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## Evolution of Determinants of Regional Development in Selected European Union Countries

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**Abstract:**

**Purpose:** Regional development can be understood as a complex economic category describing a multidimensional, heterogeneous, and long-term process aimed at enhancing the existing state of a given region based on established criteria. The purpose of this article is to determine whether the significance of the determinants of such development remains constant over time and across different regions.

**Design/Methodology/Approach:** Weights for the selected nine variables describing regional development were determined using the distance minimization method. The study was conducted on 158 regions across eight European Union countries, using data from 2010 and 2023.

**Findings:** Beyond the challenge of selecting variables that characterize regional development, it is also essential to ascertain the significance of individual indicators by assigning them specific weights. In the literature, there is often a tacit assumption that all selected diagnostic variables are assigned equal weight. However, such an approach overlooks the structure of the object, data quality, and so on.

**Practical Implications:** Precisely determining weight values that reflect the importance of various variables in the context of regional development can be valuable in identifying priority areas to be considered in a range of socio-economic decision making processes.

**Originality/Value:** This article presents the potential application of distance-minimization methods to weigh the significance of factors determining regional development.

**Keywords:** Regional development, weighting of diagnostic variables, determinants of regional development.

**JEL codes:** C1, Q4, F59.

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## **1. Introduction**

Regional development can be understood as a process of positive transformations, both quantitative and qualitative, taking place in a specific country or region. It pertains to supra-local socio-territorial systems characterized by distinctive spatial features, economic structures, and social bonds shaped by national identity (Strahl, 1998; Pociovalisteanu and Thalassinou, 2008).

Additionally, it may be viewed as the sustained growth of a region's economic potential, systematic enhancement of its competitiveness, and improvement of residents' quality of life (Chądryński, Nowakowska, and Przygodzki 2007). Regional development can also be regarded as a multidimensional indicator that, within given constraints, comprehensively captures positive changes across social, economic, environmental, and institutional-political spheres within a given area (Czyżycki, 2019).

The term "region" is frequently used in the social sciences and often carries multiple meanings. In the literature on regional studies, various definitions of "region" are found, which sometimes differ significantly. In the 1970s, EUROSTAT (the Statistical Office of the European Union) launched efforts to unify territorial units for regional statistics, facilitating comparative analyses and assessments of regional development.

Since 1988, the nomenclature for these units (The Nomenclature of Territorial Units for Statistics – NUTS) has been used in EU legislation. Despite the aim of comparability across NUTS levels, each classification tier includes regions that differ substantially in terms of area, population, and economic or administrative significance (Obrębalski, 1999).

The current NUTS 2021 classification has been valid since January 1, 2021, and includes 92 regions at the NUTS 1 level, 242 regions at the NUTS 2 level, and 1,166 regions at the NUTS 3 level, with the assumption that the average population of a NUTS 1 region should range from 3 to 7 million people, for NUTS 2 between 800,000 and 3 million, and for NUTS 3 between 150,000 and 800,000 („Common Classification of Territorial Units for Statistics (NUTS) | Fact Sheets on the European Union | European Parliament” 2024).

The diversity of processes occurring within regional territorial systems and the complex nature of regional development imply that this development is influenced by a multitude of factors. These factors can be analyzed in a general (universal) sense, regardless of the unique characteristics of a particular territorial unit, or in a specific manner, tailored to a specific spatial context (Obrębalski, 2012).

It is worth noting that in the economic literature, there appears to be no universally recognized or accepted classification of development factors. Likewise, there is no

set of indicators or rules for selecting variables that is both timeless and widely accepted by researchers. The choice of factors, therefore, depends on the ability to compare data and meet formal and substantive requirements (Słaby, 1994; Johann, 2005).

The appropriate selection of indicators should consider the spatial and temporal scope of the assessment as well as its purpose. In addition to selecting suitable variables, assigning them appropriate weights is also crucial. Literature distinguishes two main methods of determining weights (Kao, 2010), direct and indirect.

