

CONVERGENCE OR DIVERGENCE? SOCIO-ECONOMIC DEVELOPMENT IN ROMANIAN COUNTIES SINCE 2007

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Abstract

The development level of each Romanian county may be understood as a response to almost 20 years of available EU funding and structural policies that were enabled so to push Romania to socio-economic convergence and competitiveness with other European Union members. In this context, the following study aims at providing a comprehensive analysis, based on several socio-economic indicators measured since Romania's EU accession, that clusters the 41 counties and Bucharest region by level of development. While other studies on this topic analyse composite indices as one-point-in-time, this data-driven, longitudinal study overviews three CAP programming periods dynamically. The main results point out four types of clusters based on development level. The most important result is, however, how much Bucharest-Ilfov region has differentiated itself from the other counties since 2007, while other counties remain at almost the same level of development as 20 years ago.

Keywords: regional development; socio-economic indicators; clustering analysis; convergence; divergence.

Clasificare JEL : M40, M41

1. Introduction and context of the study

Tackling regional socio-economic disparities has long been on Romania's to do list. Following Romania's accession to the European Union in 2007, the country's structure of 41 counties and Bucharest-Ilfov region have followed considerably different trajectories, opposed to the convergence policy promoted both at EU and national level. Yet, some patterns have been observed by the literature (FES, 2023; Mitrică et al. 2020), Bucharest, Cluj, Timiș and Brașov metropolitan areas have progressed towards EU's average income and infrastructure standards. Meanwhile, these growth poles continuously separate from other parts of the country, such as large parts of the South, South-East and North-East regions, where economy is agriculture-based, the infrastructure is weaker and the demographic decline is heavier. Understanding how these disparities evolved in this time-frame is essential both for research purposes and for underpinning the design of future national and EU-funded policies during this time of change.

In this context, this paper responds to this need by constructing a longitudinal, multidimensional profile of Romanian counties using official statistical indicators published by the National Institute of Statistics (NIS, 2025), and by applying cluster analysis in R to classify counties according to their current level of socio-economic development. Rather than relying on a single composite indicator, such as GDP per capita (Bălăcesci and Babucea, 2018), the clustering approach draws on twelve indicators spanning five dimensions — demographic dynamics (population, natural growth, immigration, emigration, and derived net migration), labor and income (average gross monthly wage), basic services (population connected to public water supply and sewage networks), economic structure (number of active enterprises), agricultural structure (wheat yield, as a proxy for rural productivity), infrastructure (public road network length), and health services (number of hospital units) — observed at benchmark years (2000, 2007/2008, 2013/2014,

2020, 2023, and 2024, depending on NIS indicator availability) rather than as a full continuous annual series. This design, previously used by other authors (Mihokova et al., 2016; Kosowski, 2025) reflects the actual reporting structure of NIS county-level statistics, and allows the analysis to capture pre-accession, early-cohesion, Europe 2020-era, and current-period snapshots within a single comparative framework. The resulting typology provides an empirical basis for discussing convergence and divergence trends across the 2007–2025 period and for situating Romania's regional development trajectory within the broader framework of European Union cohesion policy and the United Nations Sustainable Development Goals (SDGs). Therefore, the longitudinal design of this study allows us to fill in a gap that was poorly tackled before.

