text{m}^3$)
- Notable catch-up trajectory in green and digital RAI components over 2010–2022

Opportunities

- Leapfrogging development stages through green technologies and digital education
- Attracting green investments, remote workers, and sustainable industries
- Potential for reindustrialisation and innovation through EU cohesion support
- Aligning with EU green/digital agendas to secure long-term strategic investment
- Positioning as testbeds for sustainable growth models in cohesion regions

Weaknesses

- Low traditional attractiveness score (48.2) and low GDP per capita (€17,376)
- Institutional fragility (EQI = -0.63) limiting policy effectiveness
- High agricultural employment share (4.96%) and limited diversification
- Low high-tech employment (3.12%) and tertiary education attainment (22.2%)
- Stagnant traditional RAI index suggests entrenched structural weaknesses

Threats

- Persistent brain drain, especially of young and skilled labour
- High dependence on EU funding, vulnerable to policy and budget changes
- Weak innovation ecosystems and limited entrepreneurial culture may hinder technological uptake
- Risk of losing convergence momentum, particularly in digital and traditional dimensions
- Disparities may become entrenched if transformation is not coupled with institutional

strengthening

Over the 2010–2022 period, Cluster 5 has recorded some of the most dynamic improvements in RAI values among all clusters. The green dimension displays a clear and continuous upward trajectory, nearly converging with Clusters 2 and 3 by 2022. The digital index also shows robust growth, although it remains below the EU average. The traditional dimension, however, has remained stagnant and comparatively low, confirming a structural delay in productive transformation.

Despite these advantages, internal weaknesses remain substantial. Regions in this cluster demonstrate significant underperformance in traditional attractiveness (48.2), evidenced by lower GDP per capita (€17,376), modest employment rates (69.9%), and a relatively large agricultural sector (4.96%), which reflects the persistence of less competitive economic structures. Institutional fragility, illustrated by negative governance quality indicators (EQI = -0.63), further hampers their capacity to implement cohesive innovation policies effectively. Additionally, limited high-tech employment (3.12%) and low tertiary education attainment (22.2%) reveal persistent gaps in skills and innovation readiness.

Externally, substantial opportunities exist for these regions to leverage their strengths in green transitions and emerging infrastructure to leapfrog traditional development stages. Their substantial EU support provides a critical resource for fostering reindustrialisation, enhancing digital education, and investing in sustainable economic activities, positioning them strategically within Europe's green and digital agendas. The sharp upward evolution of their green RAI score supports their potential to act as showcases for cohesion-driven environmental transformation, while the steady digital progression reinforces their suitability for decentralised innovation pilots and remote working infrastructure. Their relatively affordable living costs and improving environmental conditions (air quality at 17.7 $\mu\text{g}/\text{m}^3$ of air pollutant PM_{2.5}) also enhance their attractiveness as potential destinations for remote working and green investments.

Nevertheless, external threats pose considerable risks. Persistent brain-drain, especially of younger and skilled populations toward more economically dynamic regions, might threaten long-term development prospects. Overreliance on external EU funding makes them vulnerable to policy shifts and fluctuations in investment cycles, risking entrenched disparities if external support diminishes. Additionally, underdeveloped innovation ecosystems and limited entrepreneurial culture could impede effective adoption and diffusion of new technologies. Addressing these challenges will require targeted strategies focused on institutional strengthening,

human capital investment, and robust economic diversification policies to harness their full potential for catch-up growth.

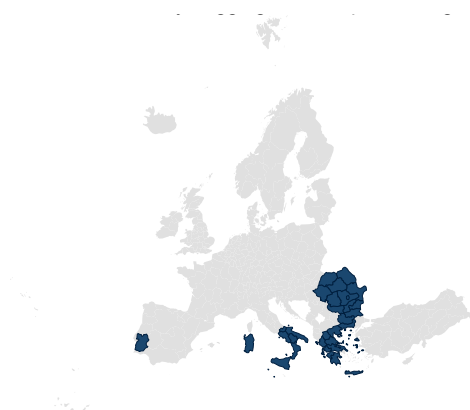
f. Cluster 6 – Structurally Lagging and Peripheral Regions

Cluster 6 encompasses structurally disadvantaged areas primarily located in Southern and Eastern Europe, including rural and insular territories of Greece (Kriti, Peloponnisos, Voreio Aigaio), southern Italy (Campania, Calabria, Sicilia, Sardegna), Bulgaria (Severozapaden, Severoiztochen), Romania (Nord-Vest, Sud-Vest Oltenia), and peripheral regions of Portugal (Alentejo). Summaries about summarises geographical distribution, relative position across metrics and SWOT analysis can be found at [Figure 4.21](#).

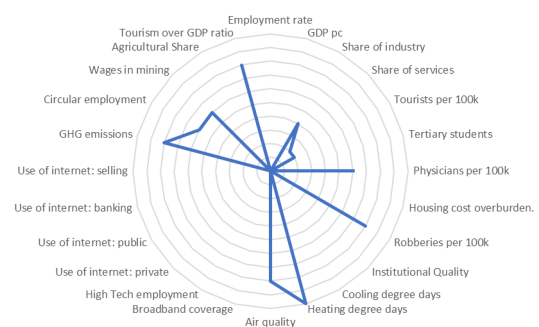
This cluster exhibits the lowest overall attractiveness (38.4), severely underperforming in traditional (28.7) and digital (45.8) dimensions, although the green dimension is slightly stronger (63.0). Regions in this group face critical infrastructure deficits, evidenced by significantly lower broadband access (62.9%), limited digital connectivity (Internet Banking use at just 14.2%), and a comparatively low employment rate (59.8%). Furthermore, their low GDP per capita (€15,836) highlights profound economic disparities relative to other EU regions.

Figure 4. 21. Cluster 6 – Structurally Lagging and Peripheral Regions

Geographical Distribution



Relative Positioning across Socioeconomic, Digital, and Environmental Metrics



Note: the chart displays normalised rankings of Cluster 6 across multiple indicators. Outer positions reflect higher (better) performance, ensuring all indicators are oriented in the same direction for comparability

Strategic SWOT Profile

Strengths

- Decent green performance (63.0), with clear

Weaknesses

- Lowest overall attractiveness (38.4), with stagnant

upward trend over time, supported by low GHG emissions (11,950 ktCO₂eq)

- Relatively good environmental conditions (air quality: 16.1 µg/m³)
- Potential for eco-tourism, organic agriculture, and renewables
- Environmental assets provide a base for place-based green strategies

Opportunities

- Use of EU cohesion funds for basic infrastructure and digital connectivity upgrades
- Strategic positioning in climate and biodiversity agendas via environmental capital
- Targeted investment in human capital and education
- Developing low-impact tourism or remote work destinations in natural areas
- Slight green RAI progress can serve as entry point for tailored development models

traditional (28.7) and digital (45.8) RAI scores

- Very low broadband access (62.9%) and digital banking usage (14.2%)
- Low institutional capacity (EQI = -1.31) and governance fragility
- High agricultural share (6.97%), low tertiary education (19.3%), and low GDP per capita (€15,836)
- High housing overburden (21.1%) and poor employment outcomes (59.8% rate)

Threats

- Persistent outmigration, especially of youth and skilled workers
- Structural dependency on EU funding makes them vulnerable to external shocks
- Climate risks linked to agricultural dependence and geographic exposure
- Absence of progress in overall RAI risks long-term marginalization
- Very limited convergence with other clusters over the last decade undermines cohesion goals

The RAI evolution between 2010 and 2022 reveals very limited progress across most dimensions for this cluster. The traditional index shows a low progress, indicating persistent structural stagnation. The green dimension shows a positive trend in the last periods in particular, suggesting that EU environmental funding may be yielding some results in targeted areas. Finally, the digital dimension experiences the faster growth, catching up with the rest of clusters. However, the overall gap with other clusters remains wide and largely unchanged over time.

Internally, these regions experience substantial weaknesses rooted in limited institutional capacities, demonstrated by very low governance quality (EQI = -1.31), hindering effective policy implementation and responsiveness to economic shocks. The high agricultural employment share (6.97%), coupled with minimal tertiary education attainment (19.3%), underscores economic structures dominated by low-productivity sectors and limited human capital development. Furthermore, significant housing affordability challenges (housing overburden rate of 21.1%) indicate persistent socio-economic vulnerabilities.

Externally, Structurally Lagging and Peripheral Regions have potential opportunities linked to their natural assets and relatively good environmental conditions, including better air quality (16.1 µg/m³ of air pollutant PM2.5) and lower greenhouse gas emissions (11,950 ktCO₂eq). This environmental quality positions them favourably to capitalise on niche economic opportunities such as eco-tourism, organic agriculture, and renewable energy initiatives. The improvement of the green RAI index supports the feasibility of building a development model around sustainability and resource-based

sectors, particularly if aligned with local strengths and low-impact industries. Enhanced EU cohesion policy support and targeted investment in digital connectivity and basic infrastructure could significantly improve their developmental trajectory.

Nevertheless, these regions remain highly exposed to substantial external threats, including persistent demographic decline, youth emigration, and socio-economic marginalisation, exacerbating their already challenging circumstances. Additionally, their limited innovation capacity and dependency on external funding expose them to economic volatility and political uncertainty. Climate change poses acute risks, particularly given their high dependence on agriculture and natural resources, further threatening long-term sustainability. Despite the growth, the lack of visible convergence in overall and digital RAI scores over more than a decade illustrates the depth of structural disadvantage and the risk of being permanently ‘left behind’ in the EU development landscape. To mitigate these threats, comprehensive strategies that address institutional weaknesses, promote human capital development, enhance digital and transport connectivity, and strategically harness environmental assets will be essential to improve resilience and foster sustained regional convergence.

5. CASE STUDIES / REGIONAL ILLUSTRATIONS

This section presents a country-level analysis of regional attractiveness and mobility for five selected EU member states: Finland, Greece, Italy, the Netherlands, and Spain. The analysis is based on the Regional Attractiveness Index (RAI), complemented with net migration flows, commuting flows, and student mobility data, offering a detailed understanding of how regional conditions are associated with demographic and functional dynamics at the subnational level.

For each country, we begin by describing regional patterns of attractiveness across the overall and three component indices—traditional, green, and digital. This is followed by an analysis of population growth and net flows across six mobility types.

Finally, to assess whether more attractive regions are associated with higher mobility, we estimate a set of panel regression models linking the different dimensions of the Regional Attractiveness Index (RAI) to six types of net mobility flows. Each type of flow is regressed on either the overall RAI or its specific components—traditional, green, and digital—using a random effects specification. This approach captures cross-sectional variation between regions while avoiding causal claims. All variables are standardised, so the resulting coefficients are directly comparable across countries, models and flows.

To highlight the main patterns observed at the European level, [Table 5.1](#) presents the results for all NUTS2 considered regions in the EU over the 2010–2022 period. The results show that the overall RAI is positively and significantly associated with all types of mobility, except for cross-border commuting. The strongest associations are found with permanent migration (0.293) and short-term student flows (0.267), suggesting that more attractive regions tend to both retain residents and draw mobile students. Seasonal migration, long-distance commuting, and long-term student flows also respond positively, though with smaller coefficients.

When we disaggregate the RAI, some important differences emerge. The digital dimension stands out as a strong and significant predictor of permanent migration (0.242) and long-term student mobility (0.174), indicating that digital infrastructure and services may be especially influential for residential relocation and education choices. The traditional dimension shows a strong effect on short-term student flows (0.313) and seasonal migration (0.213), which may reflect the role of economic fundamentals and institutional capacity in attracting temporary workers and students.

The green dimension, in contrast, has weak and mostly insignificant associations. It is only marginally significant for seasonal migration (0.0587) and shows no strong

relationship with other flows. This suggests that while environmental factors are important, they may not play a leading role in shaping net mobility when considered alongside economic and digital characteristics.

Table 5. 1 Demographic Evolution of EU Regions by Mobility-Attractiveness Cluster (2010–2022)

<i>All regions</i>	<i>Permanen t Flows</i>	<i>Seasonal flows</i>	<i>Cross border commuting</i>	<i>Long distance commuting</i>	<i>Short term student</i>	<i>Long term student</i>
<i>RAI overall</i>	0.293*** (0.0567)	0.189*** (0.0374)	-0.0147 (0.0306)	0.106*** (0.0311)	0.267*** (0.0545)	0.239*** (0.0540)
<i>R2</i>	0.0740	0.0402	0.0126	0.0117	0.0351	0.0603
<i>Observations</i>	711	3,069	3,060	3,069	1,659	1,659
<i>Number of regions</i>	237	237	237	237	237	237
<i>RAI_tradit</i>	0.0835 (0.0705)	0.213*** (0.0487)	-0.0253 (0.0291)	0.103** (0.0442)	0.313*** (0.0594)	0.0654 (0.0705)
<i>RAI_green</i>	-0.0186 (0.0538)	0.0587* (0.0356)	-0.0229 (0.0261)	0.0489 (0.0301)	-0.0693 (0.0437)	0.0427 (0.0486)
<i>RAI_digital</i>	0.242*** (0.0676)	-0.0446 (0.0480)	0.0107 (0.0216)	-0.0205 (0.0454)	0.0221 (0.0603)	0.174** (0.0777)
<i>R2</i>	0.0833	0.0484	0.0222	0.0145	0.0136	0.0641
<i>Observations</i>	711	3,069	3,060	3,069	1,659	1,659
<i>Number of regions</i>	237	237	237	237	237	237

Note: Random effects panel regressions estimate the association between standardised mobility flows and regional attractiveness indices across NUTS2 regions (2010–2022). Results are expressed in standardised coefficients and should be interpreted as associations, not causal effects. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors in parentheses.

Cross-border commuting appears to be largely unresponsive to the RAI or its subcomponents, likely because such flows depend more on geography and neighbouring labour markets than on internal regional attributes.

In sum, the findings confirm that regional attractiveness—especially in its digital and traditional dimensions—is significantly linked to a region’s ability to attract and retain population and mobile students. While the explanatory power of the models (R^2) remains modest, the results point to meaningful and differentiated roles played by the various facets of attractiveness in shaping mobility patterns across Europe.

5.1. FINLAND

We consider the 5 Finish NUTS2 regions. The region of Helsinki-Uusimaa corresponds to the capital region and is included at Cluster 1 (Metropolitan Leaders), while the rest of the regions are included at Cluster 2 (Balanced innovators). Overall, then, Finland is displaying a very good position in terms of attractiveness.

Helsinki-Uusimaa and Åland clearly leading the national rankings in terms of regional attractiveness. In 2022, the overall RAI values are particularly high in Helsinki-Uusimaa (94.9) and Åland (91.6), followed by Länsi-Suomi (77.0) and Etelä-Suomi (75.8). Pohjois- ja Itä-Suomi, although lower, still achieves a relatively strong score of 73.4, indicating a national profile of generally high and balanced attractiveness ([Figure 5.1, panels a and b](#)).

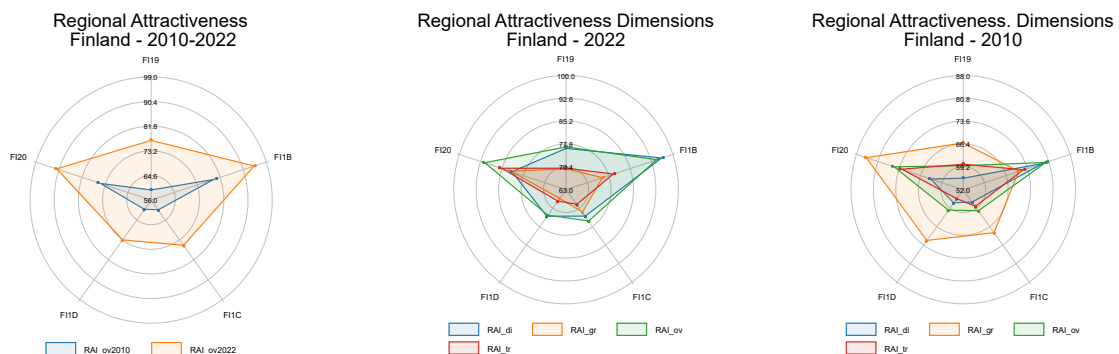
Between 2010 and 2022, all Finnish regions improved their overall RAI. The most significant progress is observed in Åland, rising from 75.8 to 91.6, and in Länsi-Suomi, with an increase of more than 17 points. This growth pattern shows that improvements have not only been concentrated in the capital region but also extend to the broader national territory, suggesting a well-structured policy environment and convergence in basic conditions of attractiveness.

