A MODEL OF ASSESSMENT OF TERRITORIAL DISPARITIES IN THE DEVELOPMENT OF HEALTH CARE SERVICES IN ROMANIA

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Abstract: *Considering the issue of disparities in health care services, we present – as a model of disparity assessment – the model of distribution of health care activities per the eight development regions existing in Romania according to Law 151/1998: 1. North-West; 2. Centre; 3. North-East; 4. South-East; 5. South Muntenia; 6. Bucharest-Ilfov; 7. South-West Oltenia; 8. West*

In Romania, the territorial-administrative structure consists of a regional level (41 districts and the Municipality of Bucharest), corresponding to the NUTS 3 statistical level, and a local level (320 towns and cities, of which 103 municipalities, 2860 communes and 12956 villages). According to Law 151/1998, eight development regions were set up, as "a framework for establishing, implementing and assessing the regional development policy as well as for collecting specific statistical data in accordance with the EUROSTAT rules for the second level of territorial classification, NUTS 2, applied in Europe.

Keywords: Territorial development; Quality of life; Health and Care Services; Welfare economics

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There are disparities between regions in all countries both in the spatial distribution of major determinants of health and in the spatial distribution of available resources for health care services. In literature, the

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economic-social disparities between regions are assessed, directly or indirectly, in relation to several indicators accepted as regulatory measures of what is acceptable or non-acceptable (M. Polese, R. Schearmur, 2005, p.131).

The models of distribution of activities specific to urban areas are used for locating a homogenous function (housing, industry, education, health a.s.o.) in an area pertaining to an urban locality or region, as they enable us to rank territories (in our case study, they are development regions) on the basis of several factors of influence in relation to resources available for carrying out certain activity. Following the classification of regions, we are able, for example, to make recommendations for the management policy and the health policy.

Based on the methodology set for our research, the analysis of the relevant factors of influence was made per four groups (domains) of interest:

- Economic-social development (DES)
- Demographic development (DD)
- Hospital network (RS)
- Medicine distribution network (DM)

For a sectoral analysis of each group of factors, we used primary indicators. The explanation of the cumulated influence of the set of indicators corresponding to each group of factors was based on a linear aggregated indicator. Therefore, regions were ranked by each synthetic indicator.

The aggregated synthetic indicator is determined as a weighted sum of primary indicators (the weights were established by various methods[1], among which the mathematical model of factorial analysis), using SPSS (Statistical Package for Social Sciences), version V19 as computation instrument. To ensure the comparability of data for aggregation, the data were standardized by various methods: in relation to the country average, to the maximum (or minimum) value, scores (of zero average and dispersion 1), or distribution over the interval [0; 110].

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[1] *The most used methods are the following:*

a) the mathematical model; for example, the factorial analysis;
b) the equal weight method;
c) the all-indicator rank average method;
d) analyses by experts.

The statistical method used to identify a small number of components, latent factors, constructions behind primary variables allowed us to use a mathematical model of factorial analysis, similar to the multiple regression equation. Every variable is expressed as a linear combination of factors that are not directly observable.

For example, the hospital bed equipment index (D) can be introduced into a linear model, depending on urban development (U) and quality of life (V),

$D = aU + bV + S$, where S is a specific factor.

But there is a fundamental difference from the regression model, where the linear combination factors are known; here we have dimensions and constructions to be defined in relation to the set of observable variables considered for the model.

If we consider a set of p standardized variables X_i, with n observed values X_{iK}, the model of factorial analysis is a set of p equations:

$$X_i = a_{i1}F_1 + \ldots + a_{iq}F_q + S_1 \quad (1)$$

where: $F_1, \ldots F_q$ are the q factors specific to the set of variables $X_1 \ldots, X_p$, *and* S_i is a factor specific to variable X_i

Initially, the common factors are not known, but they can be estimated in relation to the set of variables (reversed problem):

$$F_j = b_{j1}X_1 + \ldots + b_{jp}X_p \quad (2)$$

Actually, there were five important steps:

Step 1: After the analysis of indicators available in descriptive statistics, we compute the matrix of correlation coefficients to view the interdependence between variables and to select the representative (correlated) variables.

