Using statistical methods for analysing regional differences of labour market

László Lőkös, yr[1] – Klára Lőkös Tóth[2] – Emese Prihoda[3]

The objective of present descriptive, exploring analysis, was to demonstrate and illustrate regional (NUTS II) and county (NUTS III) level differences based on three dominant labour market indicators.

Accordingly, we pursued a statistical analysis on the 2004 and 2008 labour market indicators (basic data) of the 7 statistical regions, and the 19 counties of Hungary. These indicators are: unemployment rate, employment rate, rate of economically active population.

The comparison is made based on two years descriptive statistical data using various types of methods with taking into consideration the changes of the three main indicators of the labour market. By means of special scatter plots, we characterised and illustrated the relative changes of the regions by correlating them with each other, namely the more and more strong separation of the main groups, so as the increase of their homogeneity within groups.

Keywords: regional unemployment, rate of unemployment, rate of economically active population, employment rate, analysis, region, county

1. Introduction

According to many studies in the field of social sciences, the problem of high rate unemployment in European countries is one of the most serious phenomenon since many years now (Baranyai 2007; Cseh Papp 2008, Pál 2005, Lőkös 2005, Vajsz-Pummer 2006). The demand for reducing unemployment gets more and more attention in European general objectives, together with the propagation of a 'longer active career model', originated in demographic reasons, the so called 'ageing society' causing many stress in the labour market which enforced the reforms of the traditional pension scheme, so much as the remarkably growing appearance of unem-

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ployed young school-leaver population. In our opinion, the effective way to treat the above mentioned problem requires intervention in sub-national (regional, county, micro-regional) level, however, the evolvement of these programmes requires statistics-based regional labour market research, which may serve for the preparation of economic (labour market) decisions.

Our aspect shows and uses data of two time periods, year 2004, when Hungary joined the European Union, and year 2008, the most up-to-date data available. Our ambition is to demonstrate the changes in the field of regional labour market between the two examined periods.

2. Materials and methods

Data were downloaded from the website of Public Employment Service (PES). We drawn in territorial (NUTS[4] II: region, NUTS III: county) data from 2004 and 2008.

The three indicators we used in order to characterise the labour market situation are:

1. unemployment rate (UNR%)
2. employment rate (EMR%)
3. activity rate (Active%)

We applied different statistical methods to demonstrate the regional differences in Hungary. We started our investigation with basic descriptive statistical methods, later on, we implied the tools of hypothesis testing in order to be able to compare the data of the regions with each other. We measured the coherence between variables with correlation coefficient. In the course of different types of analysis, we used graphical illustrations, with which we supported the revealing of relationships.

3. Results

It is a widely spread and accepted statement, that the developing unemployment rate can be used to measure competitiveness. Therefore, we claim the need of analysing data which represents the status of the Hungarian labour market the most, like the employment rate, the unemployment rate and the activity rate.

Principally, we analysed the above mentioned labour market indicators in the 7 statistical regions (NUTS II) of Hungary.

[4] NUTS: Nomenclature of Territorial Units for Statistics

3.1. Regional analysis based on data form 2004 and 2008

Table 1. The changes of major labour market indicators within the examined time period

	2004	**2008**	d*	**2004**	**2008**	d*	**2004**	**2008**	d*
Region	UNR%	UNR%	UNR%	EMR%	EMR%	EMR%	Active%	Active%	Active%
CH	4.38	4.62	0.24	56.60	56.20	-0.40	59.20	58.90	-0.30
WTd	4.65	5.68	1.03	54.70	54.70	0.00	57.40	58.00	0.60
CTd	5.72	6.29	0.57	53.70	53.60	-0.10	56.90	57.20	0.30
STd	7.15	9.27	2.12	46.60	45.50	-1.10	50.00	50.20	0.20
SGP	6.81	9.20	2.39	47.00	47.60	0.60	50.40	52.40	2.00
NGP	7.46	12.15	4.69	44.80	44.30	-0.50	48.40	50.50	2.10
NH	9.16	12.26	3.10	44.50	43.90	-0.60	49.00	50.10	1.10
Total	6.08	7.81	**1.73**	50.50	50.30	**-0.20**	53.80	54.60	**0.80**

**difference 2008-2004*
Source: http://kisterseg.afsz.hu/index.php

NH: Northern Hungary, NGP: Northern Great Plain, SGP: Southern Great Plain, CH: Central Hungary, CTd: Central Transdanubia, WTd: Western Transdanubia, STd: Southern Transdanubia