Figure 5. 1 Case of Study: Finland

panel a)

NUTS 2	Region	RAI Overall		RAI Traditional		RAI Green		RAI Digital	
		2010	2022	2010	2022	2010	2022	2010	2022
FI19	Länsi-Suomi	59.7	77.0	60.2	70.1	66.9	69.9	55.8	76.5
FI1B	Helsinki-Uusimaa	80.5	94.9	72.7	79.9	71.0	75.9	79.9	96.7
FI1C	Etelä-Suomi	60.4	75.8	58.7	69.1	69.0	72.3	57.0	73.8
FI1D	Pohjois- ja Itä-Suomi	60.2	73.4	55.7	67.8	72.0	66.7	57.4	73.9
FI20	Åland	75.8	91.6	73.3	86.0	85.0	82.9	63.4	82.1

panel b)



panel c)

NUTS 2	Region	Population			Net flows					
		Pop 2010	Pop 2022	Av annual growth rate	Permanent migration	Seasonal migration	Cross-border comm	Long dist. comm	Short term student	Long term student
FI19	Länsi-Suomi	135516	138224	0.16%	-0.21‰	-0.59‰	1.07‰	-5.54‰	0.47‰	-0.003‰
FI1B	Helsinki-Uusimaa	151754	171474	1.02%	0.68‰	1.16‰	1.60‰	7.32‰	0.51‰	0.004‰
FI1C	Etelä-Suomi	115383	114631	-0.05%	-0.25‰	-0.43‰	1.66‰	3.66‰	0.34‰	-0.001‰
FI1D	Pohjois- ja Itä-Suomi	129714	127459	-0.15%	-0.38‰	-0.08‰	0.93‰	-0.52‰	0.58‰	0.001‰
FI20	Åland	27734	30344	0.75%	0.14‰	2.59‰	30.54‰	49.63‰	0.04‰	0.021‰

Note: This table reports population figures and average annual net flows per 1,000 inhabitants (‰) for each NUTS2 region over the 2010–2022 period. Net flows are shown for six types of mobility: permanent migration, seasonal migration, cross-border commuting, long-distance commuting, and short- and long-term Erasmus student mobility. Positive values indicate net inflows; negative values reflect net outflows. Population growth is expressed as an average annual rate (%).

panel d)

<i>Finland</i>	<i>Permanent flows</i>	<i>Seasonal flows</i>	<i>Cross border commuting</i>	<i>Long distance commuting</i>	<i>Short term student</i>	<i>Long term student</i>
<i>RAI overall</i>	0.264 (0.230)	0.587*** (0.190)	0.00736 (0.361)	0.265 (0.262)	-0.496 (0.504)	0.869* (0.490)
<i>R2</i>	0.220	0.338	0.0494	0.342	0.351	0.285
<i>Observations</i>	15	65	65	65	35	35
<i>Number of regions</i>	5	5	5	5	5	5
<i>RAI tradit</i>	-0.383 (0.966)	0.847 (0.536)	0.607* (0.347)	0.404* (0.243)	-1.600** (0.721)	-1.713 (1.645)
<i>RAI green</i>	0.139 (0.537)	0.0601 (0.321)	0.360* (0.211)	0.440*** (0.145)	-0.0291 (0.437)	2.143** (0.957)
<i>RAI digital</i>	0.469 (0.449)	-0.171 (0.231)	-0.364* (0.188)	-0.228** (0.102)	0.809** (0.391)	0.413 (0.629)
<i>R2</i>	0.289	0.420	0.726	0.753	0.792	0.507
<i>Observations</i>	15	65	65	65	35	35
<i>Number of regions</i>	5	5	5	5	5	5

Note: Random effects panel regressions estimate the association between standardised mobility flows and regional attractiveness indices across NUTS2 regions (2010–2022). Results are expressed in standardised coefficients and should be interpreted as associations, not causal effects. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors in parentheses.

Looking at the traditional dimension, Åland (86.0) and Helsinki-Uusimaa (79.9) rank highest in 2022, with all other regions ranging between 67.8 and 70.1. The improvement across the country reflects stronger economic fundamentals, service provision, and institutional quality.

In the green dimension, all Finnish regions show improvement between 2010 and 2022. Åland (82.9) and Etelä-Suomi (72.3) lead the national ranking in 2022, followed closely by Länsi-Suomi (69.9) and Pohjois- ja Itä-Suomi (66.7). Even regions with initially high green scores, such as Helsinki-Uusimaa, improve further, reaching 75.9. This consistent upward trend suggests strengthened performance in environmental indicators such as reduced emissions, greater circular employment, and better land-use balance. The improvement is particularly notable in Etelä-Suomi and Länsi-Suomi, where the green RAI increased by more than 5 points, reinforcing a national dynamic of convergence in sustainability outcomes.

In the digital dimension, all regions also improve considerably, with Helsinki-Uusimaa standing out as the top performer, increasing from 79.9 to 96.7. Åland (82.1), Etelä-Suomi (73.8), and Pohjois- ja Itä-Suomi (73.9) also record high levels in 2022, confirming a broad diffusion of digital infrastructure and services. Länsi-Suomi, which started from a relatively low level in 2010 (55.8), shows a remarkable gain of over 20 points, reaching 76.5. These patterns reflect successful national efforts in expanding broadband access, boosting high-tech employment, and enhancing digital uptake across households and institutions. Overall, digital attractiveness appears as one of Finland's strongest and most cohesive dimensions.

Overall, Finland shows strong and balanced gains in regional attractiveness from 2010 to 2022. All regions improved, led by Helsinki-Uusimaa and Åland, with others catching

up. Progress is driven by the traditional dimension, while green and digital attractiveness also rise steadily. Overall, the country demonstrates cohesive and converging regional development.

We now turn to an analysis of demographic trends and mobility flows across Finnish regions, focusing on population change and the intensity of different types of net movements over the 2010–2022 period ([Figure 5.1, panel c](#)). Population trends across Finnish regions between 2010 and 2022 show a marked contrast between growth in the urban core and decline in more peripheral areas. Helsinki-Uusimaa records the highest growth rate at +1.02% annually, driven by a strong demographic and functional pull. Åland also stands out with +0.75% growth, while Länsi-Suomi grows modestly (+0.16%). In contrast, Etelä-Suomi (−0.05%) and Pohjois- ja Itä-Suomi (−0.15%) both experience population decline, reflecting long-term demographic and economic challenges.

Net regional migration flows reinforce these patterns. Helsinki-Uusimaa and Åland are the only regions with positive permanent and seasonal migration balances. Helsinki-Uusimaa receives +0.68‰ permanent and +1.16‰ seasonal migrants, while Åland reports +0.14‰ and +2.59‰, respectively. All other regions show negative migration balances, especially Pohjois- ja Itä-Suomi, which records the most significant net permanent outflow (−0.38‰).

Cross-border commuting is relatively low in mainland Finland but substantial in Åland, with a remarkable 30.54‰, highlighting its special status and strong integration with surrounding labour markets. Mainland regions display moderate levels (between 0.93‰ and 1.66‰), led by Etelä-Suomi. Long-distance commuting is particularly high in Åland (49.63‰) and Helsinki-Uusimaa (7.32‰), reflecting their economic centrality. Other regions vary widely, with negative net balances in Länsi-Suomi (−5.54‰) and Pohjois- ja Itä-Suomi (−0.52‰), suggesting outflows of workers to other areas.

Regarding Erasmus students mobility, short-term student flows are modestly positive in all mainland regions, especially in Pohjois- ja Itä-Suomi (0.58‰) and Helsinki-Uusimaa (0.51‰), indicating their role as student hosts. Long-term student mobility is near zero, though slightly positive in Pohjois- ja Itä-Suomi and Åland, and marginally negative elsewhere, suggesting relative balance in degree-seeking exchanges.

In summary, Helsinki-Uusimaa and Åland emerge as clear demographic and mobility magnets, while Etelä-Suomi and Pohjois- ja Itä-Suomi face stagnation or decline, coupled with negative net migration and commuting outflows. The data confirm a strong urban–peripheral divide in population dynamics and functional integration.

We now turn to the regression analysis ([Figure 5.1, panel d](#)), to assess whether the relationship between regional attractiveness and mobility observed at the European level holds within Finland. While the number of observations is limited, these results offer insights into the direction and strength of associations in a relatively cohesive and high-performing setting.

In the Finnish case, the overall RAI is significantly and positively associated only with seasonal migration (0.587) and long-term student mobility (0.869). These findings suggest that more attractive regions are more likely to host temporary workers and long-term Erasmus students. Other flows show positive but statistically insignificant associations.

When the RAI is decomposed, more differentiated patterns emerge. The traditional dimension is positively linked to cross-border (0.607) and long-distance commuting (0.404), suggesting that economic and institutional conditions may support work-related mobility. However, it is negatively associated with short-term student mobility (−1.600), perhaps reflecting an inverse relationship between economic strength and short-term academic exchange.

The green dimension shows a consistent positive association with long-distance commuting (0.440) and cross-border commuting (0.360), indicating that the Green Transition may play a role in regional labour accessibility. It is also strongly linked to long-term student mobility (2.143), suggesting that greener regions may attract more degree-seeking Erasmus students.

In contrast, the digital dimension reveals a negative relationship with both commuting variables—cross-border (−0.364) and long-distance (−0.228)—but a strong positive association with short-term student flows (0.809), indicating a possible preference for digitally advanced regions among mobile student, or simply that those regions with faster growth in the Digital Transition (those which were lagging behind) are the ones attracting less flows.

Overall, in Finland, mobility patterns appear to be shaped by different facets of regional attractiveness in nuanced ways, with traditional and green dimensions driving commuting, and digital and green characteristics associated to student mobility.

5.2. GREECE

Greece comprises 13 NUTS2 regions, with Attiki (Athens' region) as the clear leader in terms of regional attractiveness, the only representative in the country of Cluster 1 (Metropolitan leaders). Island regions including Notio and Voreio Aigaio and Kriti (Aegean Islands, Crete) are within Cluster 4 (Economies in Regional Transition), and the remaining regions belong to Cluster 6 (Structurally Lagging and Peripheral Regions).

In 2022, the overall RAI shows significant improvement across the country. Attiki reaches a value of 57.6, well above the rest, followed by Notio Aigaio (50.1) and Voreio Aigaio (41.1). The remaining regions mostly range between 32 and 44, with Thessalia, Dytiki Elláda, and Sterea Elláda at the lower end of the spectrum. While overall levels remain modest compared to EU averages, all regions registered notable gains since 2010, narrowing territorial gaps and marking clear progress ([Figure 5.1, panels a and b](#)).

Improvements in the traditional dimension are evident, particularly in Kriti (from 29.7 to 43.2), Notio Aigaio (from 26.4 to 50.4) and Attiki (from 31.5 to 38.5). Other regions also progress but remain below 35, reflecting persistent weaknesses in economic structure, service provision, or institutional quality. Despite improvements, traditional attractiveness remains a structural bottleneck across most Greek regions.

In the contrary, the green-related dimensions indicated already high scores in 2010 which remain also in 2022. All regions maintain values above 48, with Voreio Aigaio (76.2), Ionia Nisia (74.6), and Notio Aigaio (68.4) leading this attractiveness dimension. However, most regions show slight declines, suggesting limited progress in the green transition, likely linked to tourism intensity, land use stress, or emissions rebound. Still, the green index remains Greece's strongest dimension overall.

Digital attractiveness shows the most striking improvements. All regions start from very low levels in 2010 (often below 15) and reach much higher values by 2022, with Attiki (67.8) and Notio Aigaio (45.9) standing out. Regions like Kentriki Makedonia, Dytiki Makedonia, and Ipeiros also make significant progress. These results reflect broad advances in digital infrastructure and service usage, yet important gaps remain relative to EU leaders.

Overall, Greece demonstrates substantial progress in regional attractiveness, especially in the digital domain, while still facing challenges in economic fundamentals. The green profile remains strong, though signs of strain are visible, and traditional attractiveness continues to lag behind, limiting the full potential of convergence across the country.

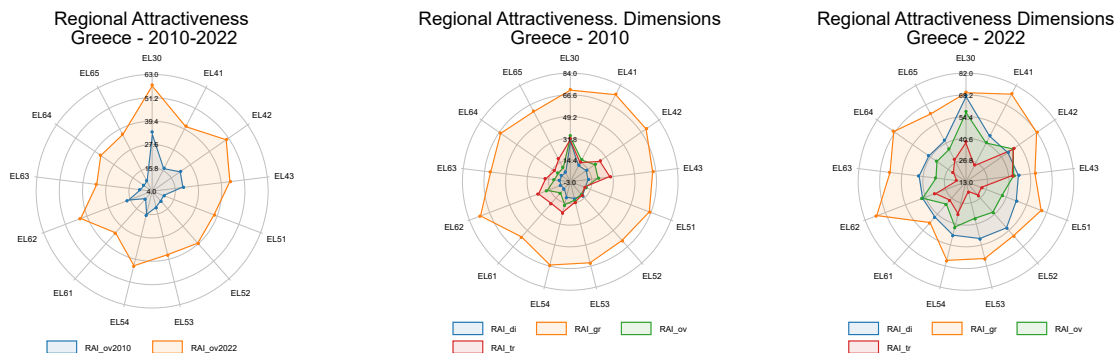
We now turn to an analysis of demographic dynamics and mobility flows across Greek regions between 2010 and 2022. [Figure 5.2 panel c](#) presents annual population growth rates alongside average net flows per 1,000 inhabitants for the six types of mobility: permanent and seasonal migration, cross-border and long-distance commuting, and Erasmus student mobility (short- and long-term).

Figure 5. 2 Case of Study: Greece

panel a)

NUTS 2	Region	RAI Overall		RAI Traditional		RAI Green		RAI Digital	
		2010	2022	2010	2022	2010	2022	2010	2022
EL30	Attiki	33.9	57.6	31.5	38.5	70.9	69.9	31.2	67.8
EL41	Voreio Aigaio	17.1	41.1	14.8	25.0	76.3	76.2	12.0	46.1
EL42	Notio Aigaio	21.7	50.1	26.4	50.4	71.9	68.4	13.2	45.9
EL43	Kriti	20.1	44.1	29.7	43.2	64.4	57.8	12.0	47.2
EL51	Anatoliki Makedonia. Thraki	10.6	38.0	9.8	23.9	65.7	64.9	10.5	47.8
EL52	Kentriki Makedonia	10.9	39.3	11.7	25.0	60.4	59.3	12.4	52.5
EL53	Dytiki Makedonia	12.7	37.3	14.3	19.9	64.4	63.7	11.3	50.6
EL54	Ipeiros	16.6	43.1	23.0	34.5	66.2	64.8	10.3	48.3
EL61	Thessalia	9.4	32.4	20.6	29.0	56.6	48.1	4.9	43.3
EL62	Ionia Nisia	17.7	43.3	25.0	34.6	75.0	74.6	5.6	43.1
EL63	Dytiki Elláda	10.4	32.7	17.5	19.3	62.1	62.3	6.0	43.6
EL64	Stereia Elláda	9.3	36.0	12.8	23.3	65.7	69.6	5.8	42.2
EL65	Peloponnisos	10.0	36.6	17.9	29.1	60.9	62.0	5.7	42.8

panel b)



panel c)

NUTS 2	Region	Population			Average Net flows					
		Pop 2010	Pop 2022	Av annual growth rate	Permanen t migration	Seasonal migratio n	Cross border comm	Lon dist comm	Short term student	Long term student
EL30	Attiki	4002871	3806550	-0.42%	-0.67‰	-0.23‰	0.06‰	-2.55‰	-0.06‰	0.002‰
EL41	Voreio Aigaio	200179	195229	-0.21%	-4.53‰	1.58‰	2.16‰	7.08‰	0.28‰	0.024‰
EL42	Notio Aigaio	332652	327517	-0.13%	8.96‰	3.60‰	1.18‰	11.27‰	0.41‰	0.009‰
EL43	Kriti	623113	623633	0.01%	0.23‰	0.78‰	1.57‰	3.50‰	0.11‰	0.000‰
EL51	Anatoliki Makedonia. Thraki	610112	560826	-0.70%	0.96‰	0.73‰	2.04‰	2.62‰	-0.22‰	0.001‰
EL52	Kentriki Makedonia	1921906	1790686	-0.59%	-0.40‰	0.07‰	0.54‰	-0.38‰	-0.07‰	0.002‰
EL53	Dytiki Makedonia	286450	253954	-1.00%	-3.10‰	0.45‰	1.07‰	2.47‰	-0.58‰	-0.004‰
EL54	Ipeiros	345960	319206	-0.67%	-0.94‰	-0.19‰	0.93‰	1.44‰	-0.12‰	0.002‰
EL61	Thessalia	746976	686344	-0.70%	-4.87‰	-0.28‰	0.36‰	-0.45‰	-0.09‰	0.002‰
EL62	Ionia Nisia	208675	204081	-0.19%	4.96‰	3.18‰	3.87‰	12.18‰	-0.08‰	0.013‰
EL63	Dytiki Elláda	692269	646621	-0.57%	-0.55‰	-0.13‰	0.40‰	0.43‰	-0.19‰	0.000‰
EL64	Stereia Elláda	559655	507072	-0.82%	-1.13‰	0.64‰	1.01‰	6.22‰	-0.06‰	0.023‰
EL65	Peloponnisos	588471	538063	-0.74%	-1.60‰	0.48‰	0.69‰	3.17‰	0.02‰	0.006‰

Note: This table reports population figures and average annual net flows per 1,000 inhabitants (‰) for each NUTS2 region over the 2010–2022 period. Net flows are shown for six types of mobility: permanent migration, seasonal migration, cross-border commuting, long-distance commuting, and short- and long-term Erasmus student mobility. Positive values indicate net inflows; negative values reflect net outflows. Population growth is expressed as an average annual rate (%).

panel d)

<i>Greece</i>	<i>Permanent Flows</i>	<i>Seasonal flows</i>	<i>Cross border commuting</i>	<i>Long distance commuting</i>	<i>Short term student</i>	<i>Long term student</i>
<i>RAI overall</i>	0.527 (0.949)	0.355 (0.218)	0.0391* (0.0212)	0.0217 (0.0487)	0.783** (0.396)	0.00988 (0.395)
<i>R2</i>	0.128	0.0778	0.124	0.121	0.128	0.168
<i>Observations</i>	39	169	169	169	91	91
<i>Number of regions</i>	13	13	13	13	13	13
<i>RAI_tradit</i>	-0.00508 (0.640)	0.437*** (0.123)	0.0235* (0.0120)	0.0640*** (0.0206)	0.737*** (0.251)	-0.202 (0.247)
<i>RAI_green</i>	0.609 (0.639)	0.327*** (0.0926)	0.0288*** (0.0107)	0.0925*** (0.0157)	-0.146 (0.248)	0.677*** (0.201)
<i>RAI_digital</i>	0.281 (1.000)	-0.560*** (0.143)	-0.0412** (0.0195)	-0.173*** (0.0245)	-0.0340 (0.466)	-0.714** (0.328)
<i>R2</i>	0.127	0.307	0.456	0.569	0.215	0.392
<i>Observations</i>	39	169	169	169	91	91
<i>Number of regions</i>	13	13	13	13	13	13

Note: Random effects panel regressions estimate the association between standardised mobility flows and regional attractiveness indices across NUTS2 regions (2010–2022). Results are expressed in standardised coefficients and should be interpreted as associations, not causal effects. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors in parentheses.

