Measurement of Human Development in the Regions of Visegrad Group Plus

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Abstract—The most common indicators for measuring the economic level of countries are the macroeconomic aggregates such as the Gross National Product or the Gross National Income per capita. Though they reflect the creation of added value, they do not include social, political, cultural or environmental aspects. It was therefore necessary to create and use alternatives for measuring ongoing economic development. These alternatives reflect socio-economic development and one of them is the Human Development Index. However, the human development index does not express the differences in regions of countries. The aim of the paper is to construct a modified Human Development Index for a group of countries of the Visegrad Group Plus (hereafter V4+) at the NUTS II level, called the NUTS Human Development Index, the NHDI. Two years were chosen for the comparison – 2005, which was the beginning of the EU memberships of most of the compared countries and the last year when all indicators were available (2013). Our expectations about the positive influence of the EU membership on decreasing regional disparities among the regions, based on the results of the NHDI, were not confirmed.

Keywords—GDP per capita, Human Development Index, lifelong learning, life expectancy, tertiary education, Visegrad Group Plus.

I. INTRODUCTION

IN In order to determine the economic level, or the rate of economic development, we most often use two indicators - the gross national (domestic) product and the gross national income. According to [1] they have their limitations – they measure only formal monetary policy and they include neither the informal economy, nor social, political, cultural and environmental aspects of development. It was therefore necessary to create a new indicator that reflects the issues of development and maturity, and thus it measures the overall socio-economic development.

Although the GDP is the most widely used indicator to measure economy´s state of affairs [2], [3] many alternatives can be applied, when the best-known and most used is an index called the Human Development Index [4].

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The Human Development Index (HDI), which has been used by the United Nations since 1990, clearly brings a different perspective on development issues and should be better able to emphasize the effect of other than just monetary (economic) factors of economy of a country. The basis of the HDI index is a greater explanatory power, which is to follow economic development or sustainable development in general. This index is able to explain better, how two or more countries with the same level of income per capita can end up with different human development outcomes [5]. The measurement of human development through the HDI is an alternative to the GDP/GNI per capita as a measure of human well-being in the last thirty years.

According to [6] HDIs are primarily nation level indicators, estimated for the country as a whole. Due to the general nature of the index, it cannot be applied by all economies in general. Therefore, many countries have introduced their own modified indexes in order to reflect their local circumstances better (more in [7] and [8]).

The constructions of the HDI do not express the differences in regions of countries as well. However, the regional disparities exist both in developing and developed countries and they influence regional development. For example [9] concluded that according to regional inequalities, expressed by the modified HDI, „two Spains" exist, divided by an invisible line that separates the North and the South. Regional disparities with declining tendency existed in India [10], [11] as well as in Iran where there has been a growing tendency according to [12]. There is the north-west/south-east division in the European regions and such vast differences in regional development among them would weaken social cohesion in Europe [13].

Based on the above, we decided to analyse this issue for a group of countries of the Visegrad Group Plus (hereafter V4+) at the NUTS II level. This group includes the Visegrad Group countries (Czech Republic, Hungary, Poland and Slovakia), Slovenia and Austria, which were included to this group on the ground of the Regional Partnership Agreement from 2001. There are 46 regions on the NUTS II level – eight in the Czech Republic, seven in Hungary, sixteen in Poland, nine in Austria, four in Slovakia and two in Slovenia. We have constructed the modified Human Development Index (NHDI) and two years were chosen for our comparison – the beginning of the memberships in the EU (2005) and the last available year for all indicators (2013). We expect that the influence of

the EU membership on decreasing regional disparities will be shown as far as the development of the NHDI is concerned.

II. DATA OF HUMAN DEVELOPMENT

The beginning of the Human Development Index dates back to 1990 when the UN Development Programme (UNDP) published the first report on human development (Human Development Report) which established the need of human development measurement and which is a more appropriate variable than previously used GDP. Human development has two forms, which should be in balance, the formation of human capabilities in terms of improving health, increasing knowledge and skills to meet human need and their own skills and competences, free time, job security, cultural, social and political events. Basically, human development is clearly and directly dependent on income. It is therefore necessary to examine other variables that point out the potential of a country much better as well as the options currently appear in human development [14].