In the direct method, weights are determined prior to data collection, for instance, based on expert opinions, and are known as a priori weights. The indirect method involves determining weights based on an analysis of the collected data (a posteriori weights), which is often considered more substantively justified. However, it is essential to remember that results may vary depending on the method used (Czyżycki, 2018).

## **2. Literature Review**

At the beginning of the 21st century, regional policy became an integral part of the economic strategy of individual states and supranational institutions. Generally, the theory of local and regional development recognizes interregional differences as an objective reality that occurs universally (Prusek, 1995), although it is often assumed a priori that these disparities are undesirable (Szymła, 2004).

The spatial differentiation of economic growth and development processes, as well as economic cohesion at both the inter- and intraregional levels, has been the subject of numerous studies. However, these analyses do not provide a clear answer regarding the underlying patterns of these processes.

Unresolved questions remain, such as whether economic growth leads to the equalization of development disparities between regions, whether economic integration positively affects reducing the development gap between participating countries and regions, how globalization processes contribute to widening disparities, and whether optimal limits for such disparities exist (Markowska-Przybyła, 2006; Adamopoulos and Thalassinos, 2020).

There is a significant body of research on spatial structures and disparities, particularly at national and regional levels. However, there is a noticeable shortage of studies focusing on intraregional disparities, especially in broader territorial contexts (e.g., within a country or across EU).

This scarcity hinders the planning and implementation of regional policies at the intraregional level and may contribute to the marginalization of their importance (Raczyk, 2010). Additionally, it could be one of the main reasons for the increasing

support for anti-system and/or Eurosceptic parties (Algan *at al.*, 2017; Rodríguez-Pose, 2018; Dijkstra, Poelman, and Rodríguez-Pose, 2020). While before the economic crisis of 2008, the European Union was often referred to as a "convergence machine" due to the substantial narrowing of disparities between EU regions, recent studies suggest that this crisis effectively halted the convergence process within the EU (Inforegio - Convergence of EU regions redux, 2024).

### 3. Research Methodology

Due to the adopted research objective, the analysis of the significance of variables describing regional development has been limited to EU countries for which Eurostat has identified at least 10 NUTS2-level units. Thus, the study includes the following regions:

- 11 regions of Belgium (BE) (Brussels-Capital Region, Province of Antwerp, Limburg, East Flanders, Flemish Brabant, West Flanders, Walloon Brabant, Hainaut, Liège, Luxembourg, Namur);
- 38 regions of Germany (DE) (Detmold Government Region, Swabia, Upper Palatinate, Kassel Government Region, Stuttgart Government Region, Trier Government Region, Darmstadt Government Region, Karlsruhe Government Region, Lower Bavaria, Koblenz Government Region, Münster Government Region, Saarland, Schleswig-Holstein, Düsseldorf Government Region, Giessen Government Region, Lüneburg Government Region, Saxony-Anhalt, Upper Franconia, Arnsberg Government Region, Middle Franconia, Rheinhessen-Pfalz, Brunswick Government Region, Lower Franconia, Leipzig Government Region, Weser-Ems Government Region, Upper Bavaria, Freiburg Government Region, Cologne Government Region, Hamburg, Hanover Government Region, Tübingen Government Region, Berlin, Dresden Directorate District, Free Hanseatic City of Bremen, Thuringia, Chemnitz Government Region, Brandenburg, Mecklenburg-Western Pomerania);
- 13 regions of Greece (EL) (Central Greece Region, Epirus Region, Peloponnese Region, West Greece Region, Central Macedonia Region, Crete Region, Western Macedonia Region, South Aegean Region, East Macedonia and Thrace Region, Ionian Islands Region, Thessaly Region, North Aegean Region, Attica Region);
- 19 regions of Spain (ES) (Ciudad Autónoma de Ceuta, Castile-La Mancha, Extremadura, Andalusia, Región de Murcia, Ciudad Autónoma de Melilla, Castile and León, Land of Valencia, La Rioja, Aragon, Cantabria, Asturias, Balearic Islands, Galicia, Canary Islands, Catalonia, Comunidad de Madrid, Basque Autonomous Community, Comunidad Foral de Navarra);