Greece exhibits a widespread pattern of population decline, with all but one region losing population over the 2010–2022 period. The largest declines are recorded in Dytiki Makedonia (–1.00%), Sterea Elláda (–0.82%), Peloponnisos (–0.74%), and Thessalia (–0.70%). The only region with population stability is Kriti, with negligible growth (+0.01%), while Notio Aigaio and Ionia Nisia experience relatively modest decreases (–0.13% and –0.19%, respectively).

Permanent interregional migration flows are negative in most regions, reinforcing the trend of depopulation. Particularly strong outflows are seen in Thessalia (–4.87‰), Voreio Aigaio (–4.53‰), and Dytiki Makedonia (–3.10‰). In contrast, Notio Aigaio (+8.96‰) and Ionia Nisia (+4.96‰) stand out as the only regions with strong positive balances, likely reflecting their touristic and insular appeal. Seasonal migration is positive in most regions, especially in Notio Aigaio (3.60‰) and Ionia Nisia (3.18‰), where seasonal work and tourism-driven mobility play a major role. Urban and mainland regions tend to show weak or negative seasonal balances.

Cross-border commuting is limited but positive across all regions, with values highest in Ionia Nisia (3.87‰) and Voreio Aigaio (2.16‰), suggesting some degree of regional integration with nearby territories, especially among islands. Long-distance commuting shows greater variation. While Notio Aigaio (11.27‰) and Ionia Nisia (12.18‰) lead with very high inflows, likely reflecting strong pull factors from temporary labour demand, Attiki (–2.55‰) and Kentriki Makedonia (–0.38‰) display outflows, possibly indicating outbound mobility of workers seeking better opportunities elsewhere.

Erasmus student flows are generally weak and often negative for short-term exchanges. The strongest positive short-term flows are seen in Notio Aigaio (0.41‰), Voreio Aigaio

(0.28‰), and Pohjois- ja Itä-Suomi (0.58‰). Long-term student mobility is positive but marginal in most regions, peaking at 0.024‰ in Voreio Aigaio.

In summary, Greek regions are experiencing a general demographic contraction, particularly in rural and northern areas, accompanied by weak or negative migration and commuting balances. A few island regions—such as Notio Aigaio, Ionia Nisia, and Kriti—stand out with more dynamic inflows, especially in seasonal migration and long-distance commuting, reflecting their tourism-oriented economic structures.

Following the previous discussion of regional attractiveness levels and mobility patterns in Greece, we now examine whether these dimensions are statistically associated ([Figure 5.2, panel d](#)). The regression results below provide a national perspective on how the overall and specific components of the Regional Attractiveness Index relate to different types of mobility flows.

In the Greek case, the overall RAI shows a significant and positive association with short-term student mobility (0.783) and a marginal association with cross-border commuting (0.0391). This suggests that regions with higher combined attractiveness tend to receive more Erasmus students and may be slightly more integrated with neighbouring labour markets. Other flow types show positive but statistically insignificant relationships.

When decomposing the RAI, the traditional dimension displays a strong and significant association with seasonal migration (0.437), long-distance commuting (0.0640), and short-term student flows (0.737). These results suggest that economic and institutional fundamentals are important drivers of temporary and educational mobility.

The green dimension also stands out. It is positively and significantly associated with four types of flows: seasonal migration (0.327), cross-border commuting (0.0288), long-distance commuting (0.0925), and long-term student mobility (0.677). This implies that greener regions, possibly with tourism activity and better environmental amenities, attract both work-related mobility and international students seeking longer stays.

Conversely, the digital dimension is negatively associated with several flows: seasonal migration (−0.560), cross-border commuting (−0.0412), long-distance commuting (−0.173), and long-term student mobility (−0.714). This pattern may reflect that more digitally advanced regions are concentrated in Attiki and a few urban centres, while much of the actual mobility—particularly commuting and student inflows—takes place in touristic or peripheral areas with lower digital scores. The time dimension, with large

increases in this dimension, also may indicate that faster increasing regions, the ones lagging behind, are the ones with lower mobility net flows.

Overall, traditional and green dimensions of attractiveness are more strongly associated with mobility in the Greek case, particularly in temporary and student flows, while the digital dimension shows a more complex and sometimes inverse relationship with mobility patterns.

5.3. ITALY

Italy is a very diverse country in terms of assignment to Attractiveness Clusters. While no region belongs to Cluster 1 (Metropolitan Leaders), two regions, Valle d'Aosta/Vallée d'Aoste and Provincia Autonoma di Bolzano/Bozen, are assigned to Cluster 2 (Balanced Innovators). Six belong to Cluster 3 (Industrial Heartlands in Transformation): Veneto, Emilia-Romagna, Piemonte, Lazio, Provincia Autonoma di Trento and Toscana. Six more belong to Cluster 4 (Economies in Structural Transition): Marche, Umbria, Friuli-Venezia Giulia, Lombardia, Abruzzo, and Liguria. Finally, the remaining regions are within Cluster 6 (Structurally Lagging and Peripheral Regions): Sardegna, Campania, Sicilia, Puglia, Molise, Calabria and Basilicata.

Overall, then, the Italian regional system displays clear territorial contrasts in overall attractiveness, though all regions improve between 2010 and 2022 ([Figure 5.3, panels a and b](#)). The most attractive regions in 2022 are concentrated in the North, with Valle d'Aosta/Vallée d'Aoste (73.4), Provincia Autonoma di Bolzano (70.1), Trento (68.5), and Friuli-Venezia Giulia (62.8) leading the ranking. Southern regions like Sicilia (31.6), Calabria (31.0), and Campania (34.8) remain at the bottom, despite notable improvements since 2010. This confirms a persistent North–South divide, albeit with gradual convergence.

In the traditional dimension, improvements are widespread, particularly in the North and Centre. Bolzano/Bozen (76.0), Valle d'Aosta (66.5), and Trento (65.8) top the ranking, reflecting strong economic and institutional capacity. Most southern regions remain well below 35, with Campania (13.4) and Calabria (13.2) still facing deep structural constraints. Nonetheless, progress is visible even in the weakest performers, indicating incremental gains in basic conditions.

In the green dimension, Italian regions maintain relatively high and stable scores, with no major declines and many regions showing modest improvements. The leading

performers in 2022 are Provincia Autonoma di Bolzano (78.1), Valle d'Aosta (88.1), Marche (77.1), and Friuli-Venezia Giulia (77.9), all of which consolidate their already strong environmental profiles. Progress is also observed in regions like Lazio, Liguria, and Toscana, though to a lesser extent. Southern regions such as Campania, Calabria, and Sicilia continue to lag behind but show slight gains. Overall, the green dimension remains a strength for many northern and central regions, likely reflecting balanced land use, stronger institutional frameworks, and the integration of sustainability principles, while the South continues to face structural challenges.

In contrast, the digital dimension shows broad-based and substantial improvements across the entire country. Nearly all regions have increased their digital scores significantly between 2010 and 2022. Valle d'Aosta (88.1), Lazio (71.3), Trento (61.0), and Lombardia (64.0) are among the top performers in 2022, highlighting growing digital capacity in both peripheral and urbanised areas. Even in structurally weaker regions such as Molise, Basilicata, and Calabria, scores have risen sharply, in some cases tripling since 2010. These gains suggest effective national investment in broadband infrastructure, widespread uptake of digital services, and improved digital literacy. The digital dimension now stands as the most dynamic and convergent component of regional attractiveness in Italy.

Overall, Italy's territorial pattern is marked by growing convergence in digital capacity, steady gains in economic fundamentals, and continued environmental resilience in the northern half of the country. However, structural gaps in the South remain a key challenge for balanced development.

We now examine demographic trends and mobility flows across Italian NUTS2 regions between 2010 and 2022 ([Figure 5.3, panel c](#)), focusing on population dynamics and average net movements per 1,000 inhabitants for different types of mobility. Italy presents a mixed demographic picture, with only four regions experiencing population growth: Bolzano (+0.52%), Lazio (+0.30%), Trento (+0.31%), and Emilia-Romagna (+0.16%). Most other regions show modest declines, while Molise (−0.65%), Basilicata (−0.61%), and Calabria (−0.51%) suffer the sharpest population contractions. These patterns reflect persistent north–south disparities, with population gains concentrated in dynamic northern and urban areas.

Permanent migration flows are generally weak but slightly positive in many central and northern regions, such as Trento (+1.22‰), Lazio (+0.80‰), and Toscana (+0.71‰). However, most of the South—including Calabria, Sicilia, and Basilicata—record negative or near-zero balances, indicating ongoing outmigration. Seasonal migration flows vary more significantly. The standout case is Valle d'Aosta, with a remarkably

high inflow of +12.72‰, likely tied to tourism. Other notable positive balances are observed in Bolzano (+3.88‰) and Emilia-Romagna (+1.41‰). Many southern and inland regions, however, show negative balances, pointing to weaker seasonal labour dynamics.

Cross-border commuting is strongest in Valle d'Aosta (+12.85‰) and Sardegna (+3.35‰). Several regions—including Lombardia (−4.77‰) and Bolzano (−1.25‰)—show negative values, possibly reflecting outbound flows to neighbouring countries (Switzerland) or statistical anomalies due to commuting definitions. Long-distance commuting is particularly high in regions with strong economic pull or transit character, such as Valle d'Aosta (+14.18‰), Bolzano (+10.27‰), and Emilia-Romagna (+7.96‰). In contrast, several southern regions including Campania (−9.00‰) and Umbria (−11.37‰) show strong net outflows, reinforcing the pattern of outward labour mobility from the South.

Short-term student flows are negative across almost all regions, with Marche (−0.40‰), Trento (−0.63‰), and Sardegna (−0.35‰) showing the largest outflows. This may reflect a concentration of Erasmus sending capacity in smaller or peripheral universities. Only Bolzano (+0.13‰) and Toscana (+0.04‰) record slightly positive balances. Long-term student flows are generally close to zero, with minor positive values in a few regions like Toscana (+0.004‰) and Umbria (+0.007‰), and small negative values elsewhere.

In sum, demographic stagnation, persistent outmigration from southern regions, and selective functional mobility in the North define the spatial pattern of mobility flows in Italy. Regions like Valle d'Aosta, Bolzano, and Trento stand out as mobility hubs, while many southern regions continue to lose population and workforce through multiple channels.

Following the analysis of regional attractiveness levels and net mobility flows in Italy, we now explore whether these characteristics are statistically associated ([Figure 5.3, panel d](#)). The regression results below shed light on how the composite and disaggregated Regional Attractiveness Index relate to different types of mobility within Italian regions.

The overall RAI is positively and significantly associated with seasonal migration (0.814) and long-distance commuting (0.109). This suggests that more attractive regions tend to receive greater inflows of temporary workers and commuters. However, there is no clear link between overall attractiveness and student mobility or permanent migration in the Italian context.

When disaggregating the RAI, the traditional dimension plays a key role. It shows strong, positive associations with seasonal migration (0.574) and long-distance commuting (0.0966), suggesting that regions with stronger economic fundamentals and public services are better positioned to attract mobile labour. Its associations with other flows remain weak or insignificant.

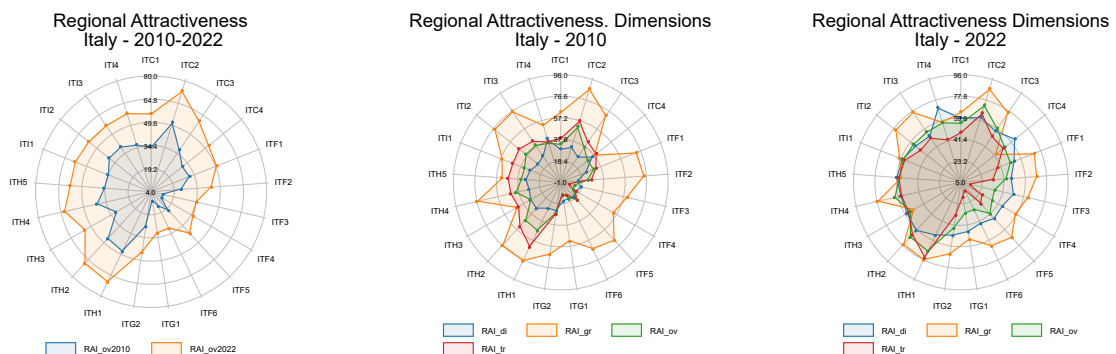
The green dimension reveals a more selective pattern. It is positively associated with cross-border commuting (0.0509), perhaps reflecting environmental and locational advantages in northern border regions. However, it is negatively associated with short-term student mobility (–0.209), possibly indicating that greener regions, which are often more rural, may be less attractive for incoming short-term students.

Figure 5. 3 Case of Study: Italy

panel a)

NUTS 2	Region	RAI Overall		RAI Traditional		RAI Green		RAI Digital	
		2010	2022	2010	2022	2010	2022	2010	2022
ITC1	Piemonte	33.7	55.4	39.3	47.5	62.6	64.7	29.2	59.7
ITC2	Valle d'Aosta/Vallée d'Aoste	51.8	73.4	57.3	66.5	87.5	88.1	32.5	62.9
ITC3	Liguria	37.4	60.3	43.3	52.4	72.1	76.4	27.1	57.7
ITC4	Lombardia	30.7	52.9	40.6	51.4	39.1	43.5	36.1	64.0
ITF1	Abruzzo	31.5	50.6	33.7	38.8	72.9	72.3	24.1	53.9
ITF2	Molise	24.0	43.9	27.2	32.7	74.9	70.0	14.9	48.3
ITF3	Campania	12.2	34.8	7.1	13.4	60.9	63.8	18.2	51.3
ITF4	Puglia	12.3	36.1	14.9	26.3	54.5	58.9	15.7	45.9
ITF5	Basilicata	21.1	41.8	21.1	30.1	70.8	69.0	17.0	47.2
ITF6	Calabria	14.8	31.0	12.0	13.2	66.0	65.0	16.0	44.0
ITG1	Sicilia	10.4	31.6	11.2	17.9	52.9	54.2	16.3	47.5
ITG2	Sardegna	27.3	44.5	28.4	33.3	65.0	66.6	25.4	50.7
ITH1	Provincia Autonoma di Bolzano/Bozen	47.8	70.1	64.1	76.0	77.9	78.1	25.5	55.0
ITH2	Provincia Autonoma di Trento	46.2	68.5	53.8	65.8	77.0	77.1	31.6	61.0
ITH3	Veneto	31.0	54.6	43.5	56.5	45.3	51.9	30.8	58.1
ITH4	Friuli-Venezia Giulia	40.9	62.8	45.7	56.9	77.1	77.9	28.7	57.7
ITH5	Emilia-Romagna	35.2	57.7	47.1	58.3	52.7	56.3	31.2	59.8
ITI1	Toscana	34.6	58.0	45.9	56.7	56.5	61.3	29.0	58.7
ITI2	Umbria	39.6	56.9	47.5	49.0	75.7	76.1	25.7	54.6
ITI3	Marche	39.8	56.8	44.3	50.6	76.7	77.1	28.0	52.6
ITI4	Lazio	36.4	58.0	37.5	43.0	53.5	58.5	40.5	71.3

panel b)



panel c)

NUTS 2	Region	Population			Average Net flows					
		Pop 2010	Pop 2022	Av annual growth rate	Permanent migration	Seasonal migration	Cross border comm	Lon dist comm	Short term student	Long term student
ITC1	Piemonte	4401572	4256350	-0.28%	0.03‰	0.29‰	-0.22‰	-4.50‰	-0.14‰	-0.019‰
ITC2	Valle d'Aosta/Vallée d'Aoste	126957	123360	-0.24%	0.18‰	12.72‰	12.85‰	14.18‰	-0.29‰	0.000‰
ITC3	Liguria	1591537	1509227	-0.44%	0.59‰	1.00‰	0.08‰	7.03‰	-0.12‰	-0.001‰
ITC4	Lombardia	9670614	9943004	0.23%	0.58‰	0.67‰	-4.77‰	1.70‰	-0.13‰	-0.007‰