Romania's regional development policy cannot be taken apart from the architecture of EU Cohesion Policy, as the base structure for the incentives, funding instruments, and priorities available to Romanian counties over the past two and a half decades (Istudor et al., 2015; Aniela et al., 2019). Based on this structure, Romania has gone through four main programming periods: the Pre-accession period (2000–2006) - shaped primarily by pre-accession instruments aimed at preparing national and regional administrative capacity for the eventual absorption of structural funds, and by the first National Development Plans, which introduced the country's eight NUTS-II development regions as the operational framework for territorial statistics and future programming; The first programming period as EU members (2007–2013) – the Cohesion Policy in this period was organised around the Lisbon Strategy's growth-and-jobs agenda, with Romania's Convergence Objective status reflecting its position as one of the EU's least developed member states. National operational programmes for this period focused heavily on basic infrastructure (transport, water and wastewater systems) and human capital development; The second programming period (2014–2020) – in Romania, this period meant eleven thematic objectives spanning competitiveness, digitalisation, low-carbon economy, climate adaptation, environmental protection, sustainable transport, institutional capacity, employment, social inclusion, education, and — for the first time with strong emphasis — integrated territorial and urban development instruments (ITI, CLLD). This period also coincided with growing EU-level attention to territorial cohesion as a goal in its own right, alongside economic and social cohesion, as articulated in the Territorial Agenda of the EU. The third, and current, programming period (2021–2027) - Romania remained among the largest net beneficiaries given its regional GDP per capita gap relative to the EU average. This period has also been shaped by the parallel deployment of the Next Generation EU recovery instrument and Romania's National Recovery and Resilience Plan, which — while formally distinct from Cohesion Policy — has reinforced many of the same priorities (green transition, digitalisation, resilience) and has interacted with structural funds in shaping county-level investment patterns since 2021. These successive programming periods are important for the present analysis because each period introduced different eligibility criteria, funding priorities, and absorption capacities across counties, all of which plausibly contributed to divergent development trajectories that a 2007–2025 clustering exercise should be able to detect.

Building on this framework, the present paper aims at:

1. Constructing a multidimensional statistical profile of Romania's 42 counties (including Bucharest) using twelve NIS indicators across demographic, labor/income, basic services, economic structure, agricultural, infrastructure, and health dimensions, observed at benchmark years between 2000 and 2024;
2. Applying cluster analysis techniques in R to classify counties into homogeneous development groups based on their most recent available data, while using earlier benchmark years to characterise each cluster's trajectory over time;
3. Interpreting the resulting typology compared to the successive EU Cohesion Policy programming periods, assessing whether counties that historically absorbed more funding, or benefited from particular policy objectives, occupy correspondingly higher development clusters.

The rest of the paper is organised as follows: a literature review section, used to contextualise the study, followed by the methodological design and the results section. Then, a discussion section is presented and a synthetic set of conclusion ends the research.

2. Literature trends

Several studies in the Romanian literature identify a structural gap between a more developed western and central area and a lagging eastern and southern area. Surd et al. (2011) describe a marked east-west duality, with the western region considerably above the national GDP per capita average while eastern and southern counties fall below it, noting this pattern parallels similar dualities in Hungary, Slovakia, and Austria. More recent rural-focused research confirms the pattern still holds for social indicators: Mitrică et al. (2020) find the lowest social development index values concentrated in Vaslui, Dolj, Olt and Teleorman counties, with territorial continuity broken only by metropolitan poles such as Iași, Galați-Brăila, Constanța, Bucharest, Pitești, Ploiești and Craiova. Other studies explore the dual nature of Romania's economy, characterized by dynamic, urban areas integrated into the EU structure and less developed rural areas struggling with poverty and lack of infrastructure (Török et al., 2022), while Benedek et. al. (2021) take a sustainability performance evaluation approach and identify Bucharest, Timiș, Cluj, Constanța, Brașov, Sibiu, and Ilfov as achieving the highest level of sustainable development, while Vaslui and Teleorman counties achieved the poorest level. One study observes that development gaps among counties have continuously increased since the transition to a market economy, despite many strategies explicitly targeting them (Goschin, 2015).

Therefore, the first research objectives become:

O1: Assessing whether the county clusters obtained through the R analysis reproduce the historically documented east–west divergence, or whether new spatial configurations have emerged since EU accession. And:

O2: To test, using the clustering results, whether county trajectories over 2000–2025 show convergence or divergence, and to relate this to capital-region agglomeration effects.

