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Socio-economic development and quality of life of NUTS-2 units in the European Union

Maciej Jewczak[1], **Magdalena Brudz**[2]

ABSTRACT

Analyses regarding socio-economic development and quality of life are an important aspect of research and discussion for many international organisations, states and local authorities. Due to the complexity and multidimensionality of these issues, conducting research can be problematic. The conclusions of various analytical centres indicate that there are many paths towards establishing a set of factors which affect quality of life and ways of assessing socio-economic development levels. Depending on the criteria considered, the most common methods for determining the degree of the advancement of life quality or socio-economic development include taxonomical techniques and analyses of potential, which are based mainly on objective data sourced from official registers.

The main purpose of the paper is to investigate the level of socio-economic development and quality of life in the European Union in the years 2004 and 2018. The analyses were conducted for a rarely used level of spatial data aggregation, i.e. for NUTS-2 units. The analysis covers only those European regions that were *EU* members in 2004. As the primary research tool, the two-dimensional development matrix was adopted, which enabled the verification of the hypothesis regarding the convergence of synthetic measures that indicate the levels of socio-economic development and quality of life in the *EU* regions. For these indices, the development matrix is also used to identify the strengths and weaknesses as well as the opportunities and threats for selected spatial units, and, at the same time, to estimate the rates of change of the socio-economic development and quality of life levels.

Key words: quality of life, development matrix, taxonomic techniques, regional analyses.

[1] Corresponding author: University of Lodz, Department of Operational Research, Łódź, Poland.
E-mail: maciej.jewczak@uni.lodz.pl. ORCID: https://orcid.org/0000-0002-7837-3486.
[2] University of Lodz, Department of Operational Research, Łódź, Poland.
E-mail: magdalena.brudz@uni.lodz.pl. ORCID: https://orcid.org/0000-0003-4994-9682.

1. Introduction

Dynamic economic and social progress forces people living in modern societies to attach great importance not only to a better/higher quality of life, but also to the socio-economic development of their inhabitants. In the European Union (*EU)* and worldwide, it is possible to identify clusters of better/less developed regions, and when following the tendencies, their arrangement may change spatio-temporally.

To make an objective analysis of both socio-economic development (*SE*) and the level of quality of life (*QoL*), it is necessary to use appropriate tools. As part of development research, some challenges may arise related to various aspects of everyday life that should be covered by the study. As a result, it is possible to identify better/weaker developed areas. Development is a term strictly connected with the issue of progress (PWN, 2021) and it is usually defined as a long-term process of directional change or as the transformation from simple, lower, less perfect forms to more complex and advanced solutions. In the socio-economic sciences, development is generally defined as the overall change or the transformations that affect both society and the economy. It is a multi-faceted and long-term process (Schumpeter, 1960; Cyrson, 1997; Begg et al., 2007; Samuelson and Nordhaus, 2012). Therefore, it should not be assigned only with direct economic progress; it should also include important social, cultural or environmental factors. For this reason, various indicators become analytically useful, although all aspects are rarely, if ever, developed equally.

Focusing solely on the assessment of the advancement of economic development, the literature most often uses gross domestic product (*GDP*) *per capita* as a development measure (Stiglitz, Sen and Fitoussi, 2010). An indicator of socio-economic progress that is frequently used due to the provision of information about the health of the surveyed population is infant mortality *per* 1 000 live births (Robine, Romieu and Cambois, 1999), or the percentage of girls attending school. In addition to these indicators, the level of development is also estimated with energy consumption *per person*, research and development (*R&D*) expenditure, educational attainment or gender wage comparisons (Stiglitz, Sen and Fitoussi, 2018).

By analysing the socio-economic development and the quality of life simultaneously, from the point of view of a single social unit, these phenomena are characterised by a subjective assessment and are not clearly defined or comprehended. In order to live better and/or happier, it is essential to consider many aspects of daily activity and discuss the issue from a broader perspective. Currently, a decent wage and a reliable occupation or a good socio-economic background are no longer sufficient (Tomkiewicz, 2018). For this reason, this type of research also involves qualitative indicators such as opinions that reflect an immeasurable element of

development. However, these indications are still subjective because each respondent has personal assessment criteria.

