



DIE ERDE

Journal of the  
Geographical Society  
of Berlin

Vol. 144, No. 1 · Research article

# In search of a relevant index measuring territorial disparities in a transition country. Romania as a case study

Ioan Ianoș<sup>1</sup>, Alexandru-Ionuț Petrișor<sup>2</sup>, Daniela Zamfir<sup>1</sup>, Andreea-Loreta Cercleux<sup>1</sup>,  
Ilinca-Valentina Stoica<sup>1</sup>, Cristian Tălângă<sup>1</sup>

<sup>1</sup> The Interdisciplinary Centre of Advanced Research on Territorial Dynamics, University of Bucharest, Bd. Regina Elisabeta nr. 4-12, sect. 5, cod 030018, Bucharest, Romania, office@cicadit.ro

<sup>2</sup> School of Urbanism, Ion Mincu University of Architecture and Urbanism, str. Academiei nr. 18-20, sector 1, cod 010014, Bucharest, Romania, a.i.petrisor@gmail.com

Manuscript submitted: 24 January 2011 / Accepted for publication: 18 January 2013 / Published online: 2 September 2013

## Abstract

Countries in transition to a market economy exhibit increased regional disparities, leading to differences in the standard of life and in the chances of the population to benefit from the radical socio-economic and political changes. Our aim in this article is to find an index other than the gross domestic product, and maybe a synthetic one, capable of measuring territorial imbalances. In search of such an index, we considered 17 indicators to be relevant and applied these to the 41 Romanian counties. The results indicate that territorial disparities in a transition country with a large rural population can be measured by an aggregate index essentially formed by the gross domestic product, the number of inhabitants per room, and the rate of school dropouts.

## Zusammenfassung

Transformationsländer, die sich auf dem Weg zu einer marktwirtschaftlichen Ordnung befinden, weisen verstärkte regionale Disparitäten auf, die zu Unterschieden im Lebensstandard führen sowie in den Chancen der Bevölkerung, von den grundlegenden sozioökonomischen und politischen Veränderungen zu profitieren. Unser Ziel in diesem Beitrag ist es, einen Index zu finden, der – anders als das Bruttoinlandsprodukt – eventuell auch als synthetischer Index in der Lage ist, räumliche Ungleichgewichte zu messen. Auf der Suche nach einem solchen Index haben wir 17 Indikatoren als relevant ausgewählt und diese auf die 41 Kreise Rumäniens angewandt. Die Ergebnisse zeigen, dass räumliche Disparitäten in einem Transformationsland mit einem hohen Anteil an ländlicher Bevölkerung durch einen aggregierten Index gemessen werden können, der sich im Wesentlichen aus dem Bruttoinlandsprodukt, der Zahl der Bewohner pro Zimmer und dem Anteil der Schulabgänger ohne Abschluss zusammensetzt.

**Keywords** Regional disparities; transition country; aggregate index; Drane-Aldrich-Creanga test, Romania

Ianoș, Ioan, Alexandru-Ionuț Petrișor, Daniela Zamfir, Andreea-Loreta Cercleux, Ilinca-Valentina Stoica and Cristian Tălângă: In search of a relevant index measuring territorial disparities in a transition country. Romania as a case study – DIE ERDE 144 (1): 69-81



DOI: 10.12854/erde-144-5

### 1. Introduction: spatial disparities and regional science

Territorial development constitutes an important research issue for economists, geographers, sociologists, spatial planners and other specialists trying to explain the existence of differences between one place and another, between one region and another, or between one country and another. Between the two world wars, but especially after 1945, following the evolution of territorial economic processes, several theories were brought up, and their implementation translated into distinct political options and eventually into beneficial results.

Taking into account the need to foster territorial development after WWII, a first theory, called “big push”, was developed by *Paul Rosenstein-Rodan* (1943) and adjusted and modified by *Francois Perroux* (1955), who phrased it the “growth poles” theory. Conceiving territorial development as a succession of imbalances, *Alfred Hirschman* (1958) formulated the “theory of unbalanced growth” according to which industrialisation, as a strategy to diminish territorial gaps, had clear limits and that it was more important to use mechanisms generating and focusing human energies towards precise targets. An initial imbalance of an activity determines important connected effects up and down the urban hierarchy. *Gunnar Myrdal* (1963) proved that the analysis of development could not be based on economic variables alone, but had to rely on non-economic variables, too. Consequently, regional growth processes were perceived by *Myrdal* as the result of circular causal and cumulative processes. *Allan Pred* (1973) added an important contribution by explaining the unequal growth of cities through the effects of, among others, the importance of clustered economic activities, innovation, and the permanent

exchange of information between cities within a certain hierarchical structure. The last decade of the 20th century saw a reconsideration of economic geography, especially through *Paul Krugman’s* works (*Krugman* 1995). In essence, his theory suggests that the initial cause of growth is of little importance, while the “path dependence” becomes decisive in territorial economic development (see also *Peet and Hartwick* 2009).

Countries in transition from a centralised to a market economy experience paradoxical phenomena; theoretically, the decline of some activities should go hand in hand with the emergence of others, but in practice, there is an important disparity: while previous economies disintegrate almost explosively, the new ones are built slowly, often unable to keep up with the pace of destruction of the former institutions and processes (*Ianoş and Heller* 2006). The most direct territorial answer to these changes is the growth of territorial imbalances, despite governments’ efforts to reduce them. Some see regional development and the consequent reduction of imbalances as processes that can be controlled through the tax system (*Suntsova* 2012). The analysis of Romania’s situation, as a case study for the transition from an over-centralised economy to a new type of economy, can provide important information on the short-term measurement of territorial disparities. After a period when rich regions became richer and poorer regions poorer, the introduction of indicators for the measurement of development levels appears to be a necessity. With this aim in mind, this study attempts to search the most relevant indicators from a set of generally possible, i.e. available, indicators.