Table 2. Descriptive statistical analysis of the major labour market indicators

	2004			**2008**		
	UNR%	EMR%	Active%	UNR%	EMR%	Active%
Mean*	6.48	49.70	53.04	8.50	49.40	53.90
Standard deviation	1.56	4.73	4.24	2.84	4.88	3.68
CV%	24.1	9.5	8.0	33.4	9.9	6.8

* simple average of regional means
Source: own creation

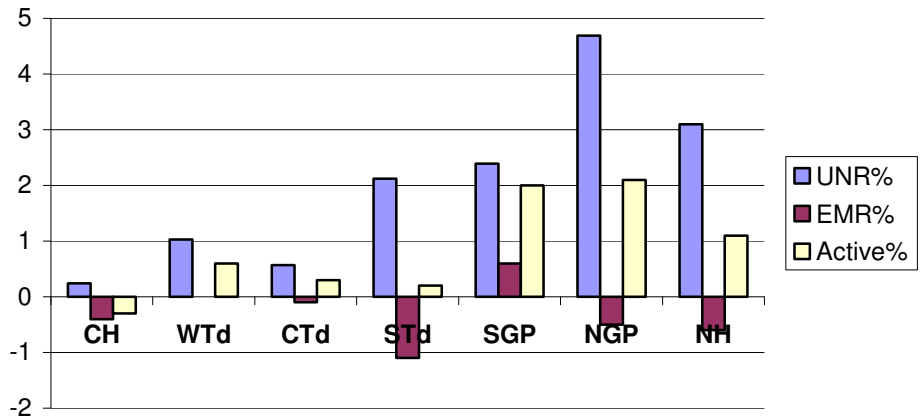
Between the two examined time periods, the unemployment rate shows the largest difference. As *table 2* shows, the unemployment rate (UNR%) has risen in all the regions, but its rate has large differences. The growth was only 0.24 percent score in Central Hungary, although in Northern Hungary it was 3.1, in Northern Great Plain it was 4.69.

The differences in the two other indicators are less remarkable. The employment rate (EMR%) has only risen in Southern Great Plain region (by 0.6 percent

score) while the rest of the regions represent a slight decrease. Southern Transdanubia is the only region where the decrease has been over 1 percent score.
Excluding Central Hungary, the activity rate (Active%) has slightly risen in all the regions, especially in Northern Great Plain (by 2.1 percent score) and in Southern Great Plain (by 2 percent score). The activity rates of regions do not show large differences, they vary between 50.1% (Northern Hungary) and 58.9% (Central Hungary).

In total (national economy level), the employment rate decreased by 0.2 percent score, the unemployment rate decreased by 1.72 percent score, while the activity rate showed a 0.8 percent score of increase. Although, we can observe larger changes in certain regions. The most dramatic change took place in Northern Great Plain, where the unemployment rate raised from 7.46% to 12.15% between 2004 and 2008. The changes of the values of each regions can be seen on *Figure 1*.

Figure 1. Illustration of the level of changes in each region (in percent score)

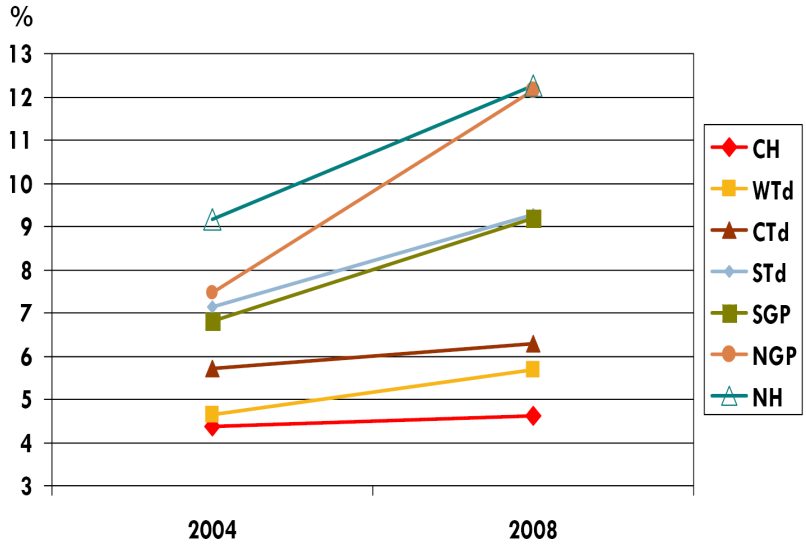


Source: own creation

In point of the three examined indicator, we can easily observe on *Figure 1*, that Central Hungary, Western Transdanubia and Central Transdanubia regions (CH, WTd, CTd) show slight change, Southern Transdanubia, Southern Great Plain and Northern Hungary (STd, SGP, NH) represents medium, while Northern Great Plain (NGP) shows large change.