A recent European-wide study, using a k-means cluster analysis identifies six region types by grouping regions according to socioeconomic profiles, revealed that western Romania falls into a cluster shared with southern Germany, the Warsaw area, southern/eastern Czechia, the Porto area and parts of Lombardy — a group with the lowest GDP per capita levels and weakest growth since 1993, persistent deindustrialization, and limited adaptive capacity (Refisch, 2026). At a sub-national scale, Polish research shows clustering also works well below NUTS-3: a triple-layer approach analysed Poland's 16 voivodships (NUTS-2), benchmarked the 25 counties within Podkarpackie, and then examined the aviation cluster "Dolina Lotnicza" as an example of an effective territorial cluster (Kourtit et. al., 2017). Moreover, Goschin (2015) brings an argued critique to a clustering methodology that only considers GDP per capita, considering that the sociological aspect is understated in this case.

Therefore, the third research objective becomes:

O3: Designing a comprehensive methodology using multiple indicators available at county level across the 2000-2025-time frame and testing whether Romania's disparities are primarily economic or multidimensional.

Several studies frame regional disparities not just east–west, but also structurally: urban vs. rural. A recent Friedrich Ebert Stiftung (FES, 2023) report identifies a cluster of dynamic urbanised counties (Timiș, Cluj, Sibiu, Brașov, Iași and Ilfov) as benefiting from the proximity of major cities, therefore having higher wages, income and in-migration than the Romanian average, alongside above-average life-expectancy and education levels, but also concerning red flags: above-average school dropout rates and low voter turnout. Another study focused on Poland confirms urban–rural typology: under Eurostat's urban-rural typology, all NUTS-3 regions are

classified as urban, intermediate or rural, with Poland in 2017 having 31 rural, 15 urban regions out of 72 (Dudek and Wrzochalska, 2019).

Therefore, the fourth research objective becomes:

O4: Cross-tabulating the R-derived development clusters against the Eurostat urban–rural typology for Romanian counties (GISCO, 2026), testing the extent to which "high-development" clusters correspond to urbanised counties (Cluj, Timiș, Ilfov, Brașov, Sibiu, Iași) and whether the urban-rural gap has widened or narrowed during 2000–2025.

3. Research methodology

3.1. Data source and software selection

The analysis draws on socio-economic and agricultural statistic indicators published by the Romanian National Institute of Statistics (NIS) through the TEMPO-online database, covering all 41 counties and the Municipality of Bucharest. The observation period spans 2007–2025, overviewing all three EU rural development programming periods since Romania's accession to the EU (2007–2013, 2014–2020, 2021–2027), allowing the analysis to situate socio-economic change against the successive cycles of EU funding absorption. Due to differences in publication schedules across NIS indicator series, not all variables are available for every year in the study period; the years actually retrieved per indicator are 2000, 2007, 2008, 2013, 2014, 2020, 2023, and 2024, depending on the series, the unevenness is treated as a data limitation.

R Studio version 4.6.1 was selected as the primary analytical tool, providing an integrated workflow for standardization, and hierarchical clustering without requiring proprietary licenses, and being widely used and readily reproducible in the regional-economics and rural-typology literature. Excel was used in the preparatory phase, for an initial correlation screening of indicators to identify redundancy before finalizing the indicator set used in the multivariate analysis. Also, the mapping function of excel was used to create an image of the resulted clusters of Romanian counties.

3.2 Indicator selection

Eleven base indicators (plus one derived indicator) were selected to represent four dimensions of rural socio-economic change: demographic dynamics, labor market and income, basic infrastructure and services, and economic and agricultural structure. Indicators were retained only where county-level (NUTS III) data were available across multiple years.

Table 1. Description of selected indicators

No.	Dimension	Indicator	Definition	Available years
1	Demographic	Population	Resident population, total	2003, 2007, 2014, 2020, 2023, 2024
2	Demographic	Natural population growth	Births minus deaths	2000, 2007, 2014, 2020, 2023, 2024
3	Demographic	Emigration	Permanent emigrants	2000, 2007, 2014, 2020, 2023, 2024
4	Demographic	Immigration	Permanent immigrants	2000, 2007, 2014, 2020, 2023, 2024
5	Demographic - derived	Net migration	Immigration – Emigration	2000, 2007, 2014, 2020, 2023, 2024
6	Income	Average gross monthly wage	Average gross earnings, all sectors	2008, 2014, 2020, 2023
7	Basic services	Population connected to sewage system	Number of pers. connected to public sewage networks	2013, 2014, 2020, 2023, 2024
8	Basic services	Population connected	Number of pers. connected	2008, 2014, 2020,

