

Regional Development of Romania, Measured with a Multidimensional PEESH Index (2000 – 2019)

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Extended Abstract

The study of socio-economic development in Central and Eastern European countries has come into the scientific spotlight especially following the EU integration since the 2000s. Romania, along with Bulgaria, had a particular political and socio-economic situation, which resulted in the postponement of the accession request in 2004. Eventually, the accession occurred in 2007, with some safeguard clauses. Therefore, the development of the country and, more specifically, the evolution of Romania's development in territorial profile starting with the 2000s is of particular interest, both from a methodological and an empirical point of view. The country registered an intense economic growth, and a consequent catching up with the EU average development level, from 23% in 2000 to 72% in 2020, measured in GDP/capita (PPP), where EU-27=100 (Benedek et al., 2021). The reverse of this positive development is the intense increase of sub-national inequalities, the socio-economic development being polarised by Bucharest, the capital city and a few regional urban core areas (Timis, Cluj, Ilfov, Sibiu), Romania being one of the most unequal countries of the EU (Benedek and Lembcke, 2017). There is a lack of knowledge regarding the factors determining this development pattern, and there is also a lack of proper measurement instruments that would enable evaluating this complex picture. Against this background, the objectives of this research can be formulated as follows:

(1) To construct a multidimensional index for measuring socio-economic development in Romania in territorial profile, which is complex enough not to depend on the variation of one or more simple development indicators. Also, this multidimensional index should integrate the previous national and international experiences on multidimensional indices for similar purposes. Thus, this index should be relevant and valid for a longer period of time.

(2) To study the evolution of NUTS3 territorial differences and inequalities in Romania, by development dimension, with special reference to the changes that have occurred over time, between the years 2000 and 2019.

(3) To identify the factors that have led to the more accelerated development of some territorial areas compared to others.

Why a new multidimensional index for measuring socio-economic development in regional perspective?

The Romanian composite indices, developed earlier, in particular by Sandu (1999, 2011) and the World Bank team (Teşliuc et al., 2016), did not cover the need to develop a multidimensional composite index for regional development, because the Sandu's 1997 index had a composition of indicators that some of them are not relevant for the years 2010-2020, and the 2011 LHDI and World Bank index (Sandu 2011, Tesliuc et al. 2016) was constructed to measure development at the local level (towns, villages), and not for regional territorial units at NUTS2 or NUTS3 level.

Based on previous research findings, it has been found that the main dimensions of a multidimensional composite index for measuring regional development should include knowledge accumulation, quality of life and underlying health levels of societies (Seth and Villar, 2017, p. 4). Thus, also taking into account the dimensions used and presented previously by Ganegodage et al. (2017) we consider that the five dimensions defined by us are relevant and appropriate both for a regional analysis of development in a Central and Eastern European country, and the selected indicators are also valid for a longer period of time. But the specific selection of the indicators for each dimension (sub-index) was established with the multivariate statistical methods from a larger variable list, which are available in territorial range for a longer series of time. Thus we have not included indicators related to digital literacy and internet use, which are very relevant for the last decade, but less applicable for the 1990's or first years after 2000.

A second important argument is related to the scope of developing multidimensional indicators at various scales, from international to sub-national. In this respect, while for composite indices for studying development differences between countries it is relevant to use dimensions that operationalise political freedom (or the phenomenon of corruption), these dimensions can be considered a constant (and not variable) factor at national level in a given country. There may also be other indicators that do not differ regionally within a country, being nationally regulated (e.g. minimum income, level of social benefits, or number of compulsory classes in education etc.), therefore relevant indices at sub-national level must be different from those that are included at international level. Also, these regional indices must be partially different in various parts of the world, depending on the level of socio-economic development of the countries concerned (illiteracy rate or the prevalence of certain diseases are irrelevant as differentiating indicators in other countries).

For the computing and weighting method of the dimensions of the new composite index, we try to find a methodological way to exclude or minimize any subjectivism mentioned in the presented papers (Periši and Wagner 2015, p. 207; Jongh and Meyer, 2019, p. 267).