<i>ITF1</i>	Abruzzo	1326015	1275950	-0.32%	-0.56‰	-0.37‰	0.53‰	-1.14‰	-0.22‰	-0.012‰
<i>ITF2</i>	Molise	315939	292150	-0.65%	-2.78‰	-1.35‰	2.22‰	-3.39‰	-0.17‰	-0.002‰
<i>ITF3</i>	Campania	5807464	5624420	-0.27%	0.00‰	-1.90‰	-0.22‰	-9.00‰	-0.20‰	-0.003‰
<i>ITF4</i>	Puglia	4090111	3922941	-0.35%	-0.27‰	-0.99‰	1.19‰	-2.93‰	-0.08‰	-0.003‰
<i>ITF5</i>	Basilicata	582618	541168	-0.61%	-1.28‰	-0.64‰	0.95‰	-5.23‰	-0.17‰	0.001‰
<i>ITF6</i>	Calabria	1973624	1855454	-0.51%	-0.47‰	-1.81‰	0.44‰	-5.75‰	-0.15‰	0.000‰
<i>ITG1</i>	Sicilia	5044045	4833329	-0.35%	-0.28‰	-1.55‰	0.47‰	-5.23‰	-0.13‰	0.000‰
<i>ITG2</i>	Sardegna	1653711	1587413	-0.34%	-0.21‰	-0.07‰	3.35‰	1.94‰	-0.35‰	0.002‰
	Provincia Autonoma di Bolzano/Bozen	500450	532616	0.52%	-0.96‰	3.88‰	-1.25‰	10.27‰	0.13‰	0.000‰
<i>ITH1</i>	Provincia Autonoma di Trento	521531	540958	0.31%	1.22‰	1.70‰	0.22‰	4.42‰	-0.63‰	-0.012‰
<i>ITH2</i>	Veneto	4863372	4847745	-0.03%	0.52‰	0.17‰	-0.23‰	-2.28‰	-0.26‰	-0.006‰
<i>ITH3</i>	Friuli-Venezia Giulia	1225910	1194647	-0.22%	0.64‰	0.12‰	0.81‰	4.64‰	-0.33‰	-0.005‰
<i>ITH4</i>	Emilia-Romagna	4340491	4425366	0.16%	0.47‰	1.41‰	0.17‰	7.96‰	-0.18‰	-0.003‰
<i>ITI1</i>	Toscana	3706592	3663191	-0.10%	0.71‰	1.10‰	0.62‰	2.43‰	-0.08‰	0.004‰
							-11.37‰			
<i>ITI2</i>	Umbria	884937	858812	-0.25%	0.94‰	-0.48‰	0.63‰	‰	-0.12‰	0.007‰
<i>ITI3</i>	Marche	1546800	1487150	-0.33%	-0.38‰	-0.61‰	0.34‰	-5.41‰	-0.40‰	-0.014‰
<i>ITI4</i>	Lazio	5516026	5714882	0.30%	0.80‰	1.01‰	-0.38‰	6.91‰	-0.09‰	-0.003‰

Note: This table reports population figures and average annual net flows per 1,000 inhabitants (‰) for each NUTS2 region over the 2010–2022 period. Net flows are shown for six types of mobility: permanent migration, seasonal migration, cross-border commuting, long-distance commuting, and short- and long-term Erasmus student mobility. Positive values indicate net inflows; negative values reflect net outflows. Population growth is expressed as an average annual rate (%).

panel d)

<i>Italy</i>	<i>Permanent Flows</i>	<i>Seasonal flows</i>	<i>Cross border commuting</i>	<i>Long distance commuting</i>	<i>Short term student</i>	<i>Long term student</i>
<i>RAI overall</i>	0.191 (0.118)	0.814*** (0.188)	0.00539 (0.0388)	0.109*** (0.0275)	-0.204 (0.135)	-0.0423 (0.136)
<i>R2</i>	0.105	0.307	0.0227	0.363	0.154	0.0703
<i>Observations</i>	63	273	273	273	147	147
<i>Number of regions</i>	21	21	21	21	21	21
<i>RAI_tradit</i>	-0.0839 (0.135)	0.574*** (0.199)	0.0233 (0.0362)	0.0966*** (0.0267)	0.118 (0.119)	-0.0606 (0.150)
<i>RAI_green</i>	-0.0584 (0.0798)	0.225 (0.139)	0.0509** (0.0251)	0.0132 (0.0193)	-0.209** (0.0838)	0.0468 (0.0994)
<i>RAI_digital</i>	0.688*** (0.260)	-0.122 (0.340)	-0.102 (0.0627)	-0.0334 (0.0425)	-0.288 (0.186)	0.000886 (0.275)
<i>R2</i>	0.316	0.302	0.153	0.321	0.237	0.0708
<i>Observations</i>	63	273	273	273	147	147
<i>Number of regions</i>	21	21	21	21	21	21

Note: Random effects panel regressions estimate the association between standardised mobility flows and regional attractiveness indices across NUTS2 regions (2010–2022). Results are expressed in standardised coefficients and should be interpreted as associations, not causal effects. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors in parentheses.

The digital dimension stands out as the strongest predictor of permanent migration (0.688), indicating that digital infrastructure and services are a major pull factor for long-term residential relocation. However, it shows no significant association with the remaining flows and even weakly negative coefficients for student mobility, though these are not statistically significant.

Overall, in Italy, seasonal and long-distance labour mobility are the most clearly linked to regional attractiveness, particularly via the traditional and digital pillars. Student mobility shows weaker and more complex patterns, while green performance appears to play a marginal but regionally specific role.

5.4. NETHERLANDS

The Netherlands comprehends up to 12 NUTS2 regions, with two of them Utrecht and Noord-Holland (region with cities as Amsterdam, Haarlem or Alkmar) belonging to Cluster 1 (Meropolitan leaders), and the other 10, to Cluster 2 (Balanced Innovators). This position is clarified in the Regional Attractiveness Indices, with very high figures overall.

In 2022, the overall Regional Attractiveness Index (RAI) in the Netherlands remains high across all regions, but with a clearly identifiable core–periphery gradient ([Figure 5.4, panels a and b](#)). The most attractive regions are Utrecht (93.7), Noord-Holland (89.8), and Overijssel (83.1), with Noord-Brabant (83.3), Flevoland (82.2), and Gelderland (82.2) close behind. These scores indicate a strong clustering of attractiveness in and around the Randstad and adjacent growth corridors. At the lower end, although still relatively

high in absolute terms, Limburg, Zeeland, and Drenthe have overall RAI scores of around 75–77.

The improvement between 2010 and 2022 is substantial across all regions, with many areas experiencing gains of 20 points or more. Utrecht and Noord-Holland started from relatively high positions and still registered improvements of over 20 points, reinforcing their national leadership. More striking, however, are the advances of Noord-Brabant (+26.7), Overijssel (+23.8), and Groningen (+19.7), indicating strong catch-up dynamics in previously mid-performing regions.

In the traditional dimension, all regions improved significantly, with Noord-Holland (92.0) and Utrecht (87.2) reaching the highest levels in 2022. These reflect strong infrastructure, labour market performance, and institutional capacity. Overijssel (+25.8), Noord-Brabant (+28.0), and Groningen (+20.6) made major strides, while even the weakest performer in 2022—Flevoland (67.0)—saw a substantial improvement from a low 46.6 in 2010. This widespread progression reflects broad national efforts in levelling up basic attractiveness and economic fundamentals.

In 2022, green attractiveness is highest in Utrecht (78.2), Overijssel (75.0), and Friesland (72.7). These regions likely combine effective environmental policies with balanced land use and a favourable profile in terms of emissions and sustainable employment. Most Dutch regions have improved their green index since 2010, though the pace has varied. Flevoland, Zeeland, and Gelderland register moderate gains, suggesting progress in environmental performance, possibly related to advances in circular employment or reductions in high-impact activities. Limburg and Noord-Brabant follow a similar upward trend, reinforcing the general convergence at moderately high levels. Drenthe is the only region showing a slight decline in its green RAI, while Noord-Holland and Zuid-Holland remain nearly flat. This may reflect persistent structural challenges in denser, industrialised areas. Nonetheless, all Dutch regions in 2022 fall within a relatively narrow range, from 56.5 to 78.2, pointing to overall progress with some remaining territorial asymmetries.

By 2022, digital attractiveness is uniformly high across the Netherlands. Utrecht (87.5), Flevoland (87.1), and Noord-Holland (86.2) lead the national rankings, reflecting widespread digital access, strong innovation ecosystems, and a high uptake of digital services by both citizens and institutions. All regions have improved their digital scores since 2010. Drenthe, Groningen, and Zeeland stand out for their significant gains, narrowing the gap with the national leaders. These improvements suggest advances in broadband infrastructure, digital literacy, and integration of digital tools in daily life and public services. Even the lowest-scoring region in 2022, Limburg (73.8), remains

well above the European average, confirming the Netherlands' cohesive performance in the digital domain. The overall trend points to successful digital mainstreaming across regional contexts, with some mid-sized and peripheral areas catching up to the historically leading urban cores.

Overall, Dutch regions have made broad progress in improving their attractiveness since 2010, particularly in the traditional dimension, where growth has been almost universal and substantial. The green and digital dimensions, however, reveal divergent dynamics. While some regions have managed to enhance their sustainability and digitalisation profiles, others—particularly major urban cores—have stagnated or declined, suggesting that earlier advantages may have eroded under newer demands and expectations.

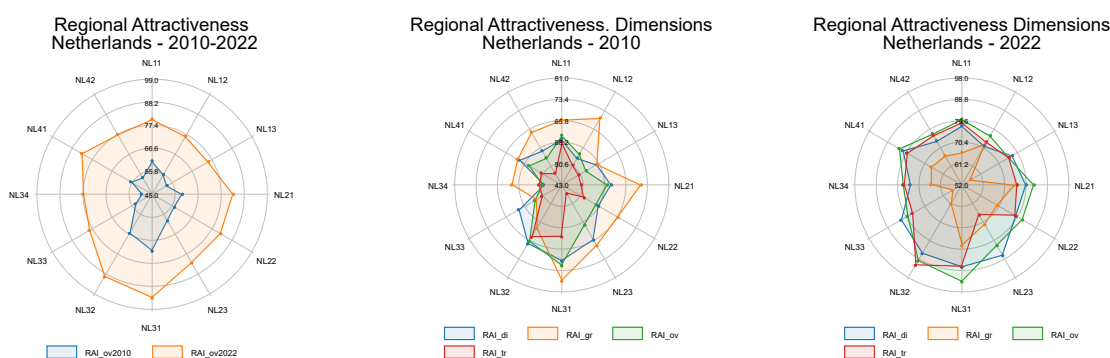
We now analyse demographic trends and mobility patterns in the Netherlands between 2010 and 2022 ([Figure 5.4, panel c](#)), focusing on regional population changes and net flows per 1,000 inhabitants for six types of mobility. The data highlight the demographic vitality of core regions and the functional integration of both central and peripheral territories.

Figure 5. 4 Case of Study: Netherlands

panel a)

NUTS 2	Region	RAI Overall		RAI Traditional		RAI Green		RAI Digital	
		2010	2022	2010	2022	2010	2022	2010	2022
NL11	Groningen	60.6	80.3	58.3	78.9	66.2	66.0	59.3	77.5
NL12	Friesland (NL)	55.7	76.5	51.1	73.3	70.5	72.7	54.0	71.4
NL13	Drenthe	53.1	75.5	50.1	75.5	57.7	56.5	57.5	77.1
NL21	Overijssel	59.3	83.1	50.1	75.9	71.3	75.0	60.7	79.7
NL22	Gelderland	57.2	82.2	52.2	78.5	66.1	69.7	58.2	79.0
NL23	Flevoland	59.5	82.2	46.6	67.0	68.0	71.8	65.6	87.1
NL31	Utrecht	71.7	93.7	61.5	87.2	77.2	78.2	70.1	87.5
NL32	Noord-Holland	66.3	89.8	64.5	92.0	60.9	61.6	67.2	86.2
NL33	Zuid-Holland	54.2	79.1	51.2	76.7	53.6	56.7	60.7	82.3
NL34	Zeeland	50.1	77.4	51.2	77.0	60.8	65.4	49.5	74.3
NL41	Noord-Brabant	56.6	83.3	51.4	79.4	61.2	67.4	60.6	81.5
NL42	Limburg (NL)	54.1	77.4	47.8	76.7	64.7	66.6	57.0	73.8

panel b)



panel c)

NUTS 2	Region	Population			Average Net flows					
		Pop 2010	Pop 2022	Av annual growth rate	Permanent migration	Seasonal migration	Cross border comm	Lon dist comm	Short term student	Long term student
NL11	Groningen	576668	590170	0.19%	1.23‰	0.79‰	9.65‰	8.76‰	-0.42‰	-0.002‰
NL12	Friesland (NL)	646305	654019	0.10%	1.24‰	0.49‰	5.25‰	5.36‰	-0.43‰	-0.006‰
NL13	Drenthe	490981	497743	0.11%	0.72‰	1.80‰	12.70‰	9.99‰	-0.03‰	0.002‰
NL21	Overijssel	1130345	1171910	0.30%	1.12‰	0.59‰	6.80‰	6.41‰	-0.33‰	0.015‰
NL22	Gelderland	1998936	2110472	0.45%	0.99‰	0.62‰	5.53‰	4.84‰	-0.17‰	0.015‰
NL23	Flevoland	387881	434771	0.96%	1.37‰	0.75‰	5.74‰	5.78‰	0.07‰	0.015‰
NL31	Utrecht	1220910	1369873	0.96%	1.09‰	0.23‰	1.84‰	1.81‰	-0.11‰	0.005‰
NL32	Noord-Holland	2669084	2909827	0.72%	3.78‰	0.59‰	5.00‰	4.93‰	0.35‰	0.025‰
NL33	Zuid-Holland	3505611	3753944	0.57%	1.69‰	0.48‰	3.76‰	3.34‰	-0.04‰	0.014‰
NL34	Zeeland	381409	386767	0.12%	1.83‰	1.68‰	18.69‰	9.59‰	-0.21‰	0.004‰
NL41	Noord-Brabant	2444158	2592874	0.49%	0.86‰	0.64‰	5.89‰	2.94‰	-0.27‰	0.008‰
NL42	Limburg (NL)	1122701	1118302	-0.03%	1.45‰	1.93‰	21.23‰	7.33‰	-0.24‰	0.010‰

Note: This table reports population figures and average annual net flows per 1,000 inhabitants (‰) for each NUTS2 region over the 2010–2022 period. Net flows are shown for six types of mobility: permanent migration, seasonal migration, cross-border commuting, long-distance commuting, and short- and long-term Erasmus student mobility. Positive values indicate net inflows; negative values reflect net outflows. Population growth is expressed as an average annual rate (%).

panel d)

Netherlands	Permanent Flows	Seasonal flows	Cross border commuting	Long distance commuting	Short term student	Long term student
RAI overall	-0.00582 (0.298)	-0.228* (0.121)	0.0438 (0.119)	0.00308 (0.0265)	0.118 (0.506)	0.163 (0.499)
R2	0.323	0.137	0.000138	0.0229	0.140	0.0833
Observations	36	156	156	156	84	84
Number of regions	12	12	12	12	12	12
RAI tradit	0.233 (0.353)	-0.189 (0.132)	0.0406 (0.125)	0.0218 (0.0280)	0.271 (0.481)	1.015* (0.540)
RAI green	-0.0701 (0.151)	-0.0512 (0.0638)	0.111 (0.0696)	0.0120 (0.0154)	-0.443** (0.219)	0.0548 (0.243)
RAI digital	-0.0839 (0.363)	-0.0103 (0.135)	-0.0517 (0.0831)	-0.0119 (0.0195)	0.502 (0.399)	-0.713 (0.491)
R2	0.428	0.127	0.00320	0.000453	0.379	0.0510
Observations	36	156	156	156	84	84
Number of regions	12	12	12	12	12	12

Note: Random effects panel regressions estimate the association between standardised mobility flows and regional attractiveness indices across NUTS2 regions (2010–2022). Results are expressed in standardised coefficients and should be interpreted as associations, not causal effects. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors in parentheses.

Population growth has been consistently positive across nearly all Dutch regions, with annual rates ranging from +0.10% in Friesland to +0.96% in both Flevoland and Utrecht. The only region showing slight decline is Limburg (–0.03%), reflecting structural demographic ageing and limited inward migration. Rapid growth in Flevoland, Utrecht, and Noord-Holland points to their role as major residential and economic hubs.

Permanent migration is positive in all regions, with the highest levels in Noord-Holland (+3.78‰) and Zeeland (+1.83‰). These flows indicate sustained attractiveness for long-term settlement, particularly in the Randstad and coastal regions. Even Limburg, despite demographic stagnation, records a positive balance. Seasonal migration follows a similar pattern, with moderate inflows across all regions. Limburg (+1.93‰) and Drenthe (+1.80‰) record the highest values, likely linked to agriculture and temporary service employment. Urban regions such as Utrecht and Noord-Holland show lower seasonal figures, consistent with their more stable labour markets.

Cross-border commuting is a prominent feature in peripheral and southern regions. Limburg (21.23‰) and Zeeland (18.69‰) top the list, reflecting strong cross-border labour links with Belgium and Germany. Drenthe, Groningen, and Overijssel also display high cross-border commuting activity, while central regions like Utrecht remain more internally oriented. Long-distance commuting shows consistently high values, especially in Drenthe (9.99‰), Zeeland (9.59‰), and Groningen (8.76‰). This reflects the spatial spread of employment and residential zones within the Netherlands' compact geography. Central regions such as Utrecht and Noord-Holland report moderate values, suggesting stronger local job markets.

Short-term Erasmus student mobility is generally negative, with small outflows in most regions. The most pronounced negative balances are in Friesland (−0.43‰), Noord-Brabant (−0.27‰), and Limburg (−0.24‰), suggesting a net sending profile for temporary exchanges. Noord-Holland (+0.35‰) and Flevoland (+0.07‰) are exceptions, with positive short-term balances. Long-term student mobility is modestly positive across most regions. Noord-Holland (+0.025‰) leads, followed by Flevoland, Gelderland, and Zuid-Holland, reflecting the presence of major universities and the ability to attract degree-seeking students. Negative or near-zero balances are observed only in Groningen and Friesland.