A. Data of Human Development Index

The Human Development Index (HDI) is a summary measure of achievements in key dimensions of human development: a long and healthy life, an access to knowledge and a decent standard of living [15]. These three dimensions have four parts - health and standard of living has one part each and education has two parts, as shown in Table 1.

TABLE I. SPECIFIC VALUES OF HDI INDIVIDUAL INDEXES SINCE 2010

component	calculation	minimum value	maximum value
health	Life expectancy at birth	20 years	85 years
education	Expected years of schooling	0	18 years
	Mean years of schooling	0	15 years
standard of living	GNI per capita (in USD/PPP 2011)	100	75.000

Because of the need to improve their explanatory power, the calculation method of two of three dimensions (health indicator index is the only one which has remained unchanged) has changed over time. The literacy rate of population has been replaced by an indicator of expected years of schooling, the combined gross enrolment by the mean number of years of education (knowledge dimension). The dimensions of living standards are now measured by GNI per capita in purchasing power parity to the USD.

HDI index calculation required the values in the range from 0 (the lowest level of human development) to 1 (the highest human development), and therefore they were determined for each dimension of the minimum and maximum values (more in [16]) based on historical evidence.

The overall HDI index was previously calculated as the arithmetic average of all indices. This method allowed for

there to be a substitution between different dimensions, i.e. low values in one dimension can be compensated by high values of another one. Since 2010, the calculations have been performed using the geometric mean, which eliminates the above substitution and ensures that a percent decline in life expectancy has the same weight as a percent decline in the index or index of education and standard of living.

B. NUTS Human Development Index

For the purpose of the paper, we adopted the same principle of HDI creating for the national level – the health dimension, knowledge dimension and dimension of a living standard. Components of each dimension, however, had to be modified because of the lack of data at the regional level (NUTS II level). Data were used from a regional database of Eurostat and the construction of the HDI of V4+ regions (NHDI) was as follows:

1. Health with the value of life expectancy at birth that represents, according to Eurostat, the mean number of years that a newborn child can expect to live if subjected throughout his life, to the current mortality conditions

2. Knowledge, which includes two components:

   a. Tertiary educated people in the age of 25-64, where the indicator is defined as a percentage of population aged 25-64 who have successfully completed tertiary studies (e.g. university, higher technical institution, etc.).

   b. Lifelong learning in the form of participation rate in education and training covers participation in formal and non-formal education and training for the age group of 25-64 are presented.

3. Standard of living, measured through GDP per capita in PPS.

These indicators were chosen, not only because of their availability, but we also believe in their greatest explanatory power in relation to human development. The life expectancy at birth classically reflects the level of health and quality of life and measures the qualitative aspects of living a healthy life. It correlates positively with human development – the higher the healthy life expectancy of region, the more developed it is.

The share of tertiary educated people in productive age on the population in this age group is connected with the ability of people (and regions) to reflect the needs of knowledge of economy and to contribute to it and human development. Lifelong learning, in the form of participation in education and training, encompasses all learning activities undertaken throughout life (after the end of initial education) with the aim of improving knowledge, skills and competences, within personal, civic, social or employment-related perspectives [17]. Due to lifelong learning people extend their possibilities for increasing their incomes. As a dimension of health, both indicators of education are positively correlated with human development.

The last but not least dimension is the GDP per capita. The implementation of this indicator was influenced by the opinion of [18] who considered the income (product) as a primarily

mean to achieve human development. The GDP per capita reflects the economic level better than its absolute value. The indicator is measured by an artificial European currency unit, the purchasing power standard (PPS). Theoretically, one PPS can buy the same amount of goods and services in each country. However, price differences across countries and regions mean that different amounts of national currency units are needed for the same goods and services.

As mentioned, we accepted the values of the HDI that range in the interval of 0-1 and formed the categories of NHDI as follows:

- very high human development, with the value of 0.800 and above
- high human development, in the interval of 0.700–0.799
- medium human development, in the interval of 0.550–0.699
- low human development, below 0.550.

III. METHODOLOGY

Based on the variables identified in the previous part of the paper and maintaining the structure of the HDI, we have constructed a modified index called NUTS II Human Development Index (NHDI). The variables entered into the NHDI are presented in the Table 2.