The study analysed the regional results for 262 NUTS-2 regions of the European Union Member States according to the *EU*'s members composition in 2004. Reducing the research to a lower level of spatial data aggregation is justified by the increase in regional heterogeneity, which represents the statistical significance of the variability level (Đurović, Bigović and Milović, 2017). Considering the conditions of local economies makes it possible to identify inequalities in regional development (Annoni, Dominicis and Khabirpour, 2019). Ertur, Le Gallo and Baumont (2006) claim that the spatial distribution of areas characterised by high/low economic development tends to show constant decomposition over time.

The data on both socio-economic development and quality of life were sourced from the Eurostat and the Organisation for Economic Co-operation and Development (*OECD*) databases. Several detailed statistics were unavailable for selected spatial data aggregation. Thus, to make the research database complete, comparable and reliable, the missing information was supported with data from the local Central Statistical Offices (*CSOs*). Based on the collected data, comparative research was conducted for 2004 and 2018, when the socio-economic differentiation and quality of life levels in the NUTS-2 units were assessed. The study estimated the synthetic indicators of socio-economic differentiation and the quality of life in each of the 262 analysed *EU* regions in order to obtain information on the quality of life and socio-economic condition of the spatial units. Additionally, as a result of the research, in the empirical part of the article, the analysed objects were further classified in the development matrix. Applying a combined and multidimensional approach to the analysed issue allowed to achieve the research goal concerning changes in the socio-economic development in relation to the quality of life of the population at the provincial level. This approach allowed for the verification of the overall hypothesis of permanent positive changes in both spheres of life of every human being.

2. Criteria for building life quality and socio-economic development indices

The aforementioned indicators illustrate only a fragment of reality. For this reason, the United Nations Development Agency (*UNDP*) annually publishes the collective Human Development Index (*HDI*). It analyses the level of development of countries based on a long and healthy life, knowledge level and also standard of living. The highest value of the synthetic index for each analysed country is a unity, with zero as the lowest value. Since it was first developed, this indicator has been modified many times. In the 30th edition in 2020, a factor measuring the impact on the natural environment was also taken into account, which analysed countries and their

inhabitants' impact on nature. As a result, the real situation of the analysed states has become much more realistic. This modification significantly influenced the classification of countries in the ranking. Some of them, previously considered worth following, fell to lower positions in the development hierarchy in 2020 (UNDP, 2020).

In 1994, the World Health Organization (*WHO*) constituted its Quality of Life Department (identified by the acronym *WHOQOL*), which characterised the term quality of life as a subjective perception of individuals' life. It takes into consideration cultural background and values assigned to personal ambitions, possibilities, rules and different obstacles (WHO, 1997). Quality of life has a huge impact on physical and mental health and relationships with others, which was assumed as a reference point in the study of theoretical and empirical considerations. Hawthorne and Osborne (2005) indicated that while constructing the quality-of-life measure, indications should always be explained from a personal perspective. However, it should be noted that each social unit makes a global assessment of the quality of its life differently, which is often influenced by the place of residence or position in the social structure.

The selection of the most important criteria that allowed to determine the indices of life quality and socio-economic development in 262 *EU* spatial units were organised in accordance with the "Better Life Index" proposed by the *OECD,* and the applied methodology corresponds with the latest recommendations of the *OECD* and the Joint Research Centre (*JRC*) of the European Commission (*EC*), *i.e.* the 10-step system for constructing indicators (OECD, 2008). Some of the determinants specified by the *OECD* were not included, or they were replaced by other characteristics due to difficulties related to the data availability at the regional level. Only objective and accessible data sources were selected. While the quality of life is a multidimensional phenomenon when constructing the life quality (*LQ)* measure, indisputable intangible factors such as education, the state of the environment or digital and information development were taken into account, following Agénor and Lim (2018).

The characteristics were initially compiled into subgroups, consistent with the classification of European statistics. The construction of the synthetic *LQ* indicator included 16 quantitative determinants that express various quality of life aspects. The measure representing the socio-economic background (*SE* index) was composed by analogy and based on 17 quantitative characteristics that illustrate numerous aspects of socio-economic development. Stanickova (2015) defined the main factors of socioeconomic development, listing six groups of characteristics that are crucial for *EU* economies. She focused on economic growth, infrastructure level, and everyday human life and education, although the interest of her research was national economies. After collecting all the studies conducted thus far, a list of summary factors was created and further applied in the analysis (Tab. 1).