Step 2: Further we determine the main axes for defining the new space of the structure of the causal dependence between the variables analysed. From the maximal set of p factors (where p is the number of variables) we take only the relevant factors (which explain as much as possible the variability of the data set).

Step 3: Following the rotation of factor axes, we apply transformations to render the common factors interpretable and compute the percentage of explanation of total variation (for each factor, and cumulated).

Step 4: For every case (unity of observation and the development region, respectively) we compute scores to achieve ranking.

Step 5: For each region, we set a global index to asses the availability of resources for providing health care services, based on synthetic indicators computed for the four groups of factors.

A. Group 1 – Economic-social development

For this group, we selected a set of 12 available indicators so that the common result should describe the regional economic-social development:

DES 1 – Net average nominal wage earnings
DES 2 – Population density: inhabitants/sq. km
DES 3 – Number of towns and cities (including municipalities)
DES 4 – Number of communes
DES 5 – Number of communes per one town or city
DES 6 – Density of public roads per 100 sq. km
DES 7 – Density of public roads per 100 sq. km (or the weight of modernized roads in all public roads)
DES 8 – Average number of employees per 100 inhabitants
DES 9 – Average number of pensioners per 100 inhabitants
DES 10 – Monthly average pension
DES 11 – Simple total length of water sewer network (km) per 100 inhabitants
DES 12 – GDP per capita

The analysis of the set of indicators regarding the statistical correlation allowed us to identify only 8 indicators that show the sense of the aggregated indicators (it shows significant positive correlations).

By means of the Group 1 aggregated indicator we computed values for each of the eight development regions.

Table 1: "Economic-social development" aggregated indicator

No.	Development region	Group 1	Rank
	North-West	339.8	6
	Centre	350.4	3
	North-East	304.0	8
	South-East	307.4	7
	South-Muntenia	345.1	4
	Bucharest-Ilfov	601.8	1
	South-West Oltenia	341.9	5
	West	364.3	2

We can analyze the region ranking by the synthetic indicator that refers to the economic social development. The Bucharest-Ilfov region stands out, being by far the most developed one, followed by the west and Centre regions. The last two of them are South-East and North-East regions.

B. Group 2 – Demographic development

The demographic factors reflect the structure of the population and the processes that affect it.

The initial set of variables for this group includes 8 indicators:

DD 1 – Weight of urban population (%)

Population weight by age groups:

DD 2 – 0-14 years

DD 3 – 15-49 years

DD 4 – 50-64 years

DD 5 – 65 years and over

DD 6 – Birth rate (number of the live born per 1,000 inhabitants)

DD 7 – Death rate (number of the deceased per 1,000 inhabitants)

DD 8 – General fertility rate (number of the live born from mothers of 15-49 years per 1,000 women of the same age).

Analyzing the matrix of correlation of the eight initially selected factors, we kept only four indicators for the computation of the indicator. On the basis of the Group 2 aggregated indicator we determined the values for each development region.

Table 2: "Demographic development" aggregated indicator

No.	Development region	Group 2	Rank
1.	North-West	117.9	3
2.	Centre	186.59	2
3.	North-East	176.56	4
4.	South-East	150.45	5
5.	South-Muntenia	128.35	7
6.	Bucharest-Ilfov	230.70	1
7.	South-West Oltenia	108.49	8
8.	West	150.41	6

The region ranking by the "Demographic development" synthetic indicator shows a high relative difference between the Bucharest-Ilfov Region ranked the first (230.70) and the South-West Oltenia region ranked

the last (108.49). Among them, two sub-groups of regions stand out for close values of the "demographic development" indicator: 176, 56-186, 59 (North-East, North-West and Centre Regions) and 150, 41-150, 45 (West and South-West Regions).

C. Group 3 – Hospital network

Initially, 12 indicators were selected for Group 3:

- ✓ Number of hospitals per 1,000,000 inhabitants:
  - RS 1 – Total
  - RS 2 – Urban
  - RS 3 – Rural
  - RS 4 – Number of hospital beds per 10,000 inhabitants
- ✓ Number of general medicine surgeries (MG) per 1,000,000 inhabitants:
  - RS 5 – Total
  - RS 6 – Urban
  - RS 7 – Rural
  - RS 8 – Number of specialized surgeries per 10,000 inhabitants
- ✓ Family surgeries:
  - RS 9 – Total
  - RS 10 – Urban
  - RS 11 – Rural
- ✓ RS 12 – Number of physicians per 10,000 inhabitants

The correlation of the twelve variables confirmed positive and significant correlations for only seven indicators, on which the computation of the aggregated indicators for this group was based for ranking the eight regions.