TABLE II. INDICATORS OF NHDI

Dimension	Indicators	Index
health	Life expectancy at birth (years)	Life expectancy index
education	Tertiary education (% of population in 25-64 years)	Tertiary education index
	Participation rate in education and training (% of population in 25-64 years)	Lifelong learning index
standard of living	GDP per capita (in PPS)	GDP index

Since we wanted to make comparisons between regions and comparisons trough out time, it was necessary to define the minimum and maximum values for each indicator in the monitored years. To determine the minima, the worst results of individual indexes from all regions of the European Union have been chosen, while for the maxima the best ones were chosen. One exception was made in case of the GDP per capita, where the second highest value was chosen. The reason for this was easy – the highest values of the GDP per capita are presented in the region of Luxembourg for both monitored years and these values are extremely high – the second highest value (Hamburg) overcomes more than 20,000 PPS. So the values of Hamburg region were determined as maxima, see Table 3.

TABLE III. MINIMUM AND MAXIMUM VALUES OF COMPONENTS

Compo nent	2005		2013	
	MIN	MAX	MIN	MAX
LEB	70.6 (Latvija)	82.3 (Marche, IT)	74.1 (Lietuva)	84.8 (Com. De Madrid, ES)
TE	7.5 (Severoza pad, CZ)	45.5 (Brabant Wallon, BE)	11.4 (Nord-Est, RO)	49.3 (Helsinki-Uusimaa, FIN)
LL	0.6 (Peloponn isos, GR)	31 (Surrey, East and West Sussex, ENG)	0.9 (Severents entralen, BUL)	30.7 (Stokholm, SVE)
GDP/c	5,200 (Nord-Est, RO)	49,400 (Hamburg, GE)	7,700 (Severoza paden, BUL)	54,500 (Hamburg, GE)

Note: LEB – life expectancy at birth (years), TE – tertiary education (%), lifelong learning (%), GDP/c – GDP per capita (PPS)

To determine the various indices, two types of calculations were used: a standardized index of life expectancy index and two education indices (1)

$$H_{stand} = \frac{(H_s - H_{min})}{(H_{max} - H_{min})} \quad (1)$$

and natural logarithmic calculation for the standard of living index (2)

$$H_{ln} = \frac{(\ln H_s - \ln H_{min})}{(\ln H_{max} - \ln H_{min})} \quad (2)$$

where H_{stand} is standardized value, H_{ln} is natural logarithm, H_s is real value, H_{min} is minimum value and H_{max} is maximum value.

The value of education index IE is calculated as the arithmetic mean of the value of index lifelong education ILL and the value of tertiary education index ITE (3)

$$I_E = \frac{I_{LL} + I_{TE}}{2} \quad (3)$$

The calculating principle of the total index then corresponds to the new approach – it is calculated as the geometric mean of all the above indices, as shown in (4)

$$HDI = \sqrt[3]{I^n{}_{LE} \cdot I^n{}_E \cdot I^n{}_{GDP}} \quad (4)$$

The required data for calculation of the NHDI are listed in

the Appendix I, the values of components are shown for years 2005 and 2013. 2005 was the first "full" year of membership in the EU (with the exception of Austria) and 2013 is the last year when the data are available for all indicators. We suppose decreasing regional disparities among the regions (expressed by the NHDI) in the monitored period, according to cohesion policy of the European Union.

IV. RESULTS

As mentioned above, three indices for the calculation of the NHDI were used – the life expectancy index, the education index and the GDP index. The values of indices were converted into the NHDI using a geometric mean. For the GDP index the logarithmic values were used, because they accurately reflect the changes in the period by the natural logarithm.

For the calculation of results we used the methodology and data described in two previous sections and in the Appendix I. The results of every NUTS II of V4+ countries, for two monitored years are presented in Appendix II.

The results of level of human development are surprising. If we analyze the NHDI in terms of categorization, the regions reached low levels of the NHDI (below 0.550), with some exceptions related to the regions with capitals (except Poland and Hungary) and certain regions in Austria. The medium human development amounted regions, in which the capital city is situated, and some Austrian regions such as Salzburg, Tyrol and Voralberg mainly due to the high value of the GDP index (the values are shown in italics in the table of Appendix II).

If we focus on the evolution of the NHDI in individual economies, we find out that the value of this index is similar in all regions of Austria - between the best and the worst value of the indices there is a difference of 34%, while in Hungary the difference between the best and the worst result is 87 percent! It is caused by a very low value of the NHDI in the Észek-Magyarország region (0.051) where the life expectation at birth component is approaching the minimum values in Table 3.