Our analysis proved, that the values of unemployment rate have the largest change in time, that is why we would like to illustrate the changes on a line chart. (Figure 2)

Figure 2. Comparison of the rate of unemployment in the two examined year



Change in %score	
CH	0.24
WTd	1.03
CTd	0.57
STd	2.12
SGP	2.39
NGP	4.69
NH	3.1

Source: own creation

The line chart above clearly shows, that while unemployment rate in Central Hungary (CH) and Central Transdanubia (CTd) regions hardly changed, the rate in Northern Great Plain (NGP) shows the largest change. In the same time, the differences can also be observed in the vertical position of the lines.

Based on the unemployment rate (UNR%), we can make 3 groups:

1. Group with stable unemployment rate, with relatively low value: Central Hungary (CH), Central Transdanubia (CTd), Western Transdanubia (WTd) regions
2. Group of moderate increase: Northern Hungary (NH), Southern Transdanubia (STd) and Southern Great Plain (SGP) regions
3. Group of large increase: Northern Great Plain (NGP) region.

Table 3. Rank-score values of regions based on the major labour market indicators

	2004			**2008**		
Region	UNR%	EMR%	**Active%**	UNR%	EMR%	**Active%**
CH	7	1	1	7	1	1
WTd	6	2	2	6	2	2
CTd	5	3	3	5	3	3
STd	3	5	**5**	3	5	**6**
SGP	4	4	4	4	4	4
NGP	2	6	**7**	2	6	**5**
NH	1	7	**6**	1	7	**7**

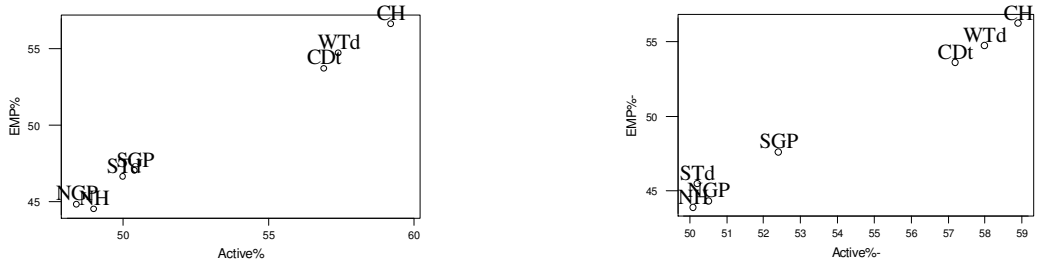
Grade 1 belongs to the region that has the highest value.
Source: own creation

Despite the fact that the value of the changes differ form each other, the rank-score values of the regions only differ in terms of the activity rate. Northern Great Plain improved its value from 7 to 5, while Southern Transdanubia and Northern Hungary regions have fallen back by 1-1 grade.

Henceforward, we analyse the position of the regions in a co-ordinate system based on indicators pairs.

Figure 4. Employment rate (EMR%) depending on active population (Active%)

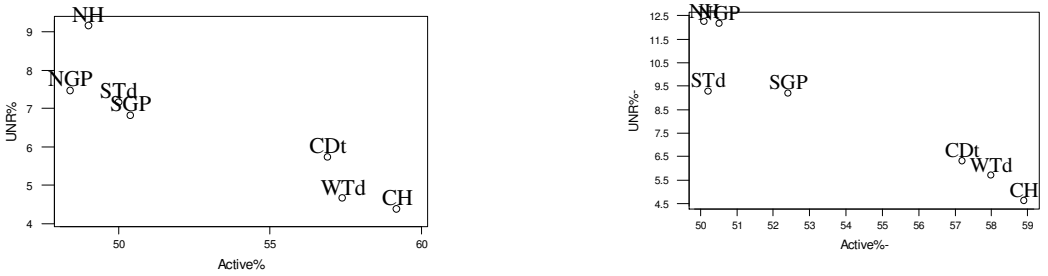
2004 **2008**



Source: own creation

Figure 5. Unemployment rate (UNR%) depending on active population (Active%)