In summary, the Netherlands presents a balanced and integrated demographic and functional system, with strong growth in urban cores, dynamic commuting networks in peripheral areas, and consistent inward migration across the country. Student mobility patterns are more variable but generally point to a well-connected and attractive higher education system.

Following the previous sections on the Regional Attractiveness Index (RAI) and mobility patterns in the Netherlands, we now assess whether these dimensions are statistically linked ([Figure 5.4, panel d](#)). The panel regressions reported below examine the association between different types of net flows and the RAI (both composite and disaggregated) across Dutch NUTS2 regions.

In this national context, the overall RAI shows no statistically significant relationship with any type of mobility, except a weak negative association with seasonal migration (−0.228) at the 10% level. This suggests that, contrary to expectations, higher overall attractiveness may not systematically correspond with stronger net inflows of population or students in the Dutch case.

Looking at the RAI components, the traditional dimension is positively associated with long-term student mobility (1.015), indicating that stronger economic, educational, and

institutional conditions may attract degree-seeking Erasmus students. Its association with other flows, including permanent and short-term migration, is positive but not significant.

The green dimension presents a negative and significant association with short-term student mobility (-0.443), suggesting that greener regions—often less urban or more tourism-intensive—may be less attractive to exchange students. Its coefficients for other flows remain low and statistically insignificant, though slightly positive for cross-border commuting.

The digital dimension does not show any statistically significant results. While its coefficient on short-term student mobility (0.502) is positive, it is not significant, and its effect on long-term student flows is negative. These results suggest that, in the Dutch case, digital attractiveness does not drive regional differences in mobility, possibly due to relatively even digital development across regions.

In summary, the Netherlands displays a weak statistical link between regional attractiveness and mobility patterns, with only a few significant results. The clearest association emerges between traditional attractiveness and long-term student flows, and between green performance and short-term student mobility, hinting at selective effects rather than a broad correlation across the mobility spectrum.

5.5. SPAIN

Two Spanish regions are enclosed within Cluster 1 (Metropolitan Leaders): Comunidad de Madrid and País Vasco, while the rest lie within Cluster 4 (Economies in Structural Transformation). Spain shows clear and widespread improvement in regional attractiveness between 2010 and 2022 ([Figure 5.5, panels a and b](#)). All regions increase their overall RAI, with particularly strong gains in the north and centre of the country. In 2022, the most attractive regions are País Vasco (78.6), Cantabria (71.0), Navarra (71.5), and Madrid (75.1). Several others—such as La Rioja, Asturias, and Illes Balears—approach or exceed 65 points. Although southern and insular regions like Andalucía, Murcia, and Canarias remain below the national average, they too show meaningful improvements, pointing to a general convergence trend.

In the traditional dimension, most regions register solid gains, particularly in the north. Navarra (70.8), País Vasco (74.4), and Cantabria (68.5) lead in 2022, reflecting their strong economic structures, labour market performance, and institutional quality. Even regions such as Madrid, Aragón, and La Rioja cross the 60-point threshold. In contrast, Andalucía (36.4) and Ciudad de Melilla (24.6) remain clearly below average, with slower

structural transitions. Despite this, all regions improve to some degree, confirming broad national efforts to strengthen economic fundamentals.

The green dimension remains relatively strong and stable, especially in northern and inland regions. Cantabria (79.0) and Asturias (70.5) maintain leading positions, while Navarra, La Rioja, and País Vasco also exceed 70 points. These regions combine relatively low emissions, strong circular employment, and balanced land use. In contrast, Andalucía, Melilla, and Murcia show persistently low scores, indicating more limited progress in environmental transition. That said, green performance has generally held steady or improved moderately across the territory.

The digital dimension stands out as the most dynamic across Spanish regions. Every region improves significantly between 2010 and 2022. Madrid (84.7) and Cataluña (74.5) lead, reflecting deep integration of digital infrastructure and services. Strong advances are also seen in traditionally mid-ranked regions such as Galicia, Asturias, Aragón, and Extremadura, where digital scores now exceed 60. Even the lowest-scoring regions—such as Melilla (68.9) and Andalucía (64.1)—have nearly closed the gap with national leaders, suggesting effective digital investment and diffusion.

Overall, Spain exhibits broad progress across all dimensions of attractiveness, with especially rapid gains in digital capacity and steady improvements in traditional fundamentals. Territorial differences persist—particularly between northern and southern regions—but there is clear evidence of convergence and functional upgrading across the board.

We now explore population evolution and mobility patterns across Spanish NUTS2 regions between 2010 and 2022 ([Figure 5.5, panel c](#)), focusing on average net flows per 1,000 inhabitants across six key mobility types. This analysis reveals both demographic contrasts and functional specialisations in the Spanish regional system. Demographically, growth is observed in 12 of the 19 regions, led by Melilla (+0.92%), Illes Balears (+0.76%), and Canarias (+0.56%), while regions such as Asturias (−0.58%), Castilla y León (−0.58%), and Galicia (−0.24%) have experienced consistent decline. The Madrid region shows robust growth (+0.47%), confirming its central role in Spain's demographic dynamics.

Permanent migration is broadly positive across the board, with particularly high values in Illes Balears (+6.08‰), Canarias (+2.88‰), and Cataluña (+1.61‰), confirming the attractiveness of urban and touristic regions. The only region with a negative balance is Melilla (−0.42‰). Seasonal migration flows are more varied. Again, Illes Balears (+2.08‰) and Madrid (+1.47‰) top the rankings, aligned with their seasonal labour

demand and tourism intensity. Negative values dominate the interior regions, especially Castilla-La Mancha (−2.47‰), La Rioja (−1.13‰), and Extremadura (−1.13‰), pointing to lower temporary employment appeal.

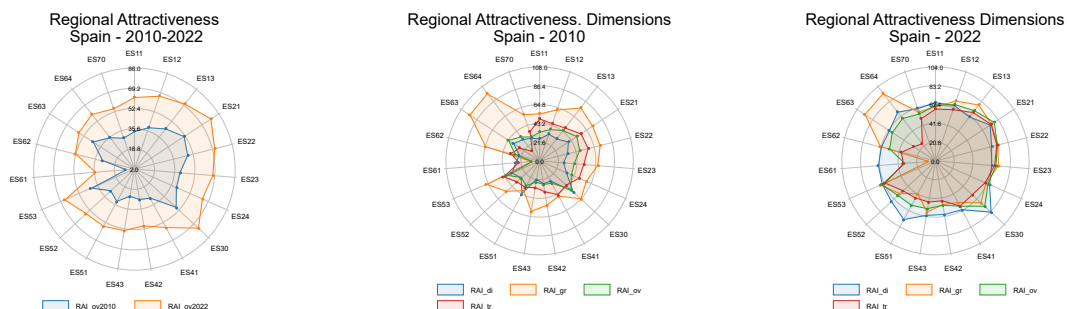
Cross-border commuting remains moderate overall but is strongly positive in Ceuta (1.62‰), Melilla (1.41‰), and Castilla y León (1.41‰). In contrast, Comunitat Valenciana (−1.07‰) and Andalucía (−1.71‰) show net outflows, suggesting labour exchanges may be oriented outwards. Long-distance commuting shows sharp territorial contrasts. Madrid (17.17‰) and Cantabria (−20.55‰) are on opposite extremes, with Madrid acting as a national commuting hub, while Cantabria suffers from outflows. Extreme values also appear in Castilla-La Mancha (−37.09‰) and Aragón (+3.50‰), reinforcing the centralisation of work opportunities in urban areas.

Figure 5. 5 Case of Study: Spain

panel a)

NUTS 2	Region	RAI Overall		RAI Traditional		RAI Green		RAI Digital	
		2010	2022	2010	2022	2010	2022	2010	2022
ES11	Galicia	33.6	61.9	48.9	57.9	54.7	60.6	25.8	65.0
ES12	Principado de Asturias	38.8	66.5	45.7	60.5	62.5	70.5	33.1	65.4
ES13	Cantabria	44.8	71.0	48.5	68.5	77.9	79.0	32.7	62.1
ES21	País Vasco	51.9	78.6	57.6	74.4	73.5	74.8	40.4	73.1
ES22	Comunidad Foral de Navarra	48.3	71.5	58.4	70.8	72.7	72.2	33.8	64.9
ES23	La Rioja	40.6	68.0	51.7	66.4	67.9	70.7	28.4	63.2
ES24	Aragón	40.7	64.3	50.3	60.9	59.4	61.9	34.5	66.2
ES30	Comunidad de Madrid	49.9	75.1	42.0	56.1	65.4	69.1	53.8	84.7
ES41	Castilla y León	30.0	57.8	44.8	57.6	46.8	53.0	27.1	62.2
ES42	Castilla-La Mancha	28.1	50.3	36.6	45.5	52.3	49.7	27.3	60.7
ES43	Extremadura	25.4	54.3	31.7	46.7	59.6	58.4	22.4	61.8
ES51	Cataluña	33.2	56.5	35.5	47.2	39.5	42.1	44.4	74.5
ES52	Comunitat Valenciana	29.2	57.2	36.1	49.6	52.5	54.3	29.5	67.0
ES53	Illes Balears	42.2	65.9	46.4	62.0	67.7	67.2	35.5	65.1
ES61	Andalucía	9.8	35.1	24.7	36.4	10.7	9.2	28.2	64.1
ES62	Región de Murcia	29.8	53.1	34.9	39.7	64.6	63.7	24.7	62.4
ES63	Ciudad de Ceuta	43.7	57.7	28.0	29.3	96.6	94.2	36.7	61.6
ES64	Ciudad de Melilla	35.5	60.0	14.8	24.6	98.6	95.0	31.7	68.9
ES70	Canarias	29.6	55.4	35.8	49.8	56.7	57.7	28.2	61.7

panel b)



panel c)

NUTS 2	Region	Population			Average Net flows					
		Pop 2010	Pop 2022	Av annual growth rate	Permanent migration	Seasonal migration	Cross border comm	Long dist comm	Short term student	Long term student
ES11	Galicia	2772466	2692829	-0.24%	1.24‰	-0.49‰	-0.50‰	-4.25‰	-0.07‰	-0.011‰
ES12	Principado de Asturias	1077102	1004960	-0.58%	1.55‰	-0.53‰	-0.24‰	-3.71‰	-0.13‰	-0.025‰
ES13	Cantabria	588512	585451	-0.04%	1.03‰	-0.28‰	1.02‰	-20.55‰	-0.08‰	-0.005‰
ES21	País Vasco	2179521	2205828	0.10%	0.75‰	0.51‰	0.49‰	7.41‰	-0.23‰	-0.012‰
ES22	Comunidad Foral de Navarra	633023	664514	0.41%	1.03‰	1.71‰	0.68‰	4.08‰	-0.29‰	-0.005‰
ES23	La Rioja	319934	319617	-0.01%	0.65‰	-1.13‰	1.18‰	1.87‰	-0.17‰	-0.007‰

ES24	Aragón	1344181	1328217	-0.10%	1.29‰	0.43‰	0.91‰	3.50‰	-0.16‰	-0.014‰
ES30	Comunidad de Madrid	6373546	6743273	0.47%	1.38‰	1.47‰	-0.87‰	17.17‰	0.11‰	-0.031‰
ES41	Castilla y León	2547401	2375586	-0.58%	0.73‰	-0.11‰	1.41‰	-4.54‰	-0.02‰	-0.014‰
ES42	Castilla-La Mancha	2084468	2058284	-0.11%	0.95‰	-2.47‰	0.51‰	-37.09‰	0.02‰	-0.001‰
ES43	Extremadura	1099610	1056808	-0.33%	0.88‰	-1.13‰	-0.55‰	-3.63‰	-0.08‰	-0.003‰
ES51	Cataluña	7463488	7761864	0.33%	1.61‰	0.54‰	-0.02‰	3.52‰	0.33‰	-0.004‰
ES52	Comunitat Valenciana	4989631	5108127	0.20%	1.25‰	-0.98‰	-1.07‰	-5.19‰	0.33‰	-0.020‰
ES53	Illes Balears	1083679	1187043	0.76%	6.08‰	2.08‰	1.27‰	4.40‰	0.33‰	0.009‰
ES61	Andalucía	8276008	8511185	0.23%	1.31‰	-0.59‰	-1.71‰	-4.15‰	0.18‰	-0.011‰
ES62	Región de Murcia	1453543	1529662	0.43%	1.40‰	0.43‰	-1.04‰	0.77‰	0.05‰	-0.008‰
ES63	Ciudad de Ceuta	79294	83054	0.39%	0.77‰	-0.25‰	1.62‰	1.71‰	0.04‰	0.002‰
ES64	Ciudad de Melilla	76049	84932	0.92%	-0.42‰	-0.85‰	1.41‰	2.06‰	0.03‰	-0.002‰
ES70	Canarias	2045163	2185609	0.56%	2.88‰	0.11‰	1.18‰	-0.01‰	0.25‰	-0.001‰

Note: This table reports population figures and average annual net flows per 1,000 inhabitants (‰) for each NUTS2 region over the 2010–2022 period. Net flows are shown for six types of mobility: permanent migration, seasonal migration, cross-border commuting, long-distance commuting, and short- and long-term Erasmus student mobility. Positive values indicate net inflows; negative values reflect net outflows. Population growth is expressed as an average annual rate (%).

panel d)

Spain	Permanent Flows	Seasonal flows	Cross border commuting	Long distance commuting	Short term student	Long term student
RAI overall	0.0982 (0.208)	0.251*** (0.0957)	0.0270** (0.0137)	0.0368 (0.0520)	-0.585*** (0.176)	-0.186 (0.230)
R2	0.198	0.125	0.139	0.0931	0.175	0.0942
Observations	57	247	247	247	133	133
Number of regions	19	19	19	19	19	19
RAI_tradit	0.169 (0.172)	0.154** (0.0767)	-0.00272 (0.0100)	0.0369 (0.0403)	-0.215 (0.134)	-0.0601 (0.170)
RAI_green	-0.0531 (0.0757)	0.0316 (0.0339)	0.0134*** (0.00452)	0.0372* (0.0199)	-0.205*** (0.0601)	0.0578 (0.0759)
RAI_digital	0.115 (0.264)	0.136 (0.116)	0.0109 (0.0143)	-0.0751 (0.0458)	-0.0308 (0.200)	-0.569** (0.276)
R2	0.244	0.137	0.200	0.00408	0.225	0.251
Observations	57	247	247	247	133	133
Number of regions	19	19	19	19	19	19

Note: Random effects panel regressions estimate the association between standardised mobility flows and regional attractiveness indices across NUTS2 regions (2010–2022). Results are expressed in standardised coefficients and should be interpreted as associations, not causal effects. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors in parentheses.

Erasmus student mobility shows a slight national tilt towards outflows. Short-term flows are negative in many regions, especially Navarra (–0.29‰) and Asturias (–0.13‰), though some urban areas like Cataluña (+0.33‰) and Madrid (+0.11‰) attract incoming students. Long-term balances are generally close to zero, with only Illes Balears (+0.009‰) and Ceuta (+0.002‰) showing small net gains.

Overall, Spain shows population and functional concentration in key metropolitan and coastal areas, while inland regions experience stagnation or decline. Net mobility flows confirm this polarisation, especially in terms of commuting and migration, reinforcing long-standing centre–periphery dynamics within the national territory.

The previous overview of regional attractiveness levels and mobility patterns in Spain, we now turn to the regression analysis to assess whether these dimensions are statistically associated (Figure 5.5, panel d). The models examine the extent to which the overall and component RAIs relate to different types of net mobility flows across the 19 Spanish NUTS2 regions.

The overall RAI is positively and significantly associated with seasonal migration (0.251) and cross-border commuting (0.0270), suggesting that more attractive regions are more likely to receive temporary workers and to be functionally connected to neighbouring labour markets. However, the association with short-term student mobility is negative and significant (-0.585), indicating that more attractive Spanish regions might experience net outflows of Erasmus students. This may reflect a pattern in which students from leading regions are more mobile internationally.

When disaggregating the index, the traditional dimension shows a positive link with seasonal migration (0.154), likely capturing the role of economically stronger regions in attracting temporary labour. It does not display significant associations with other flows.

The green dimension is negatively associated with short-term student mobility (-0.205), a result consistent with previous countries, where environmentally strong regions—often more rural or tourism-intensive—are less attractive to exchange students. It is also positively linked to cross-border (0.0134) and long-distance commuting (0.0372), suggesting that greener regions might be part of wider functional labour markets.

The digital dimension does not significantly explain most mobility types, but it shows a negative and significant association with long-term student mobility (-0.569). This may reflect that regions with stronger digital capacity—such as Madrid or Cataluña—act more as senders of degree-seeking students than hosts in international exchanges.

In summary, the Spanish results indicate that regional attractiveness—particularly through the traditional and green dimensions—is associated with labour-related mobility, while student flows, especially short-term, show inverse patterns, possibly reflecting internal inequalities in academic and international opportunities.

6. MAIN FINDINGS AND POLICY RECOMMENDATIONS

6.1. MAIN FINDINGS

Regional typologies play a critical role in both academic research and applied policy. Typologies are powerful tools to interpret spatial heterogeneity, facilitate benchmarking, and guide place-sensitive policy responses. They allow researchers and policymakers to move beyond simplistic classifications—such as urban/rural or core/periphery—and capture the multidimensional realities of territorial development. This approach is especially relevant in the context of the twin transitions (green and digital), which generate both opportunities and vulnerabilities that are distributed unevenly across Europe.