Table 1. Factors applied in the construction of the synthetic *LQ* and *SE*

Life Quality index		Socioeconomic Development index	
Subgroup	**Determinants**	**Subgroup**	**Determinants**
Education	Participation in education, and additional training rates by attainment level	**Economic accounts**	GDP in constant prices
Health protection, environment and social welfare	Health care conditioning; healthy life years and life expectancy; usage of resources, qualified medical staff; efficiency of health care; mortality rate; air pollution level of 2.5PM; subjective life satisfaction	**Labour market**	Employment level; other labour assets
		Poverty and social exclusion	Poverty rate by type; households at risk of poverty
Income	household accounts	**Science and technology**	R&D expenditure
Digital economy and information society	Internet access; use of IT tools and solutions	**Transportation**	Public roads and railroads; vehicle stock; road safety – victims of road accidents by type and severity

Source: own elaboration.

2.1. Method of building the life quality and socio-economic development indices, including the development matrix

The variables listed in the previous section were initially standardised and used to estimate the indicators of life quality and socio-economic development for each NUTS-2 region and the selected period separately. As a result, it was possible to compare the variability of the quality-of-life indicators with the results of socio-economic differentiation, *i.e.* with tendencies and indicators calculated for the analysed spatial objects.

Many paths were considered regarding how these indicators should be estimated (pattern and non-pattern methods). One crucial condition for the construction of synthetic measures is data comparability (the additivity postulate). The normalisation process also includes the elimination of negative values from the calculations and the stability of the level of variability – the postulate of constant range or stability of extreme values. To maintain data comparability, the standardisation transformation with mean and standard deviation values was used according to the following formula:

$$z_{ij} = \frac{x_{ij} - \bar{x}_j}{s_j}, \tag{1}$$

where: x_{ij} – the factor's value, $\bar{x}_j$ – the factor's value, S_j – the factor's standard deviation. Ultimately, the calculation was based on the hierarchical taxonomic measure of development proposed by Hellwig (1968):

$$m_i = 1 - \frac{d_{i0}}{d_0}, \quad (i = 1,2,\dots,n) \tag{2}$$

where: $\boldsymbol{d_{i0}} = \sqrt{\sum_{j=1}^{m}\left(\boldsymbol{z_{ij}} - \boldsymbol{z_{0j}}\right)^2}$ – the Euclidean distance between the *i*-th observation from the pattern of development, $\boldsymbol{d_0} = \sqrt{\sum_{j=1}^{m}\left(\boldsymbol{z_{0j}} - \boldsymbol{z_{-0j}}\right)^2}$ – the Euclidean distance between the pattern $\boldsymbol{z_{0j}}$ and $\boldsymbol{z_{-0j}}$ anti-pattern of development, which are implemented in the multivariant analysis in accordance with the character of each individual variable. The method considers the stimulative or destimulative impact of a characteristic for the overall level of the mi taxonomic measure. In the case of model values, when a given factor has been defined as stimulating for the general level of a complex phenomenon, its maximum value is adopted as $\boldsymbol{z_{0j}}$; in the case of a destimulating effect, by contrast, it is adopted as its minimum value. For anti-model values $\boldsymbol{z_{-0j}}$ the completely opposite situation occurs, and the minimum value for the stimulating factor is accepted, and the maximum value in the case of a destimulant (Suchecki, 2010).

The combined procedures make it possible to determine two objects (most often hypothetical) that represent the best and the worst possible alternatives. The pattern and anti-pattern perform two functions in the analysis. The first one is to assess the individual level of the phenomenon in the given *i*-th object; the second one is to provide a certain standardisation point of the size of the phenomenon.

It is known from the properties of the taxonomic measure that the higher the level of a complex phenomenon, the higher the level of the mi development measure. The measure assumes values in the range [0,1]; for the model, it takes the value of unity, and for the anti-model, it takes the zero value.

