



MULTICRITERIA ANALYSIS OF REGIONAL DISPARITIES IN THE CONTEXT OF THE EU COHESION

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MOTIVATION AND AIM OF PAPER

- The economic, social and territorial disparities in the level of regional performance are a major obstacle to the balanced and harmonious development of the regions, but also of each country as well as a whole EU.
- Quantification of regional disparities falls into important spheres of a regional policy at state and European level.
- The paper solves the problem of an alternative approach to quantitative evaluation of the regional development.
- *This research topic is supported by the Student Grant Competition of the Faculty of Economics, VŠB-TU Ostrava, project number SP2014/126 and by the Education for Competitiveness Operational Programme, project number CZ.1.07/2.3.00/20.0296.*
- *The aim of the paper* is to evaluate and compare the development of regional disparities in Visegrad Four countries over the period 2001-2011 by utilizing the selected multicriteria decision-making methods.



EVALUATION OF REGIONAL DISPARITIES IN THE EU

- The attitude of the researches to the measurement and evaluation of regional disparities is *not uniformed*.
- Most existing approaches use several disparities indicators that are processed by different less or more sophisticated mathematical and statistical methods.
- Alternative and not broadly extended approach to regional disparities evaluation represents *multicriteria decision-making methods* (e.g. AHP, TOPSIS, VIKOR).



METHODOLOGY OF PAPER

Stage 1 Define the model

- Select the appropriate MCDM methods to evaluate disparities between NUTS 2 regions in V4 - AHP (Analytic Hierarchic Process) and TOPSIS (Technique for Order Preferences by Similarity to an Ideal Solution).
- Define the model of research problem by AHP hierarchic structure (define the indicators).

Stage 2 AHP

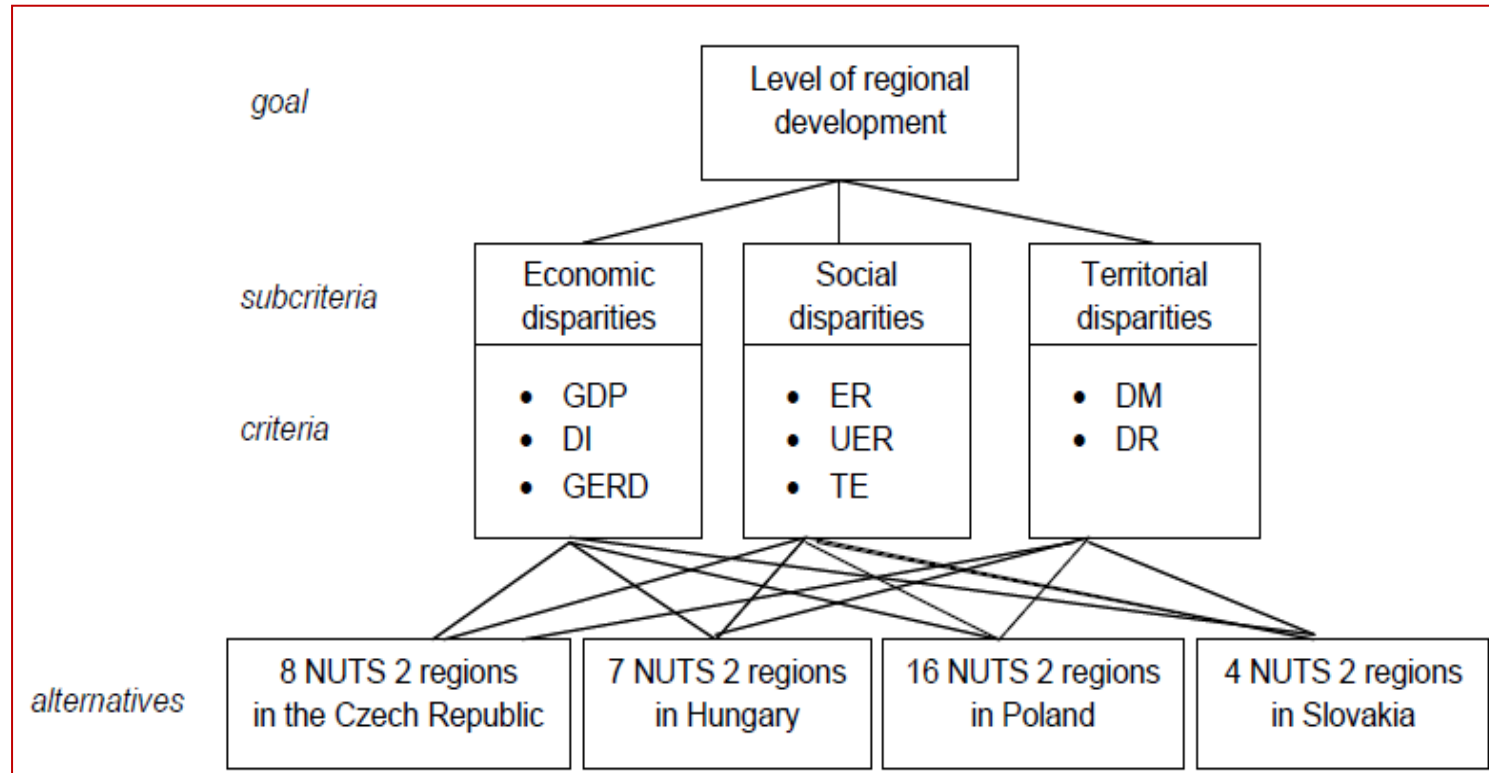
- Establish the pairwise comparison matrices.
- Perform the consistency test.
- Compute the weights of criteria.