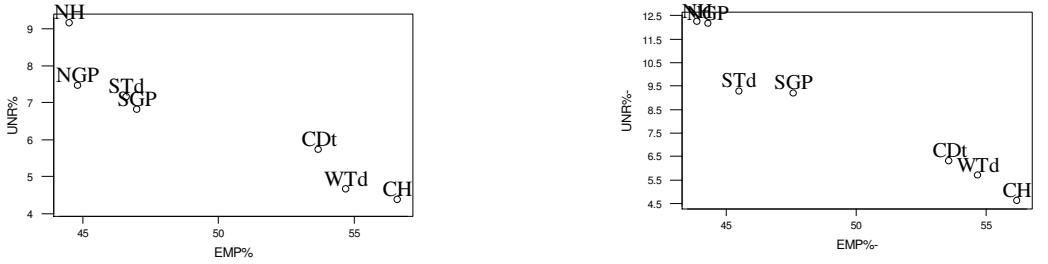
2004 **2008**



Source: own creation

Figure 6. Unemployment rate (UNR%) depending on employment rate (EMR%)

2004 **2008**

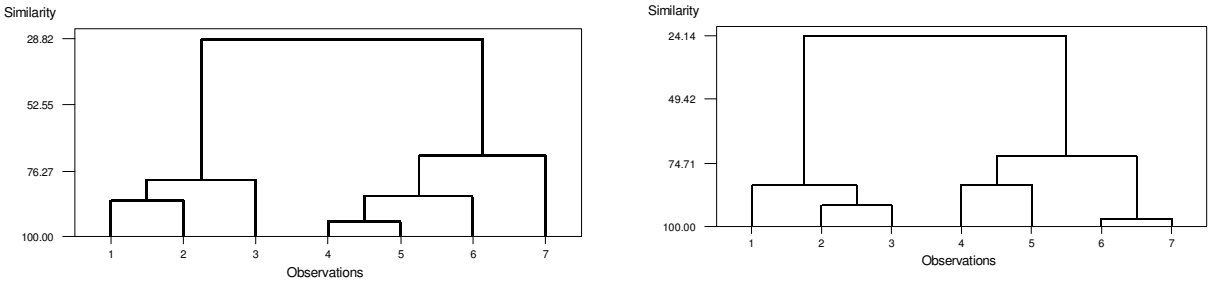


Source: own creation

The correlograms of indicator pairs consequently generate the same group of regions. *Group 1* includes Central Hungary, Western Transdanubia and Central Transdanubia (CH, WTd, CTd) regions. *Group 2* comprise Southern Great Plain, Southern Transdanubia, Northern Great Plain and Northern Hungary (SGP, STd, NGP, NH) regions. The separation of the two above mentioned groups is also confirmed by the dendogram of the cluster analysis.

Figure 7. Grouping regions with cluster analysis

2004 **2008**



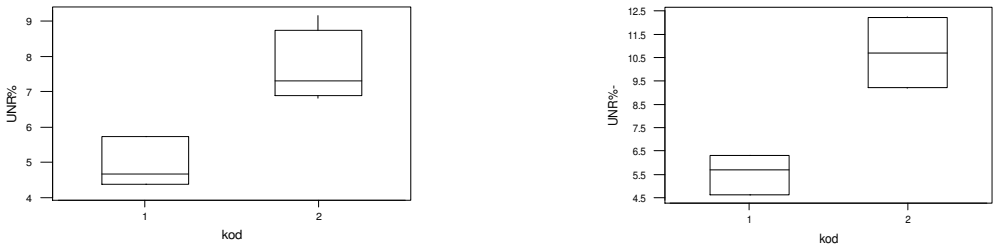
Legend: 1-CH 2-WTd 3- CTd 4- STd 5- SGP 6- NGP 7- NH

Source: own creation

We can observe on the dendograms of 2004 and 2008, that the two groups previously created remained the same, the homogeneity within the groups slightly increased. The examined attributes of regions became closer to each other within the groups. The same conclusion can be drawn if we have a look at the boxplots (*Figure 8*), which is limited to illustrate the unemployment rate.

Figure 8. Boxplots of the two groups of regions based on unemployment rate

2004 **2008**



Group 1*: CH, WTd, CTd,* ***Group 2:*** *SGP, STd, NGP, NH*

Source: own creation

County level analysis based on data form 2004 and 2008

Central Hungary has been excluded form the analysis because of the disconformities of its values.