Due to the comparability of objects ordered inside the measure, it becomes intuitive to interpret, especially for assessing the development or deterioration in the quality of life or the socio-economic development in the NUTS-2 regions. The use of the uniform set of diagnostics features makes it possible to compare the tendencies of changes in the levels of the two indices for local populations for two periods (or moments). Therefore, it is possible to introduce a graphic summary of the numerical results based on the formula of a relative increase (rate of change), calculated as follows (Hydzik, 2012):

$$\boldsymbol{rLQI}_{\frac{t}{t-1}} = \frac{\boldsymbol{LQI_t - LQI_{t-1}}}{\boldsymbol{LQI_{t-1}}}, \boldsymbol{rSE}_{\frac{t}{t-1}} = \frac{\boldsymbol{SE_t - SE_{t-1}}}{\boldsymbol{SE_{t-1}}} \tag{3}$$

where: $\boldsymbol{rLQI}_{\frac{t}{t-1}}$ – regional rate of change of the mi indicator of life quality, and $\boldsymbol{rSE}_{\frac{t}{t-1}}$ – the regional rate of change of the mi indicator of socio-economic development.

The indications that result from the change rates allowed for an additional interpretation of observed tendencies, indicating regions of improvement and/or deterioration of the development of the analysed phenomena. This comparison also allowed for the assessment of the pace of the changes noted, which is important for the implementation of *EU* policy goals and for discussions about equalising opportunities for regions considered to be weakly developed compared to Western Europe or Scandinavian countries.

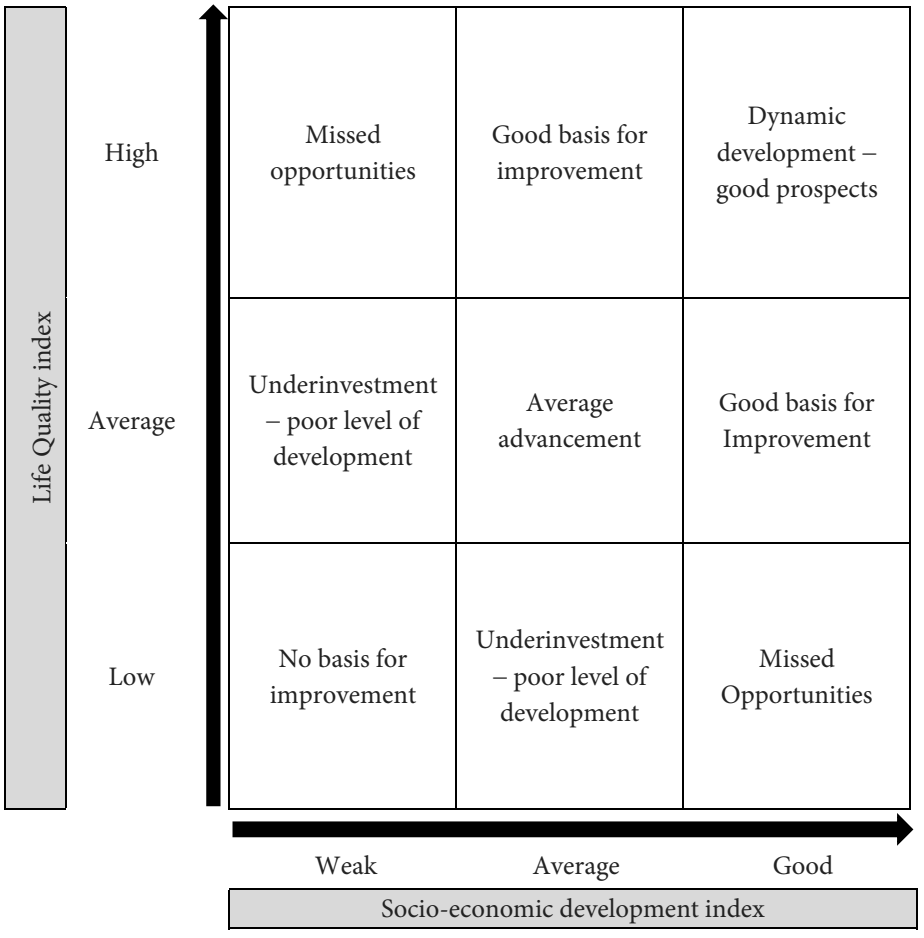

Figure 1. Development matrix design

Source: based on Jewczak and Korczak (2020).