In terms of development of the NHDI over time, it might be stated that there is not a clear positive development. Only the Czech Republic can "boast" with an increasing trend – the values of indices increased in almost its regions. Conversely, there has been a negative trend in the regions of Hungary, Austria and Slovenia. Regarding Poland, there was a slight increase in the values of nine regions compared to seven regions with the negative trend. As far as Slovakia is concerned, the decline was observed in four of the five regions.

V. CONCLUSION

The Human Development Index is one of the indicators which can measure the socioeconomic development. This indicator has been used since 1990, it measures the above mentioned development at the national level and it is used to compare differences between economies. However, there are not only disparities between economies, but also within them. For this reason we decided to construct the modified Human Development Index (NHDI) and for this purpose countries of the Visegrad Group Plus at the NUTS II level have been selected. This group includes the Visegrad Group countries (Czech Republic, Hungary, Poland and Slovakia), Slovenia and Austria and there are the 46 NUTS II regions. We analysed and compared the NHDI in two years, 2005 and 2013.

For our purpose the data had to be modified, but methodology of the NHDI was the same as for the HDI. We used three components - the health dimension (life expectancy at birth), the knowledge dimension (tertiary educated people and participation rate in education and training) and the dimension of living standard (GDP per capita).

The results of the created indices show that the value of the sub index of education reached low levels in all regions (with the exception of the Vienna region in 2013, where the value is slightly above the medium). Higher values are reached in life expectancy index in the regions of Austria, in Prague, which is the capital of the Czech Republic, and the Zahodna Slovenija region; the GDP index reaches higher values in all regions with the capitals and in regions of Austria. The overall results show that the regions in the monitored countries (with the exception of Austria) have a significant degree of regional asymmetries.

The results also show that the index values in the period do not approach and the regional disparities remain the same. The fact that the increase in the NHDI occurred in only 19 from 46 regions in the period, does not confirm our expectation about the positive influence of the EU membership on the decrease of regional disparities among the regions.

Our future research will focus on the extension of the time series for calculations of the modified human development index and on creating a factor analysis for the values of individual components of the index, including the comparison of these two results.

APPENDIX I

THE VALUE OF THE NHDI COMPONENTS IN REGIONS V4+ IN THE YEAR 2005 AND 2013

Region	2005				2013			
	LEB	TE	LL	GDP/c	LEB	TE	LL	GDP/c
Czech Republic								
Praha	77.7	27.1	9.1	39,700	80.1	38.4	8.7	46,000
Střední Cechy	75.7	10.5	4.0	17,200	78.2	19.9	9.1	19,500
Jihozápad	76.4	10.8	4.5	17,100	78.4	18.0	10.5	19,400
Severozápad	74.5	7.5	3.9	14,900	76.4	12.5	8.0	16,500
Severovýchod	76.7	10.7	5.4	15,600	78.6	16.8	13.2	18,000
Jihovýchod	76.5	14.3	7.1	16,200	79.1	22.6	9.2	20,600
Střední Morava	76.1	12.4	5.2	14,400	78.1	16.2	7.8	17,700
Moravskoslezsko	75.2	10.6	4.5	15,600	77.1	17.6	10.7	18,400
Hungary								
Közép-Magyarország	74.5	26.6	5.6	23,300	77	33.2	4.2	28,700
Közép-Dunántúl	72.9	12.6	3.4	13,600	75.5	19.0	2.0	15,600
Nyugat-Dunántúl	73.7	13.6	2.9	14,300	76.1	17.8	1.8	17,900
Dél-Dunántúl	72.8	12.9	4.0	10,000	75.2	18.3	2.6	11,900
Észak-Magyarország	71.5	12.9	3.1	9,500	74.2	16.7	2.1	10,500
Észak-Alföld	72	13.3	3.0	9,200	75.4	17.8	3.4	11,300
Dél-Alföld	72.7	13.7	3.0	9,900	75.6	18.2	2.5	11,900
Poland								
Lódzkie	73.4	16.0	4.9	10,700	75.4	23.5	3.1	16,700
Mazowieckie	75.6	23.5	5.8	17,800	77.7	35.4	6.7	28,500
Malopolskie	76.2	17.0	4.4	10,200	78.5	26.6	4.7	15,800
Slaskie	74.5	15.4	5.4	12,500	76.3	24.4	4.5	18,600
Lubelskie	74.6	17.3	5.4	8,100	77.1	25.5	4.9	12,600
Podkarpackie	76	14.1	3.4	8,300	78.6	23.1	2.6	12,700
Swietokrzyskie	75.2	16.2	3.8	8,900	77.1	26.0	3.1	13,100
Podlaskie	75.5	16.7	4.4	8,600	77.1	26.1	3.7	13,000
Wielkopolskie	75.2	15.4	4.0	12,500	77.2	23.4	3.7	19,300
Zachodniopomorskie	74.7	16.1	4.8	10,500	76.7	23.9	3.2	15,100
Lubuskie	74.6	14.8	4.3	10,500	76.3	20.6	2.8	15,000
Dolnoslaskie	74.8	17.3	6.0	11,900	76.9	25.1	4.1	20,100
Opolskie	75.7	14.3	3.7	9,600	77.2	20.9	3.1	14,500
Kujawsko-Pomorskie	74.8	13.3	5.0	10,000	76.9	20.7	3.9	14,800
Warminsko-Mazurskie	74.5	14.5	3.6	8,700	76.3	20.7	2.8	12,900
Pomorskie	75.7	16.6	5.3	11,400	77.9	26.7	5.8	17,300
Austria								
Burgenland (AT)	79.1	12.7	9.4	19,200	81.1	15.8	10.1	23,300
Niederösterreich	79.1	17.1	12.8	23,500	81	17.6	12.0	27,900
Wien	78.9	23.3	14.7	38,600	80.1	30.6	19.0	42,300