Research questions. Starting from the dimensions used by Ganegodage et al. (2017), and from the methodological and content considerations on cultural areas formulated by Sandu (1999, 2011), also considering Jongh and Meyer's (2019) caution and Greco et al. (2019) considerations on subjective weighting, as well as Periši and Wagner's (2015, p. 207) recent findings on the advantages of multidimensional methods, this research tries to answer the following questions:

(1) How and by which dimensions and indicators can we construct a multidimensional index for studying socio-economic development and territorial differences in Romania for both 2000 and 2019 years, given the criticisms of the HDI and other reflections in recent literature on multidimensional composite indexes?

(2) How have Romanian counties differentiated on the basis of a multidimensional development index and by its dimensions, and what changes can be identified in the social and economic field a decade after EU accession, compared to the pre-accession period (2000 - 2019)?

(3) Which of the development factors in the period under analysis (2000-2019) have contributed more to the social and economic development in Romanian counties, and how the differences/inequalities between counties can be delimited from the analysis in this time perspective (2000 – 2019)?

Data and Methodology

In this part of the paper, we present the way of the composite multidimensional index, called PEESH Development Index has been constructed and calculated. Then we briefly describe the statistical methods by which we analysed the results obtained on the basis of the above-mentioned new index. After then, we present the principles of the bivariate and multivariate methods that we have applied to calculate the relationship between the new PEESH Development Index, the sub-indices by dimensions, respectively the growth values of the basic indicators, in order to answer the main research questions of the paper.

The data source used is represented by macrostatistical indicators included in a database, constructed and calculated by the authors. The primary unprocessed data comes from two sources: the INS online database: *TEMPO Online* (for the years 2000 and 2019, for some indicators the latest data was available only for 2018) (NIS, 2021), and the Romanian Population and Housing Censuses from 2002 and 2011 (ratio of population with tertiary education, housing conditions, utilities data) (NIS, 2011). In total, we started from a set of 32 indicators, of which 22 indicators have been selected and included in the constructed composite index. They should satisfy all the requirements of consistency and communality, as will appear below. The list of variables can be seen in Table 1.

Table 1. The variables included in the analysis, grouped in the main dimensions of development, 2019*
Source: INS, own calculations.

*The last available data was from year 2018

**Data from Romanian Census 2011

Sub-index name	Variable name (unit)
Population dynamics	Rate of natural increase (‰)
	Net migration rate (‰)
	Ageing index (%)
	Temporary emigration rate (‰)
Economy and labour market	GDP per capita*
	Net employment ratio – 20-64 years (%)
	People employed in industry (%)
	People employed in services (%)
	Unemployment rate (%)
Education	Tertiary education rate (%)
	Gross school enrolment rate (%)
	Graduation rate of secondary education (%)
Social conditions and housing	Average floor area per person
	Share of households with access to piped water (%)
	Share of households with access to sewage networks (%)**
	Share of households with a kitchen area (%)**
	Share of households with a fixed bath (%)**
	Share of households with a central heating system (%)**
Health and life	Share of physicians per 1000 persons (‰)
	Medical sanitary staff per 1000 persons (‰)
	Share of hospital beds per 1000 persons (‰)
	Life expectancy at birth

The following indicators, although tested in the first phase of the research, were not selected for the composite index, mainly due to the insignificant correlation and communalities: density of population, urban population rate, infant mortality rate, commuting population rate, accessibility to capital city (in km), causes of death (tumours/100000pers, cardiovascular/100000pers), dropout rate (lower secondary), share of employed in ICT/total employment, number of companies/population.

Following the constitution of these sub-indexes as the main dimensions of development, the final multidimensional development index was computed by linear weighting. Subsequent to this, each dimension (sub-index) is weighted, and then aggregated in the final composite index for years 2000 and 2019. The weights were determined using a factor analysis test (PAF method).

To determine the weights for each dimension, we used the PCA method and the scores from the component-matrix employed in the construction of the development Index, which was labelled after the name of the dimensions PEESH Development Index. Thus, the weights were slightly different for the two years, and we did not forced the data to use the same weights in both time horizons (2000, respectively 2019), in order to avoid a subjective approach, as mentioned above (see also Jongh and Meyer, 2019). Based on factor matrix values (scores), we transformed them in percentages so that we can exclude any subjectivity and to obtain a comprehensive measurement.