The overall summary of the analysis carried out in the paper is based on the construction of a proposed development matrix, which is a classification technique that makes it possible to position two objects in a two-dimensional format that describes the relationship between two analysed phenomena, here: quality of life and the socio-economic development (Jewczak and Korczak, 2020).

The development matrix consists of rows and columns that present the level of individual features that differentiate the positions of objects on a scale from 0 to 1. The matrix is divided into nine equal fields, each representing the characteristics of the phenomena's development level, and they should be interpreted in accordance with the strategic field definition. From the interpretational perspective, the scatter plot design has the obvious advantage, which is connected with indicating the relationship between phenomena, the intensity and, when making temporal comparisons, indicating tendencies of change.

3. Empirical analysis results for *EU* NUTS-2 regions

To establish the relationship between the quality of life of inhabitants and the situation of socio-economic development of NUTS-2 regions in the selected *EU* countries, the quality of life *LQI* and socio-economic development *SE* indices were assessed. The spatio-temporal analysis for 2004 and 2018 adopted the reference object approach and further comparison in the ordered development matrix. On this basis, spatial objects were classified as illustrated in Fig. 2. The cloud image of the analysed objects in the 2004 development matrix allowed us to illustrate positive trends in quality of life. Meanwhile, the image for 2018 is more dispersed, and a significant part of the regions shifted to more positive strategic fields of greater development.

The impact of the socio-economic development changes was less explicit. As the research tool indicated, for both of the analysed periods, most of the spatial units were counted as objects with "no basis for improvement". Only one of the objects (the Île-de-France region) recorded an improvement in *SE* development in 2018 compared to 2014, moving to an average level. In both time points, the best situation in terms of quality of life and socio-economic development was recorded in the Swedish East Middle region, as shown by the highest coordinate in the development matrix.