Table 3: "Hospital network" aggregated indicator

No.	Development region	Group 3	Rank
	North-West	323.61	4
	Centre	324.88	3
	North-East	258.13	6
	South-East	256.81	7
	South-Muntenia	229.27	8
	Bucharest-Ilfov	483.87	1
	South-West Oltenia	288.43	5
	West	376.20	2

The "hospital network" synthetic indicator divides the eight regions into four sub-groups:

- the best equipped group: Bucharest-Ilfov Region
- the above-average equipped group: West, Centre and North-West Regions
- the rather good equipped group: South-West Oltenia Region
- the less equipped group: South-Muntenia, South-East and North-East Regions

D. Group 4 – Medicine distribution network

Initially, eight indicators were selected for this group:

- ✓ Number of pharmacies per 10,000 inhabitants
  DM 1 – Total
  DM 2 – Urban
  DM 3 – Rural
- ✓ Number of pharmaceutical outlets per 10,000 inhabitants
  DM 4 – Total
  DM 5 – Urban
  DM 6 – Rural
- ✓ DM 7 – Pharmaceutical warehouses per 10,000 inhabitants (including pharmaceutical outlets)
- ✓ DM 8 – Number of chemists per 10,000 inhabitants

The analysis of the correlation matrix of the eight factors made us keep only five indicators, which showed positive significant correlations. The values of the Group 3 aggregated indicator helped us to rank the eight development regions.

Table 4: "Medicine distribution" aggregated indicator

No.	Development region	Group 4	Rank
1.	North-West	213.87	4
2.	Centre	211.97	5
3.	North-East	210.39	6
4.	South-East	219.61	2
5.	South-Muntenia	203.49	7
6.	Bucharest-Ilfov	283.01	1
7.	South-West Oltenia	201.33	8
8.	West	217.93	3

The "medicine distribution network" synthetic indicator reveals a relatively large gap between the Bucharest-Ilfov Region, ranked first, and the other regions ranked relatively close.

E. Global assessment index of disparities in developing health care services among development regions

The aggregated indicators I1, I2, I3, I4 measuring the reference domains of the model developed in this section – economic-social development, demographic development, hospital network, medicine distribution network – were analyzed by the correlation matrix, and all of them showed positive and strong (significant) correlations.

Table 5: Global indices for assessing resources available for providing health care services by development region

No.	Development region	Global index	Rank
1.	North-West	181.63	4
2.	Centre	185.81	3
3.	North-East	165.27	5
4.	South-East	159.46	6
5.	South-Muntenia	149.90	8
6.	Bucharest-Ilfov	297.76	1
7.	South-West Oltenia	152.19	7
8.	West	185.97	2

The global indices for assessing resources available for providing health care services discriminate territorially better than the indices of each group and show smaller variation amplitude: 297.76-149.90=147.86

The region typology includes three types:

- ✓ Large: Bucharest-Ilfov
- ✓ Medium: West, Centre, North-West
- ✓ Small: North-East, South-East, South-West Oltenia, South Muntenia

On a four-item scale, we find four homogenous types of development regions:

- ✓ Very large: Bucharest-Ilfov
- ✓ Large: West, Centre, North-West
- ✓ Small: North-East, South-East
- ✓ Very Small: South-West Oltenia, South Muntenia

In Table 6 we find a comparison between the global index for assessing resources available for providing health care services (I) and specific indices: Hospital networks (I3) and Medicine distribution network (I4).

Table 6: Global assessing indices and the two indices specific to the hospital network by development regions

No.	Development region	I	I 3	I 4
	North-West	4	4	4
	Centre	3	3	5
	North-East	5	6	6
	South-East	6	7	2
	South-Muntenia	8	8	7
	Bucharest-Ilfov	1	1	1
	South-West Oltenia	7	5	8
	West	2	2	3

The comparison between the global index for assessing resources available for providing health care services and the two indices reveals stability or rank changes but on close places. An exception is the South-East Region, ranked the sixth by the global assessing index and the second by the medicine distribution network index. Analyzing the types set by grouping, the belonging to a type is preserved.