- 27 regions of France (FR) (Île-de-France, Centre-Val de Loire, Burgundy, Franche-Comté, Lower Normandy, Upper Normandy, Nord-Pas-de-Calais, Picardy, Alsace, Champagne-Ardenne, Lorraine, Pays de la Loire, Brittany, Aquitaine, Limousin, Poitou-Charentes, Languedoc-Roussillon, Midi-Pyrénées, Auvergne, Rhône-Alpes, Provence-Alpes-Côte d'Azur, Corsica, Guadeloupe, Martinique, French Guiana, Réunion, Mayotte);
- 21 regions of Italy (IT) (Campania, Sicily, Apulia, Calabria, Molise, Basilicata, Abruzzo, Sardinia, Lazio, Marche, Veneto, Liguria, Umbria, Friuli-Venezia Giulia, Piedmont, Lombardy, Emilia-Romagna, Tuscany, Provincia Autonoma di Bolzano/Bozen, Trentino-South Tyrol, Valle d'Aosta/Vallée d'Aoste);
- 12 regions of the Netherlands (NL) (Zeeland, Flevoland, Overijssel, North Brabant, Limburg, Gelderland, Utrecht, North Holland, South Holland, Drenthe, Groningen, Friesland);
- 17 regions of Poland (PL) (Podkarpackie Voivodeship, Mazowiecki regionalny, Greater Poland Voivodeship, Opole Voivodeship, Świętokrzyskie Voivodeship, Warmian-Masurian Voivodeship, Lubusz Voivodeship, Pomeranian Voivodeship, Kuyavian-Pomeranian Voivodeship, Lesser Poland Voivodeship, Łódź Voivodeship, Silesian Voivodeship, Lublin Voivodeship, West Pomeranian Voivodeship, Lower Silesian Voivodeship, Podlaskie Voivodeship, Warszawski stołeczny).

For all the above regions, data was collected to describe the following phenomena: Income of households (Euro per inhabitant) – X1; Stock of vehicles (per thousand inhabitants) – X2; Economic activity rates (percentage) – X3; Percentage of total employment in high-technology sectors – X4; Percentage of total employment in agriculture, forestry, and fishing – X5; Gross domestic product (Euro per inhabitant) – X6; Unemployment rates (percentage) – X7; Demographic balance and crude rates (percentage) – X8; Tertiary education (percentage) – X9.

The data, sourced from Eurostat, includes information describing the shaping of the values of the indicators for the years 2010 and 2023. Next, the method of minimizing the distance from the benchmark was applied (Ma, Fan and Huang, 1999), which involves determining the weight values for each variables that minimize the distance defined as:

$$\sum_{i=1}^n \sum_{j=1}^n (z_0^+ - z_{ij}^-) w_j^2 \rightarrow \min \quad (1)$$

where

$$z_0^+ = \begin{cases} \max_i z_{ij} & \text{in case of a stymulant} \\ \min_i z_{ij} & \text{in case of a destymulant} \end{cases} \quad (2)$$

However,  $z_{ij}$  values are determined according to the formulas:

- in the case of stimulants:

$$z_{ij} = \frac{x_{ij} - \min_i x_{ij}}{\max_i x_{ij} - \min_i x_{ij}} \quad (3)$$

- in the case of destimulants:

$$z_{ij} = \frac{\max_i x_{ij} - x_{ij}}{\max_i x_{ij} - \min_i x_{ij}} \quad (4)$$

The solution to assumption (1) involves determine the values of individual weights based on the formula:

$$w_j^6 = \frac{\frac{1}{\sum_{i=1}^m (z_{ij} - z_0^+)^2}}{\sum_{k=1}^m \left( \frac{1}{\sum_{i=1}^m (z_{ik} - z_0^+)^2} \right)} \quad (5)$$

The values obtained in this way meet two key assumptions regarding the weights of diagnostic variables: they are positive ( $w_j > 0$ ) and their sum equals one ( $\sum_{j=1}^m w_j = 1$ ).