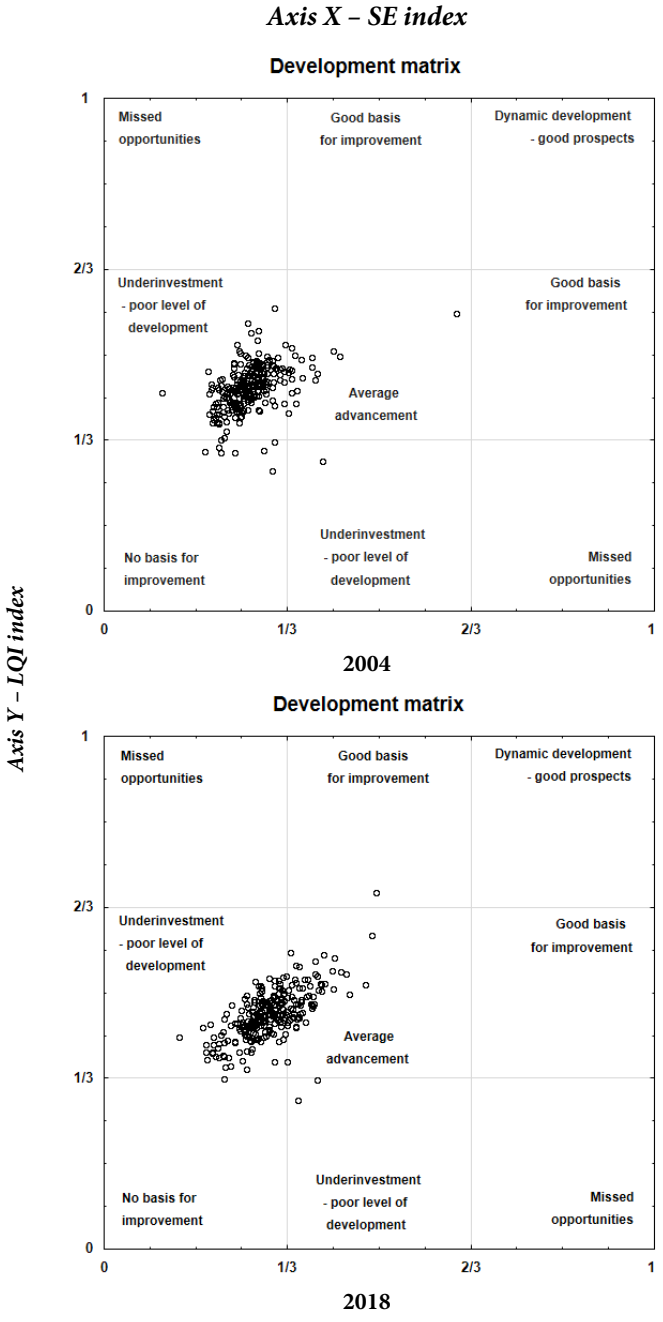

Figure 2. Results of the development matrices in 2004 and 2018

Source: developed by the Authors based on EUROSTAT, *OECD* and local *CSO*'s *LFS* data.

From the properties of the proposed analytical tool of the development matrix and the positioning of individual strategic fields, it follows quite intuitively that the closer the object is to the origin of the coordinate system, the worse the situation of the object is, i.e. "no basis for improvement". The objects' movement over time towards strategic fields of higher values of complex phenomena should be assessed as positive changes that result from the improvement of one or both phenomena simultaneously in the direction of the (1,1) coordinate. Additionally, by analysing the shape of the cloud image of the distribution of points in the scatterplot in the development matrix, it is also possible to identify the relationship that occurs between the analysed phenomena.

In 2004, the vast majority of spatial objects were characterised by an average level of intensity in the quality of life and a low level of socio-economic development. The result of such a two-dimensional classification is the concentration of coordinates within the "underinvestment and poor level of development" field. One object with the opposite relationship between the quality of life and socio-economic development was the Lithuania region. This unit recorded an average socio-economic development level with a low intensity level of the quality of life. The best positioned spatial unit in 2004 was Île de France, which noted the highest level of socio-economic development and quality of life; however, the intensity of the phenomena is considered to be an "average advancement".

When analysing the *EU* NUTS-2 regions in the final year of the analysis, it is possible to conclude that the situation of the objects generally improved over time. There was only one spatial unit (Lithuania) which was classified as "no basis for improvement" – it was also the worse-positioned object in 2004. Most objects were classified as "poor level of development", characterised by an average level of quality of life and low levels of socio-economic development. By reversing the direction of the analysis, only two objects of "poor level of development" were identified (Pays de la Loire, Calabria), which were characterised by an average level of socio-economic development and a low intensity of quality of life.

In 2018, objects indicating an "average advancement" in both quality of life and socio-economic development constituted quite a large group (more numerous than in 2004). However, the distribution of the coordinates clearly indicates that the position of the NUTS-2 objects is more stimulated by the intensity of the quality of life than by the socio-economic development. In the analysed period, only one object with a "good basis for improvement" was specified, and its position results from the noted high level of quality of life. Again, this was the region of Île de France.

By analysing the overall perception of development, a positive tendency should be emphasised, as a significant number of regions mostly positioned in the field of "underinvestment – poor level of development" in 2004 shifted towards fields of

better assessment in 2018. The direction of the tendency of the frequency distribution of the measures indicated that the observable changes should be perceived as favourable – pushing objects towards the strategic field of an average level of advancement.

When comparing the cloud images for the differentiation of distribution of points in the development matrix scatterplots, it can be easily noticed that the advancement of the condition of NUTS-2 regions is the result of changes in their levels of socio-economic development more than an improvement in the quality of life. However, the analysis demonstrated that the life quality also advanced.

This relationship between quality of life and socioeconomic development showed a positive empowerment relationship with the passage of time. In 2004, the strength of this association was established by the Rxy Spearman's coefficient at (+0.503) level and advanced in 2018 to (+0.642) – this relationship was significant at p <0.05.

The research indicated that there was an increase in the overall intensity of the life quality – this is noticeable in the extreme, minimum and maximum values of the complex phenomena. The highest levels of the recorded quality of life were observed in the Scandinavian area and Western Europe (Fig. 3).