Kärnten	79.8	16.0	11.6	24,400	81.7	17.3	13.0	28,400
Steiermark	79.8	16.6	12.3	25,600	81.8	17.5	13.1	30,700
Oberösterreich	79.8	15.4	13.2	28,700	81.4	17.2	12.7	34,500
Salzburg	79.8	18.9	12.4	32,400	82.2	21.8	13.0	40,200
Tirol	80.7	14.7	12.3	30,300	82.4	19.1	13.4	35,800
Vorarlberg	80.8	15.9	13.1	29,900	82.3	19.0	14.5	35,600
Slovakia								
Bratislavský kraj	75.4	28.4	14.8	33,700	78.1	37.5	7.1	49,000
Západné Slovensko	74.4	11.3	3.2	13,000	76.8	16.6	2.6	18,800
Stredné Slovensko	73.7	14.0	5.1	10,700	76.2	18.8	2.5	15,900
Východné Slovensko	73.9	11.2	1.8	9,900	76.2	17.5	1.9	13,800
Slovenia								
VzhodnaSlovenija	76.5	16.4	12.9	16,500	79.5	23.5	10.9	18,100
ZahodnaSlovenija	78.8	24.6	18.2	24,100	81.7	32.9	14.0	25,900

APPENDIX II
SUB-INDEXES AND NHDI FOR MONITORED COUNTRIES IN 2005 AND 2013

Region	2005				2013			
	I_{LE}	I_E	I_{GDP}	**NHDI**	I_{LE}	I_E	I_{GDP}	**NHDI**
Czech Republic								
Praha	0.607	0.398	*0.903*	**0.602**	0.561	0.487	*0.913*	**0.630**
Střední Cechy	0.436	0.095	0.531	**0.281**	0.383	0.250	0.475	**0.357**
Jihozápad	0.496	0.108	0.529	**0.304**	0.402	0.248	0.472	**0.361**
Severozápad	0.333	0.054	0.468	**0.204**	0.215	0.134	0.389	**0.224**
Severovýchod	0.521	0.121	0.488	**0.313**	0.421	0.278	0.434	**0.370**
Jihovýchod	0.504	0.196	0.505	**0.368**	0.467	0.287	0.503	**0.407**
Střední Morava	0.470	0.140	0.452	**0.310**	0.374	0.179	0.425	**0.305**
Moravskoslezsko	0.393	0.105	0.488	**0.272**	0.280	0.246	0.445	**0.313**
Hungary								
Közép-Magyarország	0.333	0.334	*0.666*	**0.420**	0.271	0.343	*0.672*	**0.397**
Közép-Dunántúl	0.197	0.113	0.427	**0.212**	0.131	0.119	0.361	**0.178**
Nyugat-Dunántúl	0.265	0.118	0.449	**0.241**	0.187	0.100	0.431	**0.200**
Dél-Dunántúl	0.188	0.127	0.290	**0.191**	0.103	0.120	0.222	**0.140**
Észak-Magyarország	0.077	0.112	0.268	**0.132**	0.009	0.090	0.158	**0.051**
Észak-Alföld	0.120	0.116	0.253	**0.152**	0.121	0.126	0.196	**0.144**
Dél-Alföld	0.179	0.121	0.286	**0.184**	0.140	0.117	0.222	**0.154**
Poland								
Lódzkie	0.239	0.183	0.321	**0.241**	0.121	0.197	0.396	**0.211**