In conclusion, the global index for assessing resources available for providing health care services reproduces quite well the ranking by the hospital network indicator and the medicine distribution indicator. But the cumulative impact of the influence of the explanatory factors of territorial disparities also reveals a polarisation phenomenon, a concept properly defined by the spatial economy theory which shows a "centre-periphery" relation. In a region, polarisation takes place between the regional centre (district capital covering the area of the whole region) and "periphery" localities (including towns) of the districts that form a region. But for planning the health system we have to consider both the regional aspects and those regarding the objective existence of some geographic barriers and the poor transport infrastructure. For example, the Buzău District and the Vrancea District are closer to such regional centres (Bucharest, Iaşi) than its own regional centre (Constanţa).

Therefore, it is worth pointing out that our typology is also confirmed by other typologies found in specialized studies, which allows us to consider our model valid both theoretically and practically. For example, D. Sandu (2013) coordinated a research study on the impact of territorial disparities for the social-economic foundation of the administrative regionalization of Romania. The aggregated ranking indicators for analyzing regional disparities was the "social development index" (IDSL), established by aggregation of seven primary indicators in accordance with a factorial score:

1) Education stock at the locality level
2) Average age of the population over 14 years
3) Life expectancy at birth
4) Number of cars per 1,000 inhabitants
5) Average area of a home
6) Gas consumption per capita
7) An index significant for multiple components of the community capital, i.e. 10 categories of urban and rural localities by number of dwellers.

The district were grouped by the IDSL size into five categories:

1. **Poor districts** (IDSL between 50 and 60[1]): Botoşani, Vaslui, Ialomiţa, Călăraşi, Giurgiu, Teleorman, Olt, Mehedinţi;
2. **Medium-low developed districts** (IDSL between 61 and 65): Suceava, Neamţ, Bacău, Vrancea, Buzău, Tulcea, Dâmboviţa, Vâlcea, Sălaj;
3. **Medium developed districts** (IDSL between 66 and 69): Iaşi, Galaţi, Brăila, Gorj, Dolj, Caraş-Severin, Alba, Bistriţa-Năsăud, Bihor, Harghita, Covasna;
4. **Medium-high developed districts** (IDSL between 70 and 74): Constanţa, Prahova, Argeş, Hunedoara, Arad, Satu Mare, Maramureş, Mureş;
5. **Developed districts** (IDSL between 81 and 84): Bucharest-Ilfov, Braşov, Sibiu, Cluj, Timiş.

In Table 7 we present the ranking of development regions in Romania, based on our model and the structure by types of districts specific to each region in accordance with IDSL (D. Sandu, 2013, p.12).

[1] *Figures represent average values of the IDSL per district localities weighted by their population.*

Table 7. Correlation between the development region ranking by global indices for assessing resources available for providing health care services and the structure of districts for each region, depending on the type of district, by the IDSL size

Development region	Ranking by the index for assessing resources available for providing health care services	Type of district by IDSL size
North-West	4	1 type-2 district 2 type-3 districts 2 type-4 districts 1 type-5 district
Centre	3	3 type-3 districts 1 type-4 district 2 type-5 districts
North-East	5	2 type-1 districts 3 type-2 districts 1 type-3 district
South-East	6	3 type-1 districts 2 type-3 districts 1 type-4 district
South Muntenia	8	4 type-1 districts 1 type-2 district 2 type-4 districts
Bucharest-Ilfov	1	Type-5 region
South-West Oltenia	7	2 type-1 districts 1 type-2 district 2 type-3 districts
West	2	

Note:

Type-1 district: poor district;
Type-2 district: medium-low developed district;
Type-3 district: medium developed district;
Type-4 district: medium-high developed district;
Type-5 district: developed district;

The correlative analysis of the two disparity assessment models is even more relevant to the polarisation between the regions on the last two places – South Muntenia and South-West Oltenia – in which we find poor and medium-low developed districts and the regions on the second and third places (except for the Bucharest-Ilfov Region, ranked the first, owing to the special position of the capital city), i.e. West and Centre Regions, which

predominantly contain type-4 and type-5 (medium-high developed and developed) districts.

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