A large body of research, from rural studies to energy geography and EU cohesion policy, demonstrates how typologies enable targeted interventions by identifying groups of regions that share structural features, institutional settings, or development pathways. As highlighted by works like Petrakos et al. (2004), spatial disparities in the EU are often rooted in accessibility and agglomeration advantages. Meanwhile, initiatives like ESPON's EDORA project and the OECD's place-based policy agenda reinforce the idea that typologies can support effective resource allocation and long-term cohesion goals.

In this light, developing clusters based on the Regional Attractiveness Index (RAI) is both analytically robust and practically useful. While composite indices help rank performance, clustering reveals how regions functionally group together—based on their economic structure, institutional quality, environmental sustainability, and digital capacity. This multidimensional typology enables policymakers to tailor interventions that align with specific regional profiles, such as industrial restructuring needs, digital gaps, or environmental vulnerabilities. Moreover, by identifying “leading,” “transitioning,” and “lagging” clusters, this classification supports differential policy prioritisation, investment strategies, and innovation pathways across EU territories.

To construct the regional typology, we applied a clustering methodology using the composite Regional Attractiveness Index (RAI), its three dimensions—traditional, green, and digital— and the indicators behind them. The chosen method combines standardisation, dimensionality reduction (via principal components), and k-means clustering, allowing for the identification of groups of regions with similar profiles in terms of their capacity to attract and retain population and investment.

The main advantage of this approach is its ability to reduce complexity and uncover underlying spatial patterns that are not immediately visible through individual indicators. It offers a data-driven and reproducible classification that reflects both structural features and dynamic potential, making it highly relevant for policy targeting and territorial benchmarking. By relying on a multi-dimensional indicator, it also moves beyond one-dimensional or purely economic rankings, incorporating aspects such as environmental quality and digital infrastructure. However, the method is not without limitations. K-means clustering requires a pre-defined number of clusters, which may influence results depending on the criteria chosen. Moreover, the method assumes spherical cluster shapes and equal variance, which may not always match the complexity of territorial realities. Finally, while the RAI incorporates a broad range of indicators, it may still omit some qualitative or context-specific factors—such as governance dynamics or historical trajectories—that are essential to fully grasp territorial performance. Despite these caveats, the clustering approach offers a solid empirical foundation for deriving regionally differentiated insights and supporting place-based policy design.

The clustering exercise produced six distinct groups of EU regions, each characterised by specific patterns of attractiveness and mobility dynamics. To deepen the interpretation of the six regional clusters, a SWOT analysis was conducted to identify their respective strengths, weaknesses, opportunities, and threats. This approach allows for a more nuanced understanding of the internal dynamics and external challenges each cluster faces, moving beyond descriptive statistics to support strategic policy thinking. Below, we summarise the patterns and the main findings of the SWOT analysis for each cluster.

Cluster 1 – Metropolitan Leaders: These are Europe's most attractive regions, combining strong economic fundamentals, advanced digital infrastructure, and relatively high environmental scores. They are predominantly large urban areas and capital regions. They stand out for consistently positive net flows across all types of mobility, especially in long-distance commuting and permanent migration, reflecting their role as hubs of opportunity. Population growth (+6.15%) over the 2010-2022 period confirms their long-term dynamism. This cluster represents the growth engines of Europe. Their challenge lies not in competitiveness, but in ensuring inclusive and sustainable development, avoiding polarisation within and around them.

- **Strengths:** Strong digital infrastructure, institutional capacity, and economic dynamism; attract both talent and investment.
- **Weaknesses:** High housing costs, congestion, and social inequalities may threaten cohesion.

- Opportunities: Leading the green and digital transitions; hubs for innovation and high-skilled employment.
- Threats: Risk of overheating, exclusionary growth, and environmental pressures due to urban density.

Cluster 2 – Balanced Innovators: These regions show a harmonious performance across the three dimensions of attractiveness. While not as dominant as Cluster 1, they perform well in digital and environmental terms and maintain moderately positive net mobility flows. Their growth is steady (+4.76%), suggesting resilience and balanced development, especially in terms of student mobility and long-term migration. These regions are quiet performers that could act as regional anchors. Targeted support could help them reinforce their role in diffusing innovation to surrounding areas.

- Strengths: Well-rounded performance; robust governance and balanced economic structures.
- Weaknesses: Moderate visibility and weaker innovation ecosystems compared to Cluster 1.
- Opportunities: Potential to scale up green and digital sectors and strengthen interregional cooperation.
- Threats: Risk of being overshadowed in funding and policy focus compared to more “extreme” cases (leaders or laggards).

Cluster 3 – Industrial Heartlands in Transformation: Concentrated in central Europe, these regions retain a strong traditional base but lag in green and digital aspects. They show mixed mobility patterns and population stagnation, with clear signs of transition. Notably, they attract long-term students, which may indicate the presence of established educational institutions, but lose population through other flows. This group requires active transformation policies, focusing on modernising their industrial fabric while ensuring social cohesion during transitions.

- Strengths: Strong traditional economy, industrial base, and demographic weight.
- Weaknesses: Lag in digital and green adaptation; ageing infrastructure and workforce.
- Opportunities: Green reindustrialisation, digital upgrading of existing sectors.
- Threats: Deindustrialisation, automation-related job losses, and stagnation.

Cluster 4 – Economies in Structural Transition: This diverse group includes regions with moderate attractiveness but internal structural tensions. While some student mobility inflows are present, permanent migration is negative, and the overall

population growth is modest (+2.41%). Their role may be transitional, depending on future policy support and investment in innovation or sustainability. Cluster 4 regions need strategic policy alignment, improving governance, connectivity, and human capital to move upward.

- Strengths: Diverse economic base and moderate scores in attractiveness.
- Weaknesses: Institutional weaknesses, uneven performance across regions.
- Opportunities: Benefiting from EU funding, investing in upskilling and administrative capacity.
- Threats: Falling into a middle-development trap if structural reforms are not implemented.

Cluster 5 – Cohesion Regions with Catch-Up Potential: Mainly located in Eastern and Southern Europe, these regions face major development gaps but also exhibit signs of emerging potential, particularly in green and digital domains. However, their mobility flows are mostly negative, and population has declined (-3.91%), suggesting that potential is not yet translating into attractiveness. This group exemplifies potential not yet realised. With the right support, it could leapfrog stages of development, but the window of opportunity is limited.

- Strengths: Improving in green and digital indicators; potential in cost-competitiveness and emerging sectors.
- Weaknesses: Persistent development gaps, low institutional quality, and demographic decline.
- Opportunities: Targeted cohesion funds, investments in infrastructure and education.
- Threats: Outmigration, youth brain drain, and long-term marginalisation.

Cluster 6 – Structurally Lagging and Peripheral Regions: This is the most disadvantaged cluster, with low scores across all dimensions, especially in traditional and digital areas. They record negative net flows in almost all mobility types and the largest population decline (-8.87%). While some positive seasonal or cross-border flows exist, structural weaknesses dominate their profile. These regions face deep structural challenges and require long-term, place-based approaches with strong territorial cohesion mechanisms.

- Strengths: Environmental and cultural assets, often untapped.
- Weaknesses: Low scores across all dimensions, poor accessibility, weak institutions.
- Opportunities: Niche tourism, decentralised energy, and rural innovation.

- Threats: Demographic collapse, loss of public services, and climate vulnerability.

These differentiated patterns confirm the value of clustering in capturing complex territorial dynamics. The typology provides a clear lens through which to assess disparities, mobility trends, and demographic change—offering a solid empirical base for tailored policy intervention. The SWOT analysis confirms that territorial disparities in Europe are not only persistent but increasingly multidimensional—spanning economic, social, environmental, and institutional domains. While leading regions must manage the risks of concentration, lagging ones require structural support, tailored investment, and governance reform. Importantly, middle-performing regions (Clusters 2–4) offer the most fertile ground for territorial convergence, if supported by smart specialisation, skills strategies, and regional coordination.

6.2. POLICY RECOMMENDATIONS

The developed typology serves as a strategic guide for formulating differentiated yet coordinated policy interventions. It enables EU institutions and Member States to align funding mechanisms and structural reforms with the distinct characteristics and developmental trajectories of each identified cluster. Leveraging insights derived from cluster analyses, SWOT assessments, and mobility flow dynamics, we propose the following cluster-specific and mobility-oriented policy recommendations, anchored by differentiation, place sensitivity, and strategic alignment with EU priorities.

1. Tailor interventions to cluster-specific needs

Cluster 1 (Metropolitan Leaders): policies should focus on managing growth sustainably by addressing spatial inequality, ensuring affordable housing, alleviating congestion, and mitigating environmental pressures. Given their strength in attracting permanent and seasonal mobility, these regions should receive support for advancing sustainable urban mobility systems, digital governance solutions, and green urban infrastructure. Innovation hubs in these areas should be reinforced to sustain their role as magnets for skilled professionals and long-distance commuters.

Cluster 2 (Balanced Innovators): These regions would benefit from policies aimed at enhancing their capacity as innovation diffusers. This involves strengthening their connections with both metropolitan centres and peripheral territories, thereby maximising their function as regional connectors. Investment in high-tech industries, research, and digital infrastructure is vital to build upon their moderate positive trends

in permanent migration and labour mobility. These efforts will help maintain their balanced demographic development and reinforce their innovation potential.

Cluster 3 (Industrial Heartlands): this cluster requires support for industrial modernisation and the green transition. Policy interventions should focus on enhancing resilience through digital upgrading, clean technologies, and environmental innovation. The moderate negative trends in permanent and commuting mobility call for reskilling programmes, job retraining, and incentives for creating innovation-oriented employment. Strengthening tertiary education and training systems will also help these regions attract and retain long-term student mobility.

Cluster 4 (Structural Transition Economies): priority should be given to improvements in governance capacity, institutional quality, and digital connectivity to bolster their readiness for transformation. These regions can capitalise on the positive trends in short-term student mobility to stimulate regional rejuvenation and the diffusion of innovation. Investment in basic infrastructure, housing affordability, and connectivity is needed to reverse negative commuting patterns and enhance permanent migration inflows.

Cluster 5 (Catch-Up Cohesion Regions): regions in this cluster should receive targeted cohesion funding directed at improving basic infrastructure, education systems, and digital accessibility. These measures are essential to counteract demographic decline and negative mobility trends. Modest positive trends in short-term student mobility should be leveraged through strengthened academic and vocational training programmes that align with local strengths. Youth retention strategies and entrepreneurship incentives are critical to stabilise population dynamics and promote economic diversification.

Cluster 6 (Structurally Lagging Regions): regions in this cluster demands comprehensive, long-term, place-based programmes. These should integrate the provision of essential public services with rural innovation strategies and incentives for sustainable economic activities such as eco-tourism and local energy production. Policies must address severe negative trends in permanent and seasonal mobility by improving digital and transport infrastructures and promoting broadband connectivity in rural areas. Regional networks focused on green industries and niche opportunities should be supported to build upon their modest environmental advantages.

2. Strengthen mobility as a lever for resilience

Mobility should be strengthened as a key driver of regional resilience. Enhancing labour mobility infrastructure—especially housing and transport—is crucial for supporting permanent and seasonal workers, particularly in Clusters 1 and 2. Expanding interregional and international student exchange programmes will be particularly beneficial in Clusters 3, 4, and 5, using student mobility to enhance regional attractiveness and retain future talent.

In all clusters, investment in remote work infrastructure and digital accessibility will help diversify regional economies and build resilience against demographic and economic fluctuations

3. Align funding and governance with territorial realities

Funding and governance frameworks must be aligned with territorial realities. EU funding instruments such as the Cohesion Policy, the Just Transition Fund, and the Recovery and Resilience Facility should be flexibly adapted to the nuanced needs of each cluster, allowing for more targeted and effective interventions. Strengthening multi-level governance is essential, enabling regional and local authorities to co-design and implement policies that are directly aligned with their specific challenges and cluster profiles. Finally, robust monitoring systems based on regional mobility and attractiveness indicators should be established to inform adaptive and evidence-based policy responses and facilitate timely adjustments to regional strategies.

In conclusion, employing this regional typology framework to guide EU and Member State policies promises more precise, evidence-based, and spatially sensitive interventions. This differentiated approach is critical to achieving territorial cohesion, balanced regional development, and equitable participation of all regions in Europe's ongoing structural transformation.

7. CONCLUSIONS

This conclusions section distils the main findings and insights from the report, offering a concise overview of the conceptual framework, methodological approach, typology construction, case study illustrations, and policy recommendations. It highlights how the regional attractiveness typology and mobility analysis can support more effective, targeted, and place-sensitive policy interventions across the European Union.

The **conceptual foundation** of this report builds upon the long-standing use of typologies in social sciences, policy design, and spatial planning as tools to organise complexity and guide targeted interventions. Typologies allow the grouping of regions with similar structural features, institutional contexts, or development trajectories, thus enabling more effective comparison, inference, and policy application beyond individual case studies. In regional science, they support benchmarking, reveal spatial disparities, and inform the allocation of resources—key functions especially relevant in light of the EU’s Territorial Agenda and Cohesion Policy.

The MOBI-TWIN project leverages this logic to develop a typology of European NUTS2 regions based on their relative attractiveness. This attractiveness is measured using the Regional Attractiveness Index (RAI), which integrates indicators across three key pillars: traditional factors (e.g. economic structure, education, institutional quality), digital readiness (e.g. broadband access, internet use), and green sustainability (e.g. air quality, circular employment). Importantly, the RAI also reflects a region’s capacity to attract and retain population—particularly relevant in the era of digital and green transitions.

The report identifies the limitations of conventional composite indices in capturing underlying structural similarities between regions and instead proposes a clustering approach that incorporates both quantitative and qualitative features. By combining Principal Component Analysis, k-means clustering, and fuzzy logic methods, the resulting typology reflects the nuanced and overlapping realities of regional development across the EU. This approach allows for the detection of shared challenges and opportunities among regions and provides a stronger empirical basis for policy design. Moreover, it recognises “transition leaders,” which are well-positioned for future success, and “trapped” or “left-behind” regions, where transformation pressures are not matched by adaptive capacity. This typology thus offers a valuable lens for understanding spatial inequalities and shaping more inclusive and place-sensitive EU strategies.

The **methodological approach** underpinning the regional typology is structured around three main steps: index construction, clustering, and validation. First, the Regional Attractiveness Index (RAI) was developed by aggregating 15 indicators across three dimensions—traditional, digital, and green attractiveness—using a transparent normalisation and weighting scheme. Second, Principal Component Analysis (PCA) was applied to reduce dimensionality and extract latent factors, which then informed the clustering process. Using a combination of k-means and fuzzy clustering algorithms, EU regions were grouped into six distinct clusters based on their structural similarities and performance in the RAI dimensions. The fuzzy approach enabled a more nuanced classification, acknowledging overlaps and transitional profiles between regions. Lastly, the clusters were validated against a set of internal and external metrics, including mobility flows and governance indicators, ensuring robustness and interpretability. This data-driven methodology enables an empirically grounded, spatially differentiated typology that reflects the complexity of regional development dynamics in the EU. The final six-cluster typology captures meaningful differences in economic structure, digital capacity, and environmental performance, offering a robust basis for differentiated policy design.

The six resulting clusters reveal a diverse and spatially uneven landscape of regional attractiveness across the EU. **Metropolitan Leaders (Cluster 1)** emerge as high-performing urban regions with strong economic and digital capacity but face challenges related to affordability and congestion. **Balanced Innovators (Cluster 2)** combine solid performance across all dimensions with strong integration potential. **Industrial Heartlands in Transformation (Cluster 3)** are economically significant but struggle with digital and green transitions. **Structural Transition Economies (Cluster 4)** show moderate performance and institutional weaknesses but possess growth potential. **Catch-Up Cohesion Regions (Cluster 5)** are primarily located in Southern and Eastern Europe and face structural disadvantages, although they show some improvement in green and digital areas. **Structurally Lagging and Peripheral Regions (Cluster 6)** are the most vulnerable, with persistent weaknesses across all pillars and limited capacity to retain or attract population. The SWOT analysis reinforces these findings, identifying for each cluster the key internal strengths and weaknesses as well as external opportunities and threats. These insights help clarify which types of mobility flows—permanent, seasonal, commuting, or student—are most relevant for each cluster, and where targeted interventions could enhance resilience and unlock potential.

The case study section offers an **in-depth analysis** of regional attractiveness and mobility dynamics **in five selected Member States: Finland, Greece, Italy, the**

Netherlands, and Spain. Using the Regional Attractiveness Index (RAI) and data on six mobility types, the case studies illustrate how regional characteristics shape population flows and demographic trends. For each country, the analysis highlights regional disparities in attractiveness and identifies how traditional, digital, and green dimensions of the RAI relate to permanent migration, seasonal mobility, commuting patterns, and student flows. Panel regression models reveal that overall attractiveness—particularly the digital and traditional pillars—has a significant influence on permanent and student mobility, while environmental factors play a more modest role. The case studies also show that cross-border commuting is less sensitive to attractiveness variables, often shaped instead by geographic proximity and external labour market dynamics. Together, these national illustrations validate the typology's relevance and underscore the importance of tailored, context-aware policy responses.