At this point, a terminological clarification is important: Throughout the paper, (i) an *indicator* represents a variable describing a relevant demographic, economic, infrastructural or quality of life dimension;



Fig. 1 Counties, development regions (a) and historical provinces (b) of Romania

Tab. 1 GDP per capita in Romania and the regions, 1994-2005

|                 | 1994<br>[US\$] | 1999<br>[US\$] | 2005<br>[US\$] | Absolute<br>change<br>1994-2005<br>[US\$] | Absolute<br>change<br>1999-2005<br>[US\$] | Share of<br>1999-2005<br>growth in<br>1994-2005<br>growth<br>[%] |
|-----------------|----------------|----------------|----------------|---|---|--|
| North-East      | 1,130          | 1,172          | 3,128          | 1,998                                     | 1,956                                     | 97,9   |
| South-East      | 1,276          | 1,470          | 3,991          | 2,715                                     | 2,521                                     | 92,9   |
| South           | 1,266          | 1,321          | 3,744          | 2,478                                     | 2,423                                     | 97,8   |
| South-West      | 1,246          | 1,423          | 3,590          | 2,344                                     | 2,167                                     | 92,5   |
| West            | 1,398          | 1,830          | 5,135          | 3,737                                     | 3,305                                     | 88,4   |
| North-West      | 1,326          | 1,522          | 4,341          | 3,015                                     | 2,819                                     | 93,5   |
| Centre          | 1,383          | 1,695          | 4,700          | 3,317                                     | 3,005                                     | 90,6   |
| Bucharest-Ilfov | 1,729          | 2,706          | 9,722          | 7,993                                     | 7,016                                     | 87,8   |
| <b>Romania</b>  | <b>1,324</b>   | <b>1,585</b>   | <b>4,574</b>   | <b>3,250</b>                              | <b>2,989</b>                              | <b>92,0</b>  |

Source: Data computed based on the National Report on Human Development 1996, and Romanian Statistical Yearbook 2007.

(ii) an *index* represents a mathematical construct resulting from the aggregation of several indicators.

## 2. Changing spatial and sectoral patterns in Romania

The spatial projection of socio-economic change over the last one and a half centuries indicates a cyclical evolution in territorial development, with periods of increase and decrease of the gaps between the large regions of the country (*Fig. 1*):

- i) an initial period of quasi-uniform development, perturbed by the first industrialisation processes in the 19th and early 20th centuries (*Tufescu 1974*), with, above all, exploitation and processing of natural resources, promoting two counties: Prahova (oil production and refining) and Hunedoara (coal and steel);
- ii) a second period (between WWI and WWII) which was dominated by an unequal development due to different speeds in the evolution of industrial activities in the regions; Bucharest, Transylvania and Banat (*Fig. 1b*) experienced an explosive growth, which introduced the first gaps between these regions and others such as Moldova, Oltenia, Southern Muntenia and Dobrogea which remained largely rural;
- iii) a third period which was characterised by the reduction of gaps due to territorial socio-economic homogenisation processes (except for a five-year expansion during the initial transition period) – a specific feature of totalitarian communism which

lasted for approximately four decades in Romania; using industrialisation as the decisive instrument able to reduce territorial imbalances (*Popescu 2000*) through the accelerated development rhythm in rural areas, the communist regime obtained some results in balanced regional development;

- iv) a fourth period (post-communist, mainly after 1995) has been marked by accentuated territorial gaps; the spatial pattern has changed in such a way that gaps between the western and the eastern part of the country have deepened as well as those between Bucharest and the rest of the country (more than 60 % of foreign investment in the first post-communist decade were located in the capital); in this period the policies promoted during communism, with an extensive industrialisation as the tool for lowering territorial imbalances in the long term, proved unsustainable in the long run; consequently, after 1995, with massive de-industrialisation and resumed tertiarisation, the uneven regional development process increased (*Antonescu 2003*). In addition, however, starting with 2005, a slight trend to shift gaps from the regional to the intra-regional scale has been noticed.

This alternating development with increasing and decreasing territorial imbalances confirms the spatial theories according to which any development should be based on the existence of territorial gaps (*Hirschman 1958*). These gaps cause disruptions of symmetry during the regional development process, and the final result is a spiral evolution of the regions, similar to the cycle dynamics of a strongly anthropogenic territorial system (*Ianoş et al. 2011*).

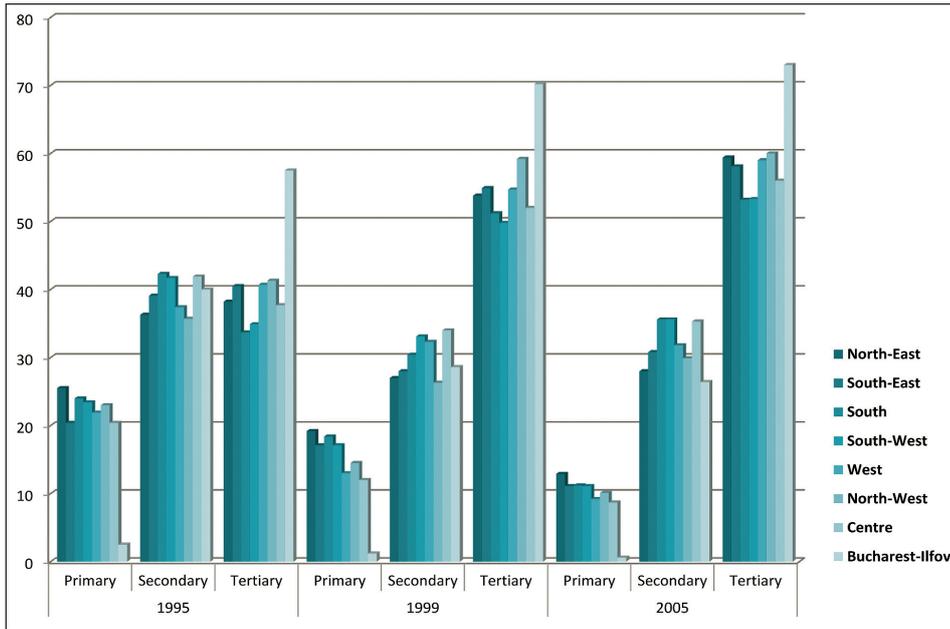


Fig. 2 Contribution of the economic sectors to GDP in the Romanian regions, 1995-2005 (%); source: data computed based on the Romanian Statistical Yearbook 2007

In order to demonstrate the dimensions of the territorial imbalance dynamics, a summary analysis was based on the comparison of the GDP figures in 1994, 1999 and 2005 (Ianoş 2006). GDP per capita increased nationwide during 1994-2005 from \$ 1,324 to \$ 4,574, i.e. by \$ 3,250 (Tab. 1), the rise was especially dramatic after 1999, with roughly 92 % occurring in those latter years. The greatest increases were noticed in the region Bucharest-Ilfov, followed by West and Centre, whereas the smallest growth was observed in the North-Eastern region.

Theoretically, effects of the adoption of the Law on Regional Development in 1998, followed by the immediate implementation of new regional development policies, should be noticed in the figures (Antonescu 2003). However, the analysis shows the reverse effect: In front of the general background of previous growth, GDP increased at a higher rate in rich regions (see also Gurău-Nica 2002). The comparison between the Western region and the North-Eastern region (see above) confirms this finding. Both relative and absolute growth are not in favour of Romania's North-Eastern region, known as the poorest not only at the country but also at EU level. While the difference in relative growth between the two regions is relatively small, the difference in absolute terms is much more marked: Between 1999 and 2005 it increased from \$ 658 to \$ 2,007. In other words, the West region inhabitant has become "richer" by \$ 1,349 than his/her counterpart in the North-East.

An analysis of how economic sectors contribute to GDP formation also demonstrates the existence of dif-

ferences between the country's rich and poor regions (Fig. 2). The general trend shows a decrease of the primary sector and a gradual increase of tertiary activities. In all regions, the tertiary sector grew significantly during 1995-1999, compared to the following period (until 2005). In the wealthier regions (Bucharest and West), the secondary sector shows a decreasing trend for all periods, while in the other regions the share of the secondary sector dropped during 1995-1999, but grew again during the next period. This observation expresses a re-launch of industrial activities after 2000, when foreign direct investment (FDI) into manufacturing industry grew spectacularly. It was especially the accession to the European Union which influenced the attraction of FDI, through a new attitude of political decision-makers (Bandelj 2010; Haar 2010).

Compared to the regional gaps, the imbalances between counties are even more obvious. A brief look at the GDP per capita values shows that Bucharest exceeds \$ 10,000, followed by the counties Timiş and Constanţa with over \$ 6,000 and Cluj, Arad, Sibiu, Braşov and Argeş with over \$ 5,000. Among the counties with the smallest per capita GDP, with values less than \$ 3,000, are the counties situated in Moldova (Botoşani and Vaslui) and Southern Muntenia (Călăraşi, Giurgiu, Teleorman, and Ilt).

The comparative analysis of maps showing the 1994 and 2005 distributions of GDP per capita presents clusters of poor countries in the north-eastern and southern part of the country. These poor areas in

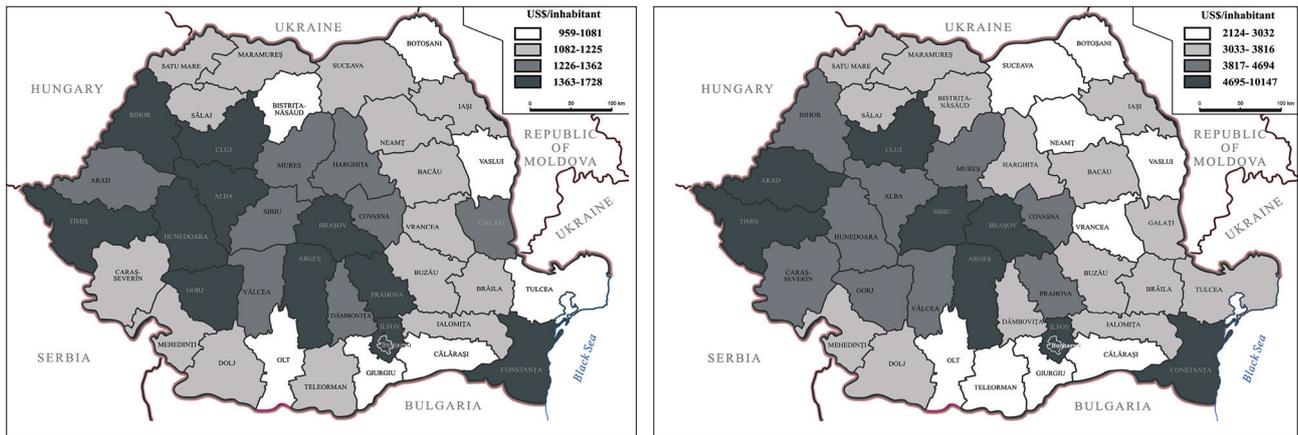


Fig. 3 GDP per capita by counties, 1994 (a) and 2005 (b)

1994 (Fig. 3a) have become more uniform, both in the north-east and in the south, in 2005 (Fig. 3b), demonstrating the need for adopting specific regional policies.

Regarding the eastern part of the country, a polycentric regional policy can have noticeable results, valorising the complementarities of regional resources and the favourable geographic positions of growth poles at different ranks (Turcanasu and Rusu 2007), such as Bacău, Suceava, Piatra Neamț, or even Botoșani, Vaslui, Roman and Barlad. For the second poverty area, assessed in the southern part of the country, the engine of territorial growth should be represented by the capital city which has a great spatial diffusion potential in terms of development. Shaping the metropolitan area, in parallel with defining and implementing average- and long-term policies of development, represents the only possibility to couple territorial energies in order to reach the goal of increasing the area's standard of life.

The Romanian particularities related to territorial development also result from the fact that the country has the largest share of rural population in the European Union (45 % of the population lives in villages). This means that some indicators, such as unemployment, are diminished because a large part of the population (circa one third) works in agriculture, in the specific conditions of subsistence agriculture (Ungureanu et al. 2002). The high rural share, precarious infrastructure and effects of international migration, mostly in the eastern and southern parts of the country, influence the regional and intraregional differentiation of growth concerning the standard of life.

### 3. Defining the work hypothesis

The previous analysis shows that the GDP reflects reality only partially when measuring the level of territorial development (Ilieva 2011). We believe that a set of indicators, aggregated in an index, would be more appropriate for the analysis of the entire national territory. The main condition is that the indicators used are relevant for the main characteristics of a territory. In this respect, they should cover at least four main dimensions: demography, economy, infrastructure and quality of life. A number of similar studies regarding territorial disparities have focused on issues related either only to economy and demography (Manic et al. 2012), or only to social, economic and standard of life aspects (Ancuța 2010).

At the same time, one of the great difficulties lies in the large number of possible indicators that could be analysed, which means that too many resources are required. Therefore we asked: Is there a possibility to reduce the number of indicators after an analysis at the macro-scale level? At the micro-scale, the analyses of basic administrative units show that it is possible. The difference is that at the micro-level, the number and the type of indicators vary according to the specificity of the geographical areas. For example, the analysis of the territorial imbalances in the upper Ialomița catchment (mountainous and hills area) shows that the number of high school graduates and population employed in agriculture are the main variables explaining the territorial disparities (Ianoș and Petrișor 2010). Within Iași County (plateau area), the number of employees per 1,000 people, the demographic ageing index, the migration balance and average annual growth are the core indicators of development, while in the Danube

Tab. 2 Variables used in the study, descriptive statistics and Normality/"broken stick" distribution tests

| No. | Variable  | Descriptive statistics |          |      |       |
|-----|---|------------------------|----------|------|-------|
|     |   | $\mu$                  | $\sigma$ | Min. | Max.  |
| 1   | FDI   | 675                    | 1295     | 40   | 6669  |
| 2   | Share of employees in the working population      | 52                     | 10       | 36   | 80    |
| 3   | Share (%) of people aged 65 and above             | 15                     | 2        | 12   | 22    |
| 4   | Unemployment rate                                 | 4                      | 2        | 1    | 10    |
| 5   | Net earnings/employee                             | 956                    | 117      | 792  | 1398  |
| 6   | Inhabitants/room                                  | 1                      | 0.1      | 1    | 1     |
| 7   | Pharmacies/10,000 inhabitants                     | 3                      | 1        | 1    | 5     |
| 8   | Physicians/10,000 inhabitants                     | 2                      | 1        | 1    | 6     |
| 9   | Rate of school dropouts                           | 2                      | 1        | 1    | 4     |
| 10  | GDP per capita                                    | 5079                   | 1983     | 2668 | 12718 |
| 11  | Employees in research/1,000 working people        | 30                     | 42       | 0    | 185   |
| 12  | Research expenses per capita                      | 29                     | 69       | 0    | 400   |
| 13  | Share (%) of population working in agriculture    | 33                     | 11       | 1    | 55    |
| 14  | Telephone calls (min./person/year)                | 13                     | 20       | 2    | 95    |
| 15  | Minutes spent on the Internet per person and year | 24                     | 22       | 6    | 104   |
| 16  | Share (%) of modernised roads                     | 30                     | 15       | 13   | 100   |
| 17  | Infant mortality                                  | 12                     | 3        | 7    | 20    |

Delta Biosphere Reserve five variables were identified: the number of out-migrants, the number of employees in transportation, commerce and communication, and the number of houses completed (Petrişor et al. 2012).

Therefore, the hypothesis of this study is that the GDP alone does not reflect the whole complexity of the territorial imbalances and that another two or three indicators can be combined to form a truly significant aggregated index.

#### 4. Data and methods

##### 4.1 Selection and descriptive statistics of the indicators

The study hypothesis resulted in the identification of a viable system of indicators that might play an important role in the measurement of territorial development gaps. The initial set of indicators was built by taking into consideration all the characteristics for a comparative and exhaustive analysis at any spatial level (63 indicators). By confronting them with the statistical evidence, and after some selection steps, 17 indicators were selected for this approach (Tab. 2); these indicators cover demographic, economic, infrastructure

and quality of life issues: six are economic (including socio-economic, such as unemployment, share of employees in the total employed population), three concern demography aspects, three infrastructure, and six the quality of life. Data were gathered from official statistics, namely the Statistical Yearbooks (2007 and 2008), the National Trade Register, the 2002 Census of Population and Houses, and directly from the National Institute of Statistics. The 17 variables are referred to by using their corresponding numbers in Table 2. The values for Ilfov County are, all over the study, the average of the values for Bucharest and Ilfov county.

The largest national administrative units in Romania are the counties. In Romanian and European statistics (EUROSTAT) on Romania, the regions of development are also frequently used (NUTS II), even though they still lack an administrative status. In addition, the use of the latter does not allow the detection of territorial imbalances at an acceptable level of detail, so an analysis at the counties' level (41 units) was chosen.

##### 4.2 Methodological steps

Statistical analyses employed several stages of applying several methods using SPSS, version 12,

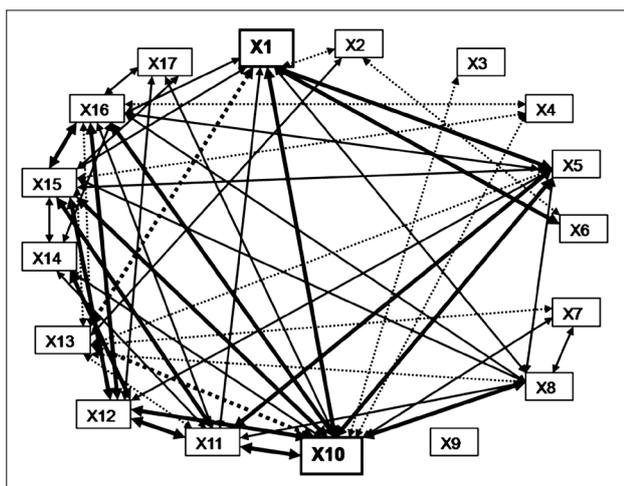


Fig. 4 Pair correlations between variables (the thickness of the lines represents the correlation intensity)

looking gradually at the relationships between chosen indicators and their significance.

1. Descriptive statistics and all possible paired correlations were computed. The latter were then used to identify the most relevant indicators as those which correlated positively with most variables.

2. For each indicator identified in the previous stage, multiple linear regression was used to test the option for its significance. In each case, two models were defined; the integral model included all indicators (except for those found most relevant and considered 'dependent variables'). After running each full model, the restricted model resulted from backward elimination of variables displaying the lowest values of the F test of partial significance, respectively the highest associated p-values, one at each time, until all remaining variables were significant at  $p=0.05$ .

3. The information identified in the previous stage was not sufficient to express the dimension of territorial gaps and their spatial distortion. For this reason, Principal Component Analysis was employed in addition to the previous methods. The method relies on the assumption that the variation of the general level of development (not measured directly) is explained by the variation of factors specific to each variable separately, but also by common factors.

4. In order to find a territorial expression of the relevance of the indicators identified to be significant for the development of Romania, a factor-analysis based geostatistical approach, used in conjunction

with the Drane-Aldrich-Creanga (DAC) statistics, was carried out. The geostatistical approach consisted of using two methods: mapping the indicators selected from Principal Component Analysis and mapping the DAC statistics.

4a. Based on the results of the Principal Component Analysis, a new index was built and its values were mapped. In addition, an ArcView 3.2 model was created starting with the distribution of each variable per county, reclassified and combined using the new weights to show the spatial distribution of the aggregated index.

4b. The DAC statistics, introduced through a study by Drane et al. 1995, was used. The purpose of introducing this test was to provide a tool for detecting spatial clusters of cases. Its computation is based on the bi-dimensional cumulative frequency distribution, defined by the formula:

$$F_n(x, y) = \frac{m(x, y)}{n}$$

where  $m(x,y)$  is the number of points in the sample of size  $n$  satisfying both conditions  $x_i \leq x$  and  $y_j \leq y$ .

$(x,y)$  takes the values  $(0, 0), \dots, (max\ x, max\ y)$ , while  $m(x,y)$  spans the interval  $(0,n)$ . Similar to  $F_n$ ,  $F_m(x, y)$  is defined for the cases (Petrișor et al. 2002). The cases are the locations of the sample where the values of a certain variable are either below or above some threshold; in this study, the cases were the 15 of 41 locations where the index has values less than 2938. The threshold was determined on the basis of the histogram of the values and represents the first interval, containing 36 % of all values. The histogram was built using Sturges' formula (Dragomirescu 1998): the number of classes is

$$nc = 1 + (10/3) \times \log_{10} N, \text{ where } N \text{ is the sample size;}$$

the length of intervals is given by the ratio of the difference between maximum and minimum values and the number of classes.

The DAC is:

$$DAC(x, y) = F_m(x, y) - F_n(x, y), \text{ for all possible values } (x, y).$$

Positive values indicate that cases accumulate faster than the other values, suggesting possible prob-

Tab. 3 Results of the Principal Component Analysis: variation explained by components

| Component | Initial eigenvalues |               |              | Extraction sums of squared loadings   |               |              |
|-----------|---------------------|---------------|--------------|---|---------------|--------------|
|           | Total               | % variability | Cumulative % | Total   | % variability | Cumulative % |
| 1         | 8.59                | 50.51         | 50.51        | 8.59  | 50.51         | 50.51        |
| 2         | 2.36                | 13.90         | 64.41        | 2.36  | 13.90         | 64.41        |
| 3         | 1.21                | 7.11          | 71.53        | 1.21  | 7.11          | 71.53        |
| 4         | 0.99                | 5.80          | 77.32        | <p>The results indicate that there are three components that explain together 71.53 % of the general variability of the development level (above).</p> <p>In this table, the numbers corresponding to the 17 components are not those assigned in Tab. 2; they are the components ordered with respect to their contribution to explaining the territorial differences of the level of development. The variable corresponding to each of the three most important components can be identified in Tab. 4, based on the maximum absolute value of the correlation coefficient between the component and each variable separately (marked using gray shading).</p> |               |              |
| 5         | 0.78                | 4.61          | 81.94        |   |               |              |
| 6         | 0.71                | 4.18          | 86.12        |   |               |              |
| 7         | 0.60                | 3.51          | 89.63        |   |               |              |
| 8         | 0.52                | 3.04          | 92.66        |   |               |              |
| 9         | 0.38                | 2.21          | 94.87        |   |               |              |
| 10        | 0.33                | 1.94          | 96.81        |   |               |              |
| 11        | 0.20                | 1.15          | 97.96        |   |               |              |
| 12        | 0.13                | 0.77          | 98.73        |   |               |              |
| 13        | 0.08                | 0.45          | 99.17        |   |               |              |
| 14        | 0.06                | 0.32          | 99.50        |   |               |              |
| 15        | 0.04                | 0.25          | 99.74        |   |               |              |
| 16        | 0.02                | 0.14          | 99.89        |   |               |              |
| 17        | 0.02                | 0.11          | 100.00       |   |               |              |

lems in the corresponding region. To compute the DAC statistics, the X-Tools extension of ArcView (version 3.2.) was used to reduce each county to its centres. The actual coordinates of the centre were obtained using ArcGIS, version 9.3. A comma-separated values text file, containing a counter, the latitude, the longitude and the value of the index for each location, was created. The DAC test was computed using a Quick Basic application using the text file and generating a similar file containing on separate lines the value of the DAC test, the latitude, the longitude and the value of the index for each location. The analysis used a modified version of the program described by *Petrişor et al.* 2002.

In mapping the spatial distribution of the variables, including the artificially created indices, we opted for generating five intervals, corresponding to levels ranging from “very low” to “very high”, using the natural breaks option in ArcView. The method identifies those thresholds able to underline the disparities in the best possible way (ESRI 1996).

## 5. Results

Following the methodological steps which resulted from the successive application of the analytical methods, it is necessary to present the results in the same sequence in which they were obtained at the end of each stage; i.e., subsection 5.1 of the results corresponds to subsection 4.2.(1) of the methodology etc.

### 5.1 Determination of the correlation coefficients and analysis of their statistical significance

The results indicate that two indicators compete for maximum relevance in explaining territorial imbalances: foreign direct investment per capita (FDI) and gross domestic product per capita (GDP). Intuitively, these variables could be considered the most important for measuring the level of development, but their values depend on the values of other variables. In all correlations between the 17 indicators, the two variables are

Tab. 4 Results of the Principal Component Analysis: correlation between variables and components

| Variable | Common elements |            | Correlations with the components |       |       |
|----------|-----------------|------------|----------------------------------|-------|-------|
|          | Initial         | Extraction | 1                                | 2     | 3     |
| 1        | 1.00            | 0.90       | 0.88                             | 0.36  | 0.05  |
| 2        | 1.00            | 0.79       | 0.79                             | -0.38 | 0.10  |
| 3        | 1.00            | 0.70       | -0.36                            | 0.70  | -0.29 |
| 4        | 1.00            | 0.39       | -0.59                            | 0.12  | -0.17 |
| 5        | 1.00            | 0.75       | 0.84                             | 0.09  | -0.19 |
| 6        | 1.00            | 0.62       | -0.06                            | -0.78 | 0.11  |
| 7        | 1.00            | 0.59       | 0.55                             | -0.41 | -0.35 |
| 8        | 1.00            | 0.67       | 0.74                             | -0.33 | -0.13 |
| 9        | 1.00            | 0.64       | 0.09                             | 0.10  | 0.79  |
| 10       | 1.00            | 0.93       | 0.96                             | -0.05 | 0.01  |
| 11       | 1.00            | 0.77       | 0.86                             | 0.13  | -0.13 |
| 12       | 1.00            | 0.81       | 0.82                             | 0.36  | -0.02 |
| 13       | 1.00            | 0.86       | -0.80                            | 0.47  | -0.05 |
| 14       | 1.00            | 0.89       | 0.89                             | 0.26  | 0.16  |
| 15       | 1.00            | 0.85       | 0.88                             | 0.18  | 0.18  |
| 16       | 1.00            | 0.53       | 0.56                             | 0.46  | 0.13  |
| 17       | 1.00            | 0.49       | -0.55                            | -0.02 | 0.43  |

closely correlated ( $r= 0,80$ ). In addition, they correlate significantly with all the other variables (Fig. 4).

**5.2 Using multiple linear regression to test the option for choosing GDP and FDI**

The next step was to test the option for these variables in relationship with the simultaneous influence of the remaining ones, considered independent. Multiple

linear regression analysis provided two regression models: one explaining the FDI fluctuations by three variables, and the other explaining GDP variations by four variables. The two prediction models, derived for each dependent variable, were written as follows:

$$a) \text{ FDI} = 0.1 \times (\text{research expenses per person}) + 11 \times (\text{minutes spent on the Internet per person and year}) + 12 \times (\text{share of modernised roads}) - 6572$$

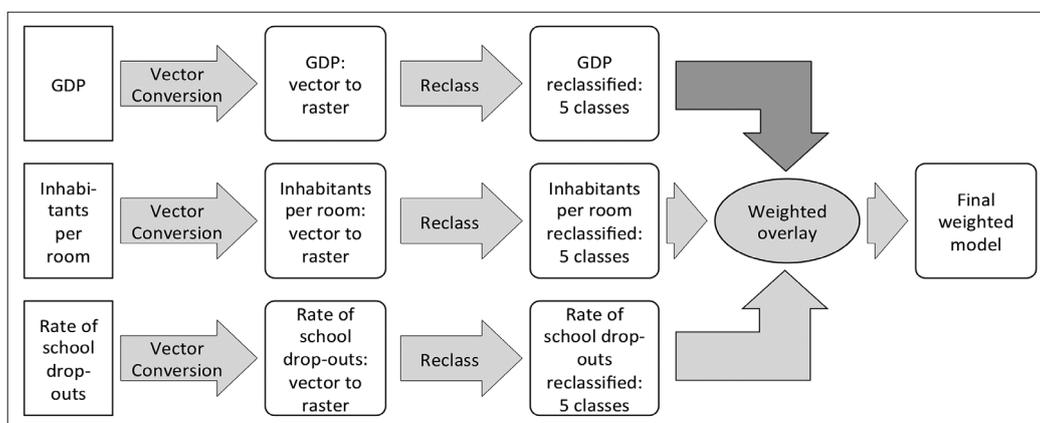


Fig. 5 ArcView model for determining the general development level based on the GDP, inhabitants per room and rate of school dropouts in the Romanian counties

Tab. 5 Parameters of the GIS model used for analysing the level of development

| Variable                | Weight (%) | Values and classes |   |
|-------------------------|------------|--------------------|---|
| GDP Weight (%)          | 71         | 2668-4459          | 1 |
|                         |            | 4459-6250          | 2 |
|                         |            | 6250-8041          | 3 |
|                         |            | 8041-9832          | 4 |
|                         |            | 9832-11623         | 5 |
| Inhabitants per room    | 19         | 0.820-0.896        | 5 |
|                         |            | 0.896-0.972        | 4 |
|                         |            | 0.972-1.048        | 3 |
|                         |            | 1.048-1.124        | 2 |
|                         |            | 1.124-1.200        | 1 |
| Rate of school dropouts | 10         | 1.00-1.52          | 1 |
|                         |            | 1.52-2.04          | 2 |
|                         |            | 2.04-2.56          | 3 |
|                         |            | 2.56-3.08          | 4 |
|                         |            | 3.08-3.60          | 5 |

b)  $GDP = 9490 - 8 \times (\text{employees/working population}) - 33 \times (\text{net earnings/employee}) - 2930 \times (\text{pharmacies/10,000 people}) - (\text{minutes spent on the Internet per person and year})$ .

The results suggested the elimination of FDI and inclusion of two other variables (inhabitants/ room and rate of school dropouts) by explaining the differences of the level of development.

### 5.3 Results of Principal Component Analysis

The analysis aimed to identify components explaining this variability (Tab. 3), corresponding to the variables with which they are most strongly correlated (Tab. 4). The first three components were included in a model for the assessment of the general level of development per county, discussed in the next section.

The results of the Principal Component Analysis indicate that the variation of the development level can be explained by the GDP (50.51 %), the number of inhabitants per room (13.90 %) and the rate of school dropouts (7.11 %). These three variables have the greatest correlation coefficients with the three components.

This analysis underlines the importance of these three indicators corresponding to their three axes: the GDP (partially explained by FDI, provided the high value of their correlation coefficient), the number of inhabitants per room, and the rate of school dropouts. Their coverage is sufficiently high: The first expresses differences in economic development, but also demographical aspects (especially related to the labour force), the second relates to housing (embedding elements of economy, social infrastructure and standard of life), while the third defines the educational status (enclosing some social characteristics).

Accounting only for these three variables, and considering that they fully explain the variability of the level of development, the weights were readjusted to sum up to 100 % instead of 71.53 %. Based on these readjusted weights and reverting the ranks of the distribution of the number of inhabitants per room due to its inverse correlation, the ArcView 3.2 model was

Tab. 6 Descriptive statistics and distribution tests for the index used to identify disfavoured areas (gray shading indicates significant differences)

| Descriptive statistics |      |      |      | Goodness of fit tests      |      |                         |     |                            |     |                    |    |              |     |
|------------------------|------|------|------|----------------------------|------|-------------------------|-----|----------------------------|-----|--------------------|----|--------------|-----|
|                        |      |      |      | "Broken stick"             |      |                         |     | Normality                  |     |                    |    |              |     |
| μ                      | σ    | Min. | Max. | x <sup>2</sup> (intervals) |      | x <sup>2</sup> (values) |     | x <sup>2</sup> (intervals) |     | Kolmogorov-Smirnov |    | Shapiro-Wilk |     |
|                        |      |      |      | Val.                       | p    | Val.                    | p   | Val.                       | p   | Val.               | P  | Val.         | p   |
| 3474                   | 1197 | 1884 | 8207 | 0.17                       | 0.99 | 1752703                 | *** | 11.5                       | *** | 0.16               | ** | 0.86         | *** |

Legend: \*\*\* – significant at p < 0.001, \*\* – significant at p < 0.01, gray shading: significant at p ≤ 0.05



Fig. 6 Spatial distribution of the general development level based on the GDP, inhabitants per room and rate of school dropouts in the Romanian counties (darker shades indicate a low level)

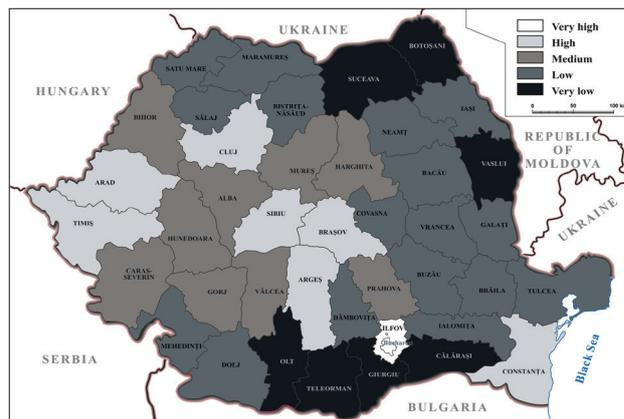


Fig. 7 Spatial distribution of disfavoured counties (darker shades) in Romania, as classified on the basis of the values of the proposed index

created starting with the distribution of each variable per county, reclassified and combined using the new weights (Tab. 5).

#### 5.4 Geo-statistical analysis, spatial relevance of the main indicators and construction of an aggregated index

The final stage in the analysis consisted of the identification of disfavoured areas. This was done by creating an aggregated index through GIS modelling based on the results of the Principal Component Analysis and mapping its distribution (4.2- 4a) and by analysing the spatial distribution of the DAC test values (4.2-4b).

##### 5.4.1 Creating an aggregated index through GIS modelling based on the results of Principal Component Analysis and mapping its distribution

An index  $I$  was built beginning from the results of the Principal Component Analysis:

$$I = \frac{50.51 \times V_{10} + 7.11 \times V_9 - 13.9 \times V_6}{71.53}$$

where  $V_{10}$ ,  $V_9$ , and  $V_6$  are variables 10, 9, and 6.

The final GIS model based on the Principal Component Analysis maps its distribution and is displayed in Figure 5. Its creation consists of several transformations imposed by the software: vector-to-raster conversion followed by the reclassification of values

in five classes. Finally, the three layers are overlapped in a synthetic index with five classes (very low – 1, low – 2, medium – 3, high – 4, very high – 5) using the weights assigned to each variable. The distribution of the synthetic index is displayed in Figure 6.

Based on the analysis of the distribution of the aggregated index, displayed in Figure 7, the threshold value 2938 was chosen. Lower values indicate a critical development level, indicating underdeveloped counties. From 41 values, 15 (36.6 %) were under the threshold. Descriptive statistics for the new index are presented in Table 6; the results indicate an asymmetrical distribution, significantly different from Normality, but similar to the “broken stick” statistical model.

##### 5.4.2 Analysis of the spatial distribution of the DAC statistic values

By the extrapolation of the values of the DAC test, using the centres of the counties representing their entire area, the spatial distribution of the DAC statistic is represented as a choropleth (graduated colour) map of the national territory (Fig. 8). The map shows that the low development level (resulting from values of the DAC statistics) indicating underdevelopment seems to concentrate in the south-eastern part of Romania. Similarly, we have to take into account the low development level in the east (Moldova) and south-west (Oltenia).

The DAC test, using the results of the Principal Component Analysis, describes reality better, pinpointing the two large poorly developed areas situated in the



Fig. 8 Spatial distribution of the DAC values used to identify underdeveloped areas (darker shades)

north-east and south of the country. Therefore, the three indicators identified using Principal Component Analysis can explain most of the territorial gaps and are sufficient for measuring regional gaps.

## 6. An interpretation of the findings

The summary analysis of the spatial configuration displayed in *Figure 7* indicates that within the historical provinces, most counties with an extensive industrial development during the totalitarian regime suffered a dramatic fall in industrial activity after the transition to a market economy and are now underdeveloped (Ianoș 2000). The new economy is developing very slowly, due to poor accessibility, mono-centric development with great differences between centre and periphery, the high share of rural population and the decrease in the quality of human resources due to international migration. The situation affects counties from the eastern (Moldova), southern and south-western (southern Muntenia and Oltenia), plus northern part (Maramureș county). The areas are not contingent, as the counties Iași and Bacău in Moldova own both infrastructure and tertiary activities (both also possess airports and universities), reflected in the faster rhythm of economic development. In all analyses before 2000, these counties were assimilated to the underdeveloped ones, i.e. taken together with the entire historical province. In 2005, their differentiation is the result of the policy of transferring uneven development from the regional to the intraregional level. The situation is similar in Oltenia, where for instance Dolj county benefits from the same advantages as Iași county.

## 7. Conclusions

The countries in transition in Eastern Europe and elsewhere passing to totally different socio-economic systems are confronted with contradictory processes that encompass the territorial aspect of the deepening of spatial imbalances. Romania is an illustrative example with the radical centralism abandoned in 1989 and its difficult economic heritage. The earlier historical evolution can be added to this, i.e. the traces of the strong influence of the three empires – Habsburg, Ottoman and Russian – on the Romanian provinces.

In the larger context of the difficulty of measuring territorial imbalances, as the basis for the formulation of regional development policies, the issue of identifying an index capable of clearly expressing territorial differences in development status has always been a challenge. The initial hypothesis of this paper was that the GDP per capita itself cannot adequately express the territorial imbalances. This, however, has only been confirmed partially (because GDP still remains an important indicator). But, in fact, two other indicators have to be added: the number of inhabitants per room and the school dropout rate. Simultaneously, even though it is also a pertinent indicator, the FDI per inhabitant indicator is not sufficiently relevant for a country like Romania, being in a transition process. It is indirectly included in the territorial variation of GDP per inhabitant.

The analysis shows that it is possible to construct an aggregated index by using the values for the three elementary and significant indicators mentioned. It is a relevant indicator when taking into account the results' spatial significance. The DAC test reconfirms the results and underlines the GDP's importance in Vrancea and Giurgiu counties in comparison to the adjacent units.

## Acknowledgements

This work was partially supported by CNCSIS-UEFISCSU, project number PNII-IDEI 194/2007 ("Controlled production of discontinuities and the treatment of profoundly disadvantaged areas"), and by project number PNII-IDEI 1948/2008 ("Urban-rural interface in the context of polycentric development").

The authors would like to thank two anonymous reviewers for their valuable comments and suggestions, which helped improving the overall quality of the manuscript.

## References

- Ancuța, C.* 2010: Territorial disparities in the Romanian Banat: Assessment, dynamics and impact on the territorial system. – JURA. Journal of Urban and Regional Analysis **2** (2): 45-62
- Antonescu, D.* 2003: Dezvoltarea regională în România: concept, mecanisme, instituții. – Bucharest
- Bandelj, N.* 2010: How EU integration and legacies mattered for foreign direct investment into Central and Eastern Europe. – Europe-Asia Studies **62** (3): 481-501
- Dragomirescu, L.* 1998: Biostatistics for Dummies [in Romanian]. – Bucharest
- Drane, J.W., D.L. Creangă, T.E. Aldrich and M.B. Hudson* 1995: Detecting adverse health events via empirical spatial distributions. – Symposium on Statistical Methods, Atlanta, GA, 24-26 January 1995
- Guran-Nica, L.* 2002: Investiții străine directe și dezvoltarea sistemului de așezări din România. – Bucharest
- Haar, L.N.* 2010: Industrial restructuring in Romania from a bilateral trade perspective: manufacturing exports to the EU from 1995 to 2006. – Europe-Asia Studies **62** (5): 779-805
- Hirschman, A.* 1958: The strategy of economic development. – New Haven, CT
- Ianoș, I.* 2000: Less favoured areas and regional development in Romania. – In: *Horváth, G.* (ed.): Regions and cities in the global world. Essays in honour of György Enyedi. – Pécs: 176-191
- Ianoș, I.* 2006: Potential, Strukturdynamik, Attraktivität der rumänischen Wirtschaft. – In: *Kahl, T., M. Metzeltin and M.-R. Ungureanu:* Rumänien. Raum und Bevölkerung. Geschichte und Geschichtsbilder. Kultur. Gesellschaft und Politik heute. Wirtschaft. Recht und Verfassung. Historische Regionen. – Österreichische Osthefte **48**: 603-622
- Ianoș, I. and W. Heller* 2006: Spațiu, economie și sisteme de așezări. – Bucharest
- Ianoș, I. and A.-I. Petrișor* 2010: Micro-scale geostatistical analysis of the level of development. Case study: mountainous and subcarpathian area of Ialomița hydrographic basin. – Geographia Technica, special issue: 47-51
- Ianoș, I., A.-I. Petrișor, I.V. Stoica, C. Sarbu, D. Zamfir and A.L. Cercleux* 2011: The different consuming of primary eco-energies and their degradation in territorial systems. – Carpathian Journal of Earth and Environmental Sciences **6** (2): 251-260
- Ilieva, M.* 2011: Territorial differences in transformation processes in Bulgaria. – Journal of Urban and Regional Analysis **3** (1): 13-25
- Krugman, P.* 1995: Development, geography and economic theory. – Cambridge, MA
- Manic, E., S. Popovic and D. Molnar* 2012: Regional disparities and regional development: The case of Serbia. – Mitteilungen der Österreichischen Geographischen Gesellschaft **154**: 191-211
- Myrdal, G.* 1963: Economic theory and underdeveloped regions. – New York, NY
- National Institute for Statistics 2007, 2008: The statistical yearbooks. – [in Romanian]. – Bucharest
- National Institute for Statistics 2002: The 2002 census of population and houses. – [in Romanian]. – Bucharest
- National Trade Register Office 2012: Commercial enterprises with foreign participation in terms of capital. Statistical synthesis. – [in Romanian]. – Bucharest
- Peet, R. and E. Hartwick* 2009: Theories of development: Contentions, arguments, alternatives. – Second edition. – New York
- Perroux, F.* 1955: Note sur la notion de pôles de croissance. – Économie appliquée **8**: 307-320
- Petrișor A.-I., J.W. Drane, K. Jackson and L. Dragomirescu* 2002: Spatial statistics: The DAC statistics. – In: American Statistical Association (ed.): Proceedings of the section on statistics and the environment. – Alexandria, VA: 2683-2686
- Petrișor, A.-I., I. Ianoș, D. Iurea and M.N. Vaidianu* 2012: Applications of principal component analysis integrated with GIS. – Procedia Environmental Sciences **14**: 247-256
- Popescu, C.R.* 2000: Industria României în secolul XX. Analiză geografică. – Bucharest
- Pred, A.R.* 1973: Urban growth and the circulation of information: The United States system of cities, 1790-1840. – Cambridge, MA
- Rosenstein-Rodan, P.* 1943: Problems of industrialization of Eastern and South-Eastern Europe. – Economic Journal **53** (210/211): 202-211
- Suntsova, A.* 2012: Optimization of budget component in macroeconomic mechanism of state and regional development. – Actual Problems of Economics **12** (138): 45-52
- Tufescu, V.* 1974: România : natură, om, economie. – Bucharest
- Turcanasu, G. et A. Rusu* 2007: Etudier le polycentrisme des systèmes urbains de la Roumanie et de la Bulgarie. – Analele științifice ale Univ. A.I. Cuza Iași, Geografie **53** (2): 97-106
- United Nations Development Programme and National Commission for Statistics 1996: National report on human development. – Bucharest
- Ungureanu, A., O. Groza and I. Muntele* 2002: Moldova – Populația, forța de muncă și așezările umane în tranziție. – Iași