#### 4. Results

Assuming equal importance of all nine analyzed variables in regional development, the weight values for each variable would be  $w_j = 1/9 = 0.1111$ . In 2010, considering all analyzed regions, the variables with above-average importance in regional development were Economic activity rates ( $w_3 = 0.2427$ ) and Unemployment rates ( $w_7 = 0.2743$ ).

In contrast, variables with the least impact included Percentage of total employment in agriculture, forestry, and fishing ( $w_5 = 0.0468$ ), Demographic balance and crude rates ( $w_8 = 0.0550$ ), Stock of vehicles ( $w_2 = 0.0689$ ), Gross domestic product ( $w_6 = 0.0690$ ), and Tertiary education ( $w_9 = 0.0735$ ) (Table 1).

However, over the 13 years analyzed, significant changes occurred in the importance of these variables for regional development. The Unemployment rates variable saw

over a 75% decrease in its weight, while the most notable increases in importance were found in the Percentage of total employment in high-technology sectors (with an increase of over 60%) and Tertiary education (with an increase of over 40%).

The analysis of the significance of these diagnostic variables shows that Economic activity rates (X3) also played a significant role in the development of individual countries' regions. This variable was one of the two most important determinants of development in both analyzed periods for countries such as Belgium, Hungary, France, Italy, and Poland, and in 2023 it became the most important determinant of regional development in the Netherlands (Table 2).

When analyzing changes in the importance of these variables over the 13-year period, it is notable that the variables with the most frequent positive changes included Stock of vehicles (Belgium, Greece, Hungary, and France), Economic activity rates (Germany, France, and the Netherlands), Percentage of total employment in high-technology sectors (Belgium, Italy), Percentage of total employment in agriculture, forestry, and fishing (Italy, Poland), and Tertiary education (Hungary, Netherlands). Among the determinants with the most significant negative changes, the most frequently noted variables were Unemployment rates (Greece, Hungary, Italy), Tertiary education (Germany, Greece, Poland), Income of households (Germany, France), Economic activity rates (Belgium, Poland), Percentage of total employment in agriculture, forestry, and fishing (Belgium, Netherlands), and Demographic balance and crude rates (France, Italy).

Overall, based on the analyses conducted, it can be confirmed that conclusions from such studies indicate that different variables hold varying significance across different countries, and that the same variables in the same countries show different values at different Times (Klóska and Czyżycki, 2021)

## **5. Discussion and Conclusion**

Based on the conducted research, it can be clearly stated that the importance of factors determining regional development evolves over time. This trend is evident both across all 158 analyzed regions in the eight selected European Union countries and within individual regions of these countries. A detailed analysis of the changes occurring in specific countries reveals two distinct groups: one in which the importance of these factors changed only slightly, and another where these changes were substantial.

The first group includes countries like Germany, where in both analyzed periods, the factors with the most influence on regional development were the stock of vehicles and demographic balance and crude rates, while the least influential factors were gross domestic product and unemployment rates. In France, the stock of vehicles and economic activity rates were the most significant factors, whereas unemployment

rates and demographic balance and crude rates had the least impact. Similarly, in Italy, economic activity rates and demographic balance and crude rates were the most important, while the stock of vehicles and the percentage of total employment in high-technology sectors held the least influence.

In contrast, the second group includes Greece, where in 2010, the most important factor was the percentage of total employment in agriculture, forestry, and fishing, shifting to the stock of vehicles by 2023. For the Netherlands, the key factor in 2010 was unemployment rates, while in 2023 it became economic activity rates.

In Poland, the most important factor in 2010 was tertiary education, which changed to unemployment rates in 2023. This indicates that the European Union's regional convergence policy, aimed at reducing internal disparities among regions, remains a highly challenging and variable endeavor over time.