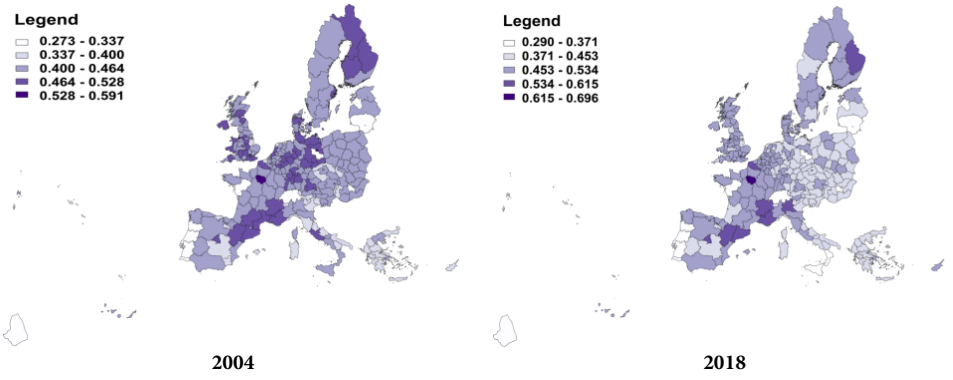

Figure 3. Values of synthetic measures for *Quality of Life* in 2004 and 2018

Source: developed by the Authors based on EUROSTAT, *OECD* and local *CSO's LFS* data.

This could be summarised by the statement that the regions located within the borders of the founding members of the *EU* were characterised by a high quality of life. These tendencies were convergent for both periods; however, it is clearly visible that the quality of life deteriorated in the regions of the United Kingdom, Germany, for most regions of Poland, Slovakia, the Czech Republic, and Romania, as well as the Balkan area.

In contrast to the LQ indicators, for the socio-economic development index, the intensity of the phenomenon decreased between 2004 and 2018. Again, this could be summarised by the extreme level of the maximum value of the synthetic measures (Fig. 4). The spatial arrangement in the selected periods is quite convergent, and the improvement in the intensity of the spatial distribution mostly concerned objects that noted a higher level in the first place.

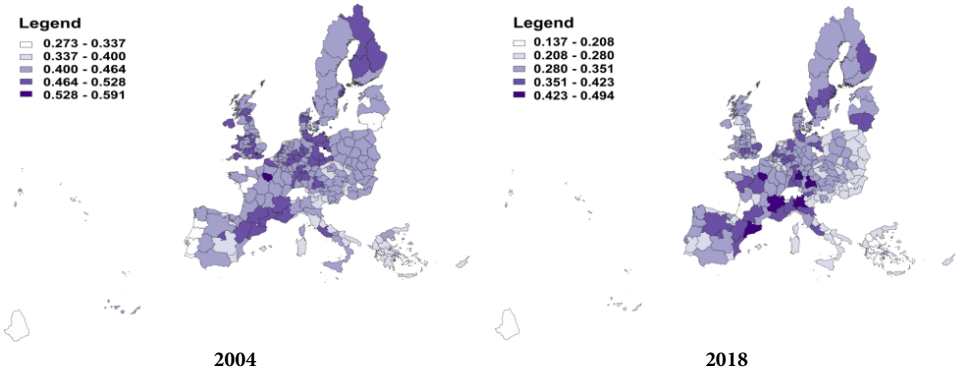

Figure 4. Values of synthetic measures for socio-economic development in 2004 and 2018
Source: developed by the Authors based on EUROSTAT, *OECD* and local *CSO*'s *LFS* data.

This situation may suggest a general improvement in the socio-economic situation in most of the NUTS-2 regions (which was previously observed by the greater dispersion within the strategic fields in the development matrix). The socio-economic development level improved in regions of the Iberian peninsula, France and Northern Italy, whereas in Poland, the level of socio-economic development for most of the analysed spatial units in 2018 was assessed at a lower intensity level compared to 2004. A positive conclusion of the analysis is the improvement in the situation of the Lithuania region, which advanced to a higher intensity group of socio-economic development in 2018. However, it should be remembered that this region was assessed as the worst for quality of life in both periods.