Table 4. County level values of the examined 6 regions based on the three major labour market indicators

		2004			2008		
Region	County	UNR%	EMR%	Active%	UNR%	EMR%	Active%
CTd	Fe	6.63	53.20	57.00	6.60	52.50	56.30
	Ko	5.08	54.90	57.90	5.02	56.40	59.40
	Ve	5.21	53.10	56.10	7.09	52.30	56.30
WTd	Gyo	4.03	53.20	55.50	4.25	55.60	58.10
	Vas	5.14	56.70	59.80	5.65	54.40	57.70
	Za	5.09	55.00	58.00	7.77	53.50	58.10
STd	Ba	7.37	43.30	46.80	9.28	44.40	49.00
	So	7.01	46.30	49.70	9.51	45.30	50.10
	To	7.00	51.70	55.60	8.92	47.70	52.30
NH	BAZ	10.10	43.50	48.40	13.61	42.40	49.10
	He	7.84	46.50	50.50	10.27	47.00	52.40
	No	8.07	45.10	49.10	11.01	44.40	49.90
NGP	Ha	6.72	46.80	50.20	10.94	44.30	49.80
	Sza	9.03	41.90	46.00	15.59	41.30	48.90
	JN	6.41	46.00	49.20	9.23	48.70	53.60
SGP	BK	7.14	49.50	53.30	8.93	48.40	53.10
	Be	7.21	43.30	46.70	10.86	44.70	50.10
	Cs	6.01	47.00	50.10	8.15	49.10	53.50

Source: http://afsz.hu/

NH: Northern Hungary, NGP: Northern Great Plain, SGP: Southern Great Plain, CH: Central Hungary, CTd: Central Transdanubia, WTd: Western Transdanubia, STd: Southern Transdanubia

Fe: Fejér, Ko: Komárom-Esztergom, Ve: Veszprém, Gyo: Győr-Moson-Sopron, Vas: Vas, Za:Zala, Ba: Baranya, So: Somogy, To: Tolna, BAZ: Borsod-

Abaúj-Zemplén, He: Heves, No: Nógrád, Ha: Hajdú-Bihar, Sza: Szabolcs-Szatmár-Bereg, JN: Jász-Nagykun-Szolnok, BK: Bács-Kiskun, Be: Békés, Cs: Csongrád

Table 5. Descriptive statistical indicators

	2004			**2008**		
Indicators	UNR%	EMR%	Active%	UNR%	EMR%	Active%
Mean*	6.73	48.72	52.22	9.04	48.47	53.21
Standard deviation	1.47	4.60	4.31	2.78	4.54	3.51
s%	**21.80**	9.40	8.30	**30.8**	9.40	6.60
Min	4.03	41.90	46.00	4.25	41.30	48.90
Max	10.10	56.70	59.80	15.59	56.40	59.40
Range	**6.07**	14.80	13.80	**11.34**	15.10	10.50
Median	6.86	**46.90**	**50.35**	9.08	**48.05**	**52.75**

* simple average of regional means

The most significant change again belongs to the unemployment rate. As far as the unemployment rate concern, the differences between regions have been increasing, which can be proved by the growth of s%, it almost doubled, it changed from 21.8 to 30.8 percent. The activity rate shows positive development, its rate increased, while its standard deviation decreased.

By using county level statistical data, the separation of the two groups of regions can also be verified by analysis of variance. In the next session, we analyse weather there is a provable statistical difference between regions by analysing the data of their counties. (we consider the data of counties as repetition data of regions)

The outcomes of the labour market analysis of the 6 regions are summarised on *table 6* below.

Table 6. Comparison of regions mean by labour market indicators

6/1. Comparison of employment rate means

NGP	NH	SGP	STd	CTd	WTd
44.900	**45.033**	**46.600**	**47.100**	**53.733**	**54.967**

6/2. Comparison of activity rate means

NGP	NH	SGP	STd	CTd	WTd
48.467	**49.333**	**50.033**	**50.700**	**57.000**	**57.767**

6/3. Comparison of unemployment rate means

WTd	CTd	SGP	STd	NGP	NH
4.753	**5.640**	**6.787**	**7.127**	**7.387**	**8.670**

Source: own creation

The employment rate and activity rate does not show any difference between the separation of region. We can separate the same groups as before. (Group 1: WTd, CTd, Group 2: STd, SGP, NH, NGP)

The unemployment rate is more differentiated. We can not clearly observe the separation of groups, though we can state significant difference between regional means many times. (Those regions, which are underlined with a common line, do not show statistically admitted difference, while regions which do not have a common line, show statistically admitted difference.)

Since the analysis of variance proved the separation of regions in many cases, hereafter, we try to determine effect of territorial affiliation. We analyse how the county level values contribute to the standard deviation of the regions. In table 7, the variance relation reflects this relationship.