The final section translates the typology and mobility findings into **actionable policy recommendations**, emphasising the need for differentiated, place-sensitive, and strategically aligned interventions. Policies should be tailored to the specific profiles of each cluster, acknowledging their structural strengths and vulnerabilities as well as the dominant mobility flows they attract or lose. For example, Metropolitan Leaders require measures to manage growth sustainably, while Structurally Lagging Regions need long-term support for basic infrastructure and rural innovation. Mobility is highlighted as a key lever of resilience—particularly permanent and student flows—which can signal latent attractiveness and human capital dynamics. Enhancing infrastructure for labour mobility, promoting interregional student exchange, and investing in digital connectivity are central to reinforcing regional capacity. The report also stresses the importance of aligning EU and national funding instruments with territorial realities, empowering regional authorities, and establishing adaptive monitoring systems. Overall, the recommendations advocate for a more spatially differentiated and evidence-based approach to EU cohesion and transition policies.

Deliverable 2.3 plays a foundational role in **supporting the broader objectives of the MOBI-TWIN** project by operationalising key concepts related to regional attractiveness and spatial mobility under the twin transition. In WP3, which focuses on the development of agent-based and microsimulation models to assess the impacts of spatial mobility patterns, the regional clusters and attractiveness indicators developed in D2.3 will serve as critical model inputs. These clusters allow for scenario differentiation and parameter calibration across varied regional profiles, particularly in assessing impacts on demographics, labour markets, and social resilience.

In WP4, which addresses policy development and stakeholder engagement, the typology and policy recommendations derived in Section 6 of this deliverable will inform the co-design of tailored regional strategies. The detailed mobility patterns and prioritised policy actions for each cluster (e.g., enhancing student flows in transitioning regions or improving permanent mobility infrastructure in lagging areas) provide a concrete evidence base for engaging regional stakeholders in WP4's participatory workshops and policy dialogues.

The deliverable also contributes to WP1, particularly by refining the conceptual framework of spatial mobility and regional attractiveness under twin transition processes. The multidimensional perspective introduced in this report—including digital, green, and socio-economic components—is incorporated in the MOBI-TWIN dataset.

Lastly, the findings of D2.3 will support WP5's communication and dissemination efforts by providing clear narratives and visual typologies to communicate complex mobility and policy dynamics to policy-makers, civil society, and the academic community. Overall, D2.3 acts as a key analytical output, directly informing modelling, scenario building, stakeholder engagement, and policy design across the MOBI-TWIN project.

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9. APPENDIX 1. LIST OF REGIONS BY CLUSTER

Table A1.1 List of Regions by Cluster

NUTS 2	Region	Cluster
AT13	Wien	Cluster 1
BE10	Région de Bruxelles-Capitale/ Brussels Hoofdstedelijk Gewest	Cluster 1
BE24	Prov. Vlaams-Brabant	Cluster 1
BE31	Prov. Brabant Wallon	Cluster 1
BG41	Yugozapaden	Cluster 1
CZ01	Praha	Cluster 1
DE21	Oberbayern	Cluster 1
DE30	Berlin	Cluster 1
DE60	Hamburg	Cluster 1
DE71	Darmstadt	Cluster 1
DK01	Hovedstaden	Cluster 1
EL30	Attiki	Cluster 1
ES21	País Vasco	Cluster 1
ES30	Comunidad de Madrid	Cluster 1
FI1B	Helsinki-Uusimaa	Cluster 1
FR10	Ile-de-France	Cluster 1
HR05	Grad Zagreb	Cluster 1
HU11	Budapest	Cluster 1
IE06	Eastern and Midland	Cluster 1
LU00	Luxembourg	Cluster 1
NL31	Utrecht	Cluster 1
NL32	Noord-Holland	Cluster 1
PL91	Warszawski stołeczny	Cluster 1
PT17	Área Metropolitana de Lisboa	Cluster 1
RO32	București-Ilfov	Cluster 1
SE11	Stockholm	Cluster 1
SK01	Bratislavský kraj	Cluster 1
AT11	Burgenland	Cluster

		2
		Cluster
AT12	Niederösterreich	2
		Cluster
AT21	Kärnten	2
		Cluster
AT22	Steiermark	2
		Cluster
AT31	Oberösterreich	2
		Cluster
AT32	Salzburg	2
		Cluster
AT33	Tirol	2
		Cluster
AT34	Vorarlberg	2
		Cluster
BE21	Prov. Antwerpen	2
		Cluster
BE22	Prov. Limburg (BE)	2
		Cluster
BE23	Prov. Oost-Vlaanderen	2
		Cluster
BE25	Prov. West-Vlaanderen	2
		Cluster
DEB2	Trier	2
		Cluster
DK02	Sjælland	2
		Cluster
DK03	Syddanmark	2
		Cluster
DK04	Midtjylland	2
		Cluster
DK05	Nordjylland	2
		Cluster
EE00	Eesti	2
		Cluster
FI19	Länsi-Suomi	2
		Cluster
FI1C	Etelä-Suomi	2
		Cluster
FI1D	Pohjois- ja Itä-Suomi	2
		Cluster
FI20	Åland	2
		Cluster
FRC2	Franche-Comté	2
		Cluster
IE04	Northern and Western	2
		Cluster
IE05	Southern	2
		Cluster
ITC2	Valle d'Aosta/Vallée d'Aoste	2
		Cluster
ITH1	Provincia Autonoma di Bolzano/Bozen	2
		Cluster
LT01	Sostinės regionas	2
		Cluster
LV00	Latvija	2
		Cluster
NL11	Groningen	2
		Cluster
NL12	Friesland (NL)	2
		Cluster
NL13	Drenthe	2
		Cluster

		2
		Cluster
NL21	Overijssel	2
		Cluster
NL22	Gelderland	2
		Cluster
NL23	Flevoland	2
		Cluster
NL33	Zuid-Holland	2
		Cluster
NL34	Zeeland	2
		Cluster
NL41	Noord-Brabant	2
		Cluster
NL42	Limburg (NL)	2
		Cluster
SE12	Östra Mellansverige	2
		Cluster
SE21	Småland med öarna	2
		Cluster
SE22	Sydsverige	2
		Cluster
SE23	Västsverige	2
		Cluster
SE31	Norra Mellansverige	2
		Cluster
SE32	Mellersta Norrland	2
		Cluster
SE33	Övre Norrland	2
		Cluster
SI04	Zahodna Slovenija	2
		Cluster
DE11	Stuttgart	3
		Cluster
DE12	Karlsruhe	3
		Cluster
DE13	Freiburg	3
		Cluster
DE14	Tübingen	3
		Cluster
DE22	Niederbayern	3
		Cluster
DE23	Oberpfalz	3
		Cluster
DE24	Oberfranken	3
		Cluster
DE25	Mittelfranken	3
		Cluster
DE26	Unterfranken	3
		Cluster
DE27	Schwaben	3
		Cluster
DE40	Brandenburg	3
		Cluster
DE50	Bremen	3
		Cluster
DE72	Gießen	3
		Cluster
DE73	Kassel	3
		Cluster
DE91	Braunschweig	3
DE92	Hannover	Cluster

		3
		Cluster
DE93	Lüneburg	3
		Cluster
DE94	Weser-Ems	3
		Cluster
DEA1	Düsseldorf	3
		Cluster
DEA2	Köln	3
		Cluster
DEA3	Münster	3
		Cluster
DEA4	Detmold	3
		Cluster
DEA5	Arnsberg	3
		Cluster
DEB1	Koblenz	3
		Cluster
DEB3	Rheinhessen-Pfalz	3
		Cluster
DEC0	Saarland	3
		Cluster
DED2	Dresden	3
		Cluster
DED4	Chemnitz	3
		Cluster
DED5	Leipzig	3
		Cluster
DEE0	Sachsen-Anhalt	3
		Cluster
DEF0	Schleswig-Holstein	3
		Cluster
DEG0	Thüringen	3
		Cluster
ITC1	Piemonte	3
		Cluster
ITH2	Provincia Autonoma di Trento	3
		Cluster
ITH3	Veneto	3
		Cluster
ITH5	Emilia-Romagna	3
		Cluster
ITI1	Toscana	3
		Cluster
ITI4	Lazio	3
		Cluster
PL21	Małopolskie	3
		Cluster
PL22	Śląskie	3
		Cluster
PL51	Dolnośląskie	3
		Cluster
PL71	Łódzkie	3
		Cluster
BE32	Prov. Hainaut	4
		Cluster
BE33	Prov. Liège	4
		Cluster
BE34	Prov. Luxembourg (BE)	4
		Cluster
BE35	Prov. Namur	4
		Cluster
CY00	Kýpros	Cluster

		4
		Cluster
DE80	Mecklenburg-Vorpommern	4
		Cluster
EL42	Notio Aigaio	4
		Cluster
ES11	Galicia	4
		Cluster
ES12	Principado de Asturias	4
		Cluster
ES13	Cantabria	4
		Cluster
ES22	Comunidad Foral de Navarra	4
		Cluster
ES23	La Rioja	4
		Cluster
ES24	Aragón	4
		Cluster
ES41	Castilla y León	4
		Cluster
ES42	Castilla-La Mancha	4
		Cluster
ES43	Extremadura	4
		Cluster
ES51	Cataluña	4
		Cluster
ES52	Comunitat Valenciana	4
		Cluster
ES53	Illes Balears	4
		Cluster
ES61	Andalucía	4
		Cluster
ES62	Región de Murcia	4
		Cluster
ES63	Ciudad de Ceuta	4
		Cluster
ES64	Ciudad de Melilla	4
		Cluster
ES70	Canarias	4
		Cluster
FRB0	Centre — Val de Loire	4
		Cluster
FRC1	Bourgogne	4
		Cluster
FRD1	Basse-Normandie	4
		Cluster
FRD2	Haute-Normandie	4
		Cluster
FRE1	Nord-Pas de Calais	4
		Cluster
FRE2	Picardie	4
		Cluster
FRF1	Alsace	4
		Cluster
FRF2	Champagne-Ardenne	4
		Cluster
FRF3	Lorraine	4
		Cluster
FRG0	Pays de la Loire	4
		Cluster
FRH0	Bretagne	4
		Cluster
FRI1	Aquitaine	Cluster

		4
		Cluster
FRI2	Limousin	4
		Cluster
FRI3	Poitou-Charentes	4
		Cluster
FRJ1	Languedoc-Roussillon	4
		Cluster
FRJ2	Midi-Pyrénées	4
		Cluster
FRK1	Auvergne	4
		Cluster
FRK2	Rhône-Alpes	4
		Cluster
FRL0	Provence-Alpes-Côte d'Azur	4
		Cluster
FRM0	Corse	4
		Cluster
HR03	Jadranska Hrvatska	4
		Cluster
ITC3	Liguria	4
		Cluster
ITC4	Lombardia	4
		Cluster
ITF1	Abruzzo	4
		Cluster
ITH4	Friuli-Venezia Giulia	4
		Cluster
ITI2	Umbria	4
		Cluster
ITI3	Marche	4
		Cluster
MT00	Malta	4
		Cluster
PL42	Zachodniopomorskie	4
		Cluster
PT11	Norte	4
		Cluster
PT15	Algarve	4
		Cluster
PT16	Centro (PT)	4
		Cluster
PT20	Região Autónoma dos Açores	4
		Cluster
PT30	Região Autónoma da Madeira	4
		Cluster
CZ02	Střední Čechy	5
		Cluster
CZ03	Jihozápad	5
		Cluster
CZ04	Severozápad	5
		Cluster
CZ05	Severovýchod	5
		Cluster
CZ06	Jihovýchod	5
		Cluster
CZ07	Střední Morava	5
		Cluster
CZ08	Moravskoslezsko	5
		Cluster
HR02	Panonska Hrvatska	5
HR06	Sjeverna Hrvatska	Cluster

		5
		Cluster
HU12	Pest	5
		Cluster
HU21	Közép-Dunántúl	5
		Cluster
HU22	Nyugat-Dunántúl	5
		Cluster
HU23	Dél-Dunántúl	5
		Cluster
HU31	Észak-Magyarország	5
		Cluster
HU32	Észak-Alföld	5
		Cluster
HU33	Dél-Alföld	5
		Cluster
LT02	Vidurio ir vakarų Lietuvos regionas	5
		Cluster
PL41	Wielkopolskie	5
		Cluster
PL43	Lubuskie	5
		Cluster
PL52	Opolskie	5
		Cluster
PL61	Kujawsko-pomorskie	5
		Cluster
PL62	Warmińsko-mazurskie	5
		Cluster
PL63	Pomorskie	5
		Cluster
PL72	Świętokrzyskie	5
		Cluster
PL81	Lubelskie	5
		Cluster
PL82	Podkarpackie	5
		Cluster
PL84	Podlaskie	5
		Cluster
PL92	Mazowiecki regionalny	5
		Cluster
SI03	Vzhodna Slovenija	5
		Cluster
SK02	Západné Slovensko	5
		Cluster
SK03	Stredné Slovensko	5
		Cluster
SK04	Východné Slovensko	5
		Cluster
BG31	Severozapaden	6
		Cluster
BG32	Severen tsentralen	6
		Cluster
BG33	Severoiztochen	6
		Cluster
BG34	Yugoiztochen	6
		Cluster
BG42	Yuzhen tsentralen	6
		Cluster
EL41	Voreio Aigaio	6
		Cluster
EL43	Kriti	6
		Cluster
EL51	Anatoliki Makedonia, Thraki	Cluster

		6
		Cluster
EL52	Kentriki Makedonia	6
		Cluster
EL53	Dytiki Makedonia	6
		Cluster
EL54	Ipeiros	6
		Cluster
EL61	Thessalia	6
		Cluster
EL62	Ionia Nisia	6
		Cluster
EL63	Dytiki Elláda	6
		Cluster
EL64	Stereá Elláda	6
		Cluster
EL65	Peloponnisos	6
		Cluster
ITF2	Molise	6
		Cluster
ITF3	Campania	6
		Cluster
ITF4	Puglia	6
		Cluster
ITF5	Basilicata	6
		Cluster
ITF6	Calabria	6
		Cluster
ITG1	Sicilia	6
		Cluster
ITG2	Sardegna	6
		Cluster
PT18	Alentejo	6
		Cluster
RO11	Nord-Vest	6
		Cluster
RO12	Centru	6
		Cluster
RO21	Nord-Est	6
		Cluster
RO22	Sud-Est	6
		Cluster
RO31	Sud-Muntenia	6
		Cluster
RO41	Sud-Vest Oltenia	6
		Cluster
RO42	Vest	6

10. APPENDIX 2. DESCRIPTIVE STATISTICS OF THE KEY VARIABLES BY CLUSTER

Table A2. 1 Mean of every indicator by Cluster

<i>Mean</i>	<i>Cluster 1</i>	<i>Cluster 2</i>	<i>Cluster 3</i>	<i>Cluster 4</i>	<i>Cluster 5</i>	<i>Cluster 6</i>
<i>Employment rate</i>	74.31	76.34	76.43	67.00	69.85	59.82
<i>GDP pc</i>	44963.0	32222.1	31645.4	24398.1	17376.4	15836.5
<i>Share of industry</i>	13.48	22.13	26.57	16.21	30.92	21.53
<i>Share of services</i>	32.68	21.90	23.83	23.80	15.41	19.50
<i>Tourists per 100k</i>	2.01	3.07	1.72	2.71	0.78	1.49
<i>Tertiary students</i>	43.53	32.89	26.22	29.21	22.16	19.34
<i>Physicians per 100k</i>	488.27	347.50	402.14	358.41	280.22	388.31
<i>Housing cost overburden rate</i>	12.35	8.37	12.54	7.74	8.25	21.07
<i>Robberies per 100k</i>	114.93	36.20	43.14	79.24	15.18	20.79
<i>Institutional Quality</i>	0.22	1.07	0.62	0.12	-0.63	-1.31
<i>Cooling degree days</i>	92.33	15.09	51.61	163.30	58.81	268.25
<i>Heating degree days</i>	2615.0	3427.5	2869.1	1881.4	3076.6	1872.8
<i>Air quality</i>	14.07	10.18	13.81	11.14	17.72	16.13
<i>Broadband coverage</i>	84.68	85.24	84.20	76.44	75.15	62.88
<i>High Tech employment</i>	7.50	3.88	3.83	2.76	3.12	1.61
<i>Use of internet: private</i>	60.82	68.09	47.79	50.60	40.16	24.22
<i>Use of internet: public</i>	57.52	70.88	48.22	47.00	40.56	14.21
<i>Use of internet: banking</i>	86.45	88.49	84.18	78.63	75.29	60.21
<i>Use of internet: selling</i>	20.10	22.26	22.56	16.39	13.18	4.13
<i>GHG emissions</i>	13031.1	11889.7	25963.4	16975.4	14971.8	11949.8
<i>Circular employment</i>	550.46	1131.52	565.47	745.12	1162.04	967.26
<i>Wages in mining</i>	2.16	4.83	4.52	1.28	2.67	2.33
<i>Agricultural Share</i>	0.37	2.46	1.37	2.96	4.96	6.97
<i>Tourism over GDP ratio</i>	2.01	3.07	1.72	2.71	0.78	1.49