		to water supply	to public water supply	2023
9	Economic structure	Active enterprises	Number of active enterprises, all sectors and sizes	2008, 2014, 2020, 2023
10	Agricultural structure	Wheat yield	Wheat production per hectare (kg/ha)	2000, 2007, 2014, 2020, 2023, 2024
11	Infrastructure	Road length	Total public road network length (km)	2000, 2007, 2014, 2020, 2024
12	Health services	Hospitals	Number of hospital units	2000, 2007, 2014, 2020, 2023, 2024

Source: authors' own conceptualization using NIS, 2025

3.3 Data extraction and typology construction

The data extracted from Tempo online (2025) was filtered and prepared for using in R studio. The resulting format panel (county / year / indicator) was used for two purposes: (a) constructing the cross-sectional input for clustering and (b) plotting post-hoc cluster trajectories over time.

3.3.1 County profile and standardization

Since not all indicators were observed in an identical set of years, the clustering input was constructed as each county's mean value per indicator across all years for which data were available, yielding a single representative socio-economic profile per county for the 2007–2025 period. All indicators were then standardized (z-score transformation) prior to multivariate analysis, since they are expressed in different types of units.

A Principal Component Analysis (PCA) was conducted on the standardized indicator matrix to assess the degree of shared variance among indicators and to check for the dominance of any single variable prior to clustering.

3.3.2 Hierarchical cluster analysis

County typology groups were derived using agglomerative hierarchical clustering with Ward's minimum variance method on the Euclidean distance matrix of the standardized indicators, as it is the standard approach in the rural and regional typology literature (Fina et al., 2021) and tends to produce compact, similarly-sized clusters suited to typological interpretation. The number of clusters (k) was determined through visual inspection of the resulting dendrogram, identifying the largest vertical gaps that could be cut without dividing visually coherent branches, retaining a four-cluster solution as being consistent with the number of groups identified in comparable Romanian regional-disparity typologies (Fina et al., 2021; FES, 2023).

3.3.3 Trajectory analysis

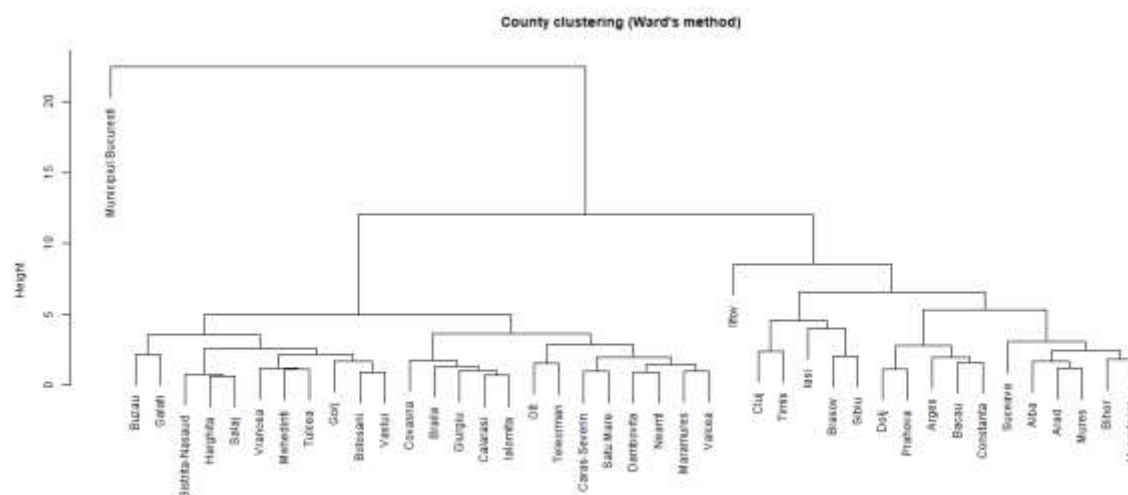
To assess whether socio-economic trajectories diverged across typology groups over the 2007–2025 period, the fixed cluster labels were joined back onto the full year-by-year panel. The cluster-level trajectories were plotted to visualize divergence or convergence in each socio-economic dimension across the study period.