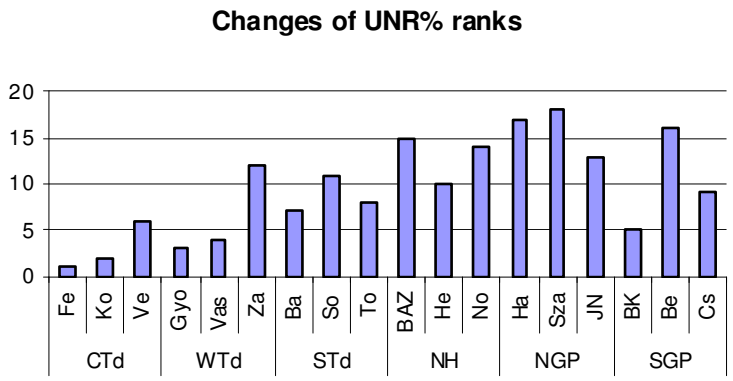
Table 7. The relationship between labour market indicators and regions

Indicator	Variance relation	Strength of relationship
UNR%	H^2= 0.731	H= 0.855
EMR%	H^2= 0.784	H= 0.885
Active%	H^2= 0.746	H= 0.864

Source: own creation

The variability of unemployment rates were determined by the region by 73%. The largest ration (H^2) belongs to the employment rate with 78.4%. In all the three cases, the relationship between the region and the labour market indicators are significant and strong. Consequently, the territorial affiliation strongly determines the labour market indicators, though other factors may also contribute to the outcomes. The rate (effect) of other factors is around 25%.

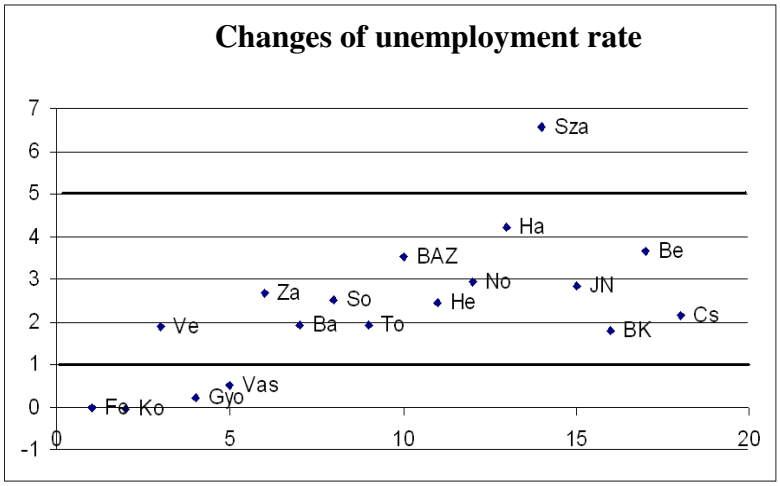
Figure 9. Ranking the changes of county level rank-score values



Source: own creation

Based on *Figure 9* we can state, that largest change occurred in Northern Great Plain and Northern Hungary regions, while values of Central Transdanubia region showed the slightest change.

Figure 10. Changes (by percentages) of the unemployment rate by county



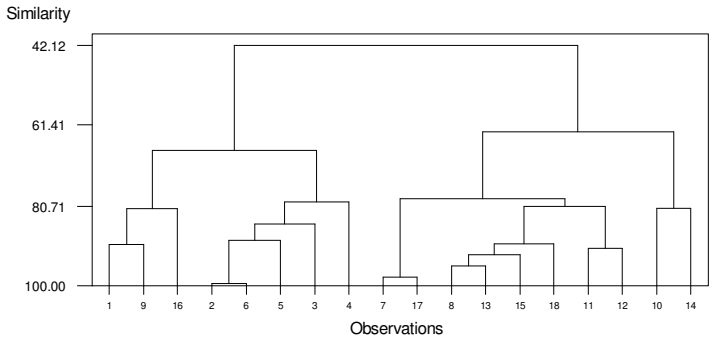
Source: own creation

The three groups of development can be clearly seen on the scatterplot above. The first group comprises those counties, where the unemployment rate changed by

less that 1%. Second group consist of counties, was between 1% and 5%, while the counties of the third group developed by more that 5%.