Table A2. 2 Coefficient of variation of every indicator by Cluster

<i>Coefficient of variation</i>	<i>Cluster</i> <i>1</i>	<i>Cluster</i> <i>2</i>	<i>Cluster</i> <i>3</i>	<i>Cluster</i> <i>4</i>	<i>Cluster</i> <i>5</i>	<i>Cluster</i> <i>6</i>
<i>Employment rate</i>	0.09	0.05	0.07	0.09	0.09	0.14
<i>GDP pc</i>	0.28	0.24	0.21	0.18	0.24	0.25
<i>Share of industry</i>	0.41	0.35	0.23	0.37	0.21	0.51
<i>Share of services</i>	0.16	0.17	0.15	0.16	0.18	0.20
<i>Tourists per 100k</i>	0.58	0.90	0.63	0.96	0.55	1.35
<i>Tertiary students</i>	0.17	0.24	0.18	0.27	0.25	0.28
<i>Physicians per 100k</i>	0.27	0.30	0.13	0.27	0.24	0.31
<i>Housing cost overburden rate</i>	0.58	0.43	0.33	0.56	0.44	0.62
<i>Robberies per 100k</i>	1.14	0.81	0.67	0.90	0.82	1.12
<i>Institutional Quality</i>	4.88	0.53	1.13	4.58	-0.51	-0.36
<i>Cooling degree days</i>	1.42	1.47	1.43	1.08	0.90	0.49
<i>Heating degree days</i>	0.28	0.28	0.16	0.40	0.14	0.39
<i>Air quality</i>	0.39	0.37	0.34	0.32	0.21	0.29
<i>Broadband coverage</i>	0.13	0.12	0.11	0.15	0.15	0.28
<i>High Tech employment</i>	0.27	0.37	0.33	0.42	0.47	0.54
<i>Use of internet: private</i>	0.30	0.23	0.23	0.32	0.33	0.56
<i>Use of internet: public</i>	0.39	0.24	0.20	0.35	0.37	0.81
<i>Use of internet: banking</i>	0.12	0.09	0.11	0.14	0.12	0.22
<i>Use of internet: selling</i>	0.49	0.46	0.40	0.56	0.50	0.66
<i>GHG emissions</i>	0.75	0.70	0.67	0.84	0.62	0.71
<i>Circular employment</i>	0.58	0.73	0.35	0.33	0.26	0.27
<i>Wages in mining</i>	0.95	1.87	1.51	1.05	1.48	1.21
<i>Agricultural Share</i>	0.82	0.51	0.67	0.73	0.56	0.35
<i>Tourism over GDP ratio</i>	0.58	0.90	0.63	0.96	0.55	1.35

Figure A2. 1 Traditional Index of Regional Attractiveness and Mobility Patterns: Net Flows by Cluster and Mobility Type

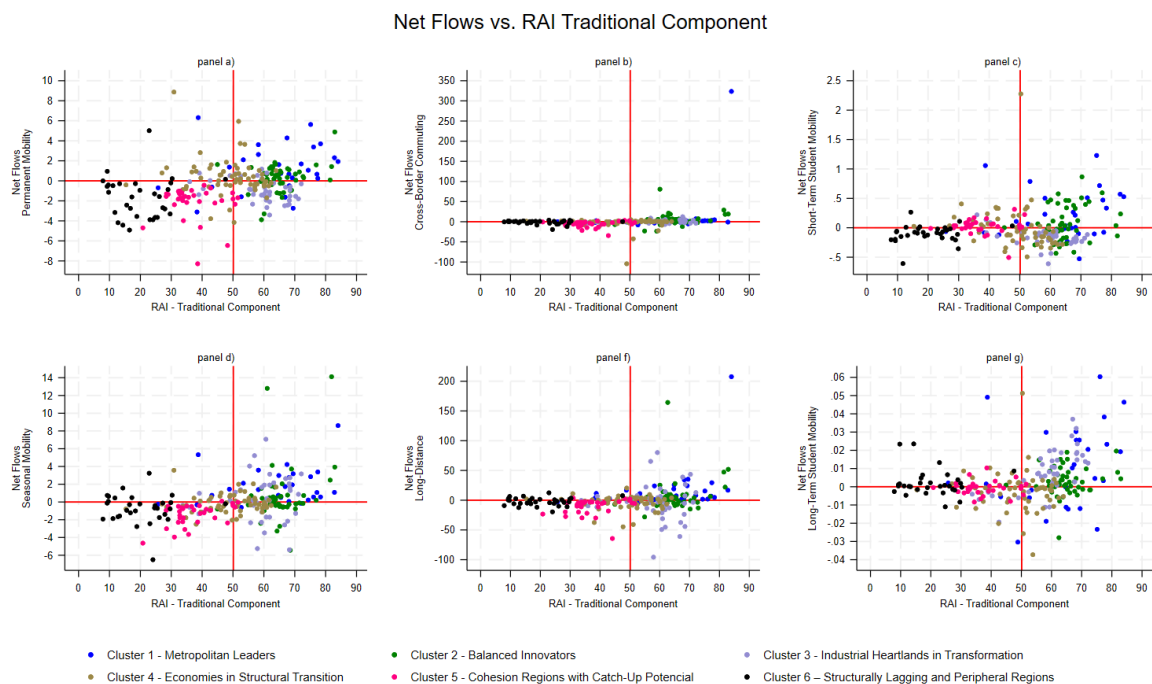


Figure A2. 2 Green Index of Regional Attractiveness and Mobility Patterns: Net Flows by Cluster and Mobility Type

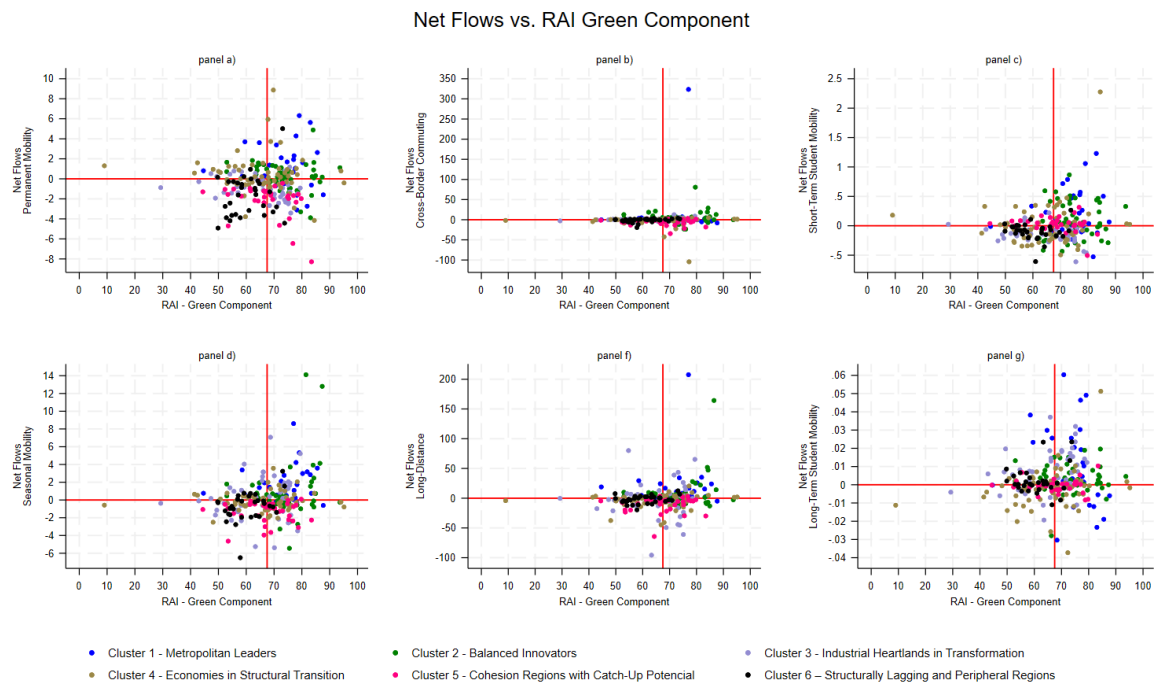


Figure A2. 3 Digital Index of Regional Attractiveness and Mobility Patterns: Net Flows by Cluster and Mobility Type

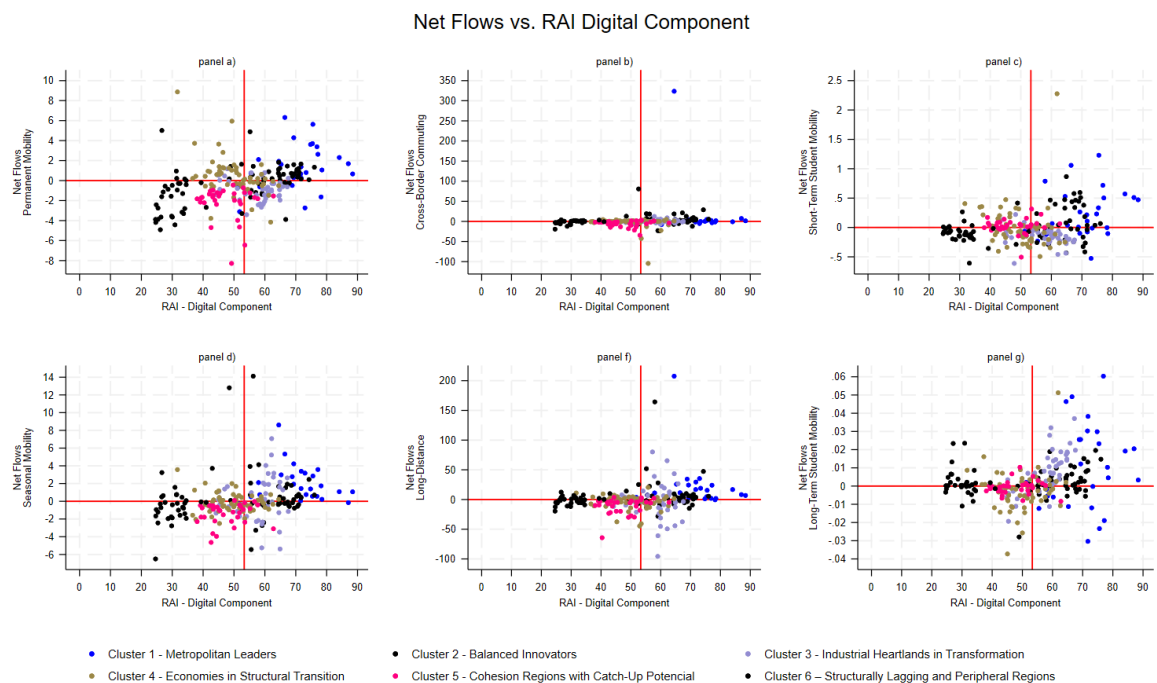


Table A2. 3 Descriptive Statistics of Net Mobility Flows by Cluster and Mobility Type

	<i>Permanent Mobility</i>	<i>Cross- Border Commuting</i>	<i>Short- Term Student Mobility</i>	<i>Seasonal Mobility</i>	<i>Long-Term Commuting</i>	<i>Long- Term Student Mobility</i>
<i>Cluster 1 – Metropolitan Leaders</i>	259999.8	2965276	82532	1376128	13900000	3728
	19999.99	228098.1	6348.615	105856	1066777	286.7692
	40327.82	61641.81	6468.18	28951.73	457697	284.3997
	15.50%	2.10%	7.80%	2.10%	3.30%	7.60%
<i>Cluster 2 – Balanced Innovators</i>	61647.31	1294197	35882	106092.3	2264218	1256
	4742.101	99553.65	2760.154	8160.947	174170.6	96.61538
	10029.45	31276.14	2767.126	8736.8	264724.2	108.1577
	16.30%	2.40%	7.70%	8.20%	11.70%	8.60%
<i>Cluster 3 – Industrial Heartlands in Transformation</i>	-205230.4	-490360.4	-91037	429653.9	-3430221	4252
	-15786.95	-37720.03	-7002.846	33050.3	-263863.2	327.0769
	31683.95	28115.84	6985.844	43389.89	481910.7	344.3718
	15.40%	5.70%	7.70%	10.10%	14.00%	8.10%
<i>Cluster 4 – Economies in Structural Transition</i>	160964.8	-4233591	-27540	-442993.4	-8247318	-4120
	12381.91	-325660.9	-2118.462	-34076.42	-634409.1	-316.9231
	25642.3	123658.8	2608.314	13197.44	99615.48	322.0058
	15.90%	2.90%	9.50%	3.00%	1.20%	7.80%
<i>Cluster 5 – Cohesion Regions with Catch-Up Potencial</i>	-298496.2	-3258755	7100	-753477.7	-6704411	-302
	-22961.25	-250673.4	546.1538	-57959.82	-515723.9	-23.23077
	48533.71	69183.98	1555.38	14858.79	226963.9	39.99615
	16.30%	2.10%	21.90%	2.00%	3.40%	13.20%
<i>Cluster 6 – Structurally Lagging and Peripheral Regions</i>	-257663.7	-1456432	-35964	-901156.7	-3007148	-238
	-19820.29	-112033.3	-2766.462	-69319.75	-231319.1	-18.30769
	42458.36	46213.82	2881.482	38266.35	69064.54	56.39501
	16.50%	3.20%	8.00%	4.20%	2.30%	23.70%

Table A2. 4 Correlation Matrix Between Regional Attractiveness Indices and Net Mobility Flows (2015–2022)

<i>Correlation Matrix</i>	<i>RAI Overall</i>	<i>RAI Traditional</i>	<i>RAI Green</i>	<i>RAI Digital</i>
<i>Permanent Mobility</i>	0.268 ***	0.287 ***	0.015	0.259 ***
<i>Cross Border Commuting</i>	0.141 ***	0.184 ***	0.067 ***	0.084 ***
<i>Short Term Student Mobility</i>	0.187 ***	0.138 ***	0.149 ***	0.191 ***
<i>Seasonal Mobility</i>	0.179 ***	0.195 ***	0.131 ***	0.124 ***
<i>Long Distance Commuting</i>	0.092 ***	0.098 ***	0.078 ***	0.061 ***
<i>Long Term Student Mobility</i>	0.228 ***	0.202 ***	0.105 ***	0.232 ***

Note: p-value < 0.01 ***, < 0.05 ** and < 0.1 *

Table A2. 5 Correlation Matrix Between Regional Attractiveness Indices and Net Mobility Flows (2015–2022). Results by Cluster.

<i>Net Flow</i>	<i>RAI Overall</i>	<i>RAI Tradit</i>	<i>RAI Green</i>	<i>RAI Digital</i>
Cluster 1 – Metropolitan Leaders				
<i>Permanent Mobility</i>	0.260	0.210	-0.078	0.310
<i>Cross-Border Commuting</i>	0.137	0.292	0.048	-0.100
<i>Short-Term Student Mobility</i>	0.271	0.143	0.147	0.293
<i>Seasonal Mobility</i>	0.175	0.232	0.140	-0.001
<i>Long-Term Commuting</i>	0.181	0.346	0.024	-0.065
<i>Long-Term Student Mobility</i>	0.187	0.289	-0.268	0.171
Cluster 2 – Balanced Innovators				
<i>Permanent Mobility</i>	0.210	0.286	-0.229	0.201
<i>Cross-Border Commuting</i>	0.080	0.224	0.024	-0.077
<i>Short-Term Student Mobility</i>	0.271	0.211	0.083	0.131
<i>Seasonal Mobility</i>	0.102	0.288*	0.224	-0.225
<i>Long-Term Commuting</i>	0.160	0.200	0.240	-0.099
<i>Long-Term Student Mobility</i>	0.432**	0.136	-0.024	0.452**
Cluster 3 – Industrial Heartlands in Transformation				
<i>Permanent Mobility</i>	-0.385*	-0.385*	-0.344*	-0.252
<i>Cross-Border Commuting</i>	0.263	0.293	0.272	0.105
<i>Short-Term Student Mobility</i>	-0.479**	-0.501***	-0.380*	-0.331*
<i>Seasonal Mobility</i>	0.144	0.092	0.160	0.126
<i>Long-Term Commuting</i>	-0.025	-0.022	0.001	-0.041
<i>Long-Term Student Mobility</i>	0.716***	0.689***	0.391*	0.727***
Cluster 4 – Economies in Structural Transition				
<i>Permanent Mobility</i>	-0.356**	-0.150	-0.092	-0.437***
<i>Cross-Border Commuting</i>	-0.143	-0.022	-0.088	-0.165
<i>Short-Term Student Mobility</i>	-0.106	-0.211	0.113	-0.090
<i>Seasonal Mobility</i>	0.065	0.116	0.090	-0.095
<i>Long-Term Commuting</i>	-0.030	-0.054	0.125	-0.128
<i>Long-Term Student Mobility</i>	0.162	-0.054	0.251	0.119
Cluster 5 – Cohesion Regions with Catch-Up Potential				
<i>Permanent Mobility</i>	-0.194	-0.047	-0.354*	-0.107
<i>Cross-Border Commuting</i>	-0.068	0.101	-0.163	-0.118
<i>Short-Term Student Mobility</i>	-0.056	0.003	-0.205	0.038
<i>Seasonal Mobility</i>	0.286	0.514**	0.039	0.129
<i>Long-Term Commuting</i>	0.200	0.182	0.090	0.210
<i>Long-Term Student Mobility</i>	0.015	0.007	-0.028	0.051
Cluster 6 – Structurally Lagging and Peripheral Regions				
<i>Permanent Mobility</i>	0.172	0.018	0.202	0.221
<i>Cross-Border Commuting</i>	0.155	-0.172	0.300	0.412*
<i>Short-Term Student Mobility</i>	-0.004	0.188	-0.051	-0.281
<i>Seasonal Mobility</i>	0.169	-0.064	0.360*	0.213
<i>Long-Term Commuting</i>	0.259	0.092	0.293	0.233
<i>Long-Term Student Mobility</i>	-0.097	-0.095	0.141	-0.211