Stage 3 TOPSIS

- Start TOPSIS procedure using the weights calculated by AHP method.
- Determine a relative closeness to the ideal solution c_j .
- Rank the regions according to distances to ideal solution.
- Perform a sensitivity analysis to study the impact of the weights of criteria equal to one on the c_j and regions' ranking.

METHODOLOGY OF PAPER

Figure 1 Hierarchic structure of evaluation system



- GDP per capita (GDP); Disposable income of households (DI); Gross domestic expenditure on R&D (GERD); Employment rate (ER); Unemployment rate (UER); Persons aged 30-34 with tertiary education attainment (TE); Density of motorway (DM); Density of railway (HB)



METHODOLOGY OF PAPER

- To determine the final weights of criteria, pairwise comparison in the context of **AHP** is applied to calculate weights of subcriteria with respect to the goal. After that criteria are pairwise compared against the subcriteria importance.
- The comparisons are taken from **Saaty's fundamental scale** (1,3,5,7,9) which indicates how many times more important one element is over another element with respect to property to which they are compared to.
- Elements are scored according to *author's subjective preferences*.

Table 1 Saaty's fundamental scale

Intensity of importance	Definition
1	equal importance
3	moderate importance
5	strong importance
7	very strong importance
9	extreme importance



METHODOLOGY OF PAPER

- **TOPSIS method** is based on the choosing of the best alternative nearest to the ideal solution (with the shortest Euclidean distance) and farthest from the negative ideal solution.
- *Firstly*, we convert all the criteria so that all of them were either minimization or maximization.
- *Second step* is to calculate the normalized decision matrix r_{ij} .

$$r_{ij} = \frac{y_{ij}}{\sqrt{\sum_{i=1}^n y_{ij}^2}},$$

- *Third step* is to calculate weighted normalized decision matrix.



METHODOLOGY OF PAPER

- *Fourth step* includes the determination of the positive ideal solution (H_j) and the negative ideal solution (D_j).

$$d_i^+ = \sqrt{\sum_{j=1}^k (v_{ij} - H_j)^2},$$

$$d_i^- = \sqrt{\sum_{j=1}^k (v_{ij} - D_j)^2},$$

- *Fifth step* includes the separation from the ideal (d_i^+) and the negative ideal solutions (d_i^-) between alternatives is calculated.

$$c_i = \frac{d_i^-}{d_i^- + d_i^+}.$$

- *Last step* includes the calculation of the *relative closeness* c_i to the *ideal solution* and rank the alternatives in descending order.



EMPIRICAL RESULTS

- Indicators GDP per capita, disposable income and unemployment rate have the highest importance in evaluation of regional disparities and the level of region's development.

Table 2 Weights of criteria

Subcriteria	Weight	Criteria	Weight	Final weight
Economic	0,730644671	GDP	0,6370	0,4654
		DI	0,2583	0,1887
		GERD	0,1047	0,0765
Social	0,188394097	ER	0,2790	0,0526
		UER	0,6491	0,1223
		TE	0,0719	0,0136
Territorial	0,080961232	DM	0,7500	0,0607
		DR	0,2500	0,0202

Source: author calculation, 2014

Weight of criteria		w =calculated by AHP				w=1			
Year		2001		2011		2001		2011	
Code	Region	c_i	Rank	c_i	Rank	c_i	Rank	c_i	Rank
CZ01	Praha	0.853	1	0.805	2	0.6750	1	0.6304	1
CZ02	Střední Čechy	0.399	4	0.292	6	0.4973	3	0.3205	6
CZ03	Jihozápad	0.321	7	0.268	7	0.2582	9	0.2767	8
CZ04	Severozápad	0.243	12	0.189	18	0.2278	11	0.2206	16
CZ05	Severovýchod	0.307	8	0.242	11	0.2637	8	0.2734	9
CZ06	Jihovýchod	0.325	6	0.294	5	0.3406	5	0.3412	5
CZ07	Střední Morava	0.252	10	0.229	15	0.2243	12	0.2415	13
CZ08	Moravskoslezsko	0.219	13	0.246	8	0.2016	15	0.2579	11
HU10	Közép-Magyarország	0.508	3	0.485	3	0.4276	4	0.4238	4
HU21	Közép-Dunántúl	0.251	11	0.184	19	0.2879	7	0.2428	12
HU22	Nyugat-Dunántúl	0.277	9	0.231	14	0.2542	10	0.2351	14
HU23	Dél-Dunántúl	0.167	15	0.104	30	0.1991	17	0.1847	25
HU31	Észak-Magyarország	0.149	19	0.053	35	0.1847	18	0.1181	33
HU32	Észak-Alföld	0.153	18	0.086	33	0.2007	16	0.1586	31
HU33	Dél-Alföld	0.185	14	0.124	27	0.2209	13	0.1991	21
PL11	Łódzkie	0.103	25	0.182	20	0.1338	28	0.2007	20
PL12	Mazowieckie	0.361	5	0.450	4	0.2899	6	0.3035	7
PL21	Małopolskie	0.137	21	0.168	21	0.2089	14	0.2270	15
PL22	Śląskie	0.159	16	0.238	12	0.1773	20	0.2714	10
PL31	Lubelskie	0.100	26	0.114	29	0.1808	19	0.1912	23
PL32	Podkarpackie	0.078	31	0.100	31	0.1331	29	0.1816	26
PL33	Świętokrzyskie	0.071	33	0.099	32	0.1456	25	0.1696	29
PL34	Podlaskie	0.095	29	0.126	26	0.1498	24	0.1874	24
PL41	Wielkopolskie	0.155	17	0.221	16	0.1241	30	0.2073	19
PL42	Zachodniopomorskie	0.114	24	0.135	25	0.0859	34	0.1548	32
PL43	Lubuskie	0.078	30	0.146	22	0.1005	32	0.1742	28
PL51	Dolnośląskie	0,137	22	0.242	10	0.1736	22	0.2127	18
PL52	Opolskie	0.077	32	0.141	23	0.1540	23	0.1929	22
PL61	Kujawsko-Pomorskie	0.099	27	0.244	9	0.1349	27	0.4719	3
PL62	Warmińsko-Mazurskie	0.044	35	0.123	28	0.0983	33	0.1690	30
PL63	Pomorskie	0.131	23	0.196	17	0.1349	26	0.2165	17
SK01	Bratislavský kraj	0.699	2	0.867	1	0.5994	2	0.5231	2
SK02	Západné Slovensko	0.148	20	0.236	13	0.1767	21	0.1748	27
SK03	Stredné Slovensko	0.098	28	0.141	24	0.1048	31	0.1133	34
SK04	Východné Slovensko	0.060	34	0.085	34	0.0766	35	0.1001	35

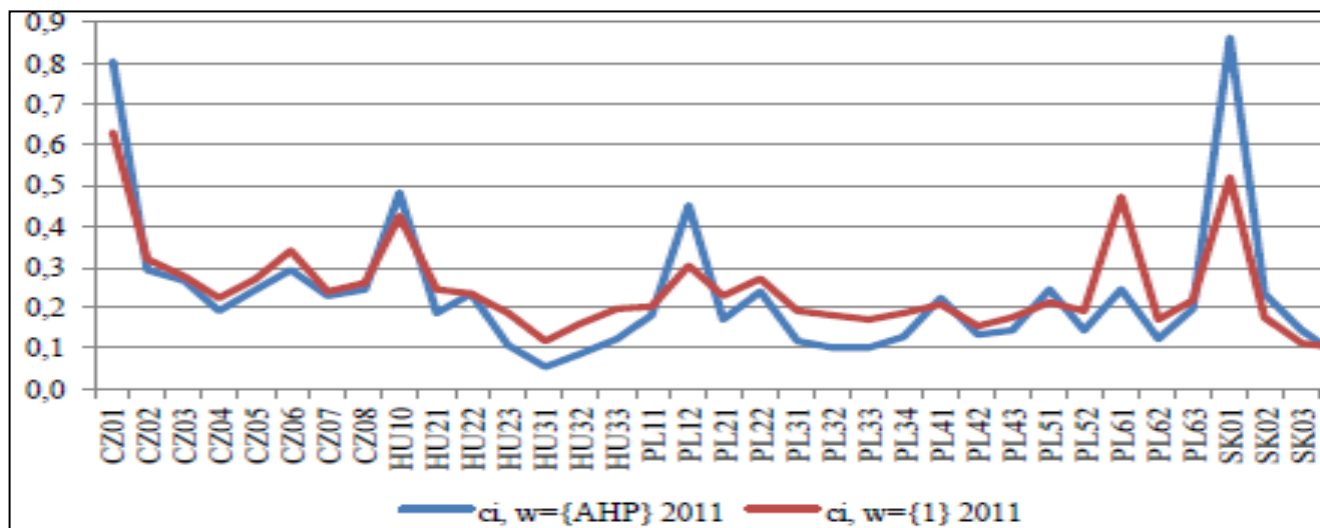
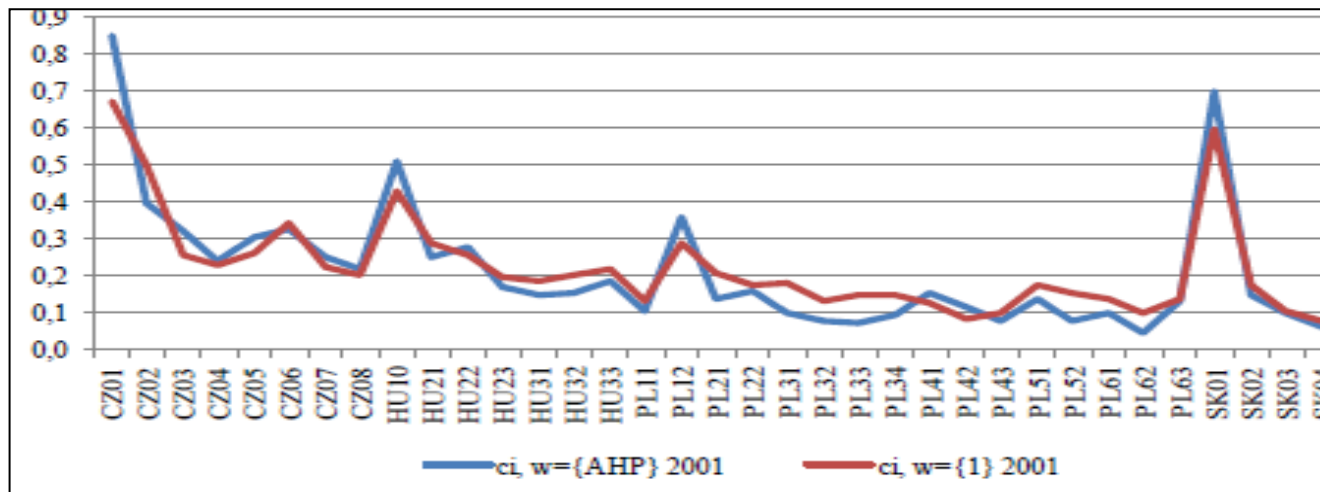
Table 3 TOPSIS method results

Source: author calculation, 2014



EMPIRICAL RESULTS

Sensitivity analysis - effects of criteria weight on c_i



Source: author calculation, 2014



CONCLUSION

- Applying AHP and TOPSIS method, the regions were ranked based on distances (disparity) to ideal solution.
- Comparison of the region's ranking indicates the trends in the level of regional development in V4 in year 2001 and 2011.
- Although some positive changes in disparities trend are observed during the examined period (especially in Poland), the regional disparities have still persisted between dominant regions with capital cities and more distant regions on the one hand and between Czech regions and Hungarian, Polish and Slovak regions on the other hand.
- The advantage of TOPSIS and AHP methods is that they are simple, easy to use and understand. The sensitivity analysis shows that the importance of criteria influences the final ranking of regions.



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