Results and conclusions

We have identified the main sources of social and economic development,–calculating the differences registered by the value if each core indicator for the years 2000 and 2019 (Table 1).

Table 4. Pearson correlation coefficients between PEESH DI for 2019 and the differential variables, computed for 2000-2019 years change (increase/decrease).

	Differentiation 2000-2019									
	Population		Health		Education		Housing		Economy	
PEESH DI 2019	Net migration	,346*	Physicians	,552**	Tert. education	,915**	Floor	,272	GDP/capita	,868**
	Ageing	-,073	Sanitations	,047	School enrolment	,441**	Water	-,183	Employment	,728**
	Temp. emigration	-,198	Hosp. beds	-,147	Sec. graduation	,369*	Bath	-,047	Ind. employment	-,547**
			Life expect.	,499**			Heating	,326*	Unemployment	-,073
							Sewage	-,090	Serv. employment	,083

* Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01 level (2-tailed).

Source: own calculations. Basic data from NIS (www.insse.ro)

Moreover, we analysed through linear regression the relationship between the increase or decline of the indicators with the PEESH DI for 2019. Based on the correlation coefficients we can see that there are three dimensions along which each indicator correlates strongly with the PEESH DI for 2019. The most significant correlations have been established for the following situations: increase of GDP/capita ($r=0.868$), increase in the education indicator (share of population with tertiary education) ($r=0.915$), increase in the employment rate ($r=0.728$), number of physicians per 1000 pers. ($r=0.552$) and decrease in employment rate in industry ($r=-0.547$). These indicators are strongly associated with the level of multidimensional development (PEESH DI) of counties (see Table 4).

We used a linear regression analysis to determine which of the indicators with increasing values between 2000 and 2019 contributed to the level of socio-economic development measured by the PEESH DI from 2019. Since three variables were removed from the final regression model (*increase in the GDP/capita*, *tertiary education graduation rate* and *change the employment rate in industry sector*) due to multicollinearity, which have anyway a strong

correlation with PEESH DI 2019, with the remaining variables we obtained a model with a very high explanatory power, where the adjusted R^2 is 0.749 (74.9%). Among the dependent variables, the largest effects (measured with standardised Beta coefficients) on the independent variable were achieved by two indicators: the increase of employment rate (0.508), and the change of the gross educational enrolment rate (0.354). Regression analysis brought to the surface an explanatory factor that was not obvious: increase of employment rate in service sector (0.225), which of course became visible after the elimination of the indicator of change the employment rate in industry sector. The increase in the number of physicians per 1000 inhabitants (0.220) and in life expectancy at birth (0.200, see table 5) are also significant.

Table 5. Linear regression coefficients to explain PEESH DI 2019 by changes of the development indicators between 2000 and 2019¹

Independent variables (Differentiation 2000-2019)	B	Standardized Beta Coefficient	Sig.	VIF
(Constant)	-2,425		,005	
Net migration	,019	,146	,272	2,993
Temporary emigration	,006	,086	,351	1,464
School enrolment	,056	,354**	,012	3,112
Secondary graduation	-,002	-,025	,839	2,735
Employment	,044	,508**	,000	1,697
Unemployment	-,020	-,072	,408	1,320
Serv. employment	,053*	,225*	,050	2,924
Floor area/person	,038	,083	,468	2,236
Fixed bath	-,008	-,056	,611	2,088
Physicians	,556	,220*	,041	1,866
Medical sanitary staff	-,007	-,006	,949	1,755
Hosp. beds	-,162	-,151	,245	2,887
Life expectancy	,159	,200*	,050	1,851
Adjusted R^2		0,749		

1. Dependent Variable: INDEX_PEESH_2019

* Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01 level (2-tailed).