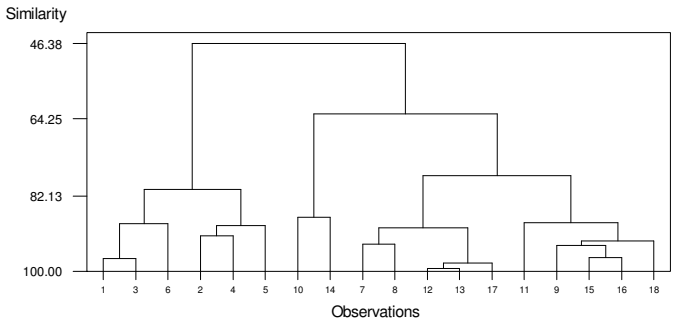
In the next part, we present the clusters of counties using the major labour market indicators. *(Figure 11)*

Figure 11. Clusters of counties using the three major labour market indicator (2004)



Source: own creation

Figure 12. Clusters of counties using the three major labour market indicators (2008)



Source: own creation

The two dendograms – based on cluster analysis - show the clusters of counties as well as the occurred changes. Based on the dendogram, we can form 4 groups, which is illustrated with boxplot on *Figure 13*.

The groups of the two time periods (2004 and 2008) comprise different counties (*Table 8*).

Table 8. Grouping of counties by the three major labour market indicators in 2004 and 2008

	Group members in 2004		Group members in 2008
1	**Fe, To, BK**	1	**Fe**, Ko, Ve, Gyo, Vas, Za,
2	Ko, Ve, Gyo, Vas, Za,	2	Ba, So, No, Ha, Be
3	Ba, So, No, Ha, Be, He, Jn, Cs	3	**To, BK**, He, Jn, Cs
4	BAZ, Sza	4	BAZ, Sza

Source: own creation

Table 9. Comparison of formed groups in 2004

Indicator	Group 1	Group 2	Group 3	Group 4
UNR%	Medium	Low	Medium	High
EMR%	High	High	Low	Low
Active%	Rather high	High	Rather low	Low

Source: own creation

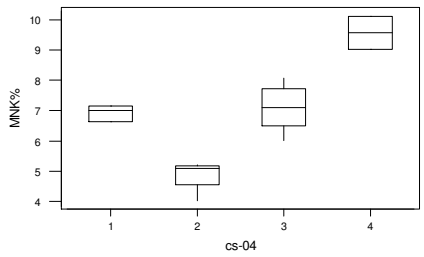
Table 10 .Comparison of formed groups in 2008

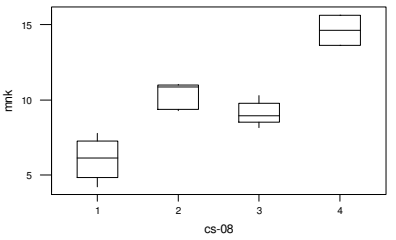
Indicator	Group 1	Group 2	Group 3	Group 4
UNR%	Low	Medium	Medium	High
EMR%	High	Worse than medium	Medium	Low
Active%	High	Low	Medium	Low

Source: own creation

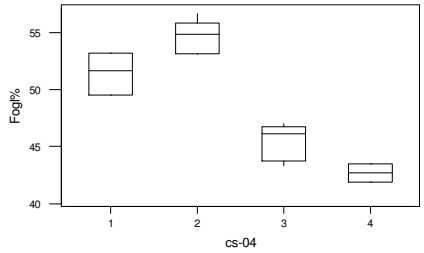
Figure 13. Boxplot illustration of the groups