4. Conclusions

The biggest advantage of the research is that the scientific analysis covered data at the regional level, while most studies focus only on quality of life or socio-economic development at the macro level. It is hard to find studies that consider differences at the regional or even local level that do not focus on the internal differentiation within national borders. The study carried out in the article provided information on the quality of life and socio-economic development in 262 NUTS-2 regions in the *EU*

Member States. The research goal was achieved by measuring the improvement in the quality of life and the socio-economic development using a taxonomic measure of development. This allowed not only to evaluate each of the i-th objects in relation to the reference object, but also to obtain results taking into account the intensity of variability of phenomena. The proposed procedure solves the problem of the impact of individual components that were taken into account when constructing the indices to reflect more accurately both the quality of life and the socio-economic situation of the regions. However, due to the configuration of the assessed measures (although they are based on reliable information sourced in official registers), the resulting quality of life and socio-economic indicators should be treated as an information point. This is due to the limitations related to data availability at the lower spatial data aggregation level.

One of the positive conclusions from the study is that the relationship between the two measures of *LQ* and *SE* was significant, in terms of non-parametrical Spearman's correlation coefficient – for 2004, the R_{xy} amounted to 0.503 (significant at p <0.05), while in 2018, the R_{xy} was 0.642 (also significant). This connection indicates that the relationship between the phenomena is positive and strengthens over time. Considering the results based on the applied development matrices, the conclusion (supported by the graphical presentation of change rate tendencies (Fig. 5)) indicates that the arrangement of objects in the coordinate system shifted towards a more positive assessment, defined as an "average advancement" in both phenomena.

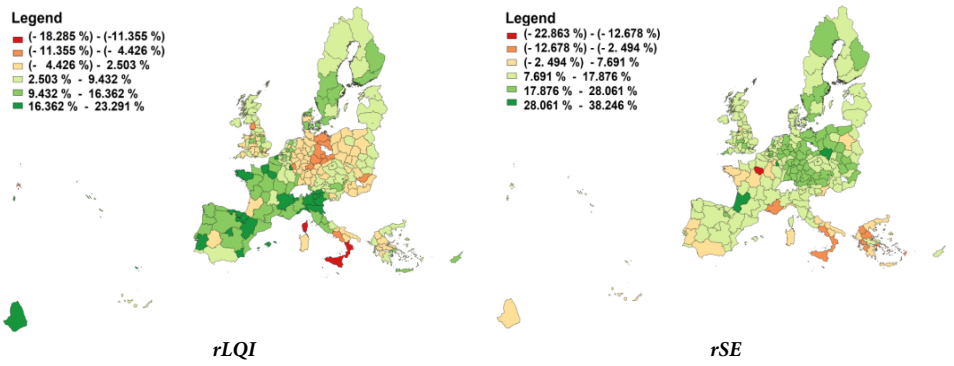

Figure 5. Rates of change in *LQI* and *SE* measures

Source: developed by Authors based on EUROSTAT, *OECD* and local CSO's *LFS* data.

For the life quality (*rLQI*), in particular, the improvement was observed within countries considered to be "more developed", with the exception of Germany. The graphics of change rates also indicate that for most of the analysed regions, there was a positive change in terms of socio-economic development (*rSE*). Again looking at the

German NUTS-2 units, although they recorded an unfavourable change in terms of the quality of life, there was an improvement in socio-economic development.

To summarise the results of the multivariate analysis, there was a positive relationship between the quality of life and socio-economic development, which strengthened over the analysed period. One should evaluate positively the regions that recorded favourable change rates in the levels of synthetic measures, which is consistent with the previously noted trends. For most of the NUTS-2 areas, the quality of life improved, except for the areas of Germany and Poland and neighbouring countries, which share a similar socio-economic background. For the regions identified with negative (unfavourable) rates of change, although the changes were not spectacularly low/high, these results might be a consequence of their migration policies of opening borders to residents of the countries admitted to the *EU* in the analysed period.

The same may be true for some regions of France, Italy and Germany, which are seen as a constant target of migration movements in Europe. Changes in the levels of socio-economic development, which accelerated in Central and Eastern Europe, should be assessed positively, with simultaneous downward trends recorded in the regions of the "old Union" countries. However, this finding may support the previously-mentioned concept of underdeveloped countries catching up to highly developed countries rather than it being the case that, overall, the quality of life or socio-economic development in well-developed economies deteriorated significantly.

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