**Table 1.** Weight values of the analyzed diagnostic variables in 2010 and 2023 for all examined NUTS 2 regions

	X1	X2	X3	X4	X5	X6	X7	X8	X9
2010	0.1078	0.0689	0.2427	0.0620	0.0468	0.0690	0.2743	0.0550	0.0735
2023	0.1170	0.0760	0.2976	0.0996	0.0661	0.0969	0.0664	0.0679	0.1124
Change(%)	8.59%	10.32%	22.62%	60.52%	41.25%	40.50%	-75.78%	23.52%	52.89%

*Source:* Own analysis based on Eurostat.

**Table 2.** Weight values of the analyzed diagnostic variables in 2010 and 2023 for NUTS2 regions of selected EU countries

	wj	X1	X2	X3	X4	X5	X6	X7	X8	X9
BE	2010	0.1300	0.0852	0.1989	0.1078	0.1142	0.0825	0.1003	0.0884	0.0927
	2023	0.1287	0.1172	0.1564	0.1256	0.0887	0.0902	0.0968	0.0888	0.1076
	Change(%)	-1.06	37.62	-21.36	16.47	-22.30	9.35	-3.43	0.44	16.03
DE	2010	0.0837	0.3424	0.1114	0.0701	0.0746	0.0572	0.0679	0.1174	0.0754
	2023	0.0707	0.3313	0.1162	0.0700	0.0753	0.0543	0.0674	0.1447	0.0700
	Change(%)	-15.51	-3.24	4.33	-0.13	1.03	-5.07	-0.63	23.20	-7.10
EL	2010	0.0829	0.1354	0.1291	0.0560	0.1899	0.0669	0.1529	0.0873	0.0996
	2023	0.0764	0.1877	0.1192	0.0594	0.1870	0.0856	0.1182	0.0786	0.0878
	Change(%)	-7.86	38.65	-7.67	6.04	-1.55	28.10	-22.65	-9.99	-11.80
ES	2010	0.1021	0.0951	0.1915	0.0728	0.1016	0.1034	0.1200	0.1114	0.1022
	2023	0.0842	0.1435	0.2012	0.0678	0.0886	0.0841	0.0653	0.1104	0.1550
	Change(%)	-17.54	50.90	5.05	-6.83	-12.75	-18.68	-45.57	-0.93	51.62
FR	2010	0.1477	0.1813	0.2174	0.0585	0.1174	0.0903	0.0509	0.0584	0.0782
	2023	0.0825	0.2932	0.2811	0.0513	0.0945	0.0622	0.0372	0.0352	0.0627
	Change(%)	-44.15	61.74	29.29	-12.31	-19.48	-31.07	-26.86	-39.62	-19.78
IT	2010	0.1128	0.0642	0.1792	0.0660	0.0850	0.1045	0.1152	0.1626	0.1106



	2023	0.1224	0.0608	0.1882	0.0817	0.1005	0.1047	0.0993	0.1297	0.1129
	Change(%)	8.49	-5.30	5.05	23.72	18.14	0.20	-13.79	-20.25	2.08
NL	2010	0.0873	0.0603	0.1322	0.1376	0.1311	0.0842	0.1960	0.0933	0.0779
	2023	0.0749	0.0651	0.1980	0.1086	0.1087	0.0841	0.1764	0.0833	0.1010
	Change(%)	-14.25	7.83	49.73	-21.09	-17.13	-0.20	-9.99	-10.65	29.66
PL	2010	0.0667	0.1243	0.1655	0.0776	0.0855	0.0563	0.0985	0.1449	0.1806
	2023	0.0841	0.1162	0.1403	0.0921	0.1239	0.0762	0.1527	0.1361	0.0785
	Change(%)	26.04	-6.55	-15.27	18.62	44.86	35.24	55.11	-6.09	-56.52

**Source:** Own analysis based on Eurostat.

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