Source: own calculations. Basic data from NIS (www.insse.ro)

The analysis of the relationships between the PEESH DI for 2019 and different variables representing the dynamic (increase or decline) of the development indicators between 2000 and 2019 has shown that the increase in GDP/capita, the increase of the employment rate, the decrease of workers' number in industry and the increase of workers' number in services decisively contributed to the level of socio-economic development for 2019 (measured with the PEESH DI). At the same time, the absolutely determinant role of education is again confirmed, both by the increase in the population with tertiary education (the strongest correlation, above 0.9) and the gross enrolment rate in undergraduate education. The improvement in lifestyle and health services is also reflected by the increase in the number of

Our paper has two original contributions to the multidimensional analysis of socio-economic development in Eastern Europe. First, the multidimensional composite index, the *PEESH Development Index*, developed in this paper, comprise 5 sub-indexes as basic dimensions of socio-economic development, with a total number of 22 indicators. The paper

demonstrated that it has a good validity, and it shows similarity with other indexes (Local Human Development Index). In addition, it can be used for different time perspectives, and it is also sufficiently complex to compensate the irregular variation of one or two indicators, an advantage especially evident in comparison with the Human Development Index and its derives.

The methodology of establishing the dimensions of the PEESH DI can be considered an original contribution, given how the paper managed to match the deductive approach with the empirical inductive one, in line with recent literature (Seth and Villar, 2017; Ganegodage et al. 2017; Greco et al. 2019), based on confirmatory factor analysis. The latter allowed us to test the way of grouping of the dimensions in the mass of variables included, as well as the level of compatibility of them. Thus, we defined the main dimensions of the PEESH DI, and calculated a sub-index for each dimension: population dynamics, economy and labour force, education, social conditions and housing, and health and life conditions. The way of inclusion of variables in the dimensions, as well as the combination and weight of dimensions were carried out avoiding the high degree of subjectivism mentioned in the presented literature (Periši and Wagner, 2015, p. 207; Jongh and Meyer, 2019, p. 267), so that the results can be accepted with confidence.

Secondly, the multivariate analysis of socio-economic development between 2000 and 2019 - based on the PEESH DI - has shown that the differentiated increase of the indicators composing the PEESH DI has resulted in a certain restructuring of the development hierarchy of Romania's counties between 2000 and 2019. While the top (positions 1-4) and the bottom (positions 1-5) of the hierarchy show a high stability, in the middle positions we have a higher dynamic. The PEESH Development Index values of the least developed counties have remained at the level of 2000, i.e. – which contradicts the mainstream literature based on GDP/capita calculations – and we cannot confirm a tendency in increasing regional inequalities between the counties. It is remarkable however, the position gains of counties like Ilfov (+13), Bistrita-Nasaud (+11) or Suceava (+9), but also the position losses registered by Mehedinti (-13), Arad, Caras-Severin or Teleorman (each -8). If we look for some common explanations for the opposing tendencies, the multidimensionality of the PEESH DI adds new important facts to the existing knowledge on regionally differentiated socio-economic development. Therefore, the paper also brings evidence to the important role played by the improvement of education and health conditions to the socio-economic development of some semi-peripheral counties. This empirical fact strengthens the idea that development cannot be reduced only on the economic growth, it comprises an important social dimension as well, which includes education, health or housing conditions. On the other hand, according to the paper, counties with higher socio-economic development have a regional economy based on large urban centres, a finding which is line with the existing recent literature (Benedek and Moldovan, 2015; Benedek et al., 2019; Török, 2019). A novel contribution is represented by the highlighting of the suburbanization process as driver of the diffusion of socio-economic development from core areas to former peripheries, the case of county Ilfov being the most relevant one. Also, cultural traditions and geographical position still seems to play a significant role in the socio-economic differentiation of counties: while four urban pole-based counties with high PEESH DI (Timis, Cluj, Sibiu and Brasov) are located close to the western borders, in Transylvania, the rest of the urban pole-based counties with lower PEESH DI levels (Iasi,

Craiova, Bacau, Buzau) are located in the southern and eastern cultural regions of Moldavia and Muntenia. (see Ban, 2014; 2020). It is also notifiable that the vast majority of counties from Transylvania maintained their above average position between 2000 - 2019, although in GDP/capita or life expectancy at birth (thus also in HDI and LHDI) they were overtaken by a number of counties from the southern and eastern part of the country