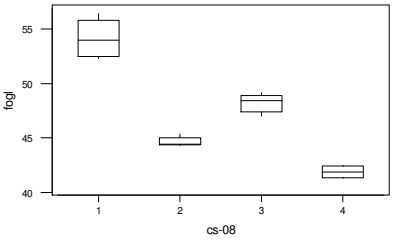
2004 **2008**



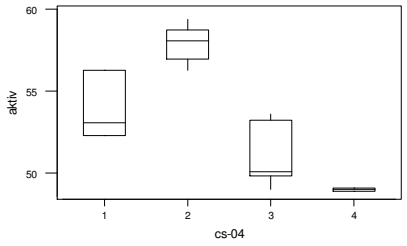


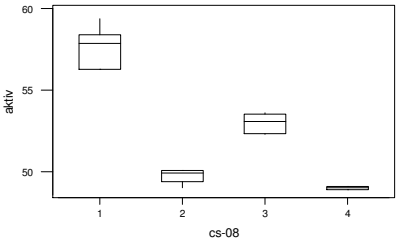
Unemployment rate





Employment rate





Activity rate

Source: own creation

4. Conclusion

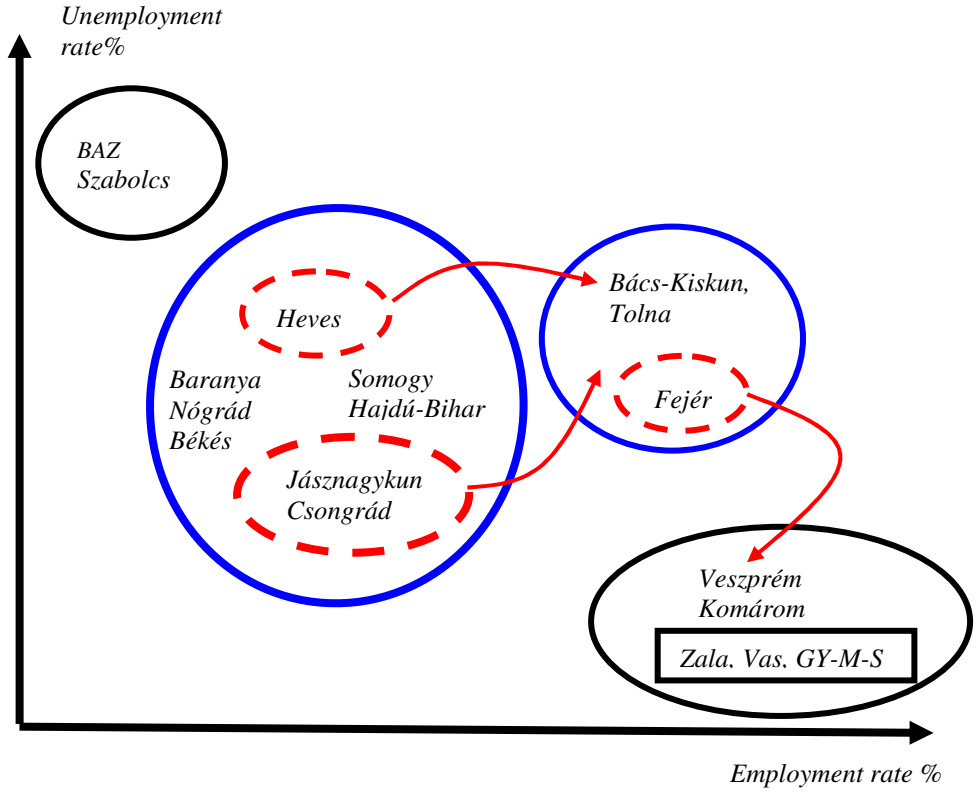
One of the main findings of our analysis is that specific clustering of the six examined EU regions can be observed in both years. The first cluster contains Central Transdanubia and Western Transdanubia and the second cluster with significant differences includes South Transdanubia, Southern Great Plain, Northern Great Plain and Northern Hungary.

The analysis of the data of NUTS 3 regions shows much more layered result. The NUTS 3 clusters based on labour market indicators do not match the clusters of NUTS 2 regions. The previously most developed cluster of NUTS 3 regions, i.e. the counties of Western and Central Transdanubia, continue to hold their high place by the two latterly analysed aspects, the labour market indicators and the administrative sectioning as well. On the other hand all the other clusters of counties includes NUTS 3 regions regardless the previous clustering of NUTS 2 regions. (*Figure 14*)

The round-shaped clusters of counties on the Figure 14 show the enclavement of year 2004. The rugged lined circles show the changes by year 2008. It can be clearly observed, that the cluster of less developed counties, i.e. Borsod-Abaúj-Zemplén and Szabolcs-Szatmár-Bereg, has not been changed.

The most advanced NUTS3 regions of Western Transdanubia, based on their labour market indicators, form a common cluster with the two counties of Central Transdanubia.

Figure 14. Groups of counties, and the changes of groups within the examined time period



Source: own creation

By the year 2008 the missing Fejér county also closes up to the cluster. Therefore, the cluster of most developed NUTS 3 region includes two entire administrative NUTS 2 regions.

In 2004 three counties of different NUTS 2 regions, Bács-Kiskun county (South Great Plain), Tolna county (Southern Transdanubia) and Fejér county (Central Transdanubia) form a cluster. From this cluster Fejér county closed up to the cluster of more developed Central Transdanubian counties, i.e. it moved to the cluster of its real administrative NUTS 2 region.

The main reasons of the advance of Fejér county is that, while its unemployment rate is mildly decreasing, the rate of the other counties of Western and Central Transdanubia (expect Komárom-Esztergom county) are distinctly increasing.

Since their rate of employment has raised, Heves, Jász-Nagykun and Csongrád counties have been moved to a better cluster, to the same group where Bács-Kiskun and Tolna counties are.

The differentiation showed in other studies of regional competitiveness and development indexes of Hungary is well observable in our present research on labour market indicators as well. The differences between more and less developed regions are increasing in Hungary.

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