The obtained typology was cross-checked against two external references: (a) the NIS degree of urbanization classification (Predominantly rural / Intermediate / Predominantly urban) available at county level in the source dataset, and (b) the four-cluster "Four Romanias" typology (Bucharest; dynamic urbanised regions; Romania's rural middle; rural and old-industrial regions with significant socio-economic challenges) developed by Fina et al. (2021), whose six-county "dynamic urbanised regions" cluster (Timiș, Cluj, Sibiu, Brașov, Iași, Ilfov) provided a directly comparable published benchmark for validating cluster membership.

4. Results, discussions and limitations

The main results based on the county clustering analysis performed in R, based on the selected socio-economic indicators in the 2007 – 2025-time frame, since the Romanian accession to the EU are further presented.

Figure 1. Cluster dendrogram of Romanian counties

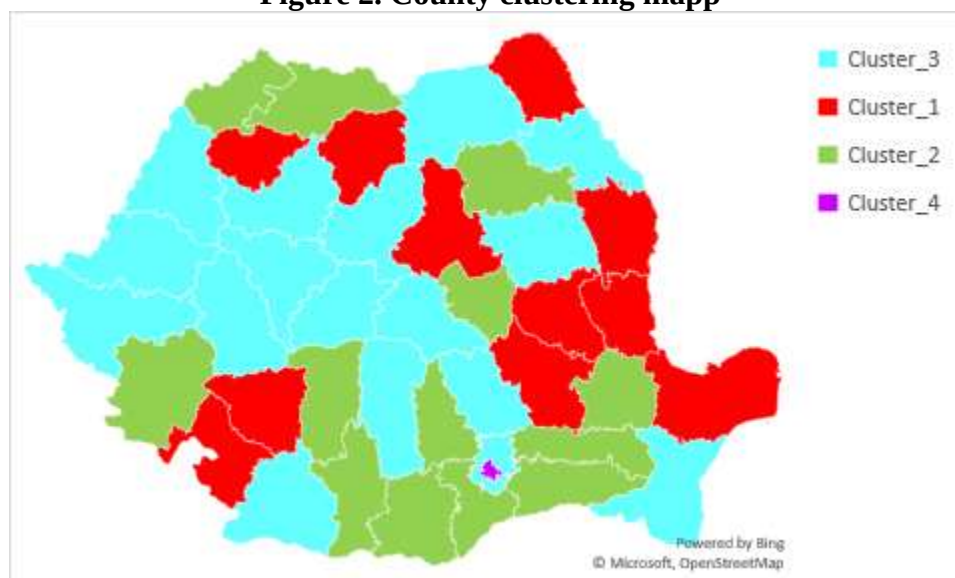


Source: authors' own results using R Studio

Bucharest Municipality separates completely from the other clusters, resembling a peak point. This is sending a strong signal that Bucharest is a statistical outlier, being more different from every other county than any two rural counties are from each other, as shown in Figure 1 and Figure 2. Bucharest Municipality is in a cluster by itself, represented in purple in Figure 2 as Cluster 4.

The second batch of counties, represented in teal in Figure 2 as Cluster 3, consists of more economically active counties: Ilfov, Cluj, Timiș, Iași, Brașov, Sibiu, Dolj, Prahova, Argeș, Bacău, Constanța, Suceava, Alba, Arad, Mureș, Bihor, Hunedoara. Cluster 1, in red in Figure 2, consists of slower counties in an economic perspective, with a more industrial-agricultural economy: Buzău, Galați, Bistrița-Năsăud, Harghita, Sălaj, Vrancea, Mehedinți, Tulcea, Gorj, Botoșani and Vaslui. The final cluster, represented in green in Figure 2 as Cluster 2, has a slower, agricultural oriented economy, and is formed by: Covasna, Brăila, Giurgiu, Călărași, Ialomița, Olt, Teleorman, Caraș-Severin, Satu Mare, Dâmbovița, Neamț, Maramureș and Vâlcea.

While Ilfov county is also represented separately in the dendrogram, as a result of the spill-over effect generated by Bucharest, its characteristics cannot be separated from other potent counties.

Figure 2. County clustering mapp

Source: authors' own results using R Studio and Excel

The mapp in Figure 2 has a close resemblance of the three hystorical regions of Romania, with few exceptions favoured by the geographical positioning, such as Constanța or the hystorical influence of former capital, such as Iași. Otherwise, the Cluster 3, the counties that have developed more consistently in this time-frame, are those located in Transilvania, the western region of Romania, Moldavia is mostly represented by counties in Cluster 1 and Wallachia is mostly represented by Cluster 2. The trajectory charts of each cluster and sets of indicators are presented in Annex 1.

The fourth cluster, in purple, representing the current capital – Bucharest, stands in a class by its own, the indicators showing the highest wages (up to 10000 lei, while the other counties stop at 7500 lei as highest value), highest number of hospital units and enterprise density, and a neat full sweage and water connection, but also with a significantly higher emigration and immigration, and a population that follows a downward trend. Other important aspects related to this cluster is the significantly descendent natural growth.

The third cluster, in teal, consists of counties that may be considered dynamic hubs due to their strongly rising wages and enterprise density. The most important aspect is the clearly rising net migration, pointing out to the attractivity of these counties and the positive natural growth for some part of the analysed period, as opposite to Bucharest.

Cluster 1, in red, presents a moderate decline, closer to rural characteristics, rather than urban, with a higher road density and hospital units than other clusters, but with moderate wage growth and persistent negative net migration and natural growth.

Cluster 2, in green, presents the deepest rural characteristics: lowest wages and enterprise density among all clusters, lowest road density and the steepest decline of the natural growth of the non-capital clusters.

These results reinforce previous studies that frame Bucharest similarly. Rank-size analysis reveals the dominance of Bucharest as the primate city (Manea, 2025; Popescu & Gavriș, 2012), alongside regional disparities in urban growth. Bucharest splitts off from every other county at a much greater dendrogram height (Figure 1) than any two counties differ from each other.

Other territorial competitiveness studies frame Bucharest-Ilfov Region as the most competitive Development Region, given the advantage conferred by Bucharest as the main economic and social polarising centre in Romania, while the eastern and southern regions, predominantly rural, experienced significant industrial decline and social deprivation (Cristina et

al., 2021; Sandu, 2026), similar to the results presented in Figure 2, where Cluster 2 includes deep rural, weakest indicators against Cluster 4 (the capital) as the most developed.

A Friedrich-Ebert-Stiftung (FES, 2023) study on Romanian regional disparities, analysed by similar procedures, obtained almost the same structure as the current analysis: Bucharest and other larger cities where quality of life is well above the country average, while about half of the population in the semirural counties is not reaching the same welfare level as dynamic urban regions, and about one in six Romanians in disadvantaged peripheral areas with abandoned villages. Also, the results of Fina et al. (2021) present a cluster of dynamic urbanized counties (Timiș, Cluj, Sibiu, Brașov, Iași, Ilfov) that benefit from proximity to dynamic cities, with higher wages, income, and internal migration, explaining the growing urban-rural divide, which is an almost exact match to Cluster 3 in the present analysis.

Given the beforehand proposed research objectives, the dendrogram does not hold for a regular poorer east – richer west duality, as the developed branch includes Constanța, Suceava, Bacău and Iași from the eastern Romania alongside Cluj, Timiș, Arad and Bihor from the western Romania, pointing out that including multiple indicators in the analysis develops Mitrică's et al. (2020) narrative, therefore O1 is not confirmed. Yet, the second theory, regarding a convergence versus divergence pattern may be seen, strongly confirming O2, despite successive cohesion strategies and being in line with previous results (Surd et al., 2011). The capital region is pulling away from the rest of the distribution, spilling over Ilfov county, its metropolitan area, while the rest of the country is not converging towards a common mean. Adding on this, Cluster 2 shows no sign of improving across the time-span, significantly diverging from the rest of the clusters, while Cluster 1 is catching up, confirming and refining Goschin's (2015) results.

Regarding O3, the results are partially confirmed by the fact that they differ from similar studies which only include economic indicators. Yet, further analysis would be needed to test if the social indicators are those that source the obtained differences. Nevertheless, there are significant results indicating a strong confirmation in Annex 1: in Cluster 4 (Bucharest), the wages have the highest value, while the natural growth and population are declining in the analysed period, therefore a GDP or wage only analysis would turn Bucharest into a dominant winner, which may be in line with previous results (Ionut, 2019), yet the social aspects point out that there are developmental aspects of Bucharest that are dragging it down. So, a significant difference between a simple economic index and a multidimensional index is obvious. In Cluster 3, as opposed to Cluster 4, the trajectories in Annex 1 point out to a different combination: rising wages and the least negative natural growth and the strongest net migration gains, providing a healthier multidimensional profile, not just an economic one, matching the Fina's et al. (2021) description of dynamic urbanised counties.

O4 is also strongly confirmed through the perspective of the net migration indicator, while Cluster 3 rises from near 0 to over 15000 separating itself from Clusters 1 and 2, which remain near 0 or even negative. Along with the number of enterprises and the wage growth, Cluster 3 becomes a winner from a multiple indicators perspective, the results being similar for Cluj, Timiș, Ilfov, Brașov, Sibiu and Iași. Adding on this, a winning cluster (Cluster 3) groups both eastern and western counties, defining it by the metropolitan status, not by geographical location, supporting Mirică's et al. (2020) results. Even more, the clustering variables (migration, number of enterprises, wages) reproduce the same results consistently across the analysed time frame, not just in one moment in time, adding weight to the study and to the fact that the east-west narrative is not supported any more.

Nevertheless, the proposed study and its methodology have certain limitations that the authors acknowledge. There is an uneven coverage across the selected indicators, for example the number of enterprises or the wages begin in 2008, sewage connection begins in 2013. While the multi-year average used for clustering mitigates this imbalance, it does not eliminate it. Also, the county level population indicators are missing until 2014, yet the regional level values exist.

Bucharest may be treated as a statistical outlier, splitting off from all other counties, which is consistent with its characterization as primate city made by other authors (Manea, 2025), but its inclusion may influence the results of other clusters. Also, a single clustering solution was used, based on the visual dendrogram, rather than a formal cluster-validity index.

5. Conclusions

The present study, aimed at providing a longitudinal analysis regarding the development of Romania's counties using clustering methodology in R, based on multiple socio-economic indicators available on Tempo online for the 2007-2025 time frame, pointed out several important aspects that should be of interest to both academics, for providing a methodological perspective that may be enhanced or offers a base for comparison to other countries, and for authorities who should take into consideration these results in managing cohesion funds in the future in order to favour the development of counties in Clusters 1 and 2 using the model offered by Cluster 3 and to counterbalance the social deficit of Cluster 4.

Overall, the divergence of Romania's counties is confirmed, but there is no uniform pattern along between counties or across the time span. The four-cluster structure indicates that this divergence is concentrated at the extremes: Cluster 2 shows no real evidence of development along with the rest of the country over 2007–2025, while Cluster 3 shows significant convergence toward Cluster 4 on several indicators. The economic and demographic development do not support each other, especially in the capital. This contrast between rising wages and declining population in Bucharest provides important empirical support for the argument that GDP- or wage- based indices alone understate, or can hide the socio-demographic restraints. The poorer east versus richer west framing of the counties is not supported, while the clustering analysis results point out to a development that stays close to metropolitan proximity, the spill-over effect being key motor for the counties in Cluster 3.

The most important question that arises from this study is what would the counties in Cluster 2 need to start their development if 20 years of available cohesion funds were not able to provide enough motivation?

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Annex 1

Indicator trajectories by rural typology cluster (2007-2025)