Mazowieckie	0.427	0.296	*0.547*	**0.410**	0.336	0.414	*0.669*	**0.453**
Malopolskie	0.479	0.188	0.299	**0.299**	0.411	0.264	0.367	**0.342**
Slaskie	0.333	0.183	0.390	**0.287**	0.206	0.232	0.451	**0.278**
Lubelskie	0.342	0.208	0.197	**0.241**	0.280	0.253	0.252	**0.261**
Podkarpackie	0.462	0.133	0.208	**0.234**	0.421	0.183	0.256	**0.270**
Swietokrzyskie	0.393	0.167	0.239	**0.250**	0.280	0.230	0.272	**0.259**
Podlaskie	0.419	0.184	0.223	**0.258**	0.280	0.291	0.268	**0.279**
Wielkopolskie	0.393	0.160	0.390	**0.290**	0.290	0.205	0.470	**0.303**
Zachodniopomorskie	0.350	0.182	0.312	**0.271**	0.243	0.203	0.344	**0.257**
Lubuskie	0.342	0.157	0.312	**0.256**	0.206	0.153	0.341	**0.221**
Dolnoslaskie	0.359	0.218	0.368	**0.306**	0.262	0.234	0.490	**0.311**
Opolskie	0.436	0.140	0.272	**0.255**	0.290	0.162	0.323	**0.248**
Kujawsko-Pomorskie	0.359	0.149	0.290	**0.249**	0.262	0.173	0.334	**0.247**
Warminsko-Mazurskie	0.333	0.141	0.229	**0.221**	0.206	0.155	0.264	**0.203**
Pomorskie	0.436	0.197	0.349	**0.311**	0.355	0.284	0.414	**0.347**
Austria								
Burgenland (AT)	0.726	0.213	0.580	**0.448**	0.654	0.212	0.566	**0.428**
Niederösterreich	0.726	0.327	0.670	**0.542**	0.645	0.268	0.658	**0.484**
Wien	0.709	0.440	*0.890*	**0.653**	0.561	0.557	*0.870*	**0.648**
Kärnten	0.786	0.293	0.687	**0.541**	0.710	0.281	0.667	**0.510**
Steiermark	0.786	0.312	0.708	**0.558**	0.720	0.285	0.707	**0.525**
Oberösterreich	0.786	0.311	0.759	**0.570**	0.682	0.275	0.766	**0.524**
Salzburg	0.786	0.344	0.813	**0.604**	0.757	0.340	0.844	**0.601**
Tirol	0.863	0.287	0.783	**0.579**	0.776	0.311	0.785	**0.575**
Vorarlberg	0.872	0.316	0.777	**0.598**	0.766	0.328	0.782	**0.582**
Slovakia								
Bratislavský kraj	0.410	0.509	*0.830*	**0.557**	0.374	0.448	*0.946*	**0.541**
Západné Slovensko	0.325	0.093	0.407	**0.231**	0.252	0.097	0.456	**0.224**
Stredné Slovensko	0.265	0.160	0.321	**0.238**	0.196	0.124	0.371	**0.208**
Východné Slovensko	0.282	0.068	0.286	**0.177**	0.196	0.097	0.298	**0.179**
Slovenia								
Vzhodna Slovenija	0.504	0.202	0.513	**0.374**	0.505	0.168	0.437	**0.333**
Zahodna Slovenija	0.701	0.407	*0.681*	**0.579**	0.710	0.379	*0.620*